Environmental Impact Assessment

Project Number: 52220-001
July 2020
Draft

Proposed Multitranche Financing Facility
Republic of the Philippines: South Commuter Railway Project

Volume 1 Main Report

Prepared by the Department of Transportation for the Asian Development Bank.

CURRENCY EQUIVALENTS

(as of 10 July 2020)

Currency unit	–	Philippine peso (PHP)
PHP 1.00	=	$ 0.020
$1.00	=	PHP 49.22

ABBREVIATIONS

ADB	–	Asian Development Bank
CNC	–	certificate of non-coverage
CSC	–	construction supervision consultant
DAO	–	DENR Administrative Order
DED	–	detailed engineering design consultant
DENR	–	Department of Environment and Natural Resources
DOTr	–	Department of Transportation
EA	–	executing agency
ECC	–	environmental compliance certificate
ECA	–	environmentally critical area
ECP	–	environmentally critical project
EIA	–	environmental impact assessment
EIS	–	environmental impact statement
EMA	–	external monitoring agency
EMB	–	environmental management bureau
EMP	–	environmental management plan
ESRD	–	Environment, social and ROW division of DOTr
GRM	–	grievance redress mechanism
IEE	–	initial environmental examination
IEEC	–	initial environmental examination checklist report
IEER	–	initial environmental examination report
LGU	–	local government unit
MFF	–	multitranche financing facility
MMSP	–	Metro Manila Subway Project
NFPA	–	National Fire Protection Association
NSCR	–	North South Commuter Railway
NSRP	–	North South Railway Project
PEISS	–	Philippine Environmental Impact Statement System
SCRP	–	South Commuter Railway Project
SCR-PMO	–	SCR Project Management Office
SPS	–	ADB Safeguard Policy Statement, 2009

NOTES

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Draft
Environmental Impact Statement Report (EISR)
for
South Commuter Railway Project (SCRP)

VOLUME I: MAIN REPORT

(Draft Environmental Impact Assessment)

July 2020

Department of Transportation (DOTr)

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LIST OF ABBREVIATIONS

Abbreviation	Explanation
AAQ	Ambient Air Quality
AD	Ancestral Domain
ADB	Asian Development Bank
A&D	Alienable and Disposable
AFP	Armed Forces of the Philippines
AIDS	Acquired Immunodeficiency Syndrome
APG	Angiosperm Phylogeny Group
APS	Auxiliary Power Supply
APSI	Air Pollution Source Installation
AR5	IPPC's Fifth Assessment Report
ATP	Automatic Train Protection
AWARE	Airport Weather Advanced Readiness Toolkit
BAFs	Bureau of Agriculture and Fisheries Standards
BD	Basic Design
BFP-SRU	Bureau of Fire Protection – Special Rescue Unit
BMB	Biodiversity Management Bureau
BOD	Biochemical Oxygen Demand
BRGY	Barangay
BS	British Standard
BSWM	Bureau of Soils and Water Management
BT	Battery
CADC	Certificate of Ancestral Domain Claim
CADT	Certificate of Ancestral Domain Title
CALC	Certificate of Land Claims
CALT	Certificate of Ancestral Land Title
CARI	Contractor's All Risk Insurance
CARP	Comprehensive Agrarian Reform Program
CBTC	Communication Based Train Control
CCA	Climate Change Adaptation
CCC	Climate Change Commission
CCTV	Closed-circuit Television
CDM	Clean Development Mechanism
CE	Critically Endangered Species
CEMMAP	Contractor's Environmental Management Plan
CENRO	City Environment and Natural Resources Office
CLUP	Comprehensive Land Use Plan
CLUDP	Comprehensive Land Use and Development Plan
CMR	Compliance Monitoring Report
CMVR	Compliance Monitoring and Validation Report
CNC	Certificate of Non-Coverage
CNO	Certificate of No Overlap
CP	Compressor
CPDO	City Planning and Development Office
CR	Critically Endangered
CS	Conservation Status

CTC	Centralized Train Control
CWD	Civil Works Division
DA	Department of Agriculture
DAO	DENR Administrative Order
DAP	Development Academy of the Philippines
DAR	Department of Agrarian Reform
dB	Decibel
dBA	A-weighted decibels
DC	Direct Current
DD / DED	Detailed Design Stage / Detailed Engineering Design Stage
dbh	Diameter at Breast-Height
DENR	Department of Environment and Natural Resources
DepEd	Department of Education
DIA	Direct Impact Area
DILG	Department of Interior and Local Government
DMU	Diesel Multiple Unit
DO	Dissolved Oxygen
DOH	Department of Health
DOST	Department of Science and Technology
DOTC	Department of Transportation and Communications
DOTr	Department of Transportation
DPWH	Department of Public Works and Highways
DRR	Disaster Risk Reduction
DSPEWPC	Department of Sustainability, Environment, Water and Population Communities
DSR	Digital Space Radio
DSWD	Department of Social Welfare and Development
DTI	Department of Trade and Industry
ECA	Environmentally Critical Area
ECC	Environmental Compliance Certificate
ECP	Environmentally Critical Project
EDSA	Epifanio delos Santos Avenue
EF	Emission Factor
EGF	Environmental Guarantee Fund
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EIAMD	Environmental Impact Assessment and Management Division
EIS	Environmental Impact Statement
EISR	Environmental Impact Statement Report
E&M	Electrical and Mechanical Systems
EMB	Environmental Management Bureau
EMC	Electro Magnetic Compatibility
EMF	Environmental Monitoring Fund
EMI	Electro Magnetic Interference
EMoP	Environmental Monitoring Plan
EMP	Environmental Management Plan
EMU	Electric Multiple Unit
EN	Endangered Species
ENRO	Environment and Natural Resources Officer
EO	Executive Order

EPRMP	Environmental Performance Report and Management Plan
ERA	Environmental Risk Assessment
ERP	Emergency Response Plan
ESD	Engineering Support Division
ESRD	Environment, Social and ROW Division
EQPL	Environmental Quality Performance Level
FBI	Field Based Investigation
FMEA	Failure Modes and Effects Analysis
FMB	Forest Management Bureau
FPIC	Free, Prior and Informed Consent
FV	Field Validation
GAF	Grievance Action Form
GCR	Greater Capital Region
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GPS	Global Positioning System
GRDA	General Residential Development Area
GRM	Grievance Redress Mechanism
GTI	Geosphere Technologies Inc
GW	Ground Water
HIV	Human Immunodeficiency Virus
HSEC	Health, Safety and Environment Committee
Hz	Hertz
IBA	Important Bird Area
IC	Industrial, Commercial
ICC	Indigenous Cultural Communities
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IEA	International Energy Agency
IEC	Information Education and Communication
IEE	Initial Environmental Examination
IESAM	Institute of Environmental Science and Management
IFC	International Finance Corporation
IGBT	Insulated Gate Bipolar Transistor
IIA	Indirect Impact Area
IP	Indigenous Peoples
IPC	Indigenous Peoples Communities
IPCC	Intergovernmental Panel on Climate Change
IPRA	Indigenous Peoples Rights Act
IRR	Implementing Rules and Regulations
IRRI	International Rice Research Institute
ISF	Informal Settler Families
IUCN	International Union for Conservation of Nature
IV	Importance Value
JICA	Japan International Cooperation Agency
KBA	Key Biodiversity Area
KW/H	Kilowatt per hour
LAeq	Equivalent continuous sound pressure level
LC	Least Concern
LCD	Liquid Crystal Display
LED	Light Emitting Diode

LFPR	Labor Force Participation Rate
LGU	Local Government Unit
LIAC	Local Inter-Agency Committee
LLDA	Laguna Lake Development Authority
LPA	Low Pressure Area
LRT	Light Rail Transit
LRTA	Light Rail Transit Authority
MBAS	Methylene Blue Active Substances
MCLUPZO	Manila City Comprehensive Land Use Plan and Zoning Ordinance
MCRP	Malolos Clark Railway Project
MCRRS	Manila-Clark Rapid Railways System
MENRO	Municipal Environment and Natural Resources Office
MGB	Mines and Geosciences Bureau
MH	Merchantable Height
MLUP	Municipal Land Use Plan
MMDA	Metro Manila Development Authority
MMFR	Mount Makiling Forest Reserve
MMSP	Metro Manila Subway Project
MMT	Multi-partite Monitoring Team
MMUTIS	Metro Manila Urban Transportation Integrated Study
MNTC	Manila North Tollways Corporation
MOA	Memorandum of Agreement
MPDO	Municipal Planning and Development Office
MPN	Most Probable Number
MRF	Materials Recovery Facility
MRT	Metro Rail Transit
MSWMB	Municipal Solid Waste Management Board
MT	Metric Ton
NAAQGV	National Ambient Air Quality Guideline Values
NAMRIA	National Mapping and Resource Information Authority
NBC	National Building Code
NBSAO	National Biodiversity Strategy and Action Plan
NCCA	National Commission for Culture and the Arts
NCCAP	National Climate Change Action Plan
NCIP	National Commission on Indigenous Peoples
NCR	National Capital Region
NECP	Non-Environmentally Critical Project
NFSCC	National Framework Strategy on Climate Change
NGO	Non-Government Organization
NHA	National Housing Authority
NHCP	National Historical Commission of the Philippines
NIPAS	National Integrated Protected Areas System
NLEX	North Luzon Expressway
NLRC	North Luzon Railways Corporation
NM	National Museum
NMTT	Navotas-Malabon-Tenejeros-Tullahan River
NPCC	National Pollution Control Commission
NSCR	North South Commuter Railway Project
NSRP	North South Railway Project

NTP	Notice to Proceed
OCC	Operation Control Center
OCD	Office of Civil Defense
ODA	Overseas Development Assistance
O&G	Oil and Grease
OSH	Occupational Safety and Health
OTS	Other Threatened Species
OWS	Other Wildlife Species
PA	Philippine Army
PAF	Project Affected Families
PAGASA	Philippine Atmospheric Geophysical and Astronomical Services Administration
PAP	Project Affected Persons
PAR	Philippine Area of Responsibility
PAST	Paleontological Statistical Software
PAWB	Protected Areas and Wildlife Bureau
PC	Pre-cast
PCSD	Project Control Support Division
PD	Presidential Decree
PDR	Project Description Report
PEISS	Philippine Environmental Impact Statement System
PEMAPS	Project Environmental Monitoring and Audit Prioritization Scheme
PENRO	Provincial Environment and Natural Resources Office
PEPRMP	Programmatic Environmental Performance Report and Management Plan
PET	Polyethylene Terephthalate
PH	Public Hearing
pH	Potential of Hydrogen
PHIVOLCS	Philippine Institute of Volcanology and Seismology
PHP	Philippine Peso
PM	Particulate Matter (in microns)
PMO	Project Management Office
PNP	Philippine National Police
PNR	Philippine National Railways
PNS	Philippine National Standard
PNSC	Philippine National Structural Code
PNSDW	Philippine National Standard for Drinking Water
PO	People Organizations
POP	Persistent Organic Pollutant
PPCC	Philippine Plant Conservation Committee
PPE	Personal Protective Equipment
PRI	Philippine Railway Institute
PSCCA	Philippine Strategy in Climate Change Adaption
PT	Pantograph
PTAC	Pilotage Trading and Construction
PUD	Planned Unit Development
PWU	Philippines Women's University
Qh	Recent deposits
QVP	Quaternary Volcanic Pyroclastic

RA	Republic Act
RAP	Resettlement Action Plan
REG	Region
RF	Rainfall
RHU	Rural Health Unit
RIC	RAP Implementation Committee
RIE	Residential, Institutional, Educational
ROW	Right-of-Way
RPM	Revised Procedural Manual
RS	Residency Status
RSD	Rolling Stock Division
SAFDZ	Strategic Agriculture and Fisheries Development Zone
SB	Sangguniang Bayan
SCPW	Society for the Conservation of Philippine Wetlands Inc.
SCRP	South Commuter Railway Project
SCTEX	Subic-Clark-Tarlac Expressway
SDP	Social Development Plan
SEMS	Social and Environmental Management Systems
SIC	Semi-conductor
SLEX	South Luzon Expressway
SMR	Self-Monitoring Report
SNC	Philippines Second National Communication on Climate Change
SPS	Safeguard Policy Statement
SPT	Standard Penetration Test
SRTM	Shuttle Radar Topography Mission
STOA	Supplemental Toll Operating Agreement
STP	Sewage Treatment Plant
STPP	Sucat Thermal Power Plant
SW	Surface Water
SWMP	Solid Waste Management Plan
TBM	Tunnel Boring Machine
TC	Trailer Car
TCLP	Toxicity Leaching Procedure
TCU	Total Color Unit
TD	Tropical Depression
TDS	Total Dissolved Solids
TESDA	Technical Education and Skills Development Authority
TH	Total Height
TIA	Traffic Impact Assessment
TMS	Train Management System
TNVIA	Transit Noise and Vibration Impact Assessment
TOR	Terms of Reference
TS	Tropical Storm
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
TY	Typhoon
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific and Cultural Organization

USD	United States Dollar
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
US FTA	United States Federal Transit Authority
USGS	United States Geological Survey
VL	Vibration Level
VU	Vulnerable Species
VVVF	Variable Voltage and Variable Frequency
WACS	Waste Analysis Characterization Study
WB	World Bank
WBCP	Wild Bird Club of the Philippines
WBCSD	World Business Council for Sustainable Development
WFP	Work and Financial Plan
WHO	World Health Organization
WQG	Water Quality Guidelines
WRI	World Resources Institute
WSS	Water Sampling Site

EXECUTIVE SUMMARY

1. This Executive Summary provides key finding of the environmental impact assessment (EIA) of the proposed South Commuter Railway Project, herein after referred to as the "Project" or "SCRP". It includes a general overview of the project, and its purpose and need; briefly describes the Project's EIA process; summarizes the major environmental impacts for key resources and aspects associated with the proposed activities and corresponding preventive, mitigating and compensatory measures; summarizes the monitoring plan; lists key consultation and coordination activities; and issues and concerns that emerged.

2. The proposed SCRP will include two sections of new railway services namely: 1) NSCR Calamba Extension; and 2) underground section connecting the SCRP to the Metro Manila Subway Project (MMSP) (i.e. Senate-FTI-Bicutan Segment or SCRP interconnecting line).

3. The project aims to provide a commuter and intercity railway service connecting Metro Manila and its adjacent northern and southern suburban areas and is deemed to be an important mass transit backbone for Metro Manila as well as for the growth corridor of the Greater Capital Region (GCR), comprising of Region III, National Capital Region (NCR) and Region IV-A.

4. The SCRP will be co-financed by the Asian Development Bank (ADB) and the Japan International Cooperation Agency (JICA).

5. This EIA assesses the SCRP including the abovementioned interconnecting line. This document is prepared as part of DOTr's compliance with ADB's safeguards requirements prior to granting any construction activities related to the project to be financed.

A. PROJECT FACT SHEET

<table>
<tr><th>Project Name</th><th colspan="3">Proposed South Commuter Railway Project</th></tr>
<tr><td rowspan="2">Project Location</td><td rowspan="2">Cities traversed by the alignment:
Manila City, Metro Manila
Makati City, Metro Manila
Taguig City, Metro Manila
Parañaque City, Metro Manila
Pasay City, Metro Manila
Muntinlupa City, Metro Manila
San Pedro City, Laguna
Biñan City, Laguna
Sta. Rosa City, Laguna
Cabuyao City, Laguna
Calamba City, Laguna</td><td>Stations location:
Blumentritt Station
España Station
Sta. Mesa Station
Paco Station
Buendia Station
EDSA Station
Nichols Station
FTI Station
Bicutan Station
Sucat Station
Alabang Station
Muntinlupa Station
San Pedro Station
Pacita Station
Biñan Station
Sta. Rosa Station
Cabuyao Station
Banlic Station
Calamba Station</td></tr>
<tr><td>Depot location:
Barangay Banlic, Calamba City, Laguna</td></tr>
<tr><td>Objective</td><td colspan="2">To expand the existing mass transport system connecting Metro Manila (MM) and south of MM areas</td></tr>
<tr><td>Project Type</td><td colspan="2">Railway and Subway System</td></tr>
<tr><td>Project Area</td><td colspan="2">Total Length: 64.2 km
Above-ground Section: Length: 58.6 km (main line) + 0.8 km (interconnecting line), Width: 30 m (including access to Depot)
Underground Section: Length: 4.8 km, two parallel single-track tunnels at depth of approx. 26 m.
Station: 19 stations, Length: 250 m, Width: 60 m
Depot: 22 hectares</td></tr>
<tr><td>Project Capacity</td><td colspan="2">Two hundred (200) commuter trains having a capacity 2,200 passengers/train (seating + standing)</td></tr>
</table>

<table>
<tr><th>Project Name</th><th>Proposed South Commuter Railway Project</th></tr>
<tr><td>Project Technology</td><td>Electric Multiple Unit (EMU) Train</td></tr>
<tr><td>Major Components of the Project</td><td>The components of the Project are: (1) Main Railway Line, (2) Stations, (3) Maintenance Depot, (4) Underground Section (5) E & M System and (6) Rolling Stock</td></tr>
<tr><td>Manpower</td><td>
<table>
<tr><th>Project Phase</th><th>Civil</th><th>E&M</th><th>Rolling Stock</th><th>Total</th></tr>
<tr><td>Pre-construction</td><td>100</td><td>60</td><td>40</td><td>200</td></tr>
<tr><td>Construction</td><td>22,575</td><td>3,079</td><td>1,026</td><td>26,680</td></tr>
<tr><td>Operation</td><td></td><td colspan="2">3,850</td><td>3,850</td></tr>
</table>
</td></tr>
<tr><td>Project/Investment Cost</td><td>PhP 344.606 Billion (JPY 727.119 Billion @ PhP 1 = JPY 2.11)</td></tr>
<tr><td>Project Duration</td><td>The Project is targeted to be operational by the 2nd quarter of 2024 or approximately a period of four (4) years for pre-construction and construction activities</td></tr>
<tr><td>Profile of the Proponent</td><td></td></tr>
<tr><td>Name of Proponent</td><td>Department of Transportation (DOTr)</td></tr>
<tr><td>Proponent’s Address</td><td>DOTr Head Office, Pinatubo Street corner Osmeña Street,
Clark Freeport Zone, Angeles City, Pampanga</td></tr>
<tr><td>Authorized Signatory/ Representative</td><td>Atty. Timothy John R. Batan
Undersecretary for Railways</td></tr>
<tr><td>Contact Details</td><td>Telephone No: (02)790-8300</td></tr>
<tr><td>Profile of the Preparer</td><td></td></tr>
<tr><td>1st EIA Preparer</td><td>GEOSPHERE Technologies, Inc.</td></tr>
<tr><td>Consultant’s Address</td><td>19D Eisenhower Tower, Eisenhower St., Greenhills, San Juan, Metro Manila</td></tr>
<tr><td>Contact Person</td><td>Engr. Ledicia T. Dela Cruz
Managing Director</td></tr>
<tr><td>Contact Details</td><td>Landline: (+632) 724-5665; 724-5667
Fax Number: (+632) 723-4250
Email Address: gti0722@geospheretech.com</td></tr>
<tr><td>2nd EIA Preparer</td><td>AECOM Philippines, Inc.</td></tr>
<tr><td>Consultant’s Address</td><td>Bonifacio Stopover Corporate Center, 14th Floor, 31st Street, 2nd Ave, Taguig, Metro Manila</td></tr>
<tr><td>Contact Person</td><td>Kathleen Anne Cruz
Project Director</td></tr>
<tr><td>Contact Details</td><td>Landline: (+632) 478 3266 ext. 247</td></tr>
</table>

B. LEGAL AND INSTITUTIONAL FRAMEWORK ON ENVIRONMENTAL IMPACT ASSESSMENT

6. Any private or public projects or activities which are likely to have foreseen adverse effects on the natural and social environment are subject to the Philippine Environmental Impact Statement System (PEISS) as primarily stipulated in Presidential Decree 1152, otherwise known as the “Philippine Environment Code (1977)” which recognizes the establishment of specific environment management policies and prescribes environmental quality standards. The law is supplemented by the Office of the President Executive Order 192 (1987), which mandates the EMB, among others, 1) to formulate environmental quality standards such as the quality standards for water, air, land, noise and radiation, 2) to recommend rules and regulations for environmental impact assessment and provide technical assistance for their implementation and monitoring and 3) to formulate rules and regulations for the proper disposal of solid wastes, toxic and hazardous substances.

7. In addition, being an ADB and JICA financed project, the proposed SCRP must comply with ADB’s Safeguard Policy Statement (2009), the JICA Guidelines for Social and Environmental Considerations (2010) and guidelines referred therein, most importantly, the WBG-IFC Environment, Health and Safety Guideline (2007).

8. The project falls under environment category A as per ADB Safeguard Policy Statement 2009 requiring a comprehensive environmental impact assessment including environmental management plan. For environment category A project, SPS also requires disclosure of draft EIA report to the public through the ADB website, 120 days before the approval of project by ADB Board for financing. The draft EIA also need to be made available to all stakeholders as part of the consultation process required under the SPS 2009.

9. JICA and ADB generally recognize national environmental standards for projects. If national environmental standards do not exist or are considered inappropriate, internationally recognized standards are used for reference purposes. If national environmental standards differ from international standards, moreover, more stringent standards are adopted. However, if sufficient justification exists, the country's national standards are applied. The environmental standards applied for the project are categorized by environmental documentation requirements of the PEISS, JICA and ADB (further detailed in **Chapter 2**).

10. Based on the above information and as comprehensively detailed in Chapter 2 of this Report, policy and regulatory requirements of the Government of the Philippines as well as the funding institutions of JICA and ADB have been carefully considered and met. Therefore, this EISR including EMP fulfill the policy and regulatory requirements of all three agencies (Government of the Philippines, ADB and JICA) involved in the project.

C. EIA PROCESS DOCUMENTATION

EIA Team

11. As this EIA Study was done by two different groups due to the nature of the project, the assessment of the above-ground portion of the SCRP was carried out by the GEOSPHERE Technologies, Inc. (**GTI**). Meanwhile, the revision and updating of the EIA Study to include the environmental and social impact aspect of the Senate-FTI-Bicutan Segment were done by the AECOM Philippines, Inc.

12. The multidisciplinary team of specialists and consultants of the GEOSPHERE Technologies, Inc. (**GTI**) with strong background in environmental assessment is composed of the people presented in **Table ES-1** GTI EIA Study Team Composition.

Table ES-1 GTI EIA Study Team Composition

Environmental Aspect/Task	Team Member	EMB Registry No.
Team Lead	Ledicia T. dela Cruz	IPCO-287
Peer Review	Noelina B. Miran	-
EIS Report Integration	Pearly Grace E. Resano	IPCO-115
	Anngela Joy N. Bagsain	-
Geology and Hydrology	Reynar Rollan	IPCO-294
Soils and Land Use	Marmelou Popes	-
	Arnel Mendoza	-
Terrestrial Flora	Enrico Replan	-
Terrestrial Fauna	Judeline Dimalibot	IPCO-176
Water Quality	Vanderleaf Capalungan	-
Freshwater Ecology	Ma. Vivian Camacho	IPCO-213
Meteorology, Air Quality and Noise	Reynaldo S. Tejada	IPCO-036
Air Quality and Noise	Rogey A. Miedes	IPCO-512
Vibration Survey and Assessment	Emmanuel G. Ramos	IPCO-117
Environmental and Social Safeguard (Socio-Cultural and Gender)	Felixberto Roquia, Jr.	IPCO-028

13. The DOTr, as the project proponent and implementing agency, is represented by Atty. Timothy John R. Batan, Undersecretary for Railways. The accountability statement of the proponent and the preparer is presented **Annex ES-1**.

14. On the other hand, the team of EIA practitioners from the side of AECOM is presented in **Table ES-2**.

Table ES-2 AECOM EIA Study Team Composition

Environmental Aspect/Task	Team Member	EMB Registry No.
Project Director / Peer Reviewer	Kathleen Anne Cruz	IPCO-164
Project Manager / EIS Report Integration	Rory Caguimbal	IPCO-229
Geologist / Geohazard Specialist	Kathleen Reolalas	-
Pedology / Land Use	Mary Grace Ecat	-
Terrestrial Flora	Danielle Dominique Deborde	-
Terrestrial Fauna	Michael de Guia	IPCO-272
Water Quality	Rosette Kassandra Dumat-ol	-
Freshwater Ecology	Danielle Dominique Deborde	-
Meteorology, Air Quality and Noise	Aquinas Hyacinth Toledo	-
Traffic impact Assessment	Jecco Louie dela Cruz	-
Socio-Economics Specialist/Social Impact Assessment Specialist	Joanne Ochoa	-
Environmental Risk Assessment Specialist	Alexander Luciano	-

15. The environmental assessment team was supplemented by noise and vibration impact assessment experts supported by ADB to ensure that the project impacts due to noise and vibration complies with internationally accepted standards.

EIA Schedule

16. The first EIA Study for the SCRP EIA covered the SCRP main line and commenced during Feasibility Study (FS) Phase which was undertaken for a period of seven (7) months starting from the conduct of Information, Education and Communication (IEC) activities as early as December 2017 up to the final submission of the EIS Report to the EMB Central Office on July 2018. In between, public scoping activities with stakeholders and technical scoping activities with EMB Central Office and EIA Review Committee (EIARC) members were undertaken from January- February 2018 that defined the scope of work for the EIA study including the baseline data and assessment methodology requirements. Subsequently, primary and secondary data gathering were conducted. Data collected were processed, analyzed and evaluated for impact assessment and formulation of Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMoP). Information were written into an EISR and the final version of the EISR were submitted to EMB Central Office during FS stage as a requirement for ECC application.

17. However, there were changes on the project scope from FS to detailed design (DD) stage that required supplementary documentation which took additional three (3) months to complete. The additional surveys for wet season were undertaken from June-July 2018 while additional surveys based on detailed design were conducted in March, April and June 2019 as part of the documentation.

18. All in all, the activities undertaken to complete the EIA, including the additional surveys, took ten (10) months which are listed in **Table ES-3**.

Table ES-3 EIA Study Schedule

Activity	Date
IEC Activities	December 13, 2017–January 10, 2018
Public Scoping	January 18, 2018, 1:00PM (Makati City) January 19, 2018, 1:00PM (Calamba City) January 24, 2018, 1:00PM (Taguig City)
Technical Scoping	February 09, 2018
Primary and Secondary Data Gathering	
Land Use	January - February 2018
Geology and Geological Hazards	February 15, 2018
Soil Quality	January 23 - February 20, 2018
Soil Quality for Possible Contamination at Banlic	March 23, 2018
Terrestrial Ecology	February 05 - 24, 2018
Hydrology/Hydrogeology	February 15, 2018
Water Quality	February 12-14, 2018
Freshwater Ecology	February 08-09, 2018
Air Quality and Noise	January 18-February 21, 2018
Vibration	February 22 - March 03, 2018
Socio-economic, Health and Perception Survey	February 06 - 27, 2018
Impact and Risk Evaluation	March 2018
Formulation of Impact/Environmental Management Plan (**EMP**) and Environmental Monitoring Plan (**EMoP**)	April 2018
Preparation of Draft EIS	January 2018 – May 2018
Submission of Draft EIS to EMB	May 11, 2018
Public Hearing	June 20, 2018, 9:00AM (Makati City) June 21, 2018, 1:00PM (Taguig City) June 22, 2018, 9:00AM (Santa Rosa City)
Additional noise and vibration impact assessment	November 2018 – February 2019
Additional Surveys (Wet Season)	
Soil Quality for Possible Contamination at STPP	August 20, 2018
Terrestrial Ecology	June 25 - July 18, 2018
Groundwater Quality	June 18 - July 19, 2018
Air Quality and Noise	June 22 - July 15, 2018
Additional Surveys based on Updated Project Design	
Soil Quality for Possible Contamination at Banlic and STPP	April 06 – 12, 2019
Air Quality and Noise	March 11-14, 2019 and April 29-30, 2019
Existing Noise Levels for Transit Noise Assessment	March 14, 2019 to April 30, 2019
Vibration	June 01 - 08, 2019
Additional Noise measurements	September 8 – October 4, 2019

19. The Senate-FTI-Bicutan Segment was added to the project scope in March 2020. This EIA was updated to reflect the additional scope and made use of the assessment (Environment Performance Review and Management Plan, EPRMP) prepared for the MMSP in 2019 by the JICA design team (JDT). The EPRMP was required to reflect the changes in the alignment during the detailed design phase as well as to amend the existing ECC which was awarded in 2017. The EPRMP covered the Senate-FTI-Bicutan Segment which is now part of the SCRP. **Table ES-4** shows the summary of the EIA Study schedule undertaken as part of the EPRMP for the MMSP. Additional assessments were conducted in February-March 2020 for the underground section to supplement the findings of the EPRMP, including a noise and vibration impact assessment for construction and operation phase, a groundwater impact assessment, an UXO risk assessment, and site inspection of spoil disposal area alternatives.

Table ES-4 EIA Study Schedule

Activity	Date
IEC Activities – Stakeholder Consultation Meeting	October 8 – 9, 2019
IEC activities – social preparation and scoping activities	May 16 – June 3, 2019
Perception Survey	May 30 and June 4, 2019
Public Scoping	July 1, 2019 (Paranaque)
Technical Scoping	July 17, 2019
Primary and Secondary Data Gathering	
Ambient air quality and noise sampling	June 20-23, 2019
Wildlife survey	June 29 – 30 and July 6 -7, 2019
Perception Survey	May 30-31 and June 3, 2019
Vegetation Survey	June 18 – 20 and July 21, 2019
Traffic Survey	July 5 and July 8, 2019
Vibration surveys	July 4 – 7, 2019
Additional Surveys based on Updated Project Design	
Spoil disposal area site inspection	February 12, 2020
Additional vibration assessment	February – March 2020

EIA Methodologies

20. The EIA for the Project conforms to the Revised Procedural Manual for DAO 2003-30 and DAO 2017-15. The baseline information are mainly primary and secondary data which were obtained from the local government units (LGUs) and other government agencies. Data collected were based from the approved EIA Scoping and Screening Form (**Annex ES-2**). **Table ES-5** The EIA Methodology shows the pertinent data, sources, and methodologies used in the conduct of this EIA study.

Table ES-5 The EIA Methodology

Environmental Components	Methodology and Approach on Baseline Survey	Methodology on Impact Assessment
LAND		
Land Use and Classification	• Review of Comprehensive Land Use Plans • Data gathering from Protected Areas and Wildlife Bureau (PAWB), National Historical Commission of the Philippines (NHCP),	• Assessment of the compatibility of the Project vis-à-vis approved land use plan and zoning classification.
Geology	• Conduct of field surveys • Review of available reports, geologic literature and information from Mines and Geosciences Bureau (MGB), Philippine Institute of Volcanology and Seismology (PHIVOLCS), Philippine Atmospheric, Geophysical and Astronomical Services (PAGASA), National Mapping and Resource Information Authority (NAMRIA) and Proponent	• Assessment of construction and operation impacts based on the construction and operation activities of the Project, and the susceptibility of the project area to natural hazards.
Pedology	• Review of existing literature and maps of the project alignment. • Conduct of field surveys and collection of soil samples	• Assessment of impacts based on the construction and operation activities to the existing environment.
Terrestrial Ecology	• Conduct field surveys at the proposed project site.	• Assessment of impacts based on the construction and operation activities to the existing ecosystem.
WATER		
Hydrology and Hydrogeology	• Review of CLUP of host LGUs and other secondary data from existing literature and maps of the project area from MGB, NAMRIA, and PHIVOLCS. • Conduct of field surveys	• Assessment of impacts based on the construction and operation activities to the existing environment and the susceptibility of the project area to flooding.
Water Quality	• Collection of groundwater and surface water samples for analysis of physical, chemical, microbiological, micro-nutrient and heavy	• Assessment of impacts based on the construction and operation to the existing environment.

Environmental Components	Methodology and Approach on Baseline Survey	Methodology on Impact Assessment
	metal analyses at Mach Union Laboratory, Inc. in Las Piñas City. Levels of DO, salinity, conductivity, TDS and Temperature were measured on-site. • Assessment of groundwater quality and freshwater quality using the Philippine National Standards for Drinking Water of 2007 (PNSDW, 2017) and DAO 2016-08 (Water Quality Guidelines and General Effluent Standards of 2016), respectively.	
Freshwater Ecology	• Characterization of trophic composition at 13 sampling stations in the rivers and creeks along the alignment. The phytoplankton samples were collected using 10µ-mesh plankton net and placed in clear plastic bottles preserved with Lugol's solution. The zooplankton samples, on the other hand, were collected using a 40µ-mesh net and placed in plastic bottles preserved with 7-10% formalin. Benthic organisms were collected from the sediments and strained using various mesh size sieves and preserved using alcohol.	• Assessment of impacts based on the construction and operation activities to the existing ecosystem. • Rapid stream visual assessment using visual habitat predictors and ecosystem quality parameters
AIR		
Meteorology and Climatology	• Collection and review of existing literature and maps of the project area from PAGASA Science Garden Complex, Quezon City and NAS UPLB, Los Baños, Laguna	• Assessment of impacts based on the construction and operation activities. • Calculation of GHG emissions using emission factor-based estimation method prescribed in The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard, Revised Edition, World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI), 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National GHG Inventories and 2014 IPCC Assessment Report. • Projection of monthly average temperature and rainfall and frequency of extreme events under medium range emission scenario using the data from PAGASA Climate Change in the Philippines, 2011.
Air Quality and Noise Level	• Conduct of ambient air quality monitoring at eight (8) sampling stations for the EIA Study and at additional four (4) sampling stations which were established during the Detailed Design phase to measure the Ground Level Concentrations (GLCs) of Carbon Monoxide (CO), Ozone (O_3), Nitrogen Dioxide (NO_2), Sulfur Dioxide (SO_2), Total Suspended Particulates (TSP), Particulate Matter of up to 10 μm (PM_{10}), Particulate Matter of up to 2.5 μm ($PM_{2.5}$) and Lead (Pb) in the project area and its vicinity. • Conduct of Noise level measurement during morning, daytime, evening, and night time using Extech Noise Data Logger at fifteen (15) sampling stations for the EIA Study and at additional four (4) stations which were established during the detailed design phase of the Project.	• The assessment of noise impacts associated with the construction of the Project employs the use of prediction model as described in the Technical Handbook for Environmental Impact Assessment of Roads (2007). • Assessment of noise impacts associated with the operation of the Project employs the use of prediction model SoundPlan based on the feasibility study and draft detailed engineering design, rail elevations, final alignment, final right-of-way, design speeds, and train specifications. • Transit Noise Assessment as conducted by ADB based on Transit Noise and Vibration Impact

Environmental Components	Methodology and Approach on Baseline Survey	Methodology on Impact Assessment
	• Conduct of Noise level measurement for Transit Noise Assessment at twelve (12) identified noise sensitive receptors within the vicinity of the project alignment. • Additional noise measurement at 41 sensitive receptors to capture the potential impacts from an elevated linear noise source. • Noise prediction for construction and operation activities.	Assessment (TNVIA) Manual of the U.S. Federal Transit Authority. • Assessment of construction noise for underground station area at FTI station was performed following the US FTA manual and sided by SounPlan 8.1 Noise Model.
Vibration	• Conduct of vibration measurement for 24 hours using Vibron Seismometer which is a seismic data recorder connected to geophones at the fifteen (15) established sampling stations for the EIA Study and at additional twelve (12) sampling stations for the Detailed Design phase of the Project. • Additional vibration measurements were conducted at three (3) sampling stations for underground section from Senate to FTI station.	• Assessment of vibration impacts associated with the construction of the Project was conducted using the prediction model developed in the Technical Handbook for Environmental Impact Assessment of Roads (2007). • Assessment of vibration impacts associated with the operation of the Project was conducted using the actual vibration measurements of similar projects with the same train structure and operation (i.e. East-Osaka Urban Rapid Transit) • Analysis of potential vibration impacts associated with the construction and operation of the proposed SCRP was conducted by ADB based on Transit Noise and Vibration Impact Assessment (TNVIA) Manual of US FTA dated May 2006. • Additional vibration impact assessment associated with construction of underground section (using TBM) and operation of subway from Senate to FTI station was conducted by ADB based on methodologies and international good practice including FTA methodology.
PEOPLE		
Socioeconomic and Public Health	• Conduct of IEC for the LGUs • Conduct of Public Scoping • Conduct of Socio-economic, Public Health and Perception Survey at host barangays • Review of the CLUP and Socio-economic Profile of host cities and municipality • Review of available secondary data, relevant studies and other information from Philippine Statistics Authority (PSA). • Gathering and review of relevant primary data critical to the study; • Collected and evaluated recent trends of secondary data on health and injury profile from the City Health Office (CHO) for possible relationship to health impacts associated with the train operation. • Literature review on the potential impacts and risks of the railway on health of people living in surrounding communities, to confirm established relationships between hazards of railway and health risks and effect to people. • Review of CLUP of the host LGUs in the preparation of the Indicative SDP, and IEC Framework.	• Assessment of impacts based on the results of IEC, Public Scoping, FGD, survey of PAFs and construction and operation activities of the proposed SCRP.

Public Consultation Documentation

21. As part of information disclosure, the final EIS, approved by EMB and concurred with by ADB and JICA, is uploaded and available on websites of DOTr, JICA and ADB. As required under ADB SPS disclosure requirement, the draft EIA has been disclosed on ADB website 120 days before the approval of project by ADB Board for financing.

Public Consultation Activities

22. In accordance with the Project IEC framework, the different consultation activities presented in **Table ES-6** were conducted to provide updated information about the Project and encourage the concerned stakeholders - affected residents, host communities, LGUs, relevant agencies, the EMB and the local DENR in the EIA process - to participate in the EIA Study.

Table ES-6 Summary of Consultation/Participation and Information Disclosure Conducted under the Project

No.	Proposed Mechanism	Dates	
		SCRP Main Line	SCRP Interconnecting Line*
Feasibility Study Stage			
1	LGU meetings	December 13, 2017–January 10, 2018	May 16 – June 3, 2019
2	NGA meetings DENR-EMB, HUDCC, NCCA, NHCP, PCUP, SHFC	November 22, 2017–September 25, 2018	January 2019 – December 2019
3	Perception survey	February 6–28, 2018	May 30-31 and June 3, 2019
4	Stakeholder consultation	January 18–August 28, 2018	August 14, 2019 (1st SCM under RAP study)
5	Focus group discussion	April 23–May 15, 2018	July 15, 2019
6	Public scoping	January 18–24, 2018	July 1, 2019
7	Public hearing	June 20–22, 2018	September 3, 2019
Detailed Design Stage			
1	LGU meetings	September 19–October 23, 2019	Not yet in DD stage
2	NGA meetings BIR, DA, DAR, DENR RO3, DENR RO-4A, DENR-FMB, DOLE, DSWD, DTI, HUDCC, LBP, NAPC, NCCA, NCIP, NHCP, NM, PAF, PAG-IBIG, TESDA	October 2018–March 2019	Not yet in DD stage
3	Stakeholder consultation	1st SCM: January 8-16 2019	Not yet in DD stage
4	Focus group discussion	November 7–September 18, 2019	Not yet in DD stage
5	Production and distribution of printed and other materials	Not yet	Not yet in DD stage
6	Online disclosure of project information	January 2018–present	Not yet in DD stage
7	Media releases/press briefings	November 2018	Not yet in DD stage

Source: JICA Design Team

D. EIA SUMMARY

Summary of Alternatives

Siting

23. The proposed SCRP will utilize the existing PNR Right-of-Way (**ROW**) and no other ROW alternative was considered because the area is highly developed.

24. During the detailed design phase, the alignment for the proposed Sucat Station was changed. From the existing ROW, the alignment will be diverted going to the area of the Old Sucat Thermal Power Plant (STPP) to accommodate the future plan for long haul train station. Similarly, for the proposed Calamba Station, this will now be located near the City Hall. In effect, the alignment will be extended by 1.2 km south of the existing PNR Calamba Station.

25. For the location of Depot, the options being considered are 1) Old Sucat Thermal Power Plant and 2) agricultural land in Banlic, Calamba City. Considering the storage of rolling stock, operation of carriage and maintenance, the agricultural land in Banlic, Calamba City was the preferred location for the Depot site.

26. During the detailed design phase, it was decided that the proposed Depot will be located in a 33-hectare agricultural land in Barangay Banlic, Calamba City, Laguna.

27. The Senate-FTIunde underground section passes through government properties within Taguig City and Paranaque City.

Technology and Design

28. For the track structure, elevated structure option was selected over the at-grade options after evaluation of impacts such as flooding and interference with existing roads.

29. For the underground section, it was determined that the best alternative for the integrated underground station (FTI Station) was Cut and Cover – Top Down Method. Meanwhile, the tunnel alignment between FTI Station and Senate Station shall be constructed through the Non-Cut and Cover Method (Shield Tunneling and New Austrian Tunneling Method (NATM)) using an Earth Pressure Balanced-type tunnel boring machine (TBM).

30. For the Rolling Stock Option, the DOTr will utilize Electric Multiple Unit (EMU) trains for the Project, which runs quieter than diesel and locomotive-drawn multiple units.

Summary of Baseline Environmental Conditions

31. Baseline conditions describe the state of the existing environment prior to project implementation. The summary of the baseline assessment is presented in **Table ES-7** Summary of the Baseline Environmental Conditions.

Table ES-7 Summary of the Baseline Environmental Conditions

Environmental Component	Description
LAND	
Land Use and Classification	• The proposed Project will utilize the existing Right-of-Way (ROW) of the Philippine National Railways (PNR) except for the segment from Solis to Sta. Mesa Station.

Environmental Component	Description
	• All of the affected LGUs are dominated by commercial and residential land use. Apart from this, cities of Sta. Rosa, Cabuyao, and Calamba also have agricultural in their dominant land uses. **Environmentally Critical Area** • The alignment of the Project does not traverse any international/local protected areas, important bird areas or key biodiversity areas, however, the nearest section of the alignment is located approximately 4 km from the Mount Makiling Forest Reserve. • Within the vicinity of the project alignment (80 m away), is the Lord Just Ukon Takayama Monument (Plaza Dilao, Paco, Manila) which was declared by the NHCP as a national heritage site. There were also identified old PNR and other structures within the PNR ROW which are considered to meet the NHCP Guideline on the Identification, Classification, and Recognition of Historic Sites and Structures. • The whole stretch of the alignment is prone to geologic (i.e. ground shaking) and typhoon hazards while only portions of the alignment located in Metro Manila are prone to periodic flooding during the rainy season. • Segment of the project alignment passes through agricultural areas (i.e. rice field) in Sta. Rosa, Cabuyao, and Calamba. One of the sites being considered for the Depot is a 33-ha agricultural in Banlic, Calamba. • There are 35 water body crossings at the project alignment. These include Pasig River, Sucat River, Alabang River, Bayanan Creek, Poblacion River (Muntinlupa), Magdaong River (Muntinlupa), Tunasan River, San Isidro River (San Pedro River), Biñan River, San Cristobal River and Calamba River. **Land Tenure Issue/s** • NLEx/ SLEx Connector Road Project, being implemented by the Department of Public Works and Highways (DPWH), is an 8 km all elevated 4-lane toll expressway extending the NLEx southward from the end of Segment 10 in C3 Road Caloocan City to PUP Sta. Mesa, Manila and connecting to the Skyway Stage 3, and mostly traversing the PNR rail track. The NLEx/ SLEx Connector Road Project will utilize the portions of PNR ROW for Solis to Pasig River which is in conflict with the Project alignment. • Due to the NLEx/ SLEx Connector Road Project, the project alignment will run outside and in parallel to PNR ROW from Solis to Pasig River which will require acquisition of private land. • PNR ROW has been proliferated by Informal Settler Families (ISFs). ISFs and their structures can be found within the bounds of the proposed 30m ROW for the proposed SCRP. Most of the structures located at approximately 2 to 10 meters from the track are a mixture of concrete and light materials with 2 or more families sharing in a structure. • The proposed Sucat Station will be located at the decommissioned Sucat Thermal Power Plant (STPP) area which is under the Power Sector Assets and Liabilities Management Corporation (PSALM). • The Pasig River Ferry Service is the only water-based transportation in Metro Manila that cruises the Pasig River from Pinagbuhatan in Pasig to Intramuros in the City of Manila. The system is owned and operated by a private company, SCC Nautical Transport Services Incorporated. There is a possibility that the proposed Project might affect the ferry operation during its construction traversing Pasig River. **Visual Aesthetic** • The existing PNR operates along the Laguna de bay which is the largest fresh water lake in the Philippines, and the third largest in South East Asia**.** The existing PNR lines being at grade structure are not visible from Laguna de Bay coast line however could be visible from Mount Makiling.
Geology/ Geomorphology	**Surface Landform/Geomorphology/Topography/Terrain/Slope** • Based on the classification by Miura et al. (2008), the segment of the Project alignment from Solis Station to Buendia Station is located within the Coastal Lowland. Meanwhile, the Senate-FTI underground section is within the Central Plateau. • The terrain class that can affect the project alignment are Cavite Manila Coastal Zone and Laguna Lakeshore. The Cavite Manila Coastal Zone corresponds to the southernmost extension of the Central Plain of Luzon. It receives eroded sediments from the rivers

Environmental Component	Description
	draining the long Cavite slope and from Pasig River. The segment from Solis Station to Nichols Station traverses this terrain unit. The Laguna Lakeshore corresponds to the gently sloping to flat area which serves as the immediate border of Laguna de Bay. The low elevation makes this area susceptible to flooding when the lake overflows. The segments from Sucat Station to Calamba Station and up to the location of the depot in Banlic, Calamba are located within this flood prone terrain unit. **Sub-surface Geology/Underground Conditions** • **Lithology and Stratigraphy**. The geologic formations within a 10-km corridor which could potentially affect the proposed railway are Recent Deposits (Qh) and Tuff and Pyroclastic (N_3 + Q_1). In the project area, Qh are found in Solis Station to Buendia Station, and Muntinlupa Station to Banlic, Calamba. Where the project line passes through built up areas, these Quaternary deposits are locally covered by pavements, embankments or partially consolidated fill. Guadalupe Formation (Marl, Reworked Tuff, Pyroclastic) underlie the gently sloping segment from Pasay Road Station to Bicutan Station. • **Regional Tectonic Setting.** The major earthquake generators relevant to the proposed SCRP include the Philippine Trench, the Philippine Fault, West Marikina Valley Fault, Lubang-Verde Passage Fault, and the Manila Trench. **Geologic and other Natural Hazard** • The hazards which can potentially affect the proposed Project include flooding and earthquake related hazards. The seismic related hazards include ground rupture, ground shaking, and liquefaction. The segments from Solis Station to Nichols Station and from Muntinlupa Station to Banlic Depot are potentially vulnerable to liquefaction in the event of a major earthquake occurrence. Earthquakes that can be generated by the major geological and tectonic structures in the region could bring about ground shaking which could affect the stability of railway line and its stations. The segment of the project between the Muntinlupa and Alabang Stations is vulnerable to ground rupture where it is intersected by trace of the active West Marikina Valley Fault. Eruptions of Taal Volcano and Mt. Cristobal will bring about ground shaking and ash fall to the project alignment.
Pedology	**Soil Types** • The project alignment will be traversing at least seven (7) types of soil. These soils are the: (1) Novaliches Clay Loam Adobe, (2) Guadalupe Clay, (3) Guadalupe Clay Adobe, (4) Quingua Silt Loam, (5) Carmona Sandy Clay Loam, (6) Lipa Loam, and (7) Macolod Clay Loam. **Soil Erosion/Loss of Topsoil/Overburden** • The baseline conditions for the erodibility of the soils along the project alignment is generally little to no erosion due to land cover and water content of the soil. The topography also plays a part on the erodibility of the soils in the area. Since the area is generally flat, the erodibility of the soils would also be lesser. **Soil Quality** • The results of the soil quality analysis in ten (10) stations showed that the pH level, organic matter, primary nutrients (Phosphorus and Potassium), magnesium and macronutrients (available Iron, Copper, Manganese and Zinc) were adequate based on the general guideline values for the fertility rating of soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy except for the pH level at Station S05 (FTI) and organic matter at Station S10 (Paciano Rizal Elementary School) which exceeded the adequate values of 5.5-8.5 and 1-8 for pH and organic matter, respectively. The levels of Potassium in Stations S04 (PNR Buendia) and S06 (PNR Sucat) were inadequate at 0.15 and 0.14 cmol/kg, respectively based on General Guidelines for the Fertility Rating of Soils of USDA Soil Taxonomy of >0.25 cmol/kg. • The levels of Lead in stations S01 (Solis), S02 (Pandacan), S03 (Sta. Mesa), S05 (FTI) and S08 (Calamba) exceeded the Target Value of the Dutch Standard but did not exceed the intervention values. The levels of Mercury, Arsenic, and Chromium hexavalent in all sampling stations did not exceed the Target Values of the Dutch Standard. The levels of mercury in six (6) stations (S01, S02, S04, S05, S06, and S07) were below the detectable limits of the method of analysis. Levels of Chromium hexavalent in stations S03, S04, S07, S08, S09, and S10 were also below the detectable limits of the analysis. Levels of

Environmental Component	Description
	Cadmium exceeded the Target Value of Dutch Standard but did not exceed the Intervention Value. **Soil Contamination** • The levels of Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium and Cyanide measured at Station SC01 (Proposed Banlic Depot) did not exceed the Toxicity Characteristic Leaching Procedure (TCLP) limits based on Table 2.1 Classification of Hazardous Wastes of DAO 2013-22. • The levels of Arsenic, Barium, Copper, Zinc, Cadmium, Chromium, Lead, Mercury, Selenium, Nickel, and Cyanide measured at Station SSR01 (Proposed Sucat Station/Depot) did not exceed the intervention values of the New Dutch List, 2000. • The levels of Arsenic, Barium, Copper, Zinc, Cadmium, Chromium, Lead, Mercury, Selenium, Nickel and Cyanide-free measured at four (4) sampling stations in the proposed Banlic Depot and at eight (8) stations in the proposed Sucat Station did not exceed the intervention values of the New Dutch List, 2000 except for the level of Zinc in STPP DD SS1 which was measured at 738 mg/Kg exceeded the Dutch intervention value of 720 mg/kg.
Terrestrial Ecology	**Terrestrial Flora** • During dry season, one hundred seven (107) morpho-species, 99 genera belonging to 42 families were documented in the six transect plots established within the SCRP main line. Dominant families in the said transect plots were Fabacae, Moraceae, Anacardiaceae, Lamiaceae, Euphorbiaceae, Annonaceae, Malvaceae, Poaceae, Convulvolaceae and Asteraceae. The most frequently occurring tree species were *Trema orientalis*, *Artocarpus altilis* (Park.) Fosb, *Ficus ulmifolia* Lamk, *Muntigia calabura* L., *Premna odorata* Blanco, *Leucaena leucocephala* (Lam.) de Wit, *Gmelina arborea* Roxb., and *Macaranga tanarius* (L.) Muell.-Arg. • As for the findings from the flora survey near the SCRP interconnecting line, a total of 239 tree individuals belonging to 49 morpho-species, 43 genera and 23 families were recorded inside the transect between FTI and Bicutan station. Dominant species were *Swietenia macrophylla* (Big leafed mahogany); *Mangifera indica* (Mangga); and *Pterocarpus indicus* (Narra). • In terms of tree flora, a total of 42 morpho-species with 40 genera belonging to 18 families were recorded in the whole project alignment. The average number of trees per quadrat (20m x 20m) is about 1 individual or an average density of 0.0025 tree/m^2 (1 tree for every 100 m^2). • A total of 13 morpho-species with unique 13 genera belonging to 8 families were recorded for understorey layer. The average density is slightly higher than that of trees, at 0.12 individual/m^2 or equivalent to 12 individuals for every 100m^2. • There are 51 ground cover species recorded from the all transect plots. • The diversity index of the project area ranged from low to moderately low, while evenness indices varied from very low to low. • Of the total taxa identified to species level, six (6) out of 107 species (6%) within the SCRP were found to be Philippine endemics or have natural habitat confined only in the country. • Five (5) species recorded from the SCRP are listed under either the Philippine Red List or the IUCN Red List of Threatened Species. Noteworthy among the list are the critically endangered (CR) Smooth Narra (*Pterocarpus indicus*) (IUCN), and a premium tree species which is specifically used in railroad ties, Molave (*Vitex parviflora*) (DAO 2007-01). • During wet season, 109 morpho-species, 102 genera belonging to 42 families were documented in the six (6) transect plots established within the project alignment. Dominant families in the said transect plots were Fabacae, Moraceae, Anacardiaceae, Lamiaceae, Euphorbiaceae, Annonaceae, Malvaceae, Poaceae, Convulvolaceae and Asteraceae. The most frequently occurring tree species were *Trema orientalis*, *Artocarpus altilis* (Park.) Fosb, *Ficus ulmifolia* Lamk, *Muntigia calabura* L., *Premna odorata* Blanco, *Leucaena leucocephala* (Lam.) de Wit, *Gmelina arborea* Roxb., and *Macaranga tanarius* (L.) Muell-Arg. The aforementioned species were present in all transects except for

Environmental Component	Description
	Artocarpus blancoi (Elmer) Merr., which was recorded in Transect 3 only with two (2) individual trees. • Similar to dry season survey, a total of 42 morpho-species with 40 genera belonging to 18 families were recorded in the whole project alignment during wet season survey. • A total of 13 morpho-species with unique 13 genera belonging to 8 families were recorded for understorey layer. The average density is extremely higher than that of trees and the dry season conditions, at 0.36 individual/m^2 or equivalent to 36 individuals for every 100 m^2. • Ground cover occupies more than 80% of the ground layer leaving less growing spaces for the other recruits of seedlings of other tree species, hence, low species diversity. • Similar to the results of dry season survey, there were 51 ground cover species recorded from the all transect plots during the wet season flora survey. • Five (5) species (4% of the total taxa identified) were found to be Philippine endemics or have natural habitat confined only in the country. • Noteworthy among the list are those species that are also included in either the Philippine red list or in the International Union for Conservation of Nature (IUCN). These include Antipolo, Piling liitan, Niog-Niogan, and Anubing. These trees should be prioritized for species conservation. **Terrestrial Fauna** • During dry season, a total of sixty-four (64) species of terrestrial vertebrate wildlife were observed and recorded during the survey conducted in 6 sites from Solis to Los Baños. These are 55 species of birds, 6 species of mammals (5 volant and 1 non-volant), and 3 species of amphibians and reptiles (2 species of frog and 1 species of lizards). • Out of the 55 species recorded in all the surveyed sites, nine endemic species of birds are recorded and thirty-nine or 69% of the total number of bird species are resident. • Among the captured and recorded species of mammals, 67% are native species, 16% endemic and 17% introduced species • No endemic species of amphibians and reptiles were recorded. Approximately 33% are introduced species and 67% are native species of amphibians and reptiles. • All or 100% of the species of birds, mammals and herpetofauna documented from the six survey sites are of Least Concern. • During wet season survey, a total of 51 fauna species were observed and recorded. It is composed of 44 species of birds, 4 species of mammals and 3 species of amphibians and reptiles. • Most of the species of birds in the monitoring sites are native or resident comprising about 66%. Eighteen percent are endemic to the country, 14% are resident-migrant and 2% is introduced. • All of the mammal species observed in all survey sites are of Least Concern and are not threatened in their habitats and ranges. All of these are highly adapted to disturbed areas especially areas near human settlements. There is not much variation in species observed in all survey sites. Among the captured and recorded species, 75% are native species and 17% endemic and 8% introduced species. • No endemic species of amphibians and reptiles were recorded. There are only two residency status noted during the survey (Native and Introduced). Approximately 33% are introduced species and 67% are native species of amphibians and reptiles.
WATER	
Hydrology/ Hydrogeology	**Drainage Morphology / Inducement of Flooding / Reduction in Stream** • The main hydrologic feature which affects the project alignment is the Laguna de Bay. It is fed by 21 major rivers draining the western and southern slopes of Sierra Madre Range and the eastern and northern slopes of the Taal-Makiling- Banahaw Volcanic Chain. The main channels of the rivers that feed into Laguna de Bay and their tributaries are intersected by the project alignment from Bicutan to Calamba, Laguna in 35 locations. These river–railway intersections are found within the Laguna Lakeshore area which is usually affected by the rise in lake water levels during the rainy season and/or major storm events.

Environmental Component	Description
	• The cities of Manila, Makati, Taguig, Parañaque, Muntinlupa, San Pedro, Biñan, Sta. Rosa, Cabuyao, and Calamba have drainage systems. However, most of the drainage structures in these LGUs are insufficient or clogged which cause flooding low lying areas. • The minor waterway crossings have estimated water depths of less than or equal to 30 centimeters (cm). The major crossings at Pasig, Biñan, Sta. Rosa, Cabuyao, San Cristobal and San Juan have inferred water depths greater than 30 cm. These conditions are expected to increase during the rainy season. The average depth of Laguna de Bay is 2.5 m. • Metro Manila suffered from serious flood damage in 1948, 1966, 1967, 1970, 1972, 1977, 1986, 1988, 1995, 1998, 1999, 2000, 2002, 2004, and 2009. Floods were caused by overflow of Pasig- Marikina—Napindan-San Juan River as well as inland drainage. In general, the project segment at the immediate banks of the main channel of the meandering Pasig River and segment from Taguig to San Pedro and from Solis Station to Bicutan are highly susceptible to flooding. • Semi-confined aquifers along the SCRP alignment are inferred to occur beneath the unconfined that underlies the entire project line. Wells drilled through these aquifers usually range in depth from 60 m to at least 200 m. The yields of these wells are used for domestic and industrial purposes. • Wells nearby the proposed Banlic Depot are generally tapping shallow aquifers. Some deepwells, though drilled within the recent alluvium, are believed to be tapping the confined aquifers of the underlying pyroclastic deposits, especially those which are close to the geologic contacts of the Recent Alluvium and Taal Tuff. • Most of the wells in Barangay Banlic are withdrawing groundwater from shallow wells which are tapping the shallow unconfined aquifers. Due to poor water quality, most of water from these shallow wells are not potable. • Large unpaved areas in close proximity to the underground section that are considered groundwater recharge areas are Villamor Golf Course, Philippine Navy Golf Club, Kagitingan Executive Golf Course, Manila American Cemetery, Libingan ng mga Bayani, Manila Golf and Country Club, Manila Polo Club, Philippine Navy Complex north of Lawton Avenue, and Philippine Army Complex south of Lawton Avenue. • A walkthrough survey of some of the host communities above the Senate-FTI underground section in Taguig City, Makati City, Pasay City, and Parañaque City identified at least 107 groundwater extraction wells with approximate depths ranging from 9 to 305 m (based on information from well owners, indicating that different aquifers are tapped). • Based on the data gathered, it is logical to assume that the tunnel is likely to be situated within the unconfined groundwater aquifer. However, further studies are needed to determine actual depths and extent of these groundwater aquifers and the potential interconnection that would be material information during the construction phase of the project.
Water Quality	**<u>Groundwater Quality</u>** • Known well depths of the tubes in Solis (GW-1), Alabang (GW-4), Cabuyao (GW-6) and within the vicinity of the Proposed Banlic Depot (DD GW-1, DD GW-2 and DD GW-4) range from 21.3 to 42.7 m. However, no well inventory data was obtained from sampling stations (GW-2, GW-3) nearest the underground section. Known ages range from 8 to 100 years. Usage varies from community drinking water supply, cooking, bathing and washing. The wells in Buendia (GW-2), and Los Baños (GW-8) are not regularly in use. The wells yielded clear water (with persistent brown particles in Los Baños or GW-8). Odor ranged from no objectionable odor to objectionable odor. Bubbles, an indicator of significantly polluted water (from cleaning substances) appeared in the samples from Solis (GW-1) and Buendia (GW-2). Drinking water generally comes from the commercial "mineral" water or from the local water utility. • During dry season, 84.90% of the twelve (12) sampling sites at sixteen (16) parameters per site complied with the PNSDW and DENR GWQG values. Out of the total 192 parameters measured in 12 sampling sites, only twenty-nine (29) or 15.10% cases of non-

Environmental Component	Description
	compliance to standards for color, temperature, fecal coliforms, total coliforms, total dissolved solids (TDS), sodium, and cyanide were recorded. • During wet season, 85.94% of the eight (8) sampling sites with sixteen (16) parameters per site complied with the PNSDW and DENR GWQG during wet season. Out of the 128 parameters measured in 8 sites, only eighteen (18) or 14.06% cases of non-compliance to standards for pH, color, temperature, fecal coliforms, total coliforms, TDS, sodium, cadmium, and lead were recorded. • Groundwater quality results of the seven (7) soil boring locations sampled along the Senate-FTI underground section in May 2019 by AMH Philppines, Inc. show that concentrations of the various water quality parameters analyzed meet the Philippine National Standard for Drinking Water (PNSDW 2017) except for sodium in IS-89A, and chloride in BGC-5 and IS-89A. **Surface Water/ Freshwater Quality** • The set of primary data obtained along the main railway line covered fourteen (14) sampling sites for twelve (12) rivers and creeks west to south of Laguna lake, plus one (1) in Laguna Lake and one (1) in Tadlac (Alligator) Lake. • During dry season, temperature readings at these sampling stations ranged from 25.7-31.3 ºC which did not exceed the DENR Class C guideline except for Bucal River (SW-9). pH readings did not exceed the guideline range of 6.5-8.5, except with the slightly lower value of 6.4 in San Pedro River (SW-5) and Saran River (SW-12). Color readings did not exceed the DENR Class C guideline of 75 TCU. Fecal coliforms and total coliforms were measured in thousands MPN/100 ml, except in Alligator Lake (SW-10). BOD in the samples were measured greater than the 7 mg/L DENR Class C Guideline, except in San Juan River (with 7 mg/L). The highest was 175 mg/L in Tunasan River (SW-4). All the samples contained low or undetected nitrates, free cyanide (CN), arsenic (As), cadmium (Cd), chromium (Cr), lead (Pb), mercury (Hg), and organophosphates with the exception of Laguna Lake on Cd (0.01 mg/L vs 0.005 mg/L guideline limit), Bgy Bucal River on As (0.0249 mg/L vs 0.02 mg/L guideline limit), and Saran River on Cd (0.011 mg/L vs 0.005 mg/L guideline limit). • During wet season, temperature readings at the sampling stations along the main railway line ranged 19.4°C to 31°C. Temperature level at Laguna Lake fell below the lower limit (25°C) set by DENR for Class C water. pH readings did not exceed the standard range of 6.5-8.5. Color readings ranged from <5 to 100 TCU. Measurements which exceeded the 75 TCU DENR Class C Guideline were noted in Tunasan River (SW-4), Biñan River (SW-6), Saran River (SW-12) and Buot Creek (SW-14). Fecal coliform counts ranged from 34 to 220,000,000 MPN/100ml. Only SW-10 (Tadlac Lake) did not exceed the 200 MPN/100 ml DENR Class C Guideline. Total coliform counts ranged from 1,600 to 540,000,000 MPN/100 ml. The highest total coliform count was measured in Tunasan River (SW-4). BOD_5 concentrations ranged from 11 to 341 mg/L. All of the stations exceeded the DENR Class C Guideline of 7 mg/L. All the stations considered for CN content determination did not exceed the DENR Class C Guideline. The concentration of Arsenic measured from the fourteen (14) surface water sampling stations ranged from <0.0009 to 0.0016 mg/L. All of the stations did not exceed the DENR Class C Guideline of 0.02 mg/L. Levels of chromium hexavalent in all of the fourteen (14) surface water sampling stations did not exceed the DENR Class C Guideline, except for Laguna Lake (SW-2), San Pedro River (SW-5), San Cristobal River (SW-7) and Tadlac Lake (SW-10). Pb contents did not exceed the 0.05 mg/L DENR Class C Guideline except in Tunasan River (SW-4). Levels of Hg and Cd in all fourteen (14) stations did not exceed the DENR Class C Guideline. All the samples contained low or undetected nitrates, and organophosphates. • As for the results for the Senate-FTI underground section, the water quality data from the DENR's monitoring stations showed that the water quality in Maricaban Creek was heavily polluted and has poor water quality. In Maricaban Creek, most of the parameters tested (i.e DO, BOD, TSS, Fecal Coliform, Phosphates) across all three monitoring stations exceeded the DAO 2016-08 WQG Class C except for Color and Nitrates. No concentration of DO was detected across three monitoring stations in Maricaban Creek. This may be associated with the elevated levels of BOD, which ranged between 81 mg/L

Environmental Component	Description
	to 141 mg/L. TSS levels, fecal coliform, and phosphate levels ranged from 61 mg/L to 100 mg/L, $2.80x10^{+09}$ MPN/100 mL to $9.20x10^{+08}$ MPN/100mL, and 2.17 mg/L to 3.41 mg/L, respectively.
Freshwater Ecology	• A total of thirteen (13) stations were surveyed at the project site. Overall conditions of freshwater bodies at the vicinity of the proposed site ranged from good to poor, which are reflective in the water quality and biological data. Bioindicator species of phytoplankton such as Pediastrum, Melosira and Fragilaria, and the occurrence of Rotifera species, such as *Brachionus urceolaris* are suggestive of these conditions. The dominance of Oligochaeta, Melanoides and Chironomidae, which are known indicators of poor quality further corroborates with these observations. Also, low dissolved oxygen at several stations and high conductivity levels at all stations indicate poor water quality. Disturbances at aquatic bodies could be largely attributed to domestic and industrial activities.
AIR	
Climatology & Meteorology	• The climate at the proposed Project falls under the category of Type 1 based on the Modified Coronas Climate Classification of Philippine Climate. Type I climate is characterized by two (2) pronounced seasons, dry from November to April and wet from May to October with maximum period from June to September. Areas under this type of climate are generally exposed to the southwest monsoon during rainy season and get a fair share of rainfall as brought about by the tropical cyclones occurring during the maximum rainy period.
Air Quality	• The ambient air quality monitoring was conducted to measure the 24-hour ambient concentrations of TSP, PM_{10}, $PM_{2.5}$, Pb, SO_2, NO_2 and 1-hour ambient concentrations of O_3 and CO at eight (8) stations along the SCRP main line during the EIA Study and at four (4) stations during the detailed design phase. Additional monitoring was conducted for the Senate-FTI underground section on 20 to 23 June 2019. This monitoring complemented the ambient air quality sampling done between 10 to 27 July 2017 (wet season) and 27 March to 5 May 2017 (dry season). • During dry season, the results of sampling for ambient air quality showed that most of the stations did not exceed the NAAQGV, except for stations AAQ3 (PNR Buendia) and DD AAQ3 (Calamba Station) for TSP, station AAQ3 (PNR Buendia) for PM_{10} concentration level, and AAQ2 (PNR Sta.Mesa) and DD AAQ2 (Banlic Depot Site) for $PM_{2.5}$ concentration levels. Warmer temperatures and lower ambient pressures may induce upward-moving air and entrains smaller, lightweight particulates like $PM_{2.5}$, and keep them suspended for a longer period of time. Higher maximum winds also result to more suspended particulates and transport them to farther areas. In addition, 24-hour concentration levels for Pb were relatively low, while CO and O_3 concentrations were not detected at the majority of the stations. • During wet season, the results of sampling for ambient air quality did not exceed the NAAQGV except for station AAQ7 (PNR Calamba) for level of $PM_{2.5}$. Higher relative humidity during wet season may cause particles of larger diameter to agglomerate, become heavier, and settle down. In addition, the concentration levels of Pb in all stations were relatively low, while CO and O_3 concentrations were not detected at majority of the stations.
Noise Level	• Noise levels were measured at fifteen (15) monitoring stations for the EIA Study and at additional four (4) stations for the detailed design phase for the main railway line. Additional noise monitoring was conducted at three monitoring stations along the Senate-FTI underground section. Noise level measurements were taken during morning (5:00 AM to 9:00 AM), daytime (9:00 AM to 6:00 PM), evening (6:00 to 10:00 PM) and nighttime (10:00 PM to 5:00AM). • Results of measurements showed that noise levels in all stations exceeded the NPCC standards and the WBG EHS guidelines for each respective classifications. • For the detailed design phase, the existing noise levels were measured at twelve (12) noise sensitive receptor areas within the vicinity of the Project. The residential area with the highest existing noise levels for 1hr Ldn was at sampling station DD TN11 in Calamba Station measured at 75.1 dBA while the lowest reading was at DD TN01 in Jose Abad

Environmental Component	Description
	Santos Avenue measured at 65.9 dBA. The existing noise levels for 24-hr Ldn at the residential areas in sampling station DD TN02 - Elias Street and DD TN06 - Alabang were high at 80.1 dBA and 87.9 dBA, respectively. The high noise level at DD TN06 was associated with the activities of the residents and tricycles which frequently passed by the nearby busy street. Tricycles are the main mode of transportation in the area. The institutional area with the highest existing noise level was the Jesus Is Lord Church in Station DD TN09 in Cabuyao at 73.1 dBA measured during the evening church service, while the lowest level was measured at 60.4 dBA during the weekday evening service of the Iglesia Ni Cristo Church at station DD TN10 near Banlic Depot. • Additional noise measurements were conducted in 41 locations between September 8-October 4, 2019 within 1-3 blocks away from the project's RoW to capture the potential impacts from an elevated linear noise source on areas that are not fully exposed to road noise but have direct line of sight to the project noise. These additional measurements yielded noise levels that are, on the average, 17.6 dB(A) and 12.7 dB(A) lower than the seasonal daytime and nighttime measurements along the project railway alignment. These figures were derived by comparing the two (2) nearest measurements to the earlier seasonal noise measurements.
Vibration Level	• Vibration levels were measured at fifteen (15) sampling stations established within the project vicinity for the EIA Study and at twelve (12) sampling stations for the detailed design phase of the proposed SCRP. Additional vibration measurements were conducted at three (3) sampling stations for the underground section from Senate to FTI station. • The observations of vibration at the areas along the Project indicate that sites vary in levels of vibration from a low of 83.5 VdB to a high of 100.8 VdB during the EIA study and from a low of 65.4 VdB to a high of 107.4 VdB for the detailed design phase. • The areas with the highest levels of vibration during EIA were in stations V13 (Tiyani Elementary School), V11 (Cabuyao Central School), and V04 (Buendia Station). Road traffic, passing trains, and walking pedestrians appear to dominate the cause of high levels of vibration. • The areas with the highest levels of vibration during detailed design phase are in stations DD V03 (Sta. Mesa), DD V07 (Muntinlupa), and DD V10 (Banlic Depot Site). Passing trains and automobiles appear to dominate the cause of vibration. • The observations of vibration measurement at the underground section indicated that except for the American Manila Cemetery, all existing vibration levels already exceeded the 84 VdB criteria value.
PEOPLE	
Demography	**<u>Population</u>** • The Project will traverse through Manila City with more than 1.7 million inhabitants according to the 2015 Census of Population by the Philippine Statistics Authority (**PSA**). It is the most populous of the cities which will be host to the Project. Next most populous, is Taguig and Parañaque City with 804,915 and 665,822 inhabitants, respectively. However, the most densely populated is Makati City with 27,000 persons per square kilometer. From 2010-2015, Taguig City has the fastest average growth rate at 4.32% per annum, while the City of Manila experienced the lowest population growth at 1.43%. • In the Province of Laguna, the most populous city among the host LGU of The Project is Calamba City. In 2015, it had a population of 454,486 (2015 Census of Population, PSA). However, the most densely populated host city in Laguna is San Pedro City with 13,547 individuals per square kilometer. The cities of Santa Rosa and Cabuyao are the fastest growing in terms of population, both had a population of 4.23% from 2010-2015. **<u>Gender and Age Profile</u>** • Generally, there is almost 1:1 proportion of male and female across Metro Manila and Laguna Province. The slight lead of female population accounted for 1% difference. Combined population of the host cities in Metro Manila and Laguna was largely composed of people in their productive age (15-64 years old) comprising 68% of the population, followed by the population of young dependents (children age 0-14 years old) making up the 28% of the population and, finally, the group of people in their retirement age (65 years old and above) accounting for 4% only of the population.

Environmental Component	Description
	• In 2018, there were more men (50.5%) than men (49.5%), with the proportion of women twice or more than twice of men in all PAPs. Majority of the PAPs belonged to the working age population, with 34.9% 21-40 years old. The proportion of dependents who are young (less than 12 years old) was approximately 27.9%, while those 61 years old and above were 4.5%, indicating that around 31% were dependents. The trend was similar for all affected LGUs, with majority having PAPs aged 21- 40 years old. **Literacy Rate, Profile of Educational Attainment** • Literacy rate in the host LGUs of The Project was high (99.8%) and higher compared to the national literacy rating in 2015. Females had a slightly higher literacy rate compared to the male population in the cities of Manila, Makati, Muntinlupa, San Pedro, Biñan, Sta. Rosa and Calamba. Males had higher literacy rate compared to the female population in City of Taguig. Males and Females had the same literacy rate in cities of Parañaque and Cabuyao. • In terms of educational attainment, the host LGUs' populace consisted largely of high school educated population, followed by elementary educated population except in cities of Makati and Parañaque wherein there were more academic degree holders than elementary educated population. • In general, the highest proportion of project-affected persons were members who had graduated high school (23.5%), reached high school (20.4%), and reached elementary level (19.3%).
Migration Profile	• Among the LGUs, Cabuyao has the highest total in-migrated household percentage as of 2010. Given that the Project will seek to utilize the existing PNR ROW, majority of the project affected households (93.2% of 11,384 households) are informal settler families/households. • Among the vulnerable groups, majority were dependents – either as babies or toddlers (81.6%) or elderly (9%). There were also some PAPs who were pregnant (3.7%), had mental disorders (0.9%), were seriously ill (0.8%), blind (0.4%) or mute or deaf (0.3%).
Historical and Cultural Heritage	• Historical and cultural heritage declared by NHCP within the vicinity of The Project includes Lord Justo Ukon Takayama Monument located in Plaza Dilao, Paco, Manila, Alberto Rizal House* in Biñan, Laguna, and the National Nutrition Council of the Philippines which could be affected by the underground tunnel from Senate Station towards FTI. • There are also identified old PNR stations and railway bridge within the PNR ROW which are considered to meet the NHCP Guideline on the Identification, Classification, and Recognition of Historic Sites and Structures.
Existing Social Infrastructure and Services	**Power Supply** • All of the host LGUs are covered by MERALCO's service area in power distribution. • In terms of access to electricity, there are more PAFs who have access to electricity through own electric meter (47.2%), followed by shared connection (44.5%). Biñan has the highest count of PAFs who have no electricity connection, followed by Muntinlupa. **Water Rights/Supply** • Majority of the households in the host LGUs have access to safer water. Water is supplied primarily by Manila Water Company and Maynilad in Metro Manila while water in cities in Laguna are supplied by water districts. **Pipeline** • The existing pipeline of First Philippine Corporation is located west of the proposed alignment. It runs along the National Highway in Muntinlupa City going north along the South Luzon Expressway (SLEx). The Black Oil Line has a branch going to the decommissioned STPP **Open Space and Recreational Area** • The host LGUs have designated open and recreational areas which are also incorporated in their Land Use Plan. Each LGU also have recreational facilities such as basketball courts and parks. **Education** • The educational facilities in the host cities include public and private day care centers, elementary schools, high schools and college facilities.

Environmental Component	Description
	Communication • Telecommunication services in the host LGUs of the Project include fixed landline telephone, cellular/mobile telephone and broadband carriers. Internet and courier services, national and local newspapers, satellite antenna are also present in the host cities. **Peace and Order (Protective Services)** • Protective services in the host cities of the Project are rendered by Philippine National Police (PNP), Bureau of Fire Protection (BFP) and Bureau of Jail Management and Penology (BJMP) with augmentation from the Tanods. PNP manning in most of the host cities is below the PNP manning level standard of 1:500. **Solid Waste Management** • Nine out of ten LGUs have their solid waste collection services contracted out to private contractors. All LGUs dispose their residual waste in engineered sanitary landfills. • At present, Manila City has 100 % coverage of solid waste collection through a private contract with Leonel Waste Management. Makati City, on the other hand, has an overall collection efficiency of approximately 86% efficiency based on 1994 data. Taguig City uses the services of a private contractor (IPM Construction) for waste collection with the contract renewed every six months dependent on the satisfactory performance of the contractor. In Parañaque City, there is a daily collection of segregated wastes along the main thoroughfares and markets, weekly collection for households or residences and for stationary sources like government offices and other institutional entities, three times a week collection is provided. Muntinlupa City also uses the services of a private contractor (REN Transport Corporation) for waste collection with 85% coverage. The wastes disposal sites are in Rodriguez, Rizal and San Pedro, Laguna. • Garbage collection in San Pedro City is managed by a garbage contractor covering 20 barangays, catering to almost 65% of the total population. Garbage collected is currently being disposed in Pilotage Sanitary Landfill, a 32-hectare facility found in Narra Road, Barangay San Antonio. At present, solid waste management in Biñan City can be considered inefficient with two dump trucks. Pilotage Trading and Construction, is a private contractor, is in charge in the everyday garbage collection. On the other hand, solid waste disposal of the City of Cabuyao is done at the sanitary landfill operated by the City of Calamba. In Calamba City, 81% of the wastes of the total population are collected and disposed daily in San Pedro, Laguna.
Public Services and Safety Profile	**Public Health Services** • Public health services in the host cities are provided through hospitals, barangay health stations, and rural health units. All LGUs have at least three hospitals with emergency services. **Mortality and Morbidity Rates** • The Socioeconomic Survey (SES) also noted the PAPs with members who experienced health problem in the past year (morbidity) and the (2) causes of death for members of the family (mortality). Most of the PAPs had members who experienced flu (42.1%). This observation was applicable to all the affected cities. There was a low incidence of hypertension (6.3%), heart problems (2.3%), diarrhea (3.1%), dengue (1.4%) and typhoid fever (1.2%) among the PAPs during the time the survey was taken. • In terms of mortality, the main causes of death among members of PAFs were hypertension (19.1%), heart problems (14.0%), cancer (4.4%) and diabetes (3.9%) **Sanitation Profile** • As of 2010, PSA data showed that most households in project affected LGUs used either their own faucet tapped to community water system or bottled water as water source for drinking. • Bases on the SES, the access to water of PAFs are mainly piped connection (29.3%), deep well (24.6%) and buying from water vendors (16.5%). However, a per-LGU analysis indicates varying trends in water access. In the cities of Manila and Taguig, access is dominated by piped connection. In Parañaque, however, majority of families bought from water vendors. In Muntinlupa, San Pedro, Biñan, Santa Rosa and Cabuyao, most families had access to water through deep wells.

Environmental Component	Description
	• In terms of access to sanitation in each LGU, at least seven (7) out of 10 PAFs had their own water-sealed toilets. This is followed by water sealed sewer septic tank shared with other households. • Top community issues identified by the PAPs include flooding (19.3%), prohibited drugs (16.7%), garbage collection (16.3%), and safety/security (13.2%). The highest count of PAPs that answered flooding are from Calamba (1,331) while the highest percentage of PAPs that answered prohibited drugs were from Biñan (24.8%).
Economic Profile	**Local Economy** • As of 2016, all Project affected LGUs are classified as first-class cities. Makati, the financial district of the country, had the most revenue among the host cities to The Project with nearly PhP 14.3 B. Manila City was next with PhP 12.8 B. Taguig City came in next with revenue of PhP 6.3 B (COA, Financial Profile, 2016). **Labor Force and Employment** • PAPs had varying income levels, with 20.8% having a monthly income of Php 12,000 to Php 15,999, 13% had an income of Php 9,000-9,999, and 11% an income of Php 16,000-19,999. In the Cities of Manila, Taguig, and Calamba, a higher proportion of PAPs earned from Php 12,000 to 15,999 monthly, with 22%, 25% and 19.7%, respectively. The same was observed in the city of Muntinlupa (24.6%), the city of San Pedro (16.4%) and the city of Biñan (21.3%). However, in the City of Santa Rosa and Cabuyao, the income level of the PAPs varied with higher proportions of PAPs with income belonging to (1) Php 12,000-15,999, (2) Php 8,000-9,999, and (3) Php 6,000-7,999. • In terms of occupation, at least five (5) out of 10 PAPs (50.4%) had no occupation, with at least 20% of the PAPs in all cities engaged in wage-based employment. 33.0% of the PAPs PAPs have their source of income from wage, while 9.4% were enterprise-based. This low percentage may be caused by the inclusion of dependent household members in the survey.
Public Access	**Existing Transportation/Traffic Situation** • Host LGUs in Metro Manila particularly Cities of Manila, Makati and Taguig are known to be traffic-congested areas. Major thoroughfares include EDSA, SLEx, and Manila South Road. • Major modes of land public transport in the host LGUs are bus, taxi, FX, jeepney, and tricycle. PNR operates from Manila City to Calamba City. **Access Points that may be Affected by the Project** • Based on the road maps of DPWH, there are several national roads that cross The Project alignment. There are seven (7) primary, fourteen (14) secondary and nineteen (19) tertiary roads that cross the alignment. These include railroad crossing at grade level and railroad crossing over or under through bridge or tunnel. • The Pasig River Ferry Service is the only water-based transportation in Metro Manila that cruises the Pasig River from Pinagbuhatan in Pasig to Intramuros in the City of Manila. The system is owned and operated by a private company, SCC Nautical Transport Services Incorporated. There is a possibility that The Project might affect the ferry operation during its construction traversing Pasig River.

Summary of Key Environmental Impacts and Management Plan

32. The main impacts of the Project are the relocation of the residents living along the right of way and the generation of dust, noise and vibration during construction; and noise impacts on communities adjacent to the railway during operation. The project will help improve the condition of traffic by providing a faster and less polluting public mass transport. **Table ES-8** Summary of the Environmental, Mitigating and Enhancement Measures, and Residual Impacts presents the summary of the environmental impacts of the proposed SCRP and the corresponding mitigating and enhancement measures, and residual impacts.

Table ES-8 Summary of the Environmental, Mitigating and Enhancement Measures, and Residual Impacts

Environmental Component	Potential Impact	Prevention/Mitigation/Enhancement Measures	Residual Impact
PRE-CONSTRUCTION			
LAND			
Land use and Classification	Conversion of at least 33-ha of agricultural land	• DOTr will coordinate with the lot owners, LGUs, other relevant agencies and concerned stakeholders in acquiring and/or securing the ROW.	Change in land use of agricultural land utilized as part of ROW
	Conflict with the NLEx-SLEx Connector Road Project of DPWH	• DOTr will coordinate with DPWH (alignment from PNR Solis to Sta. Mesa Station). • Affected section of alignment to run parallel to existing PNR alignment and avoid overlap with the NLEx-SLEx Connector Road Project of DPWH.	Acquisition of additional lots from Solis to Sta. Mesa Station.
	Potential conflict on ROW, ferry operation and public access	• DOTr will coordinate closely with the MMDA and affected ferry companies to align and ensure that the Project construction schedule and activities will be accommodated in their operation plan.	Minimal disruption on the ferry operation
PEOPLE			
People	Involuntary Resettlement of project affected persons (PAPs) (at least 7,692 households)	• DOTr will implement RAP in coordination with NHA, LGUs, and concerned stakeholders and relevant agencies that provide relocation site with complete facilities, amenities and basic services as well as livelihood for income restoration of head-of-household PAPs of ISFs and vulnerable groups.	Resettlement of project affected persons (PAPs) (at least 7,692 households); Enhanced living and livelihood conditions of resettled PAFs of ISFs and vulnerable groups
CONSTRUCTION			
LAND			
Land Use and Classification	Impairment of aesthetic view	• Maintain the construction site/ yards tidy and clean and rehabilitate after construction • Provide temporary screens/ walls to minimise the visual clatter. • Design the project facilities to harmonize with the surrounding environments (shape, colour, size, etc.).	Minimal impairment of aesthetic view
Geology/ Geomorphology	Inducement of subsidence, liquefaction, landslide, mud/debris flow	• Design and construct appropriate foundation and structures based on the combination of geotechnical, geodetic and hydrologic study, and seismicity studies, and in compliance with the National Building Code and the Structural Code of the Philippines and internationally accepted guideline.	None
Pedology	Degradation of soil quality (soil contamination)	• Prepare and implement solid waste management plan and proper disposal in accordance with RA 9003, hazardous waste disposal in accordance with RA 6969. • Use strong containment materials/methods for storage of chemicals and flammable/explosive substances	None
Terrestrial Ecology	Loss of flora and fauna within ROW and Depot site	• Prior to any clearing activity, conduct 100% inventory of the affected trees along the alignment and secure tree cutting permit in	Minimal loss of flora and fauna within ROW and Depot site

Environmental Component	Potential Impact	Prevention/Mitigation/Enhancement Measures	Residual Impact
		compliance with DENR Memorandum Order No. 2012-02. • Minimize vegetation clearing to areas to be developed only and implement the tree and vegetation management plan as part of the construction plan. • Areas not part of the development within the ROW, around the stations and depot will be prioritized for replanting activity to create buffer zone to improve wildlife habitat. • Maintain other existing vegetation within the ROW that would serve as additional buffer and filter for wildlife and would serve either as temporary shelter or habitat during and after operation.	Buffer zones to be created will serve as favourable habitat for nurturing wildlife
WATER			
Hydrology	Inducement of flooding	• Design and install drainage to accommodate the surface water runoff from the project and avoid any flooding in the area caused by the project. • Regular inspection and prompt maintenance of the drainage system, all installed structures and facilities and improve/ enhance capacity when possible.	Improved drainage system in areas along the Project alignment
Water Quality	Degradation of surface water quality	• Install wastewater treatment, portable sanitary facilities at construction sites/yards • Install temporary erosion ponds or silt traps around the major work areas. • Plan and implement construction activities in consideration to the water course, embankment, and wet/dry season.	Minimal surface water quality degradation
Water quality	Degradation of groundwater quality	• Monitor soil and groundwater quality in close proximity with the underground section where potential sources of hydrocarbons (such as gasoline stations) are present during FTI station construction and tunneling works • Conduct of a more detailed groundwater impact study during the detailed engineering design stage to avoid potential groundwater pollution	Minimal groundwater quality degradation.
AIR			
Air Quality	Degradation of air quality	• Adjust construction activities in consideration to weather system, identifying periods of high winds and drought that aggravated dust transport. • Control vehicle movement maintaining the speed limit within the construction site to <10kph • Conduct regular cleaning and clearing of construction access / sites surfaces of spoils and debris from construction equipment and vehicles and wetting of ground soil in the construction site when necessary.	Minimal degradation of air quality
Acoustic Noise	Increase in ambient noise level	• Plan and implement construction activities in consideration to time, duration, and scale to optimize the use construction equipment, machineries, and vehicles in accordance to the noise emission standard.	Moderate increase in ambient noise levels, confined to local construction sites away from noise-sensitive receptors and limited to

Environmental Component	Potential Impact	Prevention/Mitigation/Enhancement Measures	Residual Impact
		• Design and install effective noise barriers and absorbers along the alignment especially in areas with sensitive facilities and install noise control devices such as mufflers and noise suppressors to all construction equipment and machineries. • Monitor the levels of construction noise to ensure that Lmax at sensitive areas (residences, institutions, and hotels) does not exceed 85dB(A) during daytime and evening, and 80 dB(A) during nighttime. • Installing a 290 m long 3-m high perimeter temporary wall around cut-and-cover construction site of the FTI station.	daytime period and short in duration
Ground vibration	Increase in ambient vibration level	• Plan and implement construction activities in consideration to time, duration, and scale to optimize the use construction equipment, machineries and vehicles. Schedule high vibration generating activities during daytime to reduce disturbance to nearby communities. • Select construction equipment and machineries matching the scale of the construction and with minimal vibration generation if possible. • Monitor the vibration level at the Philippine Airforce Villamor Air Base and Philippine Nutrition Center (PNC) during tunneling works.	Moderate increase in vibration levels, confined to local construction sites away from sensitive receptors and limited to daytime period and short duration
PEOPLE			
People	Generation of Livelihood Opportunities and improvement of Safety	• Prioritize in hiring local qualified residents in coordination with the LGUs and employ workers in consideration to gender equality and to vulnerable group.	Increased number of employed local residents with consideration to gender equality and vulnerable group
	Change/Conflict on ROW and Impact on Public Access	• Maintain the existing public access as much as possible. However, in case of closures/barriers, disseminate information to the public, barangay and LGUs on the potential impact to the existing public access and mitigation measure through the project activities. Provide diversion route with appropriate health and safety measures. In case of any changes, prompt update on the diverted routes to the concerned communities and LGUs, • Assign traffic guide to provide assistance to the road users.	Inconvenience to public's access to schools and other services, limited to duration of construction.

Environmental Component	Potential Impact	Prevention/Mitigation/Enhancement Measures	Residual Impact
	Threat to public and occupational health and safety	• Formulation and implementation of IEC Plan to inform the affected LGU and local communities and the general public about 1) the project, project activities, duration, possible project impacts and incorporate their comments and inputs in the design, 2) the potential impact of project activities to air quality, noise, vibration, and climate change and mitigation, and safety aspects like areas that are restricted for the public, and 3) the Grievance Redress Mechanism to handle complaint/s if any. • Plan for construction sites and access route in consideration to health and safety of local communities. • Install fencing of the construction site, provision of signage and posters, and guarding of the access point to ensure that the public is prevented from entering unsafe areas. • Prepare and implement an Emergency Prepardness and Response Plan (EPRP) aligned with the policy of the DOTr and the requirements of NFPA130	Accidents may still occur, but the safety and health guidelines in place and the EPRP will significantly lower the exposure of workers and commuters to occupational and construction hazards, respectively.
	Traffic Congestion	• Conduct Traffic Impact Assessment (TIA) and based on the results of TIA, prepare and implement Traffic Management Plan (TMP), coordinate to the concerned LGUs and transport operator/s and get their inputs and approval • Schedule transport of heavy structures during period when there are fewer vehicles on the road and posting of appropriate traffic signage and warnings. • Disseminate information to the general public, host barangays and LGUs on the potential impact of the project to the existing access and provide mitigating measures.	Minimal traffic congestion may still occur; Inconvenience to commuters. The residual impacts will be confined to construction phase only.
OPERATION			
LAND			
Land Use and Classification	Impairment of visual aesthetic	• Maintain tree planting to minimise the visual impact of the project.	Trees planted along the alignment may create a positive visual impact
Geology/ Geomorphology	Inducement of subsidence, Liquefaction, Landslide, Mud/Debris Flow, etc.	• Conduct proper inspection and prompt maintenance checks to every single installed structure and facility and improve/ enhance capacity when possible. • Establish an Earthquake Emergency Response Plan • Conduct inspection in the event of natural hazard occurrence to assess damage of structures. • Regular Coordination with the PHIVOLCS for earthquake and volcanic events to adjust the train schedule as necessary.	None
Pedology (Soil Quality)	Degradation of soil quality (soil contamination)	• Strict implementation of solid waste management plan and proper disposal by an accredited contractor in accordance with RA	None

Environmental Component	Potential Impact	Prevention/Mitigation/Enhancement Measures	Residual Impact
		9003, hazardous waste disposal in accordance with RA 6969.	
WATER			
Groundwater and Freshwater Quality	Deterioration of nearby groundwater and surface water due to discharge of untreated wastewater in stations and depot	• Each commuter station and depot will have a sewage treatment plant (STP) and a separate treatment facility for non-sewage waste waters such as from sinks, and washings to meet the applicable effluent standards. Handling of potential contaminants during operation phase shall be compliant with RA 6969.	None
AIR			
Acoustic Noise	Increase in ambient noise level	• Optimize the number of train operation at nighttime to reduce generated noise. • Install effective noise barriers on each side of the track. A continuous 1 m high concrete wall throughout alignment except 887m length in 3 sections all in Makati City i.e. from chainage 10+464 to 10+743, north bound; from chainage 12+577 to 12+970, north bound; and from chainage 13+093 to 13+288, south bound. A composite noise protection wall with a vertical element of 3.0 m, and on top two elements of 0.25 m and slope of 45 degree is provided at these three locations. • Provision of noise control device such as muffler to all stationary sources (i.e. generator set). • Regular inspection and proper maintenance of trains and tracks to reduce operational noise.	Minimal increase in ambient noise levels confined to areas adjacent to alignment
Ground Vibration	Increase in ground vibration level	• Regular inspection, proper maintenance and reconditioning of trains and tracks such as rail grinding, slip-slide detectors and maintenance or replacement of suspension system, brakes and wheels.	Minimal increase in vibration levels
PEOPLE			
People	Generation of estimated 1,550 job positions; opportunities for business	• Coordinate closely with the host LGUs, specifically at the barangay level regarding hiring of regular workers to ensure that the workers being considered are legitimate residents in the area in consideration to gender equality.	Higher employment rates in the host cities
	Influx of ISFs	• Install fencing and provide guards to prevent the settlement of ISFs along the ROW.	None
	Displacement/Disturbance of residents, properties and business / institutional establishments	• Secure and develop relocation sites in an urban location prior to displacement in coordination with LGUs, SHFC and other key shelter agencies. • Provide alternative livelihood programs in coordination with the LGUs and other government agencies will include things such as vocational training for construction related works, employment in local communities, and soft loans to establish business etc. • Provide fair compensation for business establishments that will be permanently removed	Affected families (i.e. informal settler families) may eventually be provided with secured tenure through housing units with basic amenities

Environmental Component	Potential Impact	Prevention/Mitigation/Enhancement Measures	Residual Impact
	Diversion/ Relocation of utility services	• Coordinate with DOTr and the respective utility companies to maintain supply and minimize inconvenience during maintenance and switch over work	None
	Threat to public and occupational health and safety	• Design stations and underground section in accordance with NFPA 130 standard. • Undertake independent audit of tunnel safety prior to approval of detailed design. • Provide security guards in all stations to direct passengers on the safe zone. • Provide sanitary facilities or utilities in all stations and depot. • Implement the Occupational Health and Safety Management Plan. • Provide appropriate PPE to all personnel undertaking maintenance work. • Implement the Emergency Preparedness and Response Plan (EPRP) including emergency precautionary measures within the underground section	Accidents may still occur, but compliance with NFPA 130 and the safety and the EPRP will significantly lower the exposure of workers and commuters to occupational and operational hazards, respectively.
	Traffic Congestion in the areas adjacent to the proposed stations	• Establish a Traffic Management Committee, which compose of the Traffic Management of LGUs, Planning Office, PNR, DPWH, and DOTr. • Plan and implement TOD in consideration to the loading and unloading area and the circulation of the traffic as well as the integration of transport facility within the station.	Minimal traffic build-up may still occur in areas adjacent to the proposed stations
	Reduced travel time by 45 mins for commuters	• Promote benefit of reduced travel time using The Project mass transit over other modes of transportation.	Increased number of commuters using the Project for transportation

SDP Framework

33. The DOTr has formulated the Social Development Plan/Framework covering its development programs, projects and/or activities (PPAs) for cities that will be traversed by the Project in coordination with the city and municipal planning and development officers of affected local government units (LGUs). Further discussion will be required for new program and implementation arrangement. The SDP will be finalized in close consultation and coordination with the concerned LGUs prior to works, in compliance with the ECC.

34. The implementation of this SDP will be monitored through the SCRP Multipartite Monitoring Team (MMT) / Third Party Auditor (TPA) and through the Resettlement Action Plan (RAP) monitoring.

IEC Framework

35. The IEC Plan/Framework will be implemented to encourage the participation and cooperation not only of the affected households but a broader sector of stakeholders and facilitate the establishment of support linkages and feedback on the progress throughout the implementation and operation of the Project.

Abandonment Policy

36. A detailed abandonment/decommissioning plan will be developed prior to the closure of the Project facilities and within the timeframe specified in the ECC. The Abandonment and Decommissioning Plan will be prepared in accordance to DENR requirements. Appropriate documentation will be conducted during the decommissioning activities which will be made available to requesting parties. DOTr will then submit a completion report to EMB-DENR.

37. Should irreversible damages to the environment be discovered during site inspection, the extent of such damage will be investigated, and the results will be reported to the EMB-DENR and said the damages will be properly addressed by the responsible parties.

Grievance Redress Mechanism

38. A Grievance Redress Mechanism (GRM) has been proposed for the Project. The proposed GRM with a 17-step procedure will be implemented by DOTr trained and assigned dedicated grievance (GR) officers at the PMO under the DOTr's Office of the Undersecretary for Railways. This mechanism is anchored on the principles of confidentiality for complainants, procedure transparency, gender responsiveness, cultural appropriateness, and readily accessible to affected persons at no cost.

39. The Grievance Procedure has four levels: (1st) help desk/hotline, (2nd) Health, Safety and Environment Committee, (3rd) Multi-partite Monitoring Team for environment issues or DOTr's management level for health and safety issues, and (4th) DENR-EMB or Court of Justice. The upward movement of grievance cases between the levels will depend on the satisfaction of the aggrieved stakeholder and the GR officer's action on the complaint within the prescribed number of working days.

40. As part of the GRM, tools will be used such as grievance action form, acknowledgement slip, central database system, communication materials, GRM training, monitoring reports, and continuous update of the GRM guideline.

Multipartite Monitoring Team Framework and Composition

41. The Multipartite Monitoring Team (MMT) is an independent third-party entity formed after the issuance of the ECC to encourage participation of the project's various stakeholders and to monitor the project's compliance with ECC conditions as well as the EMP and EMoP during the pre-construction, construction and operation phases of the proposed project. The formation of the MMT will be initiated by the DOTr (PMO) through a Memorandum of Agreement (MOA) between the LGUs and the DOTr (PMO) with conformity of the identified MMT members, composed of representatives of relevant stakeholders. DOTr will provide funds for the MMT activities based on the Annual Work and Financial Plan approved by the parties.

42. The members of the MMT will be representatives of the local government units, non-government organizations, academe, and national government agencies.

(1) Local Government Unit (LGU)

- One (1) Provincial Environment and Natural Resources Office (PENRO) representative from each affected province;
- In case there is no PENRO, one (1) representative each from the City Environmental and Natural Resources Office (ENRO), City Planning and Development Office (CPDO) or the Sangguniang Panlungsod (SP) Environment Committee Chairman;
- RHU Chiefs; and
- Concerned Barangay Chairmen.

(2) Non-Government Organization (NGO)/ People's Organization (PO)

- One (1) environmental NGO representative;
- In case there is no environmental NGO, 1 representative from other NGOs; and
- Maximum of two (2) from locally-recognized community leaders representing vulnerable sectors such as IPs, women, senior citizen, etc.

(3) Academe

- Maximum of two (2) representatives from the academe.

(4) National Government Agencies (NGAs)

- Maximum of three (3) representatives with related mandate on the proposed project.

(5) DENR PENRO and CENRO

- At least one (1) representative per province covered by the project.

43. The DOTr has started addressing the requirement of the ECC to establish its own MMT during the detailed design phase. A Third-Party Auditor (TPA) will be engaged in lieu of MMT to monitor the compliance of the SCRP including the Senate-FTI underground section. Request was granted by DENR-EMB Central Office on February 14, 2020. A Third-Party Audit is another DENR-accepted method for validating and monitoring ECC compliance based on Presidential Decree No. 1586.

EGF and EMF Commitments

44. The DOTr commits to establish an EMF and EGF (**Table ES-9**). The EMF will be exclusively utilized to cover all costs attendant to the operation of the MMT. Whereas, the EGF will be used exclusively for the following purposes:

- Immediate rehabilitation of areas affected by damages to the environment and the resulting deterioration of environmental quality as a direct consequence of the proposed project construction, operation and abandonment;
- Just compensation of parties and communities affected by the negative impacts of the Project;
- Conduct of scientific or research studies related to the proposed project that will aid in the prevention or rehabilitation of accidents and/or environmental damages; and
- For contingency and clean-up activities, environmental enhancement measures, damage prevention programs and social equity measures including the necessary IEC and capability building activities related to the Project.

Table ES-9 Estimated EMF, EGF Trust Fund and EGF Cash Fund for the Proposed SCRP

Type of Fund	Amount (PhP)
EMF (PhP)	400,000.00
EGF Trust Fund (PhP)	5,000,000.00
EGF Cash Fund (PhP)	3,000,000.00

Institutional Arrangement for Environmental Management

45. Overall, the DOTr is the Implementing Agency of the Project. The Project Management Office (PMO) for the proposed SCRP, DOTr, is the primary point of contact with DENR-EMB, ADB and JICA with regards to environmental management of the Project. The Project will hire Construction Supervision Consultants (CSC) that includes an International Environment Specialist and a National Environment Specialist that will assist the DOTr in the monitoring of compliance of the project with the Environmental Management Plan (EMP) and Environmental Compliance and Monitoring Plan (EMoP). During project implementation, the DOTr-PMO will be assisted by a third-party environmental contractor in the monitoring of environmental parameters of the Project.

EMP and EMoP Budget

46. The estimated annual cost for implementing the EMP is Php 1,850,000 per year. This covers activities for pre-construction, construction, and operation phases. As for the EMoP, there is no estimated total cost as all the monitoring expenses were estimated at a per activity cost. Budget for the EMoP implementation will be taken from different project allocations depending on the monitoring types. Land, air, and water sampling and monitoring activities are funded by the EMF, with a total budget allocation of Php 400,000. Potential impacts concerning people are included under the Resettlement Action Plan cost. Other construction impacts identified in the EMoP are counted in the contract package cost.

1. PROJECT DESCRIPTION

47. The Department of Transportation (DOTr) is the executive department of the Government of the Republic of the Philippines (GoP) and is responsible for the maintenance and expansion of viable, efficient, and dependable transportation systems as effective instruments for national recovery and economic progress through the country's land, air and sea transportation infrastructures.

48. President Duterte's administration released a 10-point Socio-economic Agenda and among the reforms that will drive this agenda is the acceleration of infrastructure and the development of industries that will yield robust growth across the archipelago, create jobs, and uplift the lives of Filipinos. Infrastructure is among the top priorities of this administration. Public spending on infrastructure projects could reach PHP8–9 trillion pesos from 2017–2022.

49. The Build!Build!Build! Program is the administration's comprehensive infrastructure development program launched in April 2017. The program identified seventy (70) infrastructure flagship projects or high impact projects. Of these projects, nineteen (19) projects are in Mega Manila. Besides the flagship projects, four (4) projects were also listed as key projects. The projects for Mega Manila are composed of the expressway, urban road, railway, road-based public transport, and traffic management. Completion of most of the projects is within or by end of the current administration, i.e. by 2022.

50. DOTr's thrust is to guide the development of new urban centers and to meet large residential demands. The North-South Commuter Railway Project (NSCR Ex) is a major government project which aims to provide a commuter and intercity railway service connecting Metro Manila and its adjacent northern and southern suburban areas and is deemed to be an important mass transit backbone for Metro Manila as well as for the growth corridor of the Greater Capital Region (GCR), comprising of Region III, National Capital Region (NCR) and Region IV-A. The NSCR Ex is divided into two (2) phases – the NSCR Clark Extension (also known as the Malolos-Clark Railway Project, MCRP) and NSCR Calamba Extension (also known as the South Commuter Railway Project, SCRP).

51. The NSCR Calamba Extension (herein referred to as "SCRP") is a railway project stretching from Solis in Manila towards Calamba City in the Province of Laguna. The SCRP will also include an underground section connecting the North-South Commuter Railway at FTI Station and Bicutan Station with the Metro Manila Subway (MMSP) at Senate Station.

52. The SCRP will be assisted by a grant from the Japan International Cooperation Agency (JICA) and will be co-financed by the Asian Development Bank (ADB). ADB will finance main civil works, while JICA will finance the general consultant (GC), electromechanical system, and rolling stock system.

53. The scope of this EIA encompasses the SCRP including the newly integrated Senate-FTI-Bicutan segment (herein also referred to as the "SCRP interconnecting line") that connects to the MMSP. Detailed Design (DD) for the main North-South line (herein referred to as the "SCRP main line") is about to be completed; the DD for the SCRP interconnecting line is yet to be initiated. This document is prepared as part of DOTr's obligation to comply with ADB's safeguards requirements prior to project approval.

54. Currently, PNR regular route runs from Tutuban to Alabang and vice versa every hour starting at 5:00 in the morning up to 7:30 in the evening. During rush hour, a 30-minute interval is implemented. There are also Mamatid-Tutuban and Calamba-Tutuban daily trips. The trains leave Mamatid at 4:56 a.m. and in Calamba at 5:46 a.m. going to Tutuban. The trains depart Tutuban at 7:07 p.m. to Mamatid and 6:37 p.m. to Calamba.

55. The Project will not share the tracks of the proposed freight and long-haul trains. PNR line will continue its operation while the Project is being constructed. Existing tracks will be reused for the freight and long-haul trains operation.

1.1. PROJECT LOCATION AND AREA

1.1.1. Description of the Project Area

56. The SCRP alignment will traverse eleven (11) cities including Manila, Makati, Taguig, Pasay, Parañaque and Muntinlupa in Metro Manila (MM); and the Cities of San Pedro, Biñan, Santa Rosa, Cabuyao and Calamba in the Province of Laguna. The project will also utilize a vacant lot in the Municipality of Taytay in the Province of Rizal as spoil disposal area.

57. The Project will utilize the existing Right-of-Way (ROW) of the Philippine National Railways (PNR) from Solis Station in the City of Manila to Calamba Station in the City of Calamba, Province of Laguna. However, due to the existing NLEx/ SLEx Connector Road Project of the Department of Public Works and Highways (DPWH), which was also designed to utilize the PNR ROW from Sta. Mesa to Solis, Manila, the Project will utilize private lands adjacent to the PNR ROW from Solis Station to Sta. Mesa Station. DOTr will execute the power of eminent domain of the government for the use of the private lands in this section which has an estimated length of 8 km.

58. Meanwhile, the SCRP segment connecting to the MMSP, will start after the Senate Station (formerly Lawton West Station) located at the Naval Village in Fort Bonifacio in Taguig City. The alignment will then lead to the FTI station located in Barangay San Martin De Porres, and subsequently to Bicutan Station in Barangay Bicutan, also in Paranaque City. This interconnecting line has a total length of 5.6 km. The alignment approaching the FTI station until Bicutan station will be parallel to the existing PNR rail tracks on the west, and United Hills Village and United Paranaque Subdivision II on the east and will be constructed within the PNR ROW. The SCRP interconnecting line passes through government properties within Taguig City and Paranaque City (underground and above ground).

59. The SCRP stretches to a total length of 64.2 km. This includes a 58.6-km long above-ground railway section from south of Solis Station, Manila to Calamba Station (SCRP main line); and the 5.6-km segment connecting the North-South railway line at FTI and Bicutan Stations to the Metro Manila Subway at Senate Station (SCRP interconnecting line). Based on the detailed design of the SCRP main line, a 50.6-km section will be elevated, and 8.0 km will be at grade/embankment. The SCRP alignment will have nineteen (19) stations which will all be above ground while the Senate-FTI underground section will further transition to elevated level at the Bicutan Station. The project will provide more convenient direct trains for commuters coming from Valenzuela in the north of Metro Manila to Calamba in the Province of Laguna. The FTI Station will also enable commuters to transfer from the railway lines to the Taguig Integrated Terminal exchange (ITX) The locations of the stations are presented in **Table 1.1.1**. The location map of the Project is shown in **Figure 1.1.1**.

Table 1.1.1 Station Location

	Station	LGU	Geographical Coordinates		Chainage	Total (km)
			North Latitude	East Longitude		
NSCR						
	Solis	Manila	14° 38' 06.37"	120° 58' 36.03"	- 0 k 005	----
SCRP Main Line						
	Beginning Point				1 k 329	55.6
1	Blumentritt	Manila	14° 37' 20.54"	120° 59' 03.08"	2 k 205	
2	España	Manila	14° 36' 49.65"	120° 59' 42.42"	3 k 780	
3	Santa Mesa	Manila	14° 35' 59.19"	121° 00' 40.03"	5 k 951	
4	Paco	Manila	14° 34' 51.85"	121° 00' 03.59"	8 k 726	
5	Buendia	Makati	14° 33' 19.89"	121° 00' 33.16"	12 k 139	
6	EDSA	Makati	14° 32' 21.13"	121° 01' 04.51"	14 k 077	
7	Nichols	Taguig	14° 31' 38.07"	121° 01' 27.55"	15 k 302	
8	FTI	Taguig	14° 30' 17.57"	121° 02' 11.10"	18 k 660	
9	Bicutan	Parañaque	14° 29' 22.58"	121° 02' 42.27"	20 k 354	
10	Sucat	Muntinlupa	14° 26' 57.88"	121° 03' 06.35"	24 k 843	
11	Alabang	Muntinlupa	14° 25' 01.27"	121° 02' 52.11"	28 k 534	
12	Muntinlupa	Muntinlupa	14° 23' 24.69"	121° 02' 51.09"	31 k 449	
13	San Pedro	San Pedro	14° 21' 26.16"	121° 03' 27.33"	35 k 355	
14	Pacita	San Pedro City	14° 20' 55.48"	121° 03' 44.62"	36 k 429	
15	Biñan	Biñan City	14° 19' 52.73"	121° 04' 52.40"	38 k 992	
16	Santa Rosa	Santa Rosa City	14° 18' 46.25"	121° 06' 07.10"	42 k 044	
17	Cabuyao	Cabuyao City	14° 16' 10.30"	121° 07' 48.75"	48 k 107	
18	Banlic	Calamba City	14° 13' 25.92"	121° 08' 56.96"	53 k 511	
19	Calamba	Calamba City	14° 11' 48.72"	121° 09' 36.46"	56 k 832	
	End Point				56 k 952	
	Beginning Point (Depot Access)				0 k 000	3
	End of Depot				2 k 965	
SCRP Interconnecting Line						
	Beginning point (after Senate)	Taguig	14°31'46.28"	121° 01' 28.41"		5.6
1	Interconnecting Station at FTI	Parañaque	14° 30' 17.57"	121° 02' 11.10"		
2	Interconnecting Station at Bicutan	Parañaque	14° 29' 22.58"	121° 02' 42.27"		
	End point	Taguig	14°29'51.82"	121° 02' 25.64"		

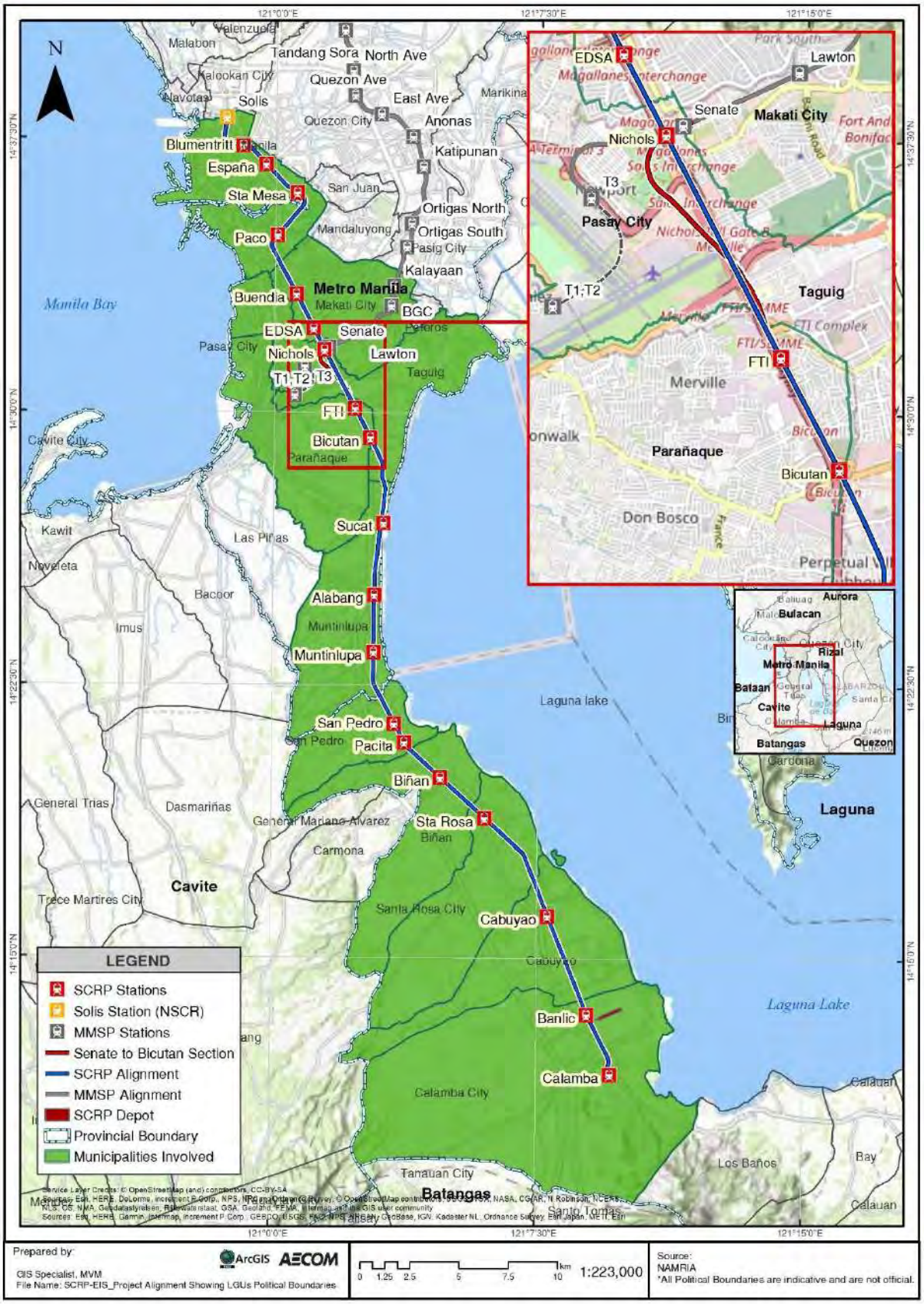


Figure 1.1.1 Project Alignment Showing LGU's Political Boundaries

1.1.2. Impact Areas

60. The direct and indirect impact areas were delineated based on country safeguard system (CSS) guidelines (i.e., Annex 2-2 of DAO 2003-30). Direct impact areas (DIAs) are generally areas where structures will be built during construction and the project operations will be conducted. Whereas indirect impact areas (IIAs) are areas immediately adjacent to the coverage of the project facilities and project operations.

61. The DIAs cover the existing PNR-ROW with an approximate width of 30 m and an estimated total length of 55.6 km and approximately 3 km depot access extended up to 100m from the boundary of the ROW. The DIA at these Project stations will have a total width of 60 m and an estimated length of 250 m extended up to 50 m from the boundary of the ROW. In addition, the DIAs also include the proposed 22-hectares depot site in Barangay Banlic, Calamba, the underground and aboveground structures of the SCRP interconnecting line with an approximate length of 5.6 km, and the proposed spoil disposal area for the tunneling works which will be located in the Municipality of Taytay in the Province of Rizal.

62. In terms of socio-economic benefits, the DIA areas include the twelve (12) host Local Government Units (LGUs) in NCR, Province of Laguna, and Province of Rizal which are the project beneficiaries for employment, business opportunities, taxes and benefits from decongestion of the road from vehicular traffic as well as the expansion of economic opportunities in the Region.

63. The IIAs will cover the adjacent barangays and nearby LGUs who will benefit from the rapid economic growth in the region and the entire country. They will benefit from the stable and reliable means of transportation that can contribute further to the economic stability of the country. **Table 1.1.1** presents the geographical location of the stations. **Table 1.1.2** presents the impact areas.

Table 1.1.2 Impact Areas of the Project

Host City	Direct Impact Barangays	Indirect Impact Barangays
Manila	Barangay 738, 735, 737, 734, 682, 685, 809, 810, 811, 814, 815, 818, 820, 825, 835, 836, 838, 839, 840, 851, 853, 855, 857, 859, 860, 861, 862, 864, 865, 867, 868, 870, 871, 872, 421, 422, 425, 426, 427, 428, 437, 440, 441, 442, 443, 444, 445, 446, 450, 451, 472, 473, 474, 475, 483, 484, 485, 487, 497, 499, 500, 503, 505, 507, 509, 511, 521, 542, 543, 544, 550, 551, 570, 571, 573, 576, 578, 579, 580, 590, 591, 592, 593, 621, 627, 628, 629, 630, 747, 748, 749, 750, 758, 759, 764, 769, 798, 799, 800, 803, 806, 807, 866, 808 347, 348, 349, 350, 351, 356, 357, 359, 363, 364, 365, 368, 369, 371, 227, 228, 161, 162, 163, 164, 165, 184, 185, 186, 198, 199, 200, 203, 204, 209, 213, 214, 216, 217, 218, 219, 220, 224	Barangay 730, 739, 740, 741, 736, 678, 680, 681, 683, 812, 813, 816, 817, 819, 821, 823, 824, 827, 686, 833, 834, 837, 842, 847, 848, 849, 850, 852, 856, 858, 863, 869, 417, 423, 424, 436, 438, 439, 447, 448, 452, 453, 476, 477, 482, 486, 488, 492, 493, 494, 495, 498, 501, 502, 504, 506, 508, 510, 522, 545, 546, 548, 552, 553, 554, 567, 569, 572, 574, 575, 577, 581, 587, 589, 603, 611, 615, 619, 626, 631, 632, 633, 634, 636, 751, 752, 755, 756, 757, 760, 763, 767, 768, 792, 793, 794, 795, 796, 797, 802, 805, 880, 896, 898, 899, 901, 902, 903, 905, 818-A, 341, 344, 345, 346, 352, 358, 360, 361, 362, 366, 367, 370, 372, 231, 148, 152, 153, 155, 166, 167, 173, 174, 177, 178 179, 181, 183, 188, 189, 190, 193, 194, 195, 201, 202, 205, 207, 210, 211, 212, 215, 221, 223
Makati	San Antonio, Pio del Pilar, Bangkal, Magallanes, San Isidro, Palanan	Bel-Air, Dasmariñas, Forbes Park, La Paz, San Lorenzo, Santa Cruz, Post Proper Southside
Pasay	Brgy. 183, Brgy. 201	Barangay 43, 46, 51, 54, 57, 62, 65, 67, 128, 130, 132, 134, 135, 137, 143, 144, 159, 166, 169, 170, 171, 172, 173, 174, 176, 177, 180, 181, 185, 191, 197
Taguig	Fort Bonifacio, Western Bicutan, Central Bicutan, North Daang Hari, South Daang Hari, Bagumbayan, Tanyag	Upper Bicutan, Lower Bicutan, Maharlika Village, Pinagsama, Central Signal Village, South Signal Village
Parañaque	San Martin de Porres, Merville, Sun Valley	B.F. Homes, Don Bosco, Marcelo Green Village, Moonwalk, San Antonio, Santo Niño
Muntinlupa	Sucat, Buli, Cupang, Alabang, Bayanan, Putatan, Poblacion, Tunasan	New Alabang Village
San Pedro	Nueva, San Antonio, San Vicente, Fatima, Pacita 1, Pacita 2	Bagong Silang, Calendola, Cuyab, Landayan, Langgam, Estrella, G.S.I.S, Magsaysay, Poblacion, Sampaguita Village, Santo Nino, United Better Living, Chrysanthemum, Maharlika, Rosario, San Lorenzo Ruiz
Biñan	Canlalay, San Vicente, Sto Niño, Zapote, Platero, San Antonio	Biñan (Poblacion), Bungahan, Santo Tomas (Calabuso), Casile, De La Paz, San Francisco (Halang), Malaban, Mampalasan, San Jose, Santo Domingo, Tubigan
Sta. Rosa	Dila, Dita, Pook, Tagapo, Labas	Macabling, Malitlit, Malusak (Poblacion), Market Area (Poblacion), Kanluran (Poblacion), Pulong Santa Cruz, Sinalhan, Balibago, Caingin, Don Jose
Cabuyao	Banlic, Brgy. Dos, Brgy. Tres, Brgy. Uno, Bigaa, Mamatid, Niugan, Pulo, Sala, San Isidro, Banaybanay	Baclaran, Butong, Diezmo, Gulod, Marinig
Calamba	Banadero, Banlic, Brgy. 1, Brgy. 3, Lecheria, Parian, San Cristobal, Halang, Real	Bucal, Canlubang, La Mesa, Lawa, Lingga, Looc, Mapagong, Paciano Rizal, Brgy 2, Brgy. 4, Brgy. 5, Brgy. 6, Brgy. 7, Prinza, San Jose, San Juan, Turbina, Uwisan

Source: JICA Design Team

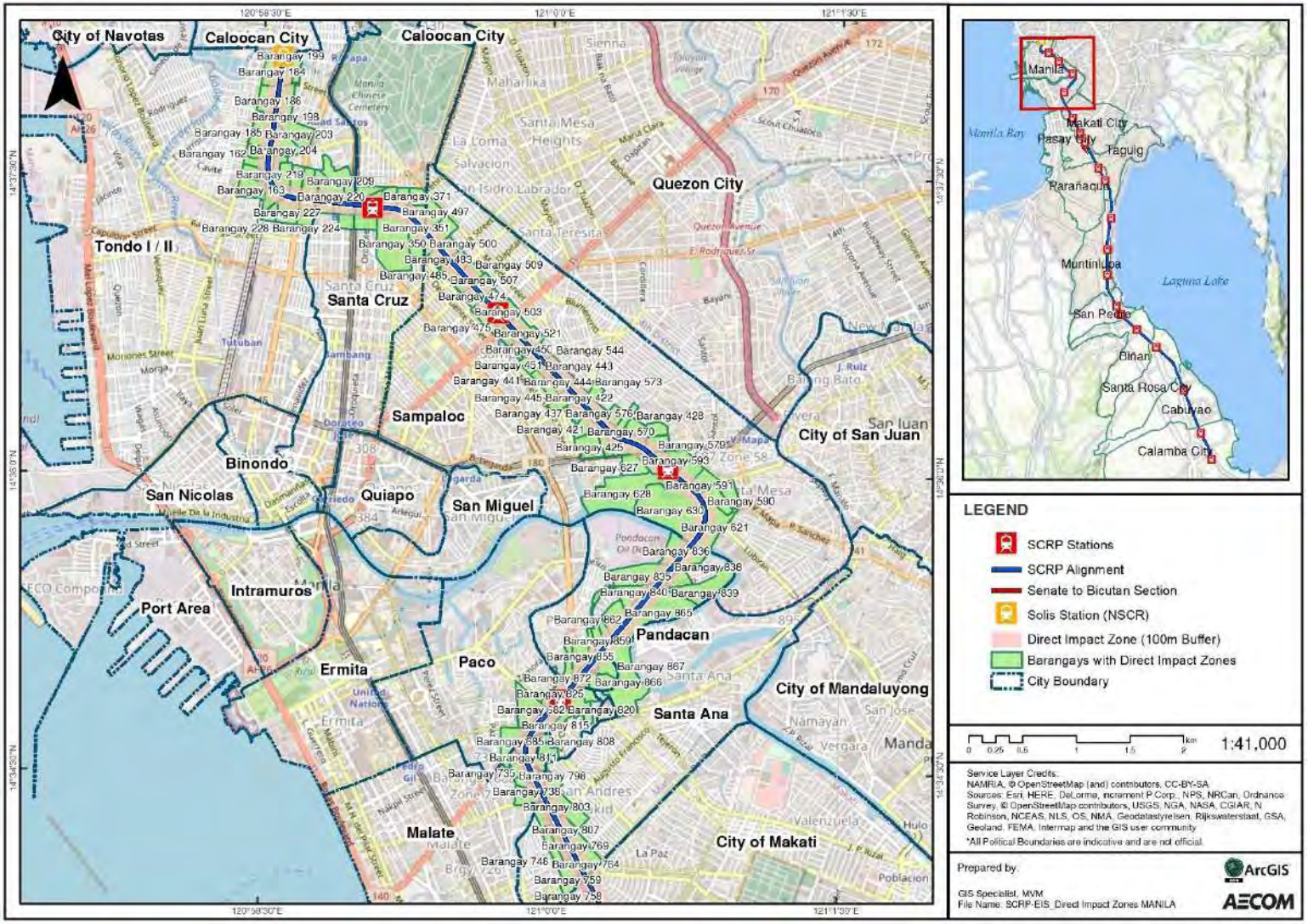


Figure 1.1.2 Barangays with Direct Impact Zones in Manila City

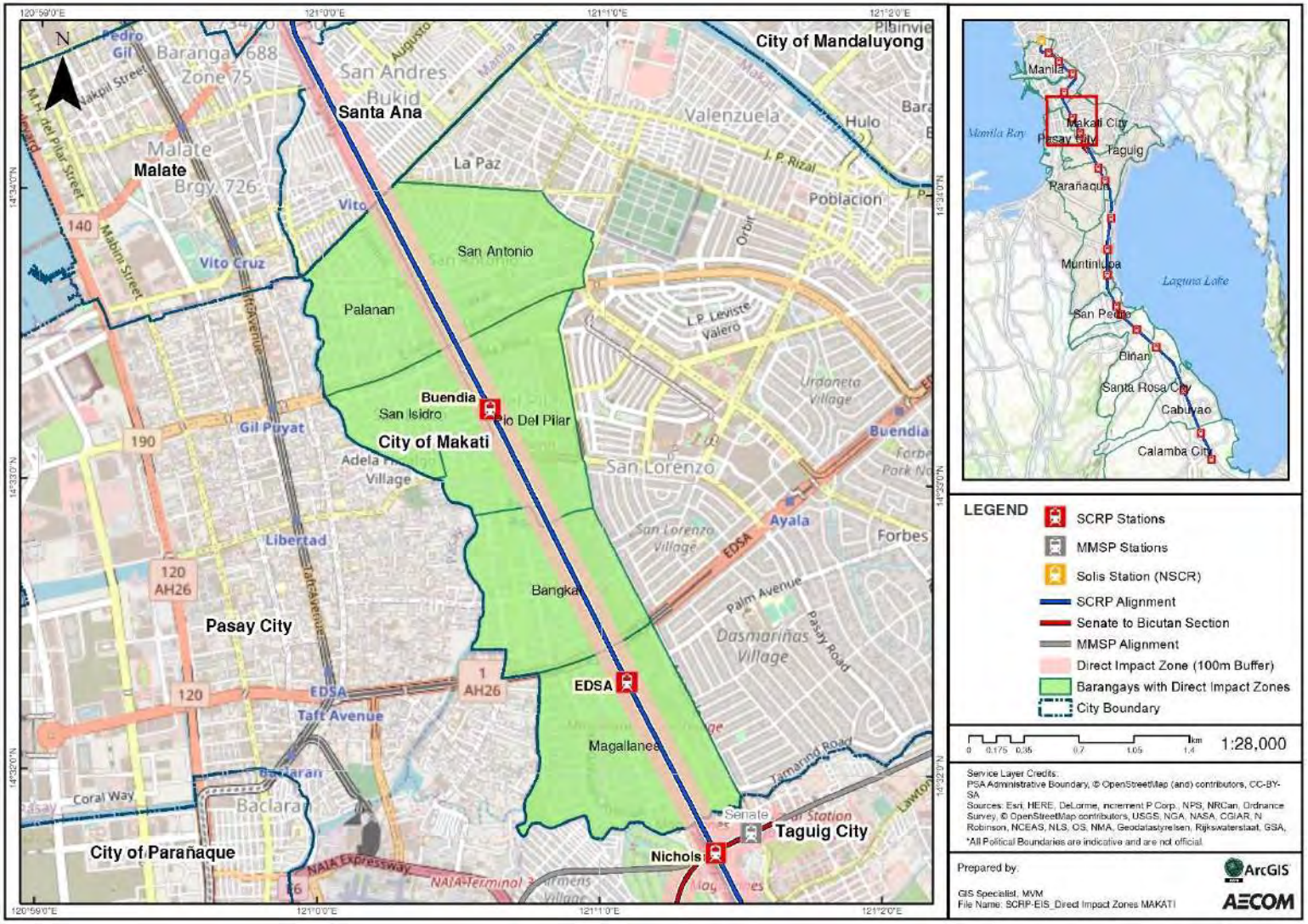


Figure 1.1.3 Barangays with Direct Impact Zones in Makati City

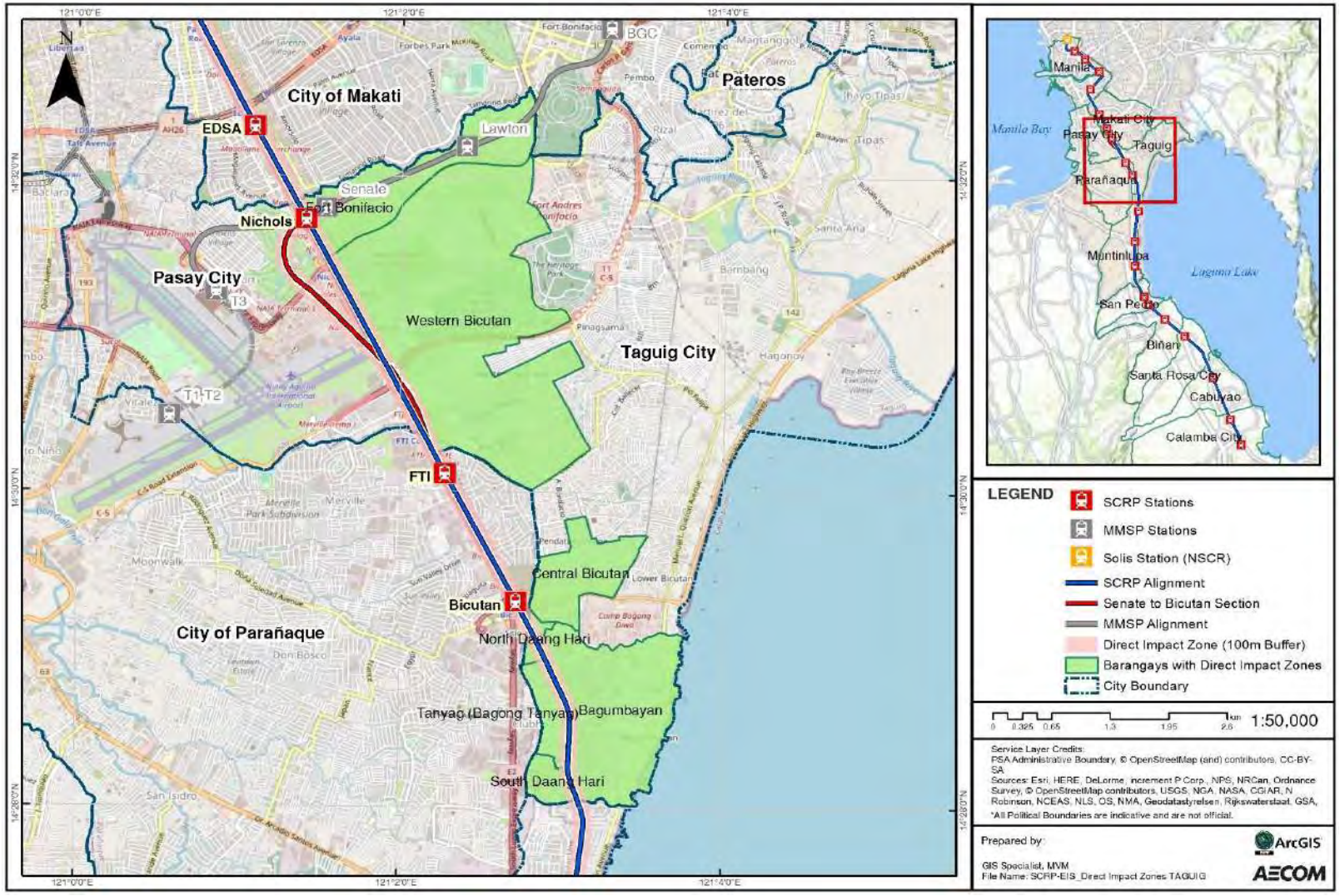


Figure 1.1.4 Barangays with Direct Impact Zones in Taguig City

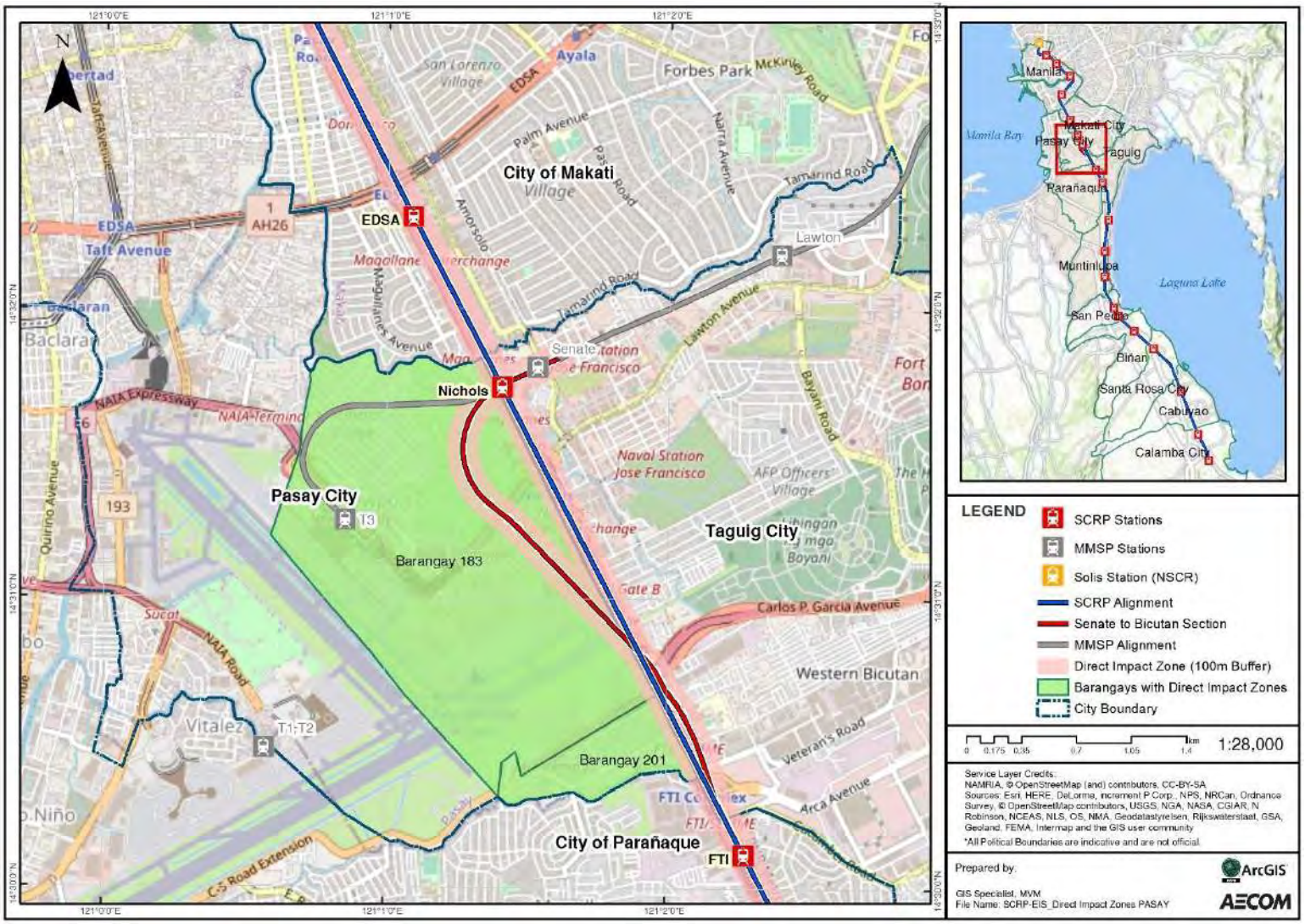


Figure 1.1.5 Barangays with Direct Impact Zones in Pasay City

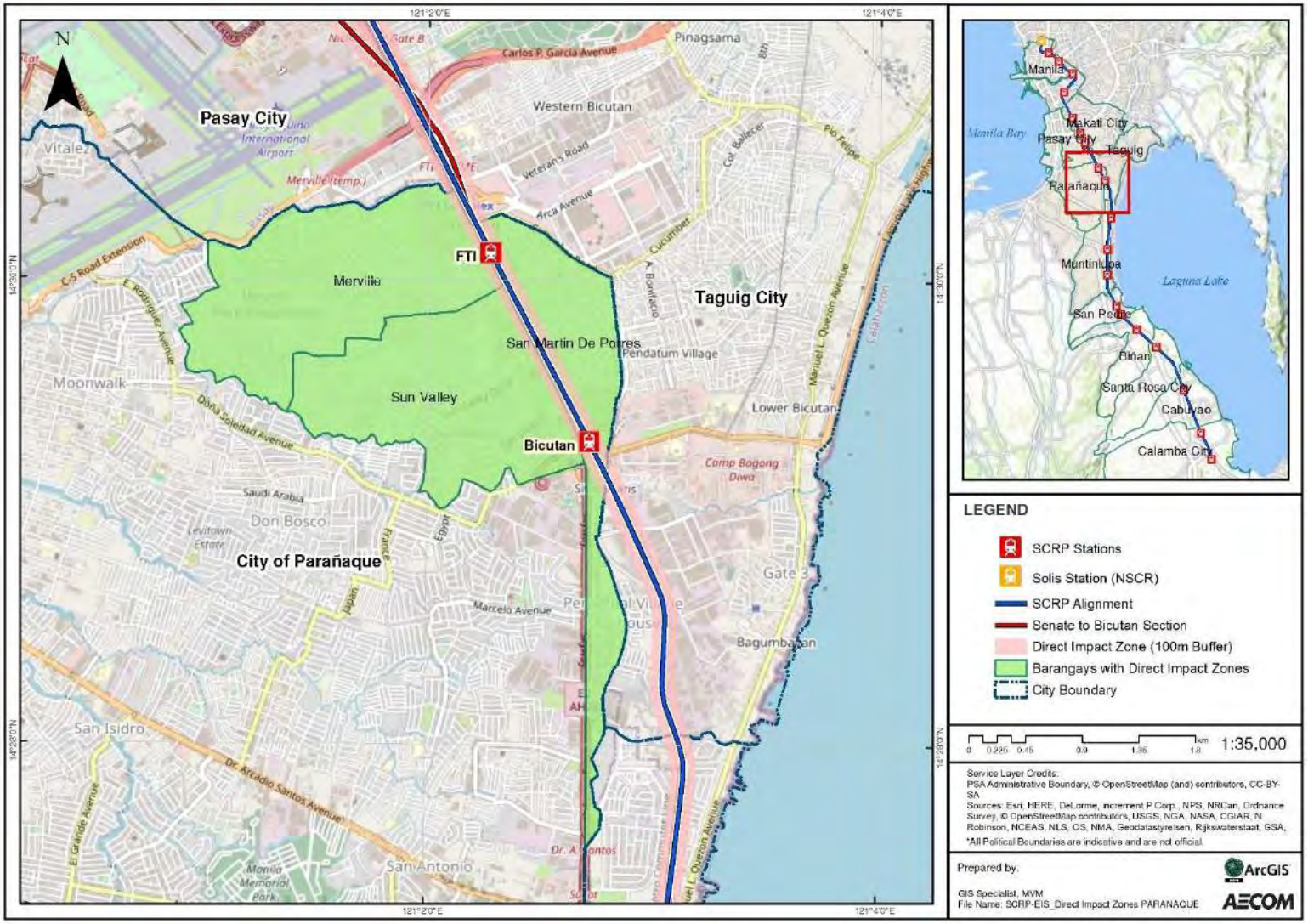


Figure 1.1.6 Barangays with Direct Impact Zones in Parañaque City

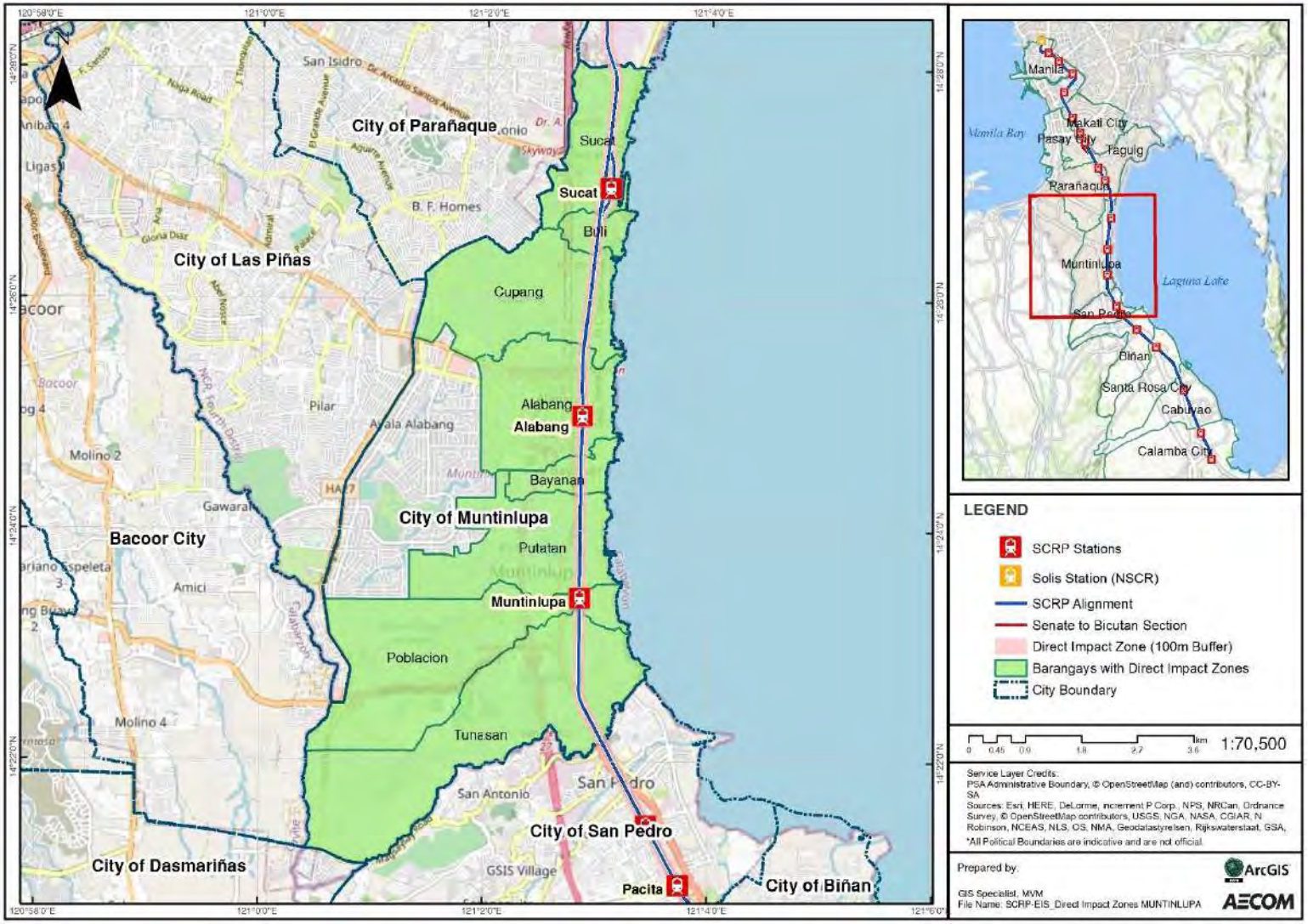


Figure 1.1.7 Barangays with Direct Impact Zones in Muntinlupa City

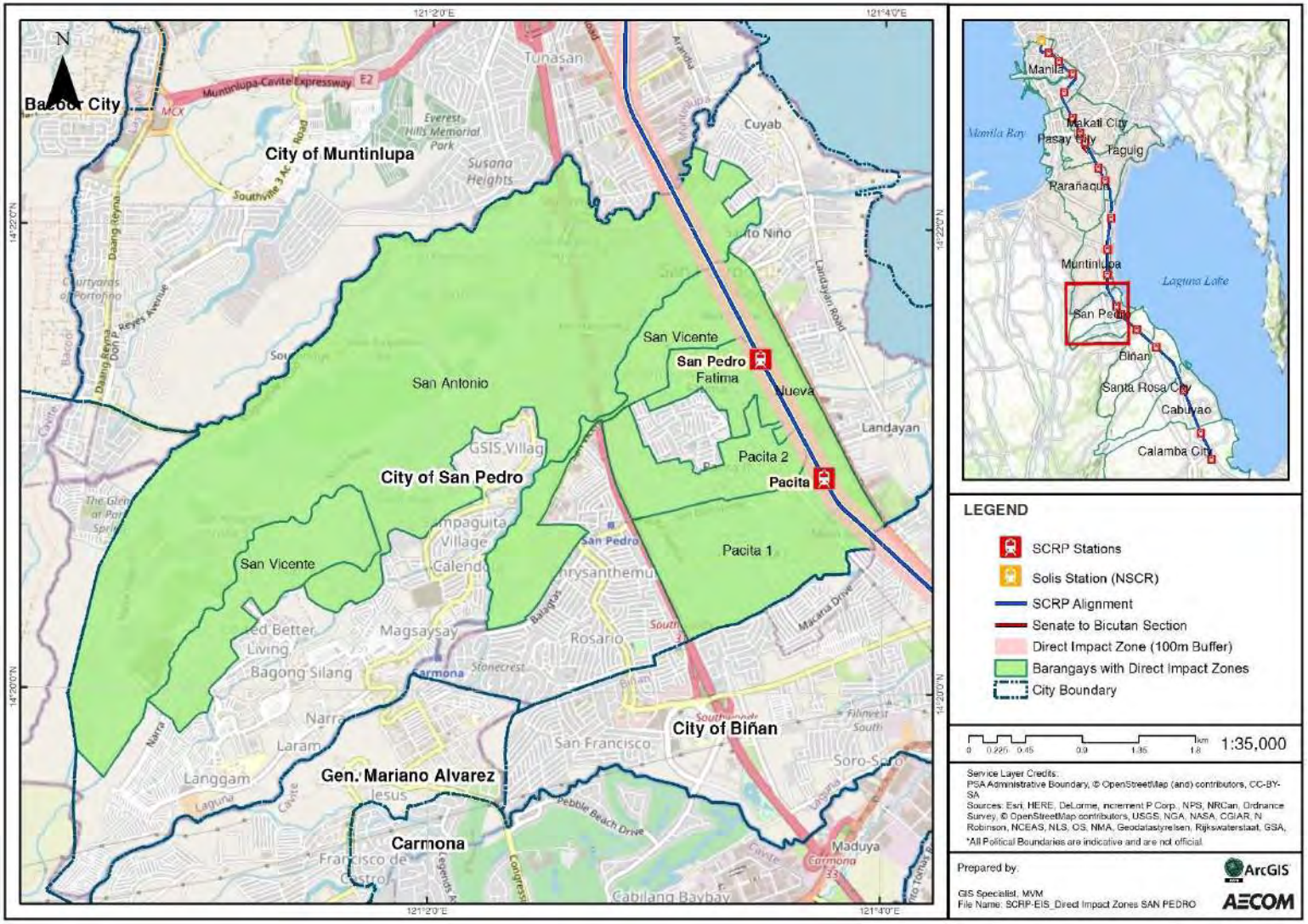


Figure 1.1.8 Barangays with Direct Impact Zones in San Pedro City

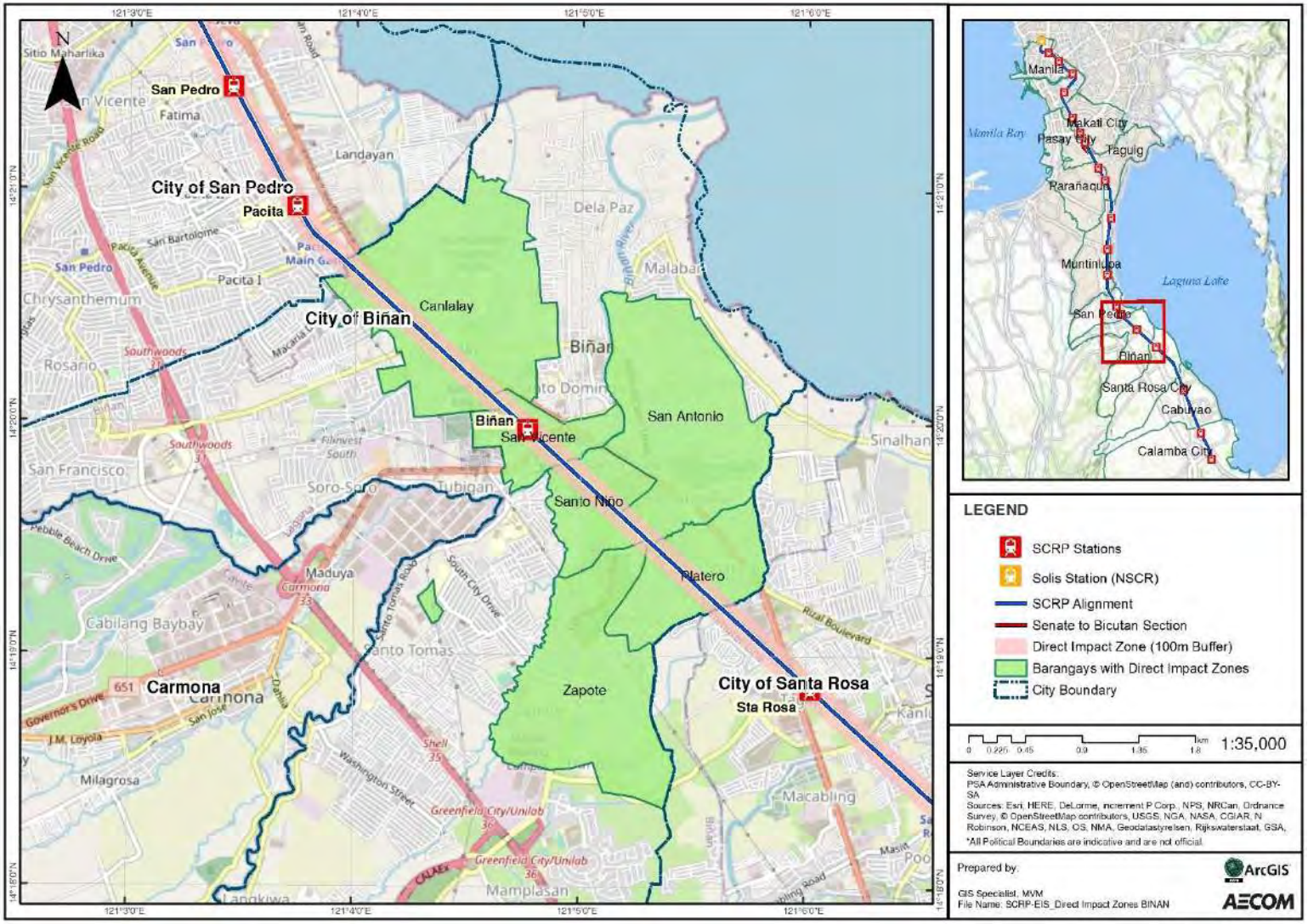


Figure 1.1.9 Barangays with Direct Impact Zones in Biñan City

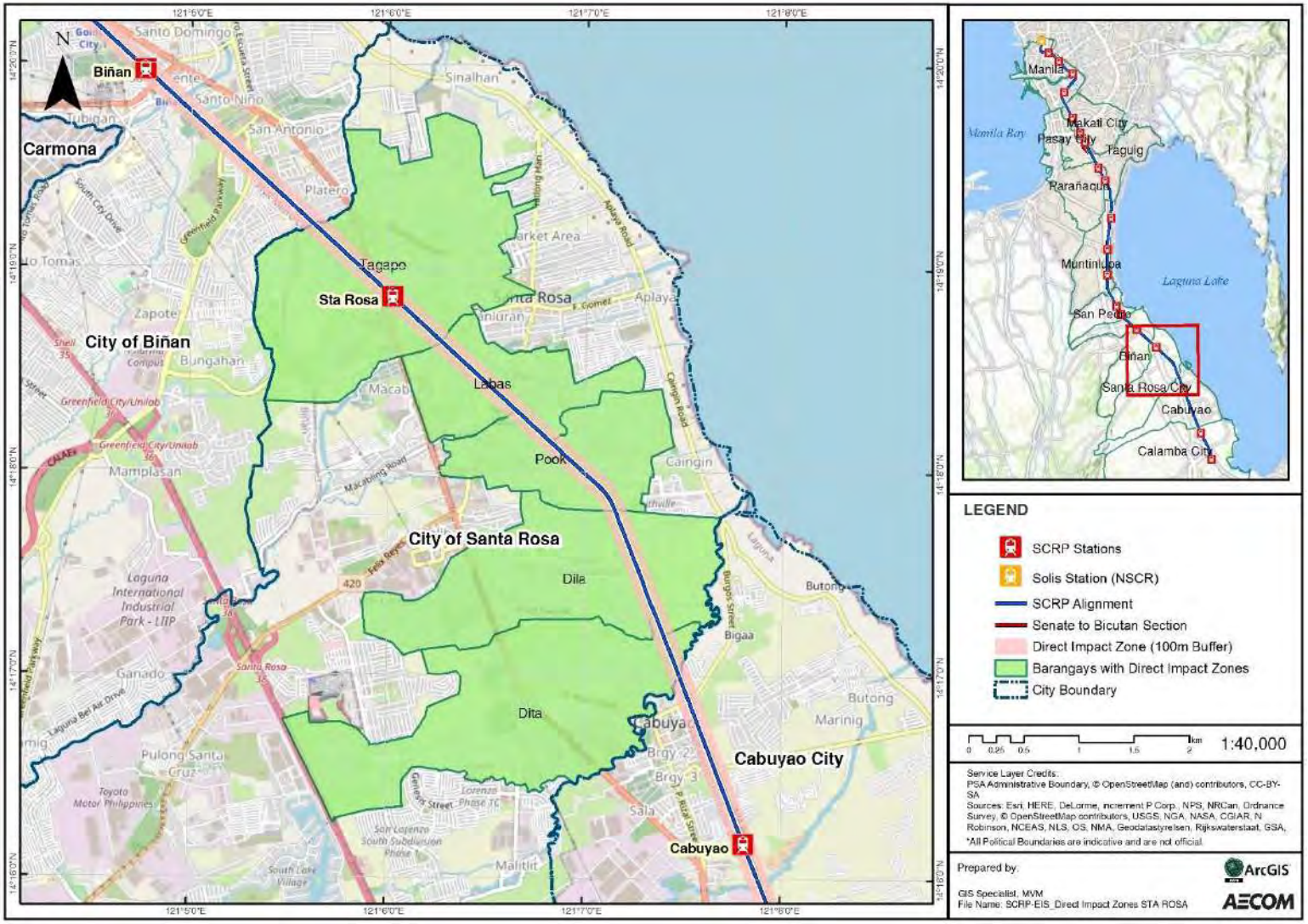


Figure 1.1.10 Barangays with Direct Impact Zones in Sta. Rosa City

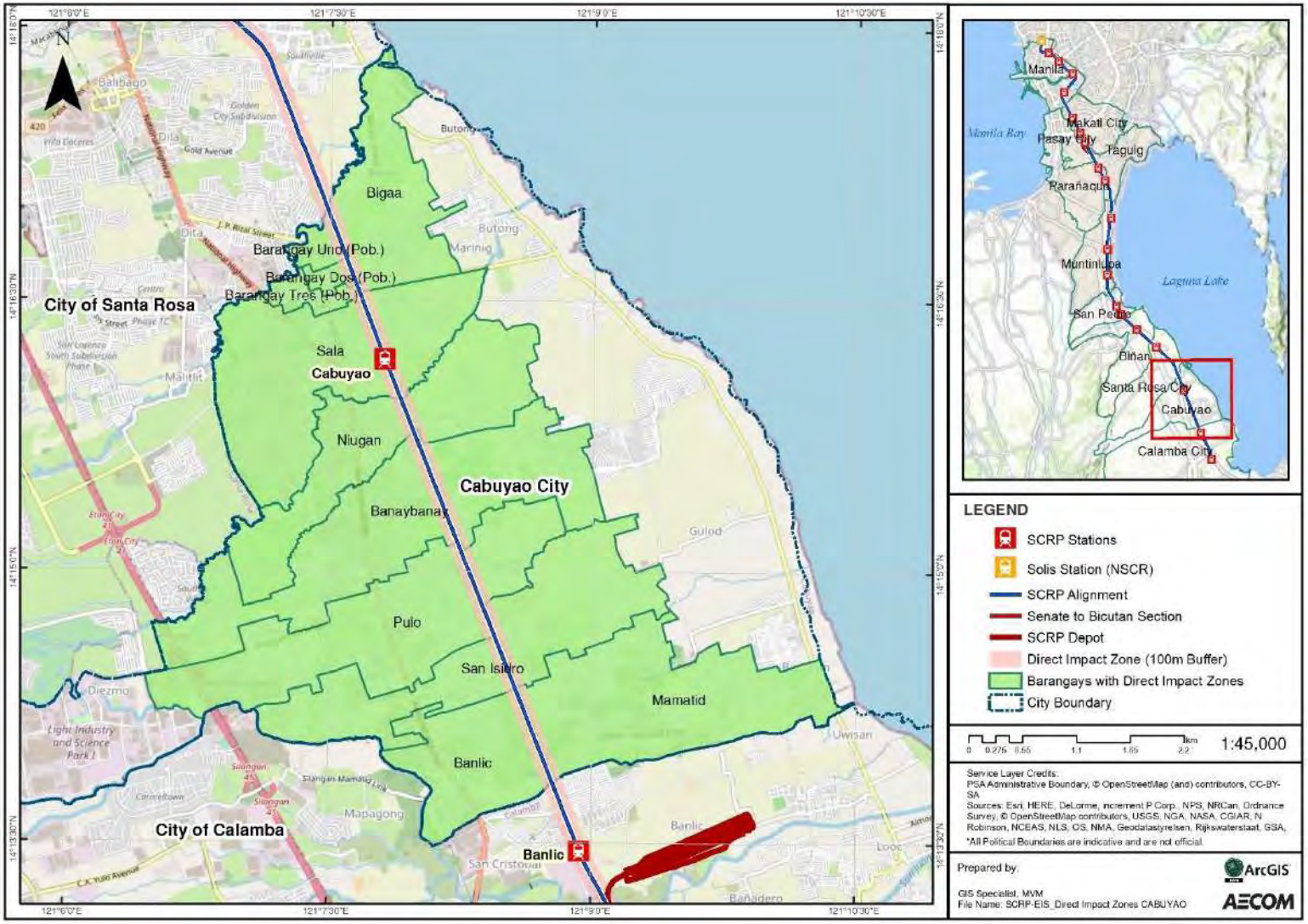


Figure 1.1.11 Barangays with Direct Impact Zones in Cabuyao City

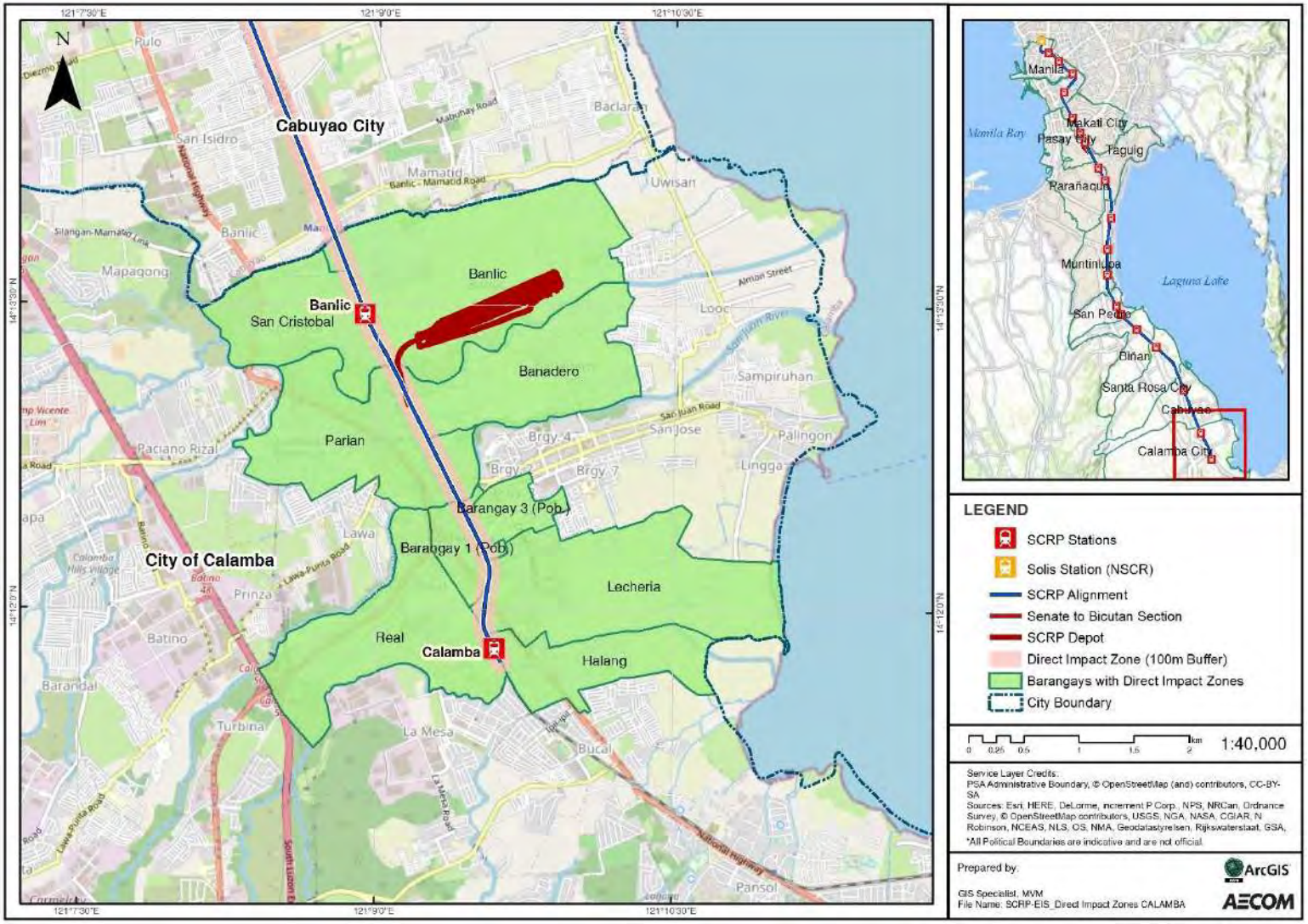


Figure 1.1.12 Barangays with Direct Impact Zones in Calamba City

Figure 1.1.13 Barangays with Direct Impact Zones in Taytay, Rizal

1.2. PROJECT RATIONALE

64. The population of Metro Manila in the Philippines increased by 1.5 times from 8.0 million in 1990 to 12.0 million in 2010. With a population density of 20,000 per km², NCR is home to about 13% of the population of the Philippines and the main economic center accounting for 38% of the country's gross domestic product (GDP).

65. Severe traffic congestion and environmental degradation characterize Metro Manila particularly at city centers where high density development continues. Urban sprawl has spilt over onto surrounding northern and southern provinces which are within daily commuting distance from Metro Manila. With increasing vehicle ownership, congestion is expected to worsen, further increasing travel times of commuters.

66. Urban rail services including Metro Rail Transit (MRT), Light Rail Transit (LRT) and commuter rail offer a more efficient alternative to road-based transport, however, the existing network needs to be significantly expanded in reach and capacity in order to meet the increased daily passenger transit demand. A mass transit service connecting Metro Manila with its adjacent areas is currently limited and as such, this presents a significant bottleneck to the further development of Metro Manila and its adjacent northern and southern suburban areas.

67. For this reason, the expansion of the existing mass transportation system has been identified by the Government as one of its highest priorities. Based on the Metro Manila Urban Transportation Integrated Study (MMUTIS) formulated by the Philippine Government in 1996, with the technical and financial assistance from JICA, an Urban Development Plan and Transportation Network Development Plan was established with 2015 as the target year.

68. Today, Manila is serviced by LRT1, LRT2, and MRT3, with a total length of 51.2 km of railway services. However, there is still a large demand for mass public transport to meet the transit needs of the fast-growing and highly dense metropolis. While there is a rail commuter service by the PNR connecting the capital to the southern cities as far as Los Baños in Laguna Province, its current capacity is not enough for the traffic demand and to be a better transit backbone to the southern suburban area.

69. To guide the development of new urban centers and to meet large residential demands, a commuter railway service to connect Metro Manila with its adjacent southern suburban areas is deemed to be an important mass transit backbone for Metro Manila as well as for the growth corridor of the GCR, comprising of Metro Manila and Region IV-A.

1.3. PROJECT ALTERNATIVES

70. Alternatives to the present alignment and ancillary facilities were considered as part of the development of the SCRP. The objective of the consideration of alternatives is to identify the most viable choices for the alignment minimizing the environmental and social impacts of the project while maximizing the benefits from the projects. The succeeding subsections provide information on the "No Project Option" and the alternatives considered for the SCRP.

1.3.1. No Project Option

71. Public transportation access from the suburbs to Metro Manila is not sufficient, and it is a bottleneck for further development in the southern direction. In the southern part, very few non-electrical PNR trains are operating up to Calamba in Laguna Province. Urgent measures are needed to ensure public transportation linking the northern and southern parts to the metropole.

72. Therefore, if the SCRP which is the railway traffic linking the southern part to Metro Manila stays undeveloped, sustainable growth of the local industry will be hampered and the environment of the area will deteriorate further by the traffic congestion and air pollution, Therefore, not

pursuing the Project is not an option.

1.3.2. SCRP Main Line Alternatives

1.3.2.1. ROW Alternative Options

73. An alternative ROW for the Project was not initially considered because the use of existing PNR ROW is deemed to have the least land acquisition and involuntary resettlement. It was later confirmed that the NLEX-SLEX Connector Road Project of DPWH will utilize part of the PNR ROW from Solis to Santa Mesa area in Manila which could not be changed anymore as it is at its final design stages. Given this, the alignment of the Project would have to adjust westwards. This would entail additional land acquisition for Project to compensate for several meters of PNR ROW to be occupied by the Connector Road.

1.3.2.2. Structure Alternative Options

74. The three structure alternative options considered for the SCRP are: (1) elevated/ viaduct structure; (2) underground structure; and (3) at-grade structure including embankments. **Table 1.3.1** presents the comparison of the structural type options.

Table 1.3.1 Comparison of Structural Type of Project

	Elevated Structure (All line)	**Underground Structure** (All line)	**At-Grade Structure** (Including Embankment)
Social Environment			
Land Acquisition	The required ROW is narrower than at-grade structure.	The required ROW is the widest.	The required ROW is wider than underground structure.
Affected Households	Resettlement of PAPs and ISFs within the ROW is necessary.	Resettlement of PAPs and ISF is low.	Resettlement of PAPs and ISFs within the ROW is necessary.
ROW	The necessary ROW between stations is 30m and 60m at station.	The necessary ROW between stations is 30m and 60m at station.	The necessary ROW between stations is 30m and 60m at station.
Dividing of local community	Little impact of community division.	No impact of community division.	Significant impact of community division.
Natural Environment			
Protected Area	Small impact is expected.	Tunnel structure has very little impact on the ground.	Significant impact is expected.
Biodiversity	Small impact is expected.	Tunnel structure has very little impact on the ground.	Significant impact is expected.
Flooding Risks	As it is an elevated structure, the tracks will not be submerged in case of flooding.	Excavation and tunneling sites may collect rainfall and groundwater. Need to provide sufficient drainage and other measures to prevent submersion in the tunnel in case of flooding.	Need measures to prevent flooding for at-grade structure.
Pollution Prevention			
Noise	Noise will be generated along the railway, but the impact can be mitigated by installing noise barriers.	There will be no noise along the railway.	Noise will be generated along the railway, but the impact can be mitigated by installing noise barriers.
Air Pollution	The operation of construction machinery and vehicles during construction is expected to generate air pollution.	During construction, transportation of excavated soil by vehicle is expected to generate air pollution.	There will be relatively few vehicles loading embankment material during construction and air pollution risk is relatively low.
Water Pollution	Little impact.	Possible impact on groundwater due to construction.	Little impact.
Ground Subsidence	No ground subsidence.	Low risk of ground subsidence because of underground structure.	There is a risk of land subsidence in case of soft ground.

	Elevated Structure (All line)	**Underground Structure** (All line)	**At-Grade Structure** (Including Embankment)
Engineering			
Construction Difficulty	Standard construction sequence and difficulty. More complex for long-span river bridges.	Very complicated construction methodology of main alignment and stations.	Simple construction sequence for fully at-grade sections.
Construction Time	Long.	Longest.	Long if soil improvement is necessary.
Operation /Maintenance	Maintenance and cost are less than underground structure.	High maintenance cost.	Low maintenance cost but, in case of ground subsidence or condition change, reparation is very difficult.
Disaster Prevention	Relatively safe and measures are easy compared to underground structure.	If a fire occurs in the tunnel, it will become a major disaster.	Relatively safe and measures are easy compared to an elevated structure.
Earthquake	Structures are designed in consideration of earthquakes.	Structures are designed in consideration of earthquakes.	Elevated structures are designed in consideration of earthquakes while for at-grade structures in low embankments, the impact of the earthquake is limited.
View from the Train Windows	Pleasant.	No View.	Pleasant.
Landscape	Structure design needs to consider the impact on surrounding landscape.	No impact on the landscape.	Structure design needs to consider the impact on surrounding landscape.
Physical Conditions	Few impacts on roads.	No impacts on roads.	Significant impact on existing roads and there are risks of intrusion into railway crossings and rails.
Evaluation	It has fewer advantages than underground option in terms of social and environmental aspects, but it is a good option for the construction period and construction cost. Impact on roads is small. After overall evaluation, this option will be adopted for most sections.	It is a good option for social and environmental aspects, but it is not adopted as the construction period is long and the cost is expensive.	It can be adopted in sections where the impact on existing road/s is small and requires lower cost.

Source : JICA Design Team

1.3.2.3. Vertical Alignment Alternative Options

75. There are four primary considerations to determine the vertical alignment option. These are:

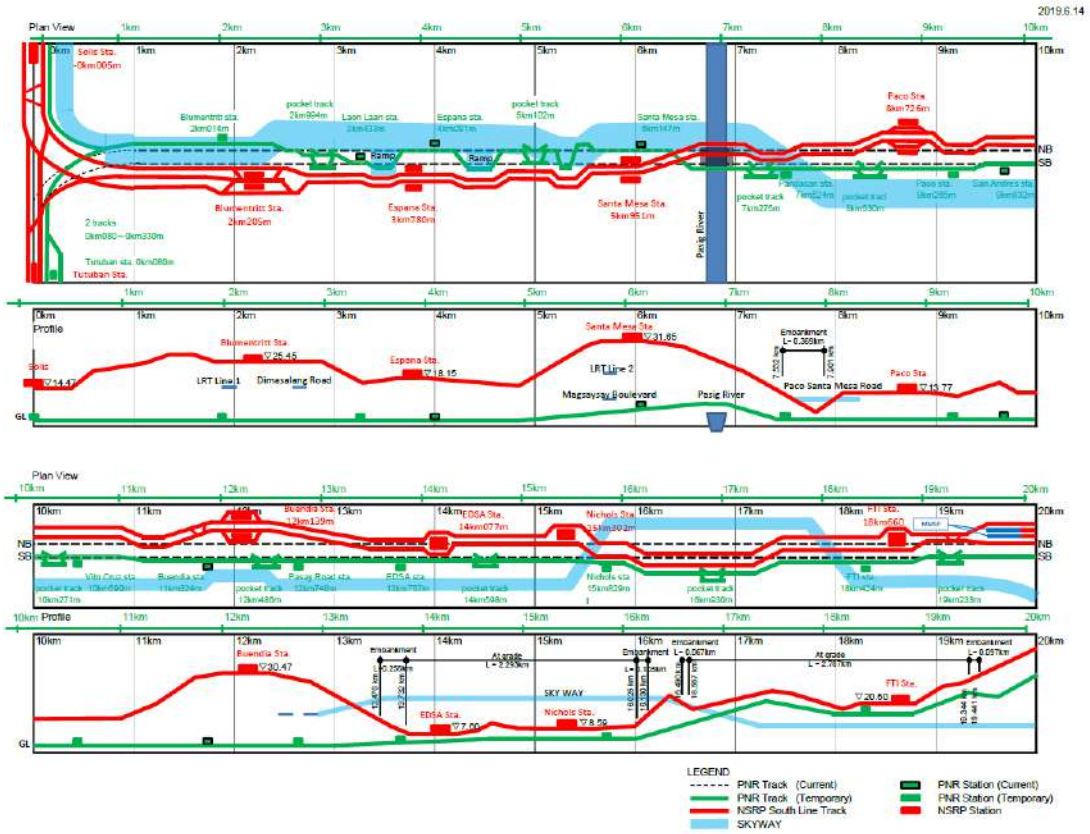
- Future traffic volume in 2025;
- Flood risk based on Project NOAH's 100-year flood hazard map;
- Critical points determined in the DED; and
- Interference of active fault where safety and restorability or convenience will prevail.

76. In addition, significant issues relative to railroad crossing will also be considered. These are:

- Low service for transportation at the railroad crossing;
- Bottleneck railroad crossing for transportation where traffic congestion often occurs;
- Bottleneck railroad crossing for passenger/walker;
- Narrow sidewalk at the railroad crossing;
- Occurrence of many accidents at the railroad crossing (2 or more accidents in the last 5 years); and

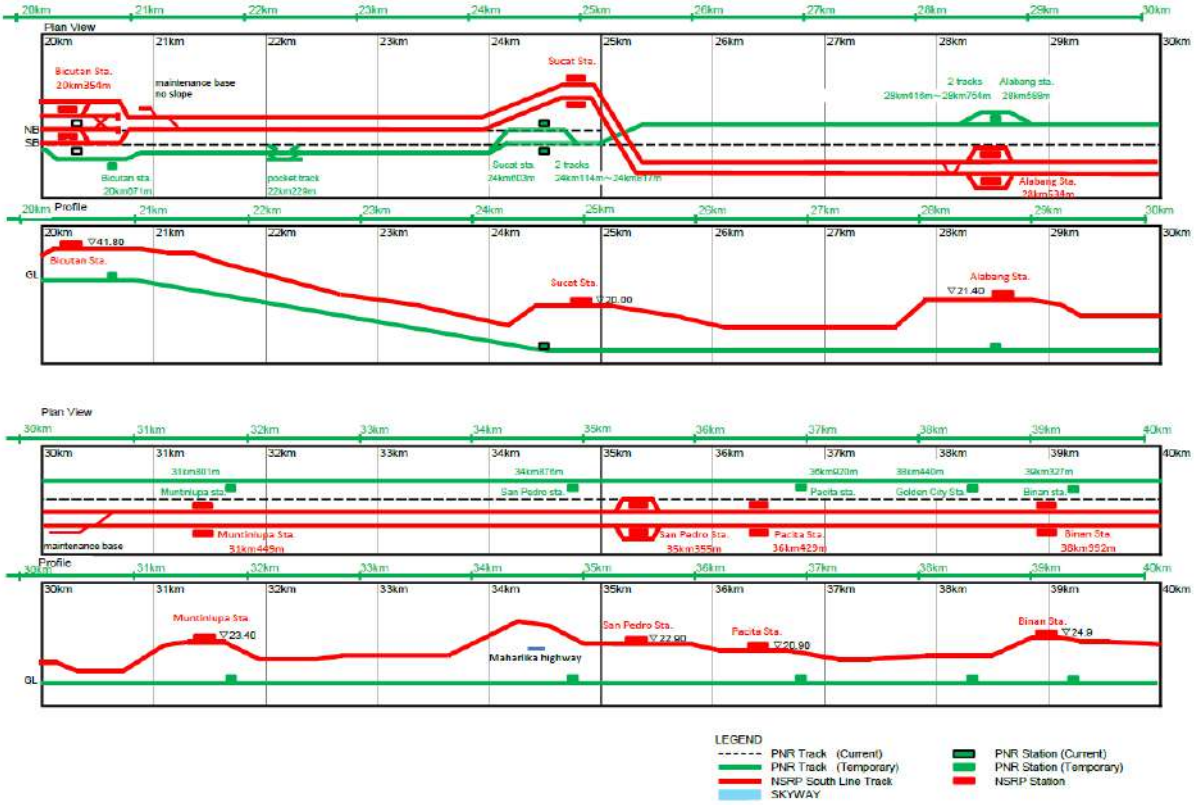
- School route at the railroad crossing.

77. Additional consideration is the presence of an active fault between Bicutan to San Pedro. Presented in **Figure 1.3.1**, **Figure 1.3.2**, and **Figure 1.3.3** are the vertical alignment schematic profile for the project.



Source: JICA Design Team

Figure 1.3.1 Option Description - Schematic Profile (Blumentritt to FTI)



Source: JICA Design Team

Figure 1.3.2 Option Description - Schematic Profile (Bicutan to Biñan)

Source: JICA Design Team

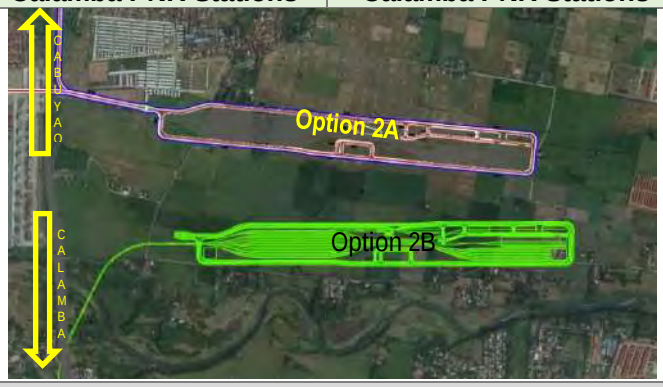
Figure 1.3.3 Option Description - Schematic Profile (Santa Rosa to Calamba)

1.3.2.4. Depot Alternative Options

78. There are three sites being considered for the Depot. As a result of the alternative comparison, Option 2B was selected as shown in **Table 1.3.2**.

- Option 1: Sucat Power Plant Area: Old Power Plant with an approximate area of 0.13 km² (13 ha).
- Option 2A: Between Mamatid and Calamba: Irrigated Agricultural Land with an approximate area of 0.22 km² (22 ha).
- Option 2B: Between Mamatid and Calamba: Irrigated Agricultural Land with an approximate area of 0.22 km² (22 ha).

Table 1.3.2 Alternative Comparison of Depot Site

	Option 1 Sucat Thermal Power Plant Area	Option 2A Between Mamatid and Calamba PNR Stations	Option 2B Between Mamatid and Calamba PNR Stations
			
Social Environment			
Land use	Old Power Plant: Decommissioned in 2002 : Approximately 13 hectares. River Bend Consolidated Mining Corp., a private firm, has an existing contract with Power Sector Assets and Liabilities Management Corporation (PSALM) for dismantling of movable equipment and its clean-up.	Agricultural land with portion of built-up areas.	Agricultural land with small portion of built-up areas.
Land Acquisition	Loss of houses due to the access line. Limited area for land acquisition.	Loss of house/s and agricultural land (22 ha). Land acquisition necessary.	Loss of house/s and agricultural land (22 ha). Land acquisition necessary.
Resettlement	Resettlement of dozens of PAFs along the access line to the depot.	PAFs within the area being considered. Risk of loss of income of farmers.	PAFs within the area being considered. Risk of loss of income of farmers.
Natural Environment			
Protected Area	No encroachment to any protected area.	No encroachment to any protected area.	No encroachment to any protected area.
Land Alteration	Need additional land acquisition for the depot site as well as access route to the 13-ha depot.	Need to change land classification (22 ha. irrigated agricultural land).	Need to change land classification (22 ha. irrigated agricultural land).
Vegetation	Some vegetation/ grass, approximately 50 trees	Rice fields, approximately 30 coconut and other trees.	Rice fields, less trees affected compared to option 2A.
Pollution			
Noise and Vibrations	Concentrated residential area, potential impacts of noise and vibration.	Adjacent to low-cost housing in the northwest, potential impacts of noise and vibration.	Low noise and vibration risk.
Water	Risk of water pollution of Laguna de Bay due to sediment loaded water discharged during construction, if not mitigated.	Risk of water pollution to San Cristobal River due to sediment loaded water discharged during construction, if not	Risk of water pollution to San Cristobal River due to sediment loaded water discharged during construction, if not mitigated.

	Option 1 Sucat Thermal Power Plant Area	Option 2A Between Mamatid and Calamba PNR Stations	Option 2B Between Mamatid and Calamba PNR Stations
		mitigated.	
Engineering			
Construction difficulty	Need to demolish existing structures prior to construction. The land is limited and constrains the facility layout.	The land is vast and little constraints in facility layout. There are settlements in the west and southeast.	The land is vast and little constraints in facility layout. There are settlements in the south.
Construction cost	Costly	Economical	Most economical
Operation	Close to urban area and convenient for commuting to the depot site.	Accessibility might be an issue.	Accessibility not an issue.
Start in practice	Can be operated as soon as rails are laid to the depot.	Can be operated as soon as rails are laid to the depot.	Can be operated as soon as rails are laid to the depot.
Evaluation	Considering the storage capacity of rolling stock, operation of carriage and maintenance, it is more difficult compared to the other 2 options (near Mamatid).	Considering the storage capacity of rolling stock, operation of carriage and maintenance, the option can be considered for depot. However, the land class conversion is required and close to residential area which might be impacted by the noise generated from its operation.	Considering the storage capacity of rolling stock, operation of carriage and maintenance, the option is the preferred site for depot. However, the land class conversion is required.

Source: JICA Design Team

1.3.2.5. Station Alternatives

79. In the following maps, red rectangle area shows the FS Station Location, and the blue rectangle area shows the DD Station Location.

(1) España Station

80. **Table 1.3.3** presents the comparison of FS to DD España Station location.

Table 1.3.3 Comparison of FS to DD España Station Location

Particulars	FS Station Location	DD Station Location
Location		
Reason for location change	Northeast part of PNR ROW will be affected by future connector road and España Station will be located approximately 390m northwest from the FS design station avoiding major water pumping station and reservoir of a water supply concessionaire. Furthermore, the existing station will be operational even during the construction of the new station.	

Particulars	FS Station Location	DD Station Location
Social Environment		
Land use	PNR ROW, public access and mixed-use private property. Road access that will be affected will require realignment	PNR ROW, public access and mixed-use private property
Land Acquisition	Necessary since alignment has been moved to southwest of the PNR ROW to give way to DPWH project. This will affect several private properties and the BLISS Housing area.	Necessary since alignment has been moved to southwest of the PNR ROW to give way to DPWH project. This will require acquisition of private properties and the pumping station and reservoir.
Resettlement	Resettlement of PAFs expected, will require KSA intervention for resettlement/relocation aspect.	Pumping Station and reservoir will be relocated but no area in the vicinity with has the same dimension could be acquired and Resettlement of PAFs expected
Traffic	The project is expected to contribute to the traffic volume plying surrounding roads particularly due to transport of equipment and materials during construction and influx of passengers during operation. Traffic mitigating measures should be in place once the station will be completed and operational	The project is expected to contribute to the traffic volume plying surrounding roads particularly due to transport of equipment and materials during construction and influx of passengers during operation. Traffic mitigating measures will be in place once the station will be completed and operational
Access	Major public roads will not be closed plus the project is bounded by major access roads including España Boulevard, Antipolo St., Algeciras St., and intersects Loyola St. Affected streets will be relocated and realigned to cater the station needs	Major public roads will not be closed plus the project is bounded by major access roads including España Boulevard, Antipolo St., Algeciras St., and intersects Florentino St. Traffic mitigating measures will be in place once the station will be completed and operational
Natural Environment		
Protected Area	No nearby protected area	No nearby protected area
Vegetation	Build-up area. Few patches of trees within the PNR ROW.	Build-up area. Few patches of trees within the PNR ROW.
Land Alteration	Flat area. No alteration needed.	Flat area. No alteration needed.
Pollution		
Noise and Vibrations	Potential noise and vibration risks on sensitive receptors	Potential noise and vibration risks on sensitive receptors mostly local residents
Water	Low risk of water pollution particularly in a waterway adjacent to the project which is located north-northwest. Concessionaire reservoir will be affected.	Low risk of water pollution particularly in a waterway adjacent to the project which is located north-northwest and in the avoided reservoir.
Flood	Area is susceptible to flooding but the elevated structure type makes it less prone to flooding.	Area is susceptible to flooding but the elevated structure type makes it less prone to flooding.

(2) Santa Mesa Station

81. **Table 1.3.4** presents the comparison of FS to DD Santa Mesa Station location.

Table 1.3.4 Comparison of FS to DD Santa Mesa Station Location

Particulars	FS Station Location	DD Station Location
Location		
Reason for location change	The proposed Santa Mesa Station (DD) will be located approximately 35m northwest of the proposed FS station. It will be connected to LRT 2 Pureza Station located 600m west from the proposed station by providing new pedestrian bridge along Magsaysay Boulevard. The proposed DD station was shifted to be closer to a major thoroughfare R. Magsaysay Blvd.).	
Social Environment		
Land use	PNR ROW and mixed-use private property	PNR ROW and mixed-use private property
Land Acquisition	Necessary since alignment has been moved to southwest of the PNR ROW to give way DPWH project.	Necessary since alignment has been moved to southwest of the PNR ROW to give way DPWH project. The University newly constructed facilities will be affected which will require Land Acquisition.
Resettlement	Resettlement of PAFs affected with a bigger number.	Resettlement of PAFs affected and replication of the affected building within the university area will be required.
Traffic	The project is expected to contribute to the traffic volume plying surrounding roads particularly due to transport of equipment and materials during construction and influx of passengers during operation. The existing road within the proximity of the station will become saturated in terms of traffic volume and traffic mitigating measure shall be provided.	The project is expected to contribute to the traffic volume plying surrounding roads particularly due to transport of equipment and materials during construction and influx of passengers during operation. The existing road within the proximity of the station will become saturated in terms of traffic volume and traffic mitigating measure shall be provided.
Access	Major public roads will not be closed plus there are a number of roads to access the station. Magsaysay Blvd. is the major road to access the station. It can also be accessed through the streets of Anonas and Albina. It can also be easily accessed through LRT 2 and NLEX-SLEX Connector Road. The pedestrian overpass shall be connected to the existing LRT 2 Pureza Station for better connectivity.	Major public roads will not be closed plus there are a number of roads to access the station. Magsaysay Blvd. is the major road to access the station. It can also be accessed through the streets of Anonas and Albina. It can also be easily accessed through LRT 2 and NLEX-SLEX Connector Road. The pedestrian overpass shall be connected to the existing LRT 2 Pureza Station for better connectivity.
Natural Environment		
Protected Area	No nearby protected area	No nearby protected area
Vegetation	Build-up area. Few patches of trees within the PNR ROW.	Build-up area. Few patches of trees within the PNR ROW.
Land Alteration	Flat area. No alteration needed.	Flat area. No alteration needed.
Pollution		
Noise and Vibrations	Potential noise and vibration risks on sensitive receptors mostly local residents and PUP students	Potential noise and vibration risks on sensitive receptors mostly local residents and PUP students

Particulars	FS Station Location	DD Station Location
Water	Low risk of water pollution in Pasig river where sediment run-off may flow with appropriate mitigation	Low risk of water pollution in Pasig river where sediment run-off may flow with appropriate mitigation
Flood	Not flood-prone area and the structure is elevated	Not flood-prone area and the structure is elevated

(3) Paco Station

82. **Table 1.3.5** presents the comparison of FS to DD Paco Station location.

Table 1.3.5 Comparison of FS to DD Paco Station Location

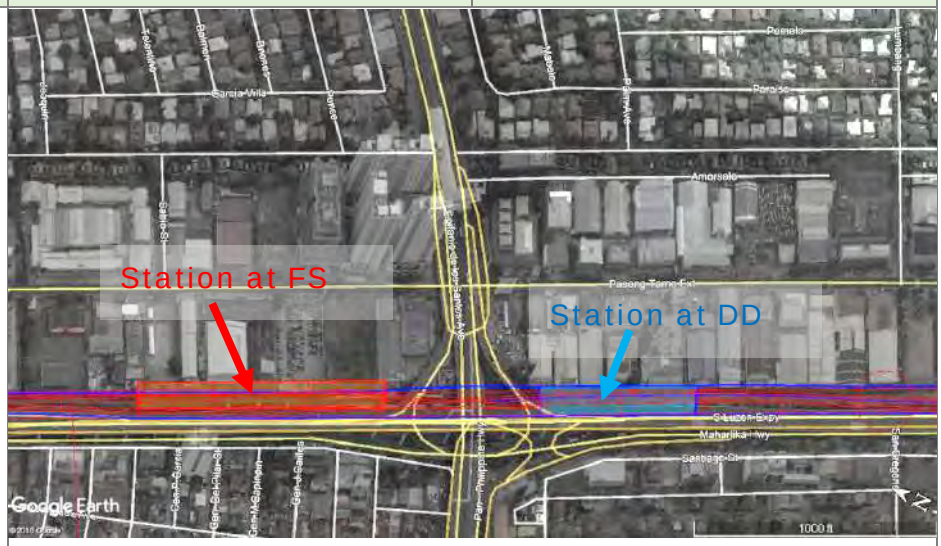
Particulars	FS Station Location	DD Station Location
Location		
Reason for location change	The proposed Paco Station shall be located approximately 155m northeast of the FS proposed location. The City of Manila has accepted the proposed location along Quirino Avenue, opposite of Plaza Dilao with Monument of Ukon Takayama. To avoid impact on the historical station as discussed with NHCP, the new station will be situated beside the historical PNR station.	
Social Environment		
Land use	PNR ROW and mixed-use private property, particularly private properties on the Eastern side of the station.	PNR ROW and mixed-use private property particularly private properties on the Eastern side of the station.
Land Acquisition	Land acquisition is necessary	Land acquisition is necessary
Resettlement	Resettlement of PAFs expected; Existing Paco PNR Station will be affected	Resettlement of PAFs expected
Traffic	Medium to high risk to traffic congestion at Pedro Gil St. Quirino Ave will have appropriate drop off to minimize impact to traffic.	Low to medium risk to traffic congestion at Pedro Gil St. Quirino Ave will have appropriate drop off to minimize impact to traffic.
Access	The project site may be accessed through Quirino Avenue and Pedro Gil St. In addition, major public roads will not be closed.	The project site may be accessed through Quirino Avenue and Pedro Gil St. In addition, major public roads will not be closed.
Natural Environment		
Protected Area	The station will be constructed to utilize the Old Paco PNR Station remaining structure. The station is 80 m away from Plaza Dilao with Monument of Ukon Takayama.	The station will be constructed to utilize the Old Paco PNR Station remaining structure. The station is 80 m away from Plaza Dilao with Monument of Ukon Takayama (affected and removed by another project).
Vegetation	Patches of trees along the PNR ROW	Patches of trees along the PNR ROW
Land Alteration	Flat area. No alteration needed.	Flat area. No alteration needed.
Pollution		
Noise and Vibrations	Potential noise and vibration risks on	Potential noise and vibration risks on

Particulars	FS Station Location	DD Station Location
	sensitive receptors	sensitive receptors mostly local residents and students
Water	Low risk of water pollution particularly in nearest waterbody 500 m southeast of the project	Low risk of water pollution particularly in nearest waterbody 350 m southeast of the project
Flood	Not flood-prone area and the structure is elevated	Not flood-prone area and the structure is elevated

(4) EDSA Station

83. **Table 1.3.6** presents the comparison of FS to DD EDSA Station location.

Table 1.3.6 Comparison of FS to DD EDSA Station Location

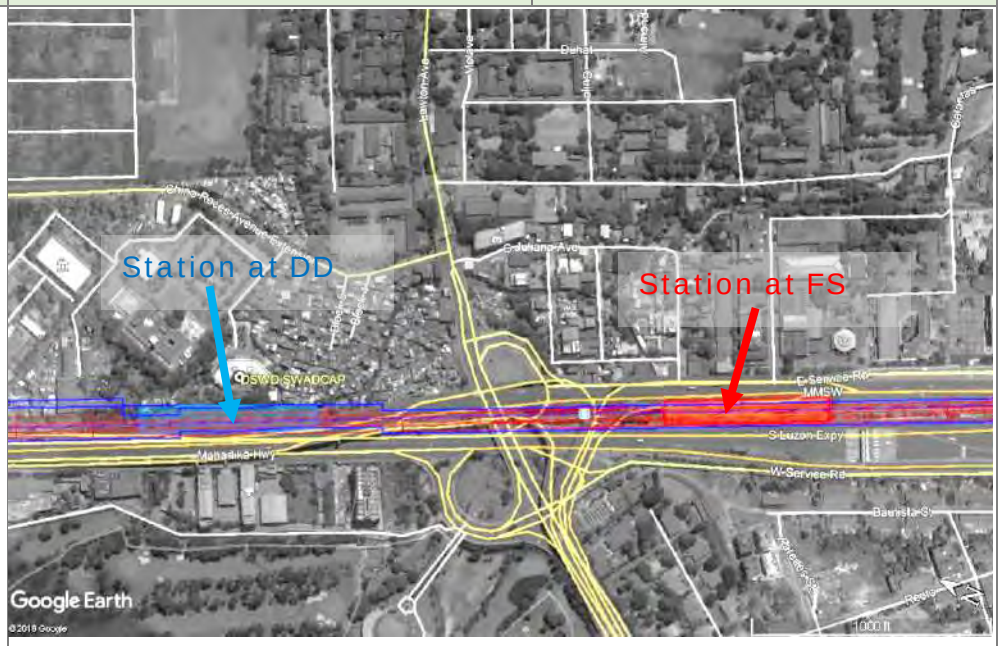
Particulars	FS Station Location	DD Station Location
Location		
Reason for location change	EDSA Station will be located south of the existing EDSA PNR Station. It is near the interchange of Magallanes with Epifanio de los Santos Avenue (EDSA). The station was moved approximately 448m to the southeast of the FS station, to consider vehicle and pedestrian access which is more feasible than the FS proposed location.	
Social Environment		
Land use	PNR ROW and mixed-use private property with Major business development	PNR ROW and mixed-use private property with Major business development
Land Acquisition	Land acquisition is necessary for areas outside PNR ROW; mostly commercial and residential	Land acquisition is necessary for areas outside PNR ROW; mostly industrial establishments
Resettlement	No ISF affected; EDSA PNR Station will be affected	No ISF affected
Traffic	Traffic circulation is not feasible	Traffic circulation is feasible
Access	The project site may be accessed through EDSA, Maharlika Highway, South Luzon Expressway and MRT3 (Magallanes Station) via elevated pedestrian overpass.	The project site may be accessed through EDSA, Maharlika Highway, South Luzon Expressway and MRT3 (Magallanes Station). via elevated pedestrian overpass.
Natural Environment		
Protected Area	No nearby protected area	No nearby protected area
Vegetation	Build-up area. Few patches of trees within the PNR ROW.	Build-up area. Few patches of trees within the PNR ROW. Part of the Makati Mini park under the Magallanes flyover will be affected
Land Alteration	Flat area. No alteration needed.	Flat area. No alteration needed.
Pollution		
Noise and Vibrations	Low risk to sensitive receptors as the station is much nearer to commercial	Low risk to sensitive receptors as the station is much nearer to industrial

Particulars	FS Station Location	DD Station Location
	establishments	establishments
Water	Waterbodies (Estero de Gallina/ Dilain Creek, etc.) are far from the project site so there is low risk of water pollution	Waterbodies (Estero de Gallina/ Dilain Creek, etc.) are far from the project site so there is low risk of water pollution
Flood	Flood prone area	Flood-prone area. The structure is elevated

(5) Nichols Station

84. **Table 1.3.7** presents the comparison of FS to DD Nichols Station location.

Table 1.3.7 Comparison of FS to DD Nichols Station Location

Particulars	FS Station Location	DD Station Location
Location		
Reason for location change	The proposed location of Nichols Station is 500m north of the Nichols Interchange. The proposed station will be located beside the DSWD's SWADCAP (Social Welfare and Development Center for Asia and the Pacific) training center, owned by the Department of Education (DepEd) approximately 680m northwest of the proposed station during the feasibility study. The proposed DD station will become a part of the proposed major development of the DepEd area to consider MMSP station and other plan mixed-use commercial residential area.	
Social Environment		
Land use	PNR ROW and mixed-use private property	PNR ROW and mixed-use government and private property with some proclaimed area for resettlement
Land Acquisition	Land acquisition is necessary	Land acquisition is necessary
Resettlement	Resettlement of PAFs expected	Resettlement of PAFs expected
Traffic	The project is expected to contribute to the traffic volume plying surrounding roads particularly due to transport of equipment and materials during construction and influx of passengers during operation. The station will require major road closure, the connection of East Service road to SLEX.	The project is expected to contribute to the traffic volume plying surrounding roads particularly due to transport of equipment and materials during construction and influx of passengers during operation. The proposed station and the alignment will require relocation of the major road access around 250 meters south from the intersection with East Service Road and SLEX.
Access	Accessible through Maharlika Highway, South Luzon Expressway/ Skyway, East Service Road, NAIA, MMSP, Nichols Interchange. In addition, major public roads will not be closed.	No direct Access through Maharlika Highway, South Luzon Expressway/ Skyway, East Service Road, NAIA, MMSP, Nichols Interchange. Access could only be provided through Pasong

Particulars	FS Station Location	DD Station Location
		Tamo Extension towards a new road in the DepEd property leading to the station.
Natural Environment		
Protected Area	No nearby protected area	No nearby protected area
Vegetation	Build-up area	Build-up area
Land Alteration	Flat area. No alteration needed.	Flat area. No alteration needed.
Pollution		
Noise and Vibrations	Potential noise and vibration risk on sensitive receptors including students, local residents and commercial establishments.	Potential noise and vibration risk on sensitive receptors including students, local residents and commercial establishments.
Water	With appropriate mitigation, low risk of water pollution is only expected in Maribacan Creek which is directly traversed by the station.	With appropriate mitigation, low risk of water pollution is only expected in Maribacan Creek which is directly traversed by the station.
Flood	Not flood prone area; structures are elevated	Not flood-prone area; structure is elevated

(6) Sucat Station

85. **Table 1.3.8** presents the comparison of FS to DD Sucat Station location.

Table 1.3.8 Comparison of FS to DD Sucat Station Location

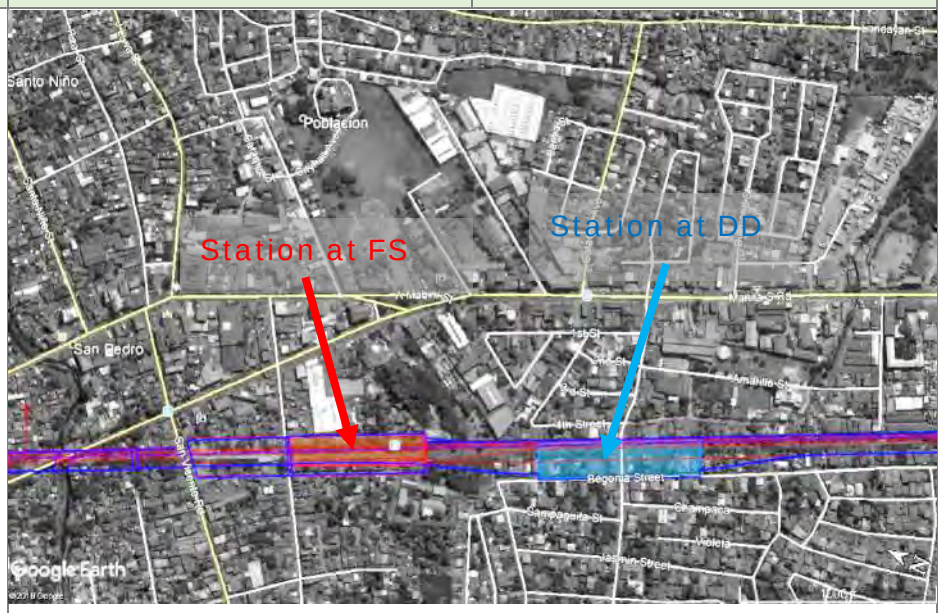
Particulars	FS Station Location	DD Station Location
Location		
Reason for location change	Following the change in the alignment of the railway, the proposed station shall also be moved 220 m southeast of the FS proposed location for Sucat Station. This will provide direct access to the planned Long Haul Train Station.	
Social Environment		
Land use	PNR ROW and mixed-use private property	PNR ROW and Government property
Land Acquisition	Land acquisition is necessary	Agreement with PSALM for the use of the site. Acquisition is necessary along the alignment going to the station
Resettlement	Resettlement of PAFs expected; existing Sucat PNR Station will be affected	Resettlement of PAFs is expected along the alignment going to the station.
Traffic	Congested area	Less impact on traffic
Access	Accessible through MERALCO Road which is connected to Manuel L. Quezon Avenue, Sucat Interchange, East Service Road and Dr. Arcadio Santos Avenue.	Accessible through Manuel L. Quezon Road, connected to MERALCO ROAD, Concepcion Street, East Service Road, South Luzon Expressway/ Skyway and Dr. Arcadio Santos Avenue.
Natural Environment		
Protected Area	No nearby protected area	No nearby protected area

Particulars	FS Station Location	DD Station Location
Vegetation	Patches of trees along the PNR ROW	Patches of trees inside the demolished STPP
Land Alteration	Flat area. No alteration needed.	Flat area. No alteration needed.
Pollution		
Noise and Vibrations	Potential risk for sensitive receptors is greater. Adjacent areas are residential.	Potential risk for sensitive receptors is less as it will be put up mainly in an industrial area
Water	With appropriate mitigation measure, low risk of water pollution is expected	With appropriate mitigation measure, low risk of water pollution is expected in Laguna de Bay and Buli River
Flood	Flood prone area. Structures are elevated	Flood prone area. Structure is elevated

(7) San Pedro Station

86. **Table 1.3.9** presents the comparison of FS to DD San Pedro Station location.

Table 1.3.9 Comparison of FS to DD San Pedro Station Location

Particulars	FS Station Location	DD Station Location
Location		
Reason for location change	San Pedro Station shall be located approximately 420m southeast of the proposed location during the feasibility study. Station location has been changed to avoid existing San Pedro PNR Station. Accessibility is also less congested via Crismor Avenue. The proposed FS station will be very near the high viaduct structure on top of the Manila South Road Bridge, requiring high elevation station rather than the DD proposed station.	
Social Environment		
Land use	PNR ROW; mixed-use private property; light developed area	PNR ROW; mixed-use private property; light developed area
Land Acquisition	Land acquisition is necessary for areas outside PNR ROW	Land acquisition is necessary for areas outside PNR ROW
Resettlement	Resettlement of PAFs expected; Historical structure of PNR will also be affected	Resettlement of PAFs expected
Traffic	Possible impact on traffic. Congested area,	Possible impact on traffic. Less congested area, quite narrow access road
Access	Direct access from San Vicente Road	Direct access from Crismor Avenue.
Natural Environment		
Protected Area	No nearby protected area	No nearby protected area
Vegetation	Build-up area with patches of trees along PNR ROW	Build-up area with patches of trees along PNR ROW
Land Alteration	Flat area. No alteration needed.	Flat area. No alteration needed.

Particulars	FS Station Location	DD Station Location
Pollution		
Noise and Vibrations	Potential noise and vibration risks on sensitive receptors is greater	Potential risk for sensitive receptors is less
Water	Low risk of water pollution	Low risk of water pollution
Flood	Not flood-prone area	Not flood-prone area

(8) Pacita Station

87. **Table 1.3.10** presents the comparison of FS to DD Pacita Station location.

Table 1.3.10 Comparison of FS to DD Pacita Station Location

Particulars	FS Station Location	DD Station Location
Location		
Reason for location change	Pacita Station shall be located approximately 400m to the northwest from the proposed site during the feasibility study. The proposed station was positioned to avoid the old PNR Pacita Station and to decongest Pacita Avenue. The proposed FS station will be located in the curve portion of the alignment and very near the commercial area while the proposed DD station is very near to a vacant lot that could be used as an intermodal transport terminal in the future with lesser developed area than the proposed FS station.	
Social Environment		
Land use	PNR ROW and mixed-use private property	PNR ROW and mixed-use private property
Land Acquisition	Land acquisition is necessary	Land acquisition is necessary
Resettlement	Resettlement of PAFs	Resettlement of PAFs
Traffic	Possible impact on traffic	Possible impact on traffic
Access	Accessible from Pacita Avenue Sta Teresita and Taguile St.	Accessible from Sta. Teresita Road and nearby roads including Pacita Avenue
Natural Environment		
Protected Area	No nearby protected area	No nearby protected area
Vegetation	Build-up area with patches of trees along PNR ROW	Build-up area with patches of trees along PNR ROW
Land Alteration	Flat area. No alteration needed.	Flat area. No alteration needed.
Pollution		
Noise and Vibrations	Potential noise and vibration risks for sensitive receptors	Potential noise and vibration risks for sensitive receptors
Water	Low risk of water pollution	Low risk of water pollution
Flood	Not flood-prone area	Not flood-prone area

(9) Biñan Station

88. **Table 1.3.11** presents the comparison of FS to DD Biñan Station location.

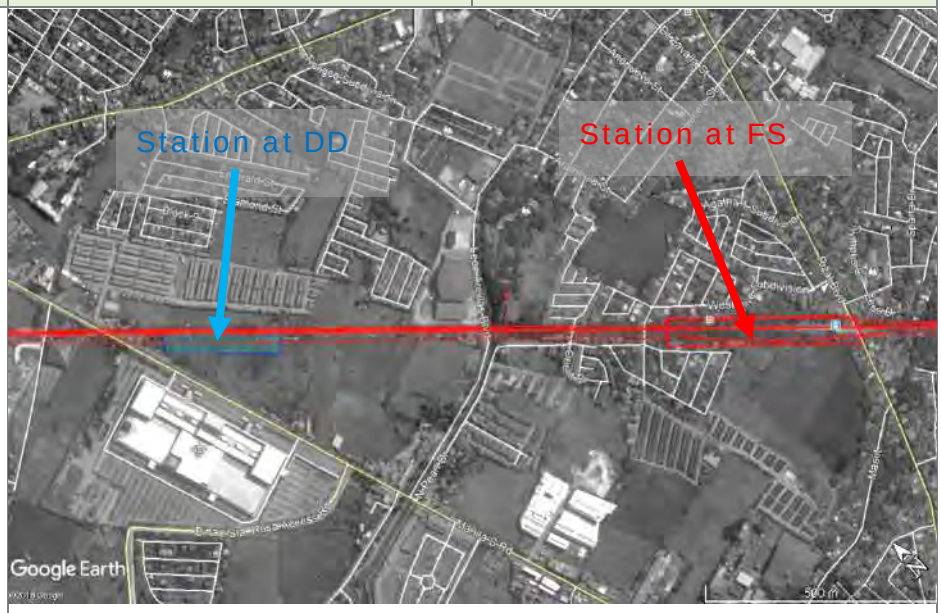
Table 1.3.11 Comparison of FS to DD Biñan Station Location

Particulars	FS Station Location	DD Station Location
Location		
Reason for location change	The location of the Biñan Station will be across General Malvar Street, avoiding the existing Biñan PNR Station and public recreation area. Avoided greater congestion in Gen. Malvar St. since FS station cuts across Gen. Malvar St. The proposed FS station is very near the light to heavy developed area than the DD proposed station which has light developed area.	
Social Environment		
Land use	PNR ROW and mixed-use private property. Light to heavy developed area and close to residential and lesser commercial areas.	PNR ROW and mixed-use private property. Light developed area and close to residential and commercial areas.
Land Acquisition	Land acquisition is necessary; Biñan PNR Station will be affected.	Land acquisition is necessary; Biñan PNR Station was avoided
Resettlement	Resettlement of PAFs expected and relocation of Biñan PNR Station.	Resettlement of PAFs expected
Traffic	Possible traffic congestion in Gen. Malvar St. Greater impact is expected since the site cut through Gen. Malvar St.	Possible traffic congestion at Gen. Malvar St.
Access	Direct access to Gen. Malvar St. and San Vicente Road, Possible additional access road at the eastern side of the station going to the National road.	Direct access to main road and avoided the existing Biñan PNR Station which is across Gen. Malvar St. Possible additional access road quite far to the National Road.
Natural Environment		
Protected Area	No nearby protected area	No nearby protected area
Vegetation	Build-up area with patches of trees	Build-up area with patches of trees
Land Alteration	Flat area. No alteration needed.	Flat area. No alteration needed.
Pollution		
Noise and Vibrations	Potential noise and vibration risks on sensitive receptors	Potential noise and vibration risks on sensitive receptors
Water	Low to medium risk of water pollution particularly in nearest waterbody south of the project	Low risk of water pollution
Flood	Not flood-prone area	Not flood-prone area

(10) Santa Rosa Station

89. **Table 1.3.12** presents the comparison of FS to DD Santa Rosa Station location.

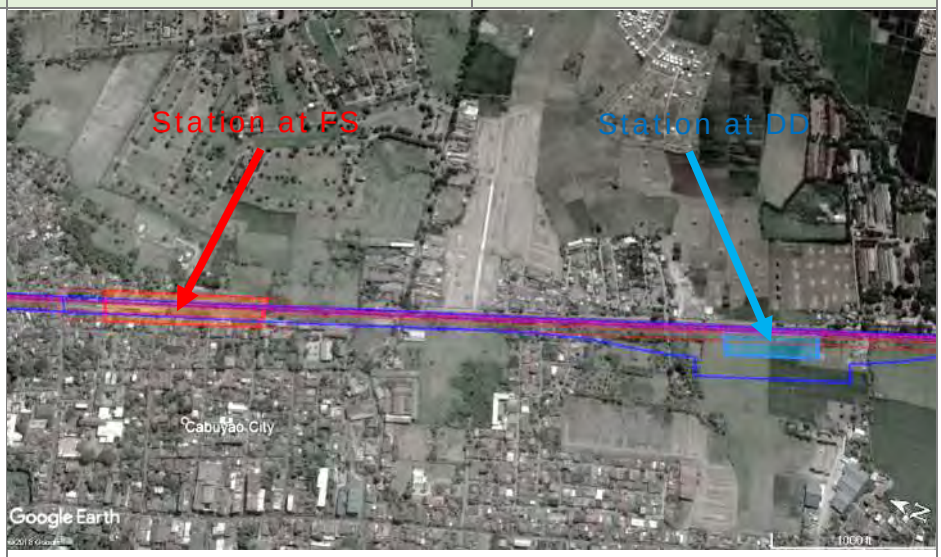
Table 1.3.12 Comparison of FS to DD Santa Rosa Station Location

Particulars	FS Station Location	DD Station Location
Location		
Reason for location change	Santa Rosa Station shall be located in Brgy. Malusak, Santa Rosa City, Laguna. Moving 1,020m northwest from the proposed station during the FS phase, the DD proposed location will be in front of Santa Rosa City Multi Complex Building and beside the planned road which will serve as an extension of the Biñan – Sta. Rosa Access Road. This will provide accessibility for passengers going to and from the city hall and commercial areas. Station location change is in coordination with Sta. Rosa City LGU. Change in station location also avoided Sta. Rosa PNR Station. The proposed DD station will then be in the proximity of the developed and to be developed area and near the National Road.	
Social Environment		
Land use	PNR ROW and mixed-use private property	PNR ROW and mixed-use private property
Land Acquisition	Land acquisition is necessary	Land acquisition is necessary
Resettlement	Resettlement of PAFs; Existing Sta. Rosa PNR Station will be affected.	Resettlement of PAFs; Existing Sta. Rosa PNR Station will not be affected, with lesser number.
Traffic	Possible traffic congestion in a Rizal Boulevard	Possible traffic congestion in Manila south road
Access	Direct access to Rizal Boulevard	Direct access to Manila South Road and Leon Arcillas Blvd.
Natural Environment		
Protected Area	No nearby protected area	No nearby protected area
Vegetation	Patches of trees along the PNR ROW; rice field on the southwest	Patches of trees and coconut along the PNR ROW
Land Alteration	Flat area. No alteration needed. Soil conditioning might be necessary for some portions	Flat area. No alteration needed.
Pollution		
Noise and Vibrations	Potential noise and vibration risks on sensitive receptors is greater	Potential noise and vibration risks on sensitive receptors is less
Water	Low risk of water pollution	Low risk of water pollution
Flood	Flood prone area, near the creek that overflows during a heavy downpour	Not flood-prone area

(11) Cabuyao Station

90. **Table 1.3.13** presents the comparison of FS to DD Cabuyao Station location.

Table 1.3.13 Comparison of FS to DD Cabuyao Station Location

Particulars	FS Station Location	DD Station Location
Location		
Reason for location change	Cabuyao Station shall be located within the jurisdiction of Cabuyao City. The DD proposed station has moved 1,150m southeast from the FS proposed location. The municipality of Cabuyao has accepted the proposed location for Cabuyao central terminal as representative station. The access road in front of the station is planned to be expanded and Intermodal terminal at the east side of the DD station is also envisioned by the LGU for better connectivity.	
Social Environment		
Land use	PNR ROW and mixed-use private property; light developed area near residential areas	PNR ROW and mixed-use private property; light developed area near commercial areas
Land Acquisition	Land acquisition is necessary	Land acquisition is necessary
Resettlement	Resettlement of PAFs expected; existing Cabuyao PNR Station will be affected	Resettlement of PAFs expected. Lesser compared to FS station location
Traffic	Possible impact on traffic	Possible impact on traffic may require road widening
Access	Accessible via	Accessible via NIA road and proposed connection to the National Highway.
Natural Environment		
Protected Area	No nearby protected area	No nearby protected area
Vegetation	Patches of trees along the PNR ROW and build-up area	Patches of trees along the PNR ROW and rice field at the west part
Land Alteration	Flat area. No alteration needed.	Flat area. No alteration needed.
Pollution		
Noise and Vibrations	Potential noise and vibration risks on sensitive receptors is greater	Potential noise and vibration risks on sensitive receptors is less
Water	Low risk of water pollution	Low risk of water pollution
Flood	Not flood prone area	Not flood prone area

(12) Banlic Station (New)

91. An additional station will be placed at Barangay Banlic resulting from the request of the local government of Calamba City with the support of the DOTr that a station in the barangay be situated in order to support the plans of placing the South Depot and resettlement area in the barangay. The location of the station is close to the South Depot and at the open area beside Villa Palao Road as shown in **Figure 1.3.4**.

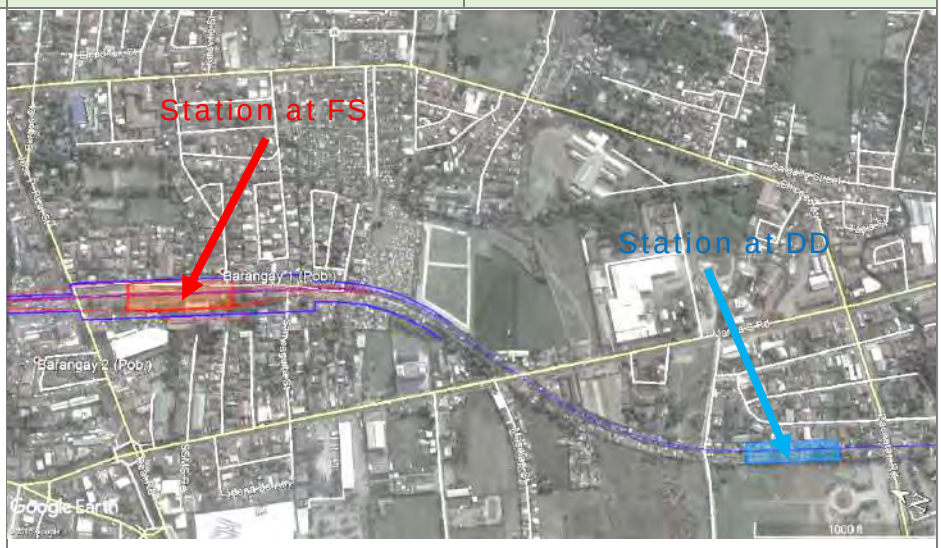
Source: JICA Study Team

Figure 1.3.4 Location of the Proposed Banlic Station (New)

(13) Calamba Station

92. **Table 1.3.14** presents the comparison of FS to DD Calamba Station location.

Table 1.3.14 Comparison of FS to DD Calamba Station Location

Particulars	FS Station Location	DD Station Location
Location		
Reason for location change	Calamba Station was initially planned to be located in the area of the PNR Calamba Station for easy access. Upon consultation with the concerned agencies and Calamba City, the location was adjusted. From its initial location, the proposed station was moved 1,020m to the southeast. LGU requested the proposed DD location in view of the congestion that will happen to the proposed FS station considering that the area is highly developed with very narrow street.	
Social Environment		
Land use	PNR ROW, public access and mixed-use private property	PNR ROW and mixed-use private property 15 m from existing Rizal Monument and traverses an open space where Rizal Coliseum is currently being constructed.
Land Acquisition	Land acquisition is necessary	Land acquisition is necessary
Resettlement	Resettlement of PAFs	Less private properties affected and lesser number of PAPs to be affected.
Traffic	Possible impact on traffic. Access road within the ROW is part of the development and may cause possible landlocked in some areas.	The station is bounded by two major thoroughfares to its northwest and southeast which may contribute traffic due to transport of equipment during construction and influx of passengers during operation. Widening of the proposed additional access road could be done in the future.
Access	Access road within the ROW will be affected	All major access roads will not be blocked
Natural Environment		
Protected Area	Buffer zone of Makiling Forest Reserve is 4kms away	Buffer zone of Makiling Forest Reserve is 3kms away
Vegetation	Build-up area with patches of fruit-bearing trees	Patches of fruit-bearing and other trees within the PNR ROW. Western part is an open area
Land Alteration	Flat area. No alteration needed.	Flat area. No alteration needed.
Pollution		
Noise and Vibrations	Potential noise and vibration risks on sensitive receptors	Potential noise and vibration risks on sensitive receptors
Water	Low risk of water pollution	Low risk of water pollution particularly in a waterway southeast of the station or located in Barangay Halang that flows further towards Laguna de Bay.
Flood	Area is slight to moderately susceptible to flooding but the elevated structure type makes it not prone to flooding.	Area is slight to moderately susceptible to flooding but the elevated structure type makes it not prone to flooding.

1.3.2.6. Technology Alternatives

93. The DOTr will utilize Electric Multiple Unit (EMU) trains for the Project. An EMU is a multiple unit train consisting of self-propelled carriages, using electricity as the motive power. It requires no separate locomotive, as electric traction motors are incorporated within one or a number of carriages. An EMU is usually formed by two (2) or more semi-permanently coupled carriages, but electrically powered single-unit railcars are also generally classed as EMUs.

94. EMUs are popular on commuter and suburban rail networks around the world due to their fast acceleration and pollution-free operation. Being quieter than Diesel Multiple Units (DMU) and locomotive-drawn trains, EMUs can operate later at night and more frequently without disturbing nearby residents.

1.3.3. SCRP Interconnecting Line Alternatives

95. The selection of the alternatives for the route and technology for the interconnecting line was done using criteria shown in **Table 1.3.15**.

Table 1.3.15 Selection Criteria for the SCRP Interconnecting Line

No.	Criteria	Suitability
V	Very Good or Desirable	Suitable or proper
G	Good or Desirable	Recommendable or acceptable
M	Middle	Recommendable or acceptable in case of no other options
B	Bad or Improper	Not recommendable or not acceptable

Source: 2017 EIS

1.3.3.1. Horizontal alignment alternatives

96. Two alignment options were studied for the SCRP interconnecting line, including (i) one alignment connecting FTI Station (SCRP) to Bonifacio Global City Station (MMSP) with an additional station at Cayetano in Taguig City (“original alignment”); and (ii) one alignment connecting FTI Station with Senate Station (“new alignment”). **Figure 1.3.5** shows both alignments considered.

97. The original alignment option going through Cayetano Station in Taguig City was not desirable due to the fault line found running parallel to the station. In the original alignment, one station is proposed to be in Cayetano Boulevard in Taguig. Upon completion of the EIA for the MMSP, the proposed station was found located parallel to the West Valley Fault (WVF), which is approximately 23 meters west and 41 meters east of different segments of the alignment. The alternative route was selected where from Bonifacio Global City Station the alignment was shifted toward Lawton Avenue where two stations, Lawton (formerly Lawton East) and Senate (formerly Lawton West) Stations, were established. The SCRP interconnecting line connects the Senate Station (MMSP) to FTI Station (SCRP) through an underground section. The map of the new alignment can be found in **Figure 1.1.1**.

98. Alternative options for the interconnecting line were carefully studied by the engineering team to come up with an alignment and a station design that will have the least environmental and social impacts. The section between Senate to FTI Station will traverse the underground of government land. The section between FTI Station and Bicutan Station is designed within the PNR ROW in order to minimize displacement and reduce the number of affected persons. Between FTI Station and Bicutan Station, the north-bound line of the existing PNR will be shifted to the west side of the main line after completion of SCRP. Detailed layout of rail lines will be studied in the detailed design stage. The more compact and integrated design of the integrated underground and at-grade station in FTI will reduce the overall land acquisition requirement and therefore also reduce the number of affected households.

Figure 1.3.5 Original and New Alignment of the SCRP Interconnecting Line

1.3.3.2. Tunneling and Excavation Methodology Alternatives

(1) Integrated FTI Station

99. Two methodologies were considered for the construction of the underground structures for the integrated FTI Station. In the Cut and Cover – Top Down Method, a continuous reinforced concrete wall referred to as the Diaphragm Wall, will be constructed along the perimeter of the excavation. After which, temporary king posts will be driven to the ground to support the next construction phase. The ground is then excavated to construct the topmost slab while leaving enough openings to transport personnel and equipment in and out of the construction area. The excavation process will be repeated until the bottom-most level of the station box and permanent structural columns are constructed. On the other hand, in the Cut and Cover – Bottom Up Method, the Diaphragm walls are installed first, similar to the Top Down Method. Afterwards, the station is excavated while struts are placed in between the Diaphragm walls to hold them in place. Once the bottom-most floor is reached, the floors are built from the bottom up and once the top is reached the station is backfilled and the surface is reinstated.

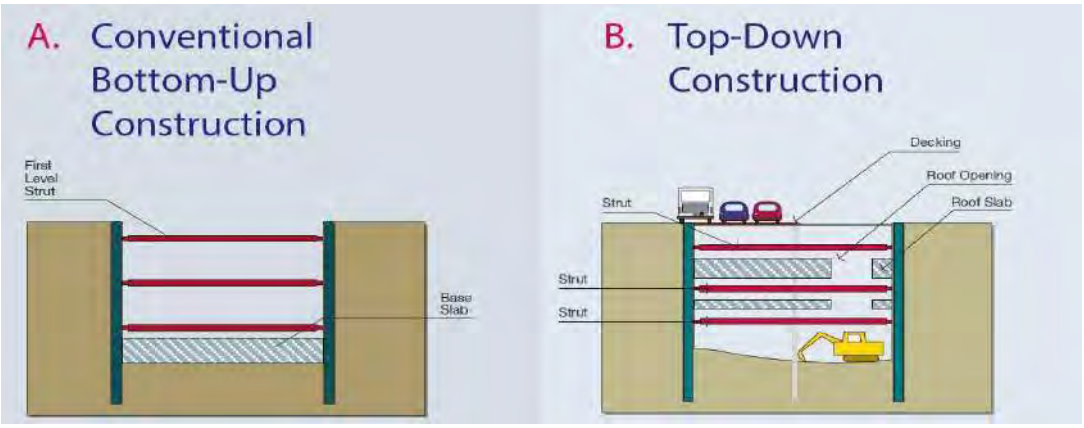
100. It was determined that the best alternative for excavating and constructing the station was the Top Down Method. The assessment of the tunneling method alternatives for station sections is shown in **Table 1.3.16**. An illustration of top down versus bottom up methods can be found in **Figure 1.3.6.**

Table 1.3.16 Tunneling Method Alternatives for the integrated FTI Station

Alternative	Cut & Cover – Top Down Method		Cut & Cover – Bottom Up Method	
Utility Diversion	Almost all utilities need to be relocated but utility anchoring protection works are not required during excavation.	Good	Some utilities need to be relocated which can obstruct the retaining wall construction and temporary deck installation. Remaining utilities shall be protected by temporary anchorage method.	Good
Temporary	Not Required	Very	Required. Temporary decking needs	Poor

Alternative	Cut & Cover – Top Down Method		Cut & Cover – Bottom Up Method	
Decking		Good	to be removed after work completion.	
Temporary Strutting System	Not required. Retaining wall shall be supported by a permanent slab.	Very Good	Required. Temporary strutting needs to be removed during construction of permanent structure.	Poor
Material Movement	Materials need to be removed and installed from the temporary opening. Location of the temporary opening can be determined due to material movement plan.	Good	Openings can be made, if there are no obstructing utilities.	Very Good
Flood Control	Opening can be limited. So easy to control flooding.	Very Good	It is difficult to control flooding because of the construction area is covered by temporary decking plate.	Bad
Construction Duration	Construction of utility diversion takes time. But many of temporary works can be omitted, which are utility protection, installation and removal of decking and strutting works.	Very Good	Many of temporary works are required, which includes utility protection, installation and removal of decking and strutting works. Overall total duration works would be longer	Poor
Total Cost	Many of activities can be omitted. Overall total cost could be lower.	Very Good	Most of the temporary works need to be done. Overall total cost could be higher.	Poor
Quality	Quality control during construction of permanent wall and Colum is required, but is manageable, using self-compaction concrete and non-shrink cement grouting works.	Very Good	Almost all of concrete casting can be done without any obstruction. Basically, quality can be controlled easily.	Very Good
Total Judgement	Very Good		Good	

Source: JICA Study Team



Source: www.railsystem.net

Figure 1.3.6 Illustration of Top-Down versus Bottom Up Methods of Cut and Cover

(2) Underground Section between Senate Station and FTI Station

101. Two tunneling methodologies were considered for the construction of the underground structures between Senate Station and FTI Station. Using the same selection criteria as shown in **Table 1.3.15**, it was determined that the best alternative was the Non-Cut and Cover Method (Shield Tunneling and New Austrian Tunneling Method (NATM)). Shield tunneling and NATM are both cost-efficient strategies that involve immediate installation of a support system during excavation to stabilize the surrounding ground and provide a foundation for gradually advancing the machine. The assessment of the tunneling method alternatives for the Senate-FTI underground section is shown in **Table 1.3.17**.

Table 1.3.17 Tunneling Method Alternatives for the Senate-FTI underground section

Alternative	Option 1 (Cut and Cover Method)				Option 2 (Non-Cut and Cover Method – Shielded Tunneling and NATM)			
General Description	● Generally utilized at shallow depth locations (15 m) because of the financial aspect, but is rarely utilized for tunneling in between stations because of traffic congestion due to works				● Possible to excavate inside the earth by a shielded tunneling machine regardless of conditions on the ground ● Since traffic congestion due to works is the most objectionable factor for the Philippines, this method is desirable			
	V □	G □	M ■	B □	V ■	G □	M □	B □
Cost	Comparatively inexpensive for tunnels at shallow depth				More expensive than the Cut and Cover Method for tunnels at shallow depth			
	V ■	G □	M □	B □	V □	G ■	M □	B □
Construction Period	Overall period is shorter than Non-Cut and Cover Method because it's possible to conduct construction of civil works at the same time as the shielded tunnel construction between stations				Overall period is longer than Cut and Cover Method because enlargement works are conducted after the completion of the shielded tunnel construction			
	V ■	G □	M □	B □	V □	G □	M ■	B □
Construction Disturbance	Relatively greater dust and noise impacts may arise				Less noise and disturbance to surrounding environment			
	V □	G ■	M □	B □	V ■	G □	M □	B □
Construction Safety	Comparatively higher risk levels presented by having more mobile equipment and more workers in contact with unstable and irregular ground				Lower risks because of the use of an automated machine and the immediate installation of support linings			
	V □	G ■	M □	B □	V ■	G □	M □	B □
Risk of Subsidence	Relatively greater risk of subsidence due to shallow works				Risk factors include the compressive strength variation in the support lining segments and the pile bearing capacity.			
	V □	G □	M ■	B □	V □	G ■	M □	B □
Countermeasure for Groundwater Inflow	Auxiliary measures are frequently required to prevent boiling and heaving at the bottom of excavation.				Needs no auxiliary measures except for at the launching and arriving portion but requires groundwater assessment studies to predict estimated water inflow and appropriate design needed for the TBM			
	V □	G ■	M □	B □	V □	G ■	M □	B □
Social/Environment Friendliness	Temporary roads must be ensured in order to prevent negative impacts from the works on traffic which require land acquisition of about 12 m.				Limited impact on road traffic at the station sections and shafts, so they could influence road traffic and cause residence relocation as well			
	V □	G □	M ■	B □	V □	G ■	M □	B □

Source: JICA Study Team

1.3.3.3. Spoil Disposal Area / Site Selection

102. The tunneling and excavation works for the SCRP interconnecting line are anticipated to generate 1,557,700 m^3 of excess soils. As a result, a suitable spoil disposal area (SDA) is vital. Currently, various spoil disposal areas are being considered. This will be finalized and approved by the Project Engineer before the construction phase of the segment. Considerations for the selection and approval of the spoil disposal site shall not in any way relieve the Contractor of his responsibility, inter alia, for land acquisition, provision of temporary access, work preparation to spoil disposal, management of the spoiling operation and rehabilitating the site after completion of spoil disposal.

103. The selection of spoil disposal area shall abide by the following criteria:

- Preference shall be given to the backfilling of excavated areas as an aid to site restoration. Therefore, the Engineer may permit or direct that worked-out areas be used as spoil disposal sites.
- Other sites where spoil disposal will not result in a potential safety hazard, instability, erosion, or water management problems.
- Spoil sites should be located away from wetland areas, tributaries, and rivers. If riverside sites are required, the Contractor shall be required to receive permission from the Engineer for approval and must employ best practices in consultation with the Contractor's Environmental Manager.

104. The selection of spoil disposal areas/sites shall not be located:

- On irrigated rice fields;
- On slopes of more than 25 degrees;
- Where geological structures are unfavorable to stability (e.g. in fault or where structural plans are dipping out of the slope);
- On slopes that are subjected to stream erosion;
- On spurs above converging stream channels;
- On talus slopes or in any situation where they might be expected to load a slope along a failure plane;
- On areas identified to be protected areas or special status habitat;
- In any water course or drainage line, whether permanent or seasonal;
- On areas which might affect the stability or safety of the Works or adjacent property or land;
- On areas which might interfere with natural or artificial drainage;
- On areas which may be environmentally unsuitable;
- On areas where adequate health and safety procedures are not in place;
- Disposal sites should also avoid forest, cultivated land, active slope failure areas, and gullies;
- Areas of groundwater discharge, sources of drinking or irrigation water;
- Areas where failure of the spoil tip would endanger or harm the Works or buildings or cultivated land; and
- Areas where permanent stabilization of the filled disposal area would be difficult.

105. The Project Engineer may restrict, prohibit, or otherwise direct the Contractor to modify the spoil disposal proposals if, in the Engineer's opinion, they are likely to cause unacceptable environmental damage.

106. **Table 1.3.18** Alternatives identified as spoil disposal sites shows the summary of the potential areas to be developed as spoil disposal sites for the Senate-FTI-Bicutan segment.

Table 1.3.18 Alternatives identified as spoil disposal sites

No	Municipality	Location	Total Volume (has/m^3)		Distance from FTI Station (km)	Dump Site Ownership	Remarks
1	Taytay	Muzon	13.5 has	1.2M	16.04	LGU of Taytay, Rizal	SFJV: Disposal and spreading of disposed soil
2	Taytay	Sta. Ana	9 has	1.6M	13.26	LGU of Taytay, Rizal	Back-up site for demolition waste and other wastes
3	Meycauayan	Saluysoy	54 has	1.6M	28.6	Mr. Gary Boo	To be used for soil disposal only Owner willing to secure necessary permits and
4	Obando	Panghulo	6–20 has	1M	23.6	Mr. Gary Boo	

No	Municipality	Location	Total Volume (has/m^3)		Distance from FTI Station (km)	Dump Site Ownership	Remarks
							spread disposed soil Owner is willing to accept demolition wastes and other wastes Choice of SFJV for MMSP
5	San Mateo	Maly	8 has	0.6M	26.6	Engr. Boyet Lambino	Choice of SFJV for MMSP

107. Among the areas identified, the two areas in Taytay, Rizal are currently being considered for the SCRP interconnecting line. The sites are both owned by the local government of Taytay which is willing to secure the necessary permits and clearances for the project. These were also primarily chosen because the rest of the site alternatives are prioritized by the Shimizu-Fujika-Taneka-EEI Joint Venture (SFJV) for the MMSP.

1.4. PROJECT COMPONENTS

108. The main components of the SCRP include: 1) Main Line, 2) Interconnecting Line, 3) Stations, 4) Maintenance Depot, 5) Railway System, 6) Support facilities, 7) Emergency System, 8) Universal Design, 9) Temporary facilities, and 10) Pollution control devices.

1.4.1. Main Line

109. The Project alignment is 55.6 km long from Solis, Manila to Calamba Station and approximately 3 km depot access. The track will consist of PC Sleeper and Ballast (crushed stone). The required ROW width of the railway track is set 30 m all along the alignment (width of viaduct is 10.3 m).

110. The proposed vertical alignment is taken at ground level as much as possible, when the vertical clearance is satisfied; otherwise, the vertical alignment is designed elevated. The elevated section (viaduct) is planned over urban areas at a length of 50.6 km; at-grade and embankment sections are planned at 8.0 km. This lowers the construction costs, or it will shorten the construction period.

111. The commuter trains and airport access trains come from Metro Manila and head to Clark International Airport (CIA). The proposed maximum speed of the airport access train is 160 km/h in contrast to 120 km/h of local trains. Thus, for the high-speed operation of the airport access train, the Project has the capability to achieve a higher speed than NSCR Project, which is in its construction phase. As for the topographic features, the elevation is relatively flat throughout the alignment.

1.4.1.1. Tracks

112. The track gauge is 1,435mm, which consists of Elastic Sleeper and Ballast (crushed stone). The required ROW width of the railway track is set at 30m all along the alignment. Track components are summarized in **Table 1.4.1**.

Table 1.4.1 Components of Elastic Sleeper Directly Fastened / Ballasted Track

No.	Component	Elastic Sleeper	Ballasted Track
1.	Track Form	Elastic sleeper directly fastened track on concrete bed in main line	Ballasted track in at-grade of main line and depot.
2.	Rail Section	Weight 60 kg/m rails for mainline, Standard length 25m,	Weight 50 kg/m rails, Standard

No.	Component	Elastic Sleeper	Ballasted Track
		HH rail for outer rail at curvature radius 800m or less.	length 25m.
3.	Continuous Welded Rails (CWR)	CWR with expansion joints at necessary locations required, according to Japanese technical standards Rail shall generally be Flash Butt Welded (FB), Gas Pressure (GP) Welded or Alumino-thermic (AT) welded.	-
	Short Welded Rails (SWR)	SWR and normal fish plated track at other than CWR locations.	-
4	Ballast	-	Crushed stone ballast of minimum 150 mm thickness under sleeper. Ballasted track is laid on subballast layer surface.
5.	Sleepers	Elastic mono-block pre-stressed concrete sleepers are adopted. Normal 666 mm spacing between sleeper centers using 12 numbers per 8m, shortening 625mm. at curvature radius 600 m or less. Plastic/FFU sleepers are adopted turnout section.	Mono-block pre-stressed concrete sleepers are adopted. 37 sleepers per 25m for normal 675 mm spacing between sleeper centers.
6.	Fastening system	Wire spring with base-plate, Anti-theft type is selected for elastic sleepers	Wire spring non-tie-plate for PC sleeper, Anti-theft type is selected.
7.	Turnouts	#12 or #10 turnouts with 60kg/m rail on FFU sleepers. Movable nose crossings are used along 160km/h speed section.	#8 or #6 turnouts with 50kg/m rail on timber sleepers.
8.	Expansion Joints	Expansion Joints is used at necessary site of CWR (continuous welded rail) at near long span bridge and near turnouts.	
9	Insulated joints	Glued insulated joints are used in CWR tracks at necessary site depending on signaling system.	Insulated joints are used near turnout and at necessary site depending on signaling system.

Source: JICA Design Team

1.4.1.2. Structure Type

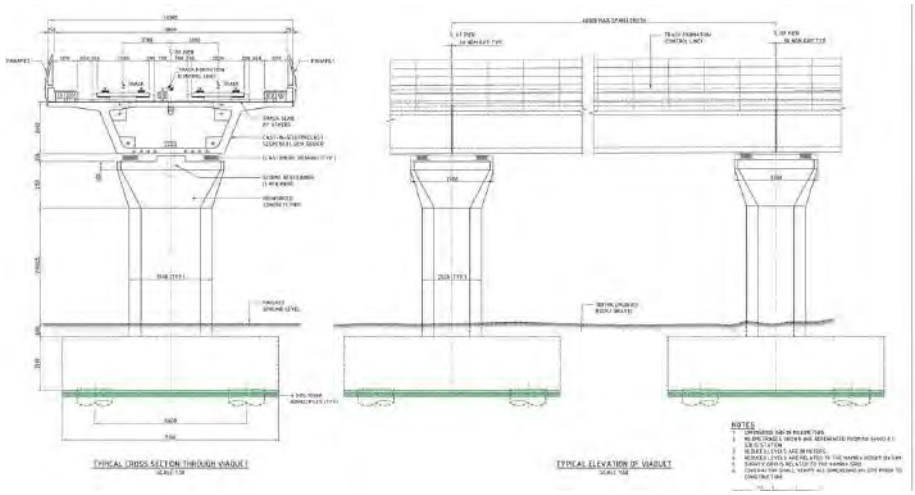
(1) Viaduct

113. PC segmental pre-stressed box girder with 40m span is adopted for the project as the optimal type based on environment impact, cost efficiency, erection time and ground condition.

Source: JICA Design Team

Figure 1.4.1 PC segmental box girder

Table 1.4.2 Viaduct Super Structure

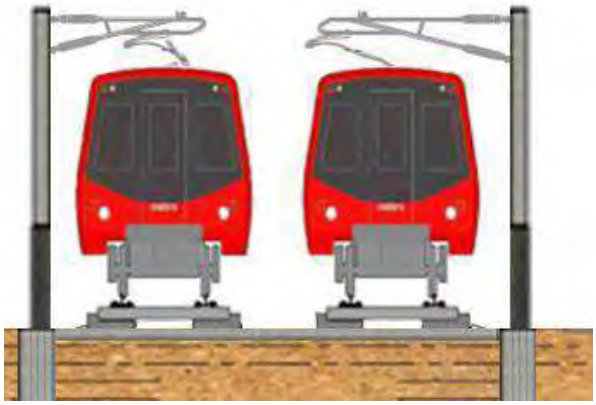
Item	Precast Segmental Pre-Stressed Box Girder
Arrangement	40m spans x 5 spans = 200m length
Viaduct Superstructure / Substructure Detail (Typical)	
Structural Form - Superstructure	Superstructure per 200m Box Concrete = 220 cubic m x 5 spans = 1,100 cubic m Box Steel Rebar = 32, 965 kg x 5 spans = 165 tonnes Box Post Tensioning = 6,527 kg x 5 spans = 33 tonnes Therefore, it can be seen that Option 2 Superstructure is the lowest cost when compared over a similar length
Structural Form - Substructure	Substructure per 200m No. of piers = 5 per 200m Pier Concrete = 45 x 5 = 225 cubic m Pier steel rebar = 9,000 kg x 5 = 45 tonnes Pilecap Concrete = 152.6 x 5 = 763.0 cubic m Pilecap rebar = 30.50 x 5 Nos = 152.5 tonnes Piles = 8 Nos 1,500 mm dia. x 30m (for seismic) x 5 = 1,200 lin. m.

Source: JICA Design Team

(2) At Grade

114. At grade will be adopted where it would not impact to the regional split. The at-grade section are planned in the suburban areas and farmlands where elevating the railway is not necessary for economic efficiency. SCRP is at grade from north of EDSA Station until FTI Station, due to existing road bridges and the height restrictions near Manila airport's flight path.

115. **Figure 1.4.2** shows the cross-section of a typical at-grade structure.



Source: JICA Design Team

Figure 1.4.2 Cross-section of typical At Grade

(3) Embankment

116. Embankment will be adopted where it would not impact the regional split. The embankment will be planned in suburban areas and farmlands. The Embankment Profile Plan is better to set a lower alignment for economic efficiency.

117. **Figure 1.4.3** shows the cross-section of a typical embankment.

Source: JICA Design Team

Figure 1.4.3 Cross-section of a typical embankment

(4) Bridges

118. The Project crosses rivers and roads at different locations. At some of these intersections (i.e. ROW crossing Pasig River, etc.), bridges will be constructed to avoid interference with existing structures and transportation/ navigation (see **Table 1.4.3**). The locations where these bridges will be built are within the 30m Project ROW.

Table 1.4.3 List of Span Layout of Viaducts and Bridges at Major Crossings

No	km	Crossing	Span Layout	Structure Type	Piers in river
1	1+485	Jose Abad Santos	2 x 60m	2 x Single Span Steel Box Girder Bridge	-
2	1+681	Ipil St. (NB track)	45m+70m+45m	3 span continuous PC-Box Girder Bridge	-
3	1+328	Solis SB (PNR Junction)	45m+70m+45m	3 span continuous PC-Box Girder Bridge	-
4	1+342	Solis NB (PNR Junction)	60m+80m+60m	3 span continuous PC-Box Girder Bridge	-
5	2+000	Blumentritt	65m	Single Span Steel Box Girder Bridge	-
6	2+740	Dimasalang	60m	Single Span Steel Box Girder Bridge	-
7	5+610	Magsaysay	60m+100m+60 m	3 span continuous PC-Box Girder Bridge	-
8	6+748	Pasig River Bridge	50m+70m+50m	3 span continuous PC-Box Girder Bridge	2
9	11+556	Gil Puyat	60m+90m+60m	3 span continuous PC-Box Girder Bridge	-
10	12+460	Antonio Arnaiz Ave.	60m	Single Span Steel Box Girder Bridge	-
11	24+363	Manuel L. Quezon Ave2	60m+100m+60 m	3 span continuous PC-Box Girder Bridge	-
12	25+166	Manuel L. Quezon Ave3	60m	Single Span Steel Box Girder Bridge	-
13	25+198	PNR Crossing1	60m+100m+60 m	3 span continuous PC-Box Girder	-
14	27+360	Alabang River	50m+70m+50m	3 span continuous PC-Box Girder	-
15	31+587	Magdaong River	40m+50m+40m	3 span continuous PC-Box Girder Bridge	-
16	33+957	A Mabini St.	60m+90m+60m	3 span continuous PC-Box Girder Bridge	-
17	34+379	Pan Philippine Highway1	60m+100m+60 m	3 span continuous PC-Box Girder Bridge	-
18	39+282	San Vicente Binan River	60m+90m+60m	3 span continuous PC-Box Girder Bridge	-
19	40+222	Sto. Nino Cross Road	40m+50m+40m	3 span continuous PC-Box Girder Bridge	-
20	41+709	Pan Philippine Highway2	60m+90m+60m	3 span continuous PC-Box Girder Bridge	-
21	46+380	Cabuyao River1	40m+50m+40m	3 span continuous PC-Box Girder Bridge	-
22	48+478	Cabuyao River2	40m+50m+40m	3 span continuous PC-Box Girder Bridge	-
23	53+985	San Cristobal River	120m	Single Span Steel Arch Bridge	-
24	55+301	Calamba River	60m+100m+60 m	3 span continuous PC-Box Girder Bridge	-
25	56+203	Pan Philippine Highway3	60m+100m+60 m	3 span continuous PC-Box Girder Bridge	-
26	01+223 Depot Access Track	San Cristobal River	40m+50m+40m 40m,40m,35m	3 span continuous PC-Box Girder Bridge 3 x Single PC Box Girder Bridge	5

Source: JICA Design Team

(5) Historical and Cultural Heritage

119. For the old PNR stations buildings, the project sets up a buffer zone of 5m as much as possible for security and maintenance. This proposal has been submitted to the Cultural Agencies (NCCA, NM, NHCP) and DOTr is waiting for their decision. The target structures statuses are shown in **Table 1.4.4.**

Table 1.4.4 List of old PNR stations buildings and Project approach

Buildings	Year constructed	Project Approach
Abad Santos Signal Tower	1916 (102 years old)	No buffer zone was considered. As a result of consultation with PNR and DOTr, it was decided to relocate the Abad Santos Signal Tower.
Old PNR Vito Cruz Station	1931 (87 years old)	No buffer zone was considered. As a result of consultation with PNR and DOTr, it was decided to relocate the Old PNR Vito Cruz Station.
Old PNR Paco Station	1913 (105 years old)	Buffer zone was considered. As a result of consultation with PNR and DOTr, it was decided to keep the old PNR Paco Station.
Old PNR Buendia Station	1931 (87 years old)	No buffer zone was considered. As a result of consultation with PNR and DOTr, it was decided to relocate the Old PNR Buendia Station.
Old PNR Alabang Station (with restroom structure)	1959 (59 years old)	No buffer zone was considered. As a result of consultation with PNR and DOTr, it was decided to demolish the old PNR Alabang Station (with restroom structure).
Old PNR San Pedro Station	1965 (54 years old)	No buffer zone was considered. As a result of consultation with PNR and DOTr, it was decided to demolish the old PNR San Pedro Station.
Old PNR Pacita Station	1949 (69 years old)	No buffer zone was considered. As a result of consultation with PNR and DOTr, it was decided to relocate the old PNR Pacita Station.
Old PNR Binan Station	1948 (70 years old)	No buffer zone was considered. As a result of consultation with PNR and DOTr, it was decided to relocate the old PNR Biñan Station.
Old PNR Cabuyao Station	1949 (69 years old)	No buffer zone was considered. As a result of consultation with PNR and DOTr, it was decided to demolish the old PNR Cabuyao Station.

Source: JICA Design Team

1.4.2. Interconnecting Line

120. Through the series of meetings with the DOTr, JICA, and ADB, an agreement has been reached that the connecting line from the Senate Station (MMSP) towards the FTI Station and Bicutan Station will become an integrated component of the SCRP. The civil works (including TBM works) for the additional section will be financed by the ADB while JICA will finance the electromechanical system.

121. The new segment will provide ease of access for passengers coming from the Metro Manila Subway traveling towards adjacent southern sub-urban areas. Line interchange will be available at the FTI Station and the Bicutan Station, both located in the City of Parañaque (**Figure 1.1.6**). The location of both stations and the corresponding coordinates of the project site are presented in **Table 1.1.1**.

122. The components of the SCRP interconnecting line are listed in **Table 1.4.5**. Specifications are described in **Table 1.4.6**.

Table 1.4.5 SCRP Interconnecting Line Components

Structure/Component	Length (m)	Configuration	Platform Type
TBM tunnel (from but excluding Senate Station to FTI Station)	3,640	Parallel tracks	-
Integrated FTI Station	315	2-Storey underground structure (bottom horizontal track level) with main line tracks at grade	Island Platform
Underground tunnel//box	476	Parallel tracks	-
Underground U-shaped structure / embankment / abutment	364	Parallel tracks	-
Elevated Section (ramp to Bicutan Station)	674		
Integrated Bicutan Station	180	Parallel tracks	Side Platform

Structure/Component	Length (m)	Configuration	Platform Type
Switchback and storage track	420	Parallel tracks	
Total	**6,069**		

Source: JICA Study Team

Table 1.4.6 Project Components, Facility Scaling and Equipment Specifications for the SCRP Interconnecting Line

Particulars	Technical Parameter	Specifications		
Train Operation Plan	Maximum Speed	80 kph (underground sections)		
	Gauge	1,435 mm (standard gauge)		
	Length	Embankment	Elevated	Underground
		0.0 km	0.8 km	4.8 km
	Number of Stations	At Grade	Elevated	Underground
		-	-	1
	Traction Power Supply	Overhead Rigid Conductor System (Underground)		
	Standard Passenger Capacity	Seated	Standing (7 passengers/m2)	Total
	Lead Car	45	221	266
	Intermediate Car	54	231	285
	Capacity on a Train (8 car train)	Capacity per car	Number of cars	Capacity per train
	Lead Car	266	2	532
	Intermediate Car	285	6	1,170
	Total Passengers	-	8	2,242
	System Operational Specifications	Year		
		2020		2030
	Train Composition (8 cars)	8		8
	Number of Operational Trains	9		12
	System Capacity (PPHPD)	20,178		26,904
Railway Alignment and Structure Plan	***Horizontal Curve Radius***			
	For Main Line	More than 160 m		
	For Stations	More than 400 m		
	For Turnout	More than 160 m (Main Line)		
	Transition Curve Length	Maximum out of L1, L2, L3		
		L1=600C		
		L2=7.4CV		
		L3=6.7CdV		
	Length between Transition Curves	More than 20 m		
	Maximum Gradient			
	For Main Line	35/1,000		
	For Stations	Level (0), 5/1,000 (absolute maximum) The underground section installs the gradient for a drainage		
	For Stabilizing Track	Level (0), 5/1,000 (absolute maximum) The underground section installs the gradient for a drainage		
	For Turnout	Level (0), 25/1,000 (absolute maximum) The underground section installs the gradient for a drainage		
	Vertical Curve	Radius 3,000 m (4,000 m where curve radius is less than 800 m) Vertical curve is required for more than 10/1,000 of gradient change		
	Width of Formation			
	Cut and cover tunnel and U-shaped retaining wall section	More than 2.8 m		
	Shield Tunnel Section	The width which can arrange the evacuation passage width of 1 m or more.		

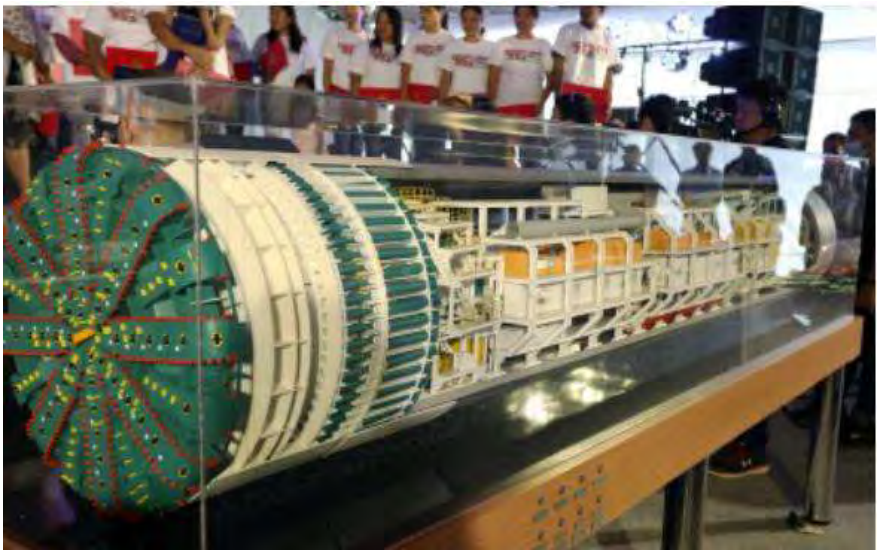
Particulars	Technical Parameter	Specifications		
	Depot	More than 3.0 m		
	Other Sections	More than 3.15 m		
	Distance Between Track Centers	More than 4.0 m (Main Line). More than 4.0 m (Station). More than 4.0 m (Stabilizing track)		
	Width of Structural Gauge	3.4 m (underground), 3.8 m (others)		
	Station Platform			
	Platform Length	210 m (for 10 cars train for future)		
	Platform Width	10 m (Standard, island platform) 7.5 m (Standard, separate platform)		
Operation Plan	Peak Hour Boarding plus Alighting of Passengers	Year		
		2025	2035	2040
	Senate Station (MMSP)	2,329	7,195	7,552
	FTI Station (SCRP)	6,587	13,670	14,948
	Bicutan Station (SCRP)	8,201	18,374	21,534

1.4.2.1. Tunnel Boring Machine (TBM) Operation

123. The components of the Senate-FTI underground section are presented in **Table 1.4.5.** As previously mentioned, the TBM tunneling method will be used for the Senate-FTI underground section while the Cut and Cover method will be applied to the station sections of the alignment.

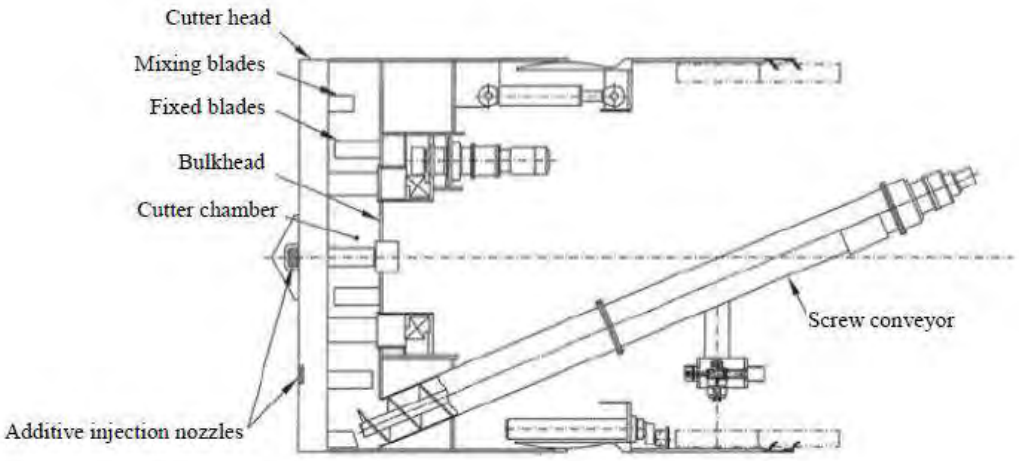
124. Based on actual ground conditions subject to detailed studies during the DED phase of the Senate-FTI underground section, Earth Pressure Balanced shield machine (EPBM) may be used. This type of TBM is being considered in the northernmost section of the MMSP currently in its construction phase. The TBM will have a seven-meter diameter cutterhead and is a closed-faced type shield machine. In an EPBM type TBM, the excavated soil is continuously taken and stored in a closed working chamber and used as additional counterbalance against existing overburden and hydrostatic pressures. This balancing act prevents the occurrence of ground heave or settlement. Additionally, this machine uses a screw conveyor that controls this balance and removes the fluidized muck (soil + fluids) from the working chamber. **Figure 1.4.4** shows a photo of the actual scale model of the TBM presented during the ground breaking ceremony of the MMSP for its Partial Operability (PO) section in Quezon City.

125. The speed and discharge rate of the screw conveyor is controlled by the operator inside the working area in the EPMB which is completely sealed against the fluid pressure of the ground outside the machine. This type of TMB is chosen as this is compatible with a wide variety of ground types allowing tunneling activities in soft, wet, or unstable ground with considerable speed and safety. The TBM is expected to operate between 20-27 meters below ground surface.



Source: JICA Study Team

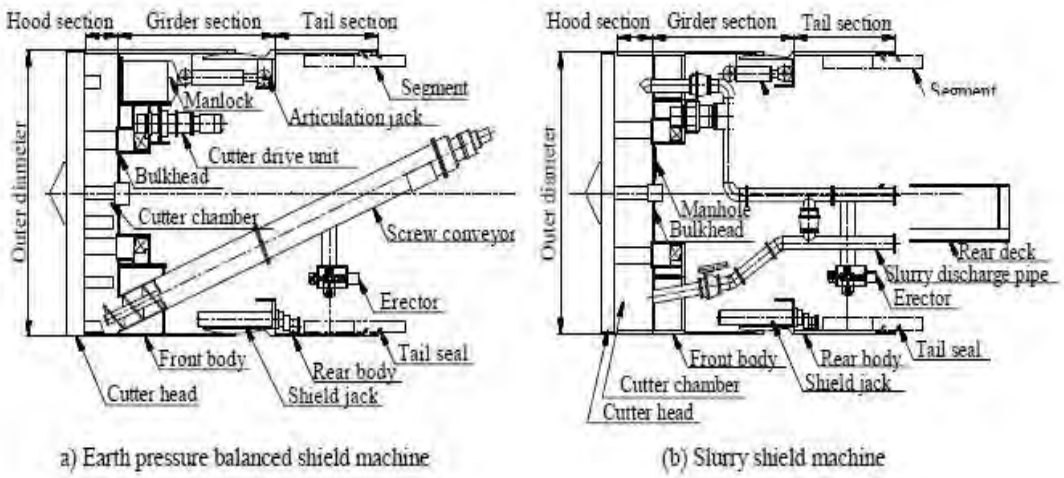
Figure 1.4.4 Scale Model of TBM designed for the SCRP tunneling works



Source: Standard Specifications for Tunneling (Japan Society of Civil Engineers, 2016)

Figure 1.4.5 Components of the Tunnel Boring Machine (TBM)

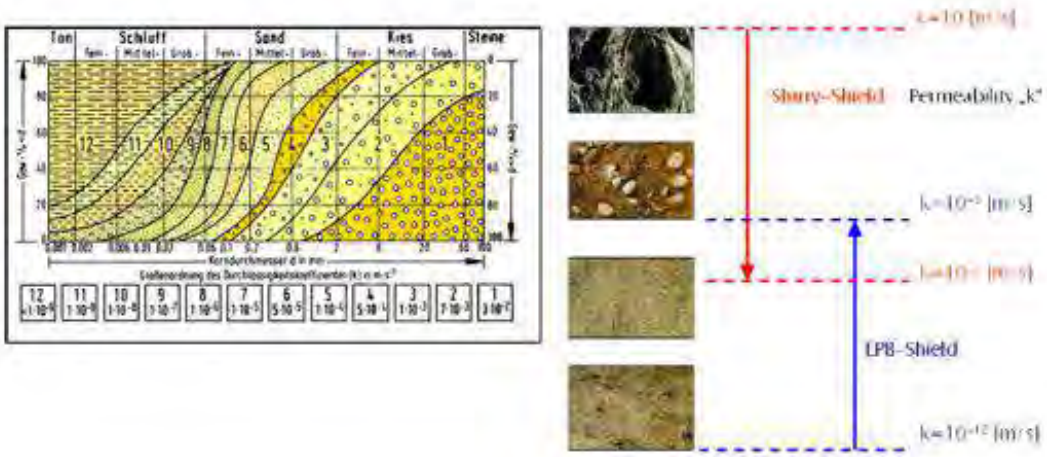
126. In the event of a highly permeable section, Slurry Shield TBM may be used (**Figure 1.4.6**). To stabilize the cutting face, the Slurry Shield machine feeds slurry in a cutter chamber. Slurry discharge is transported through pipes, allowing the working space to be completely closed, providing a high level of safety and good environmental conditions for construction. Slurry type shield machine is suitable for impermeable soils including alluvial gravel mixed with sand, alternating layers of loosely cemented and soft ground, soil with high water content that may not form a self-standing of cutting face, or alternating layers with high water content which is possible susceptible to ground collapse and water inflow.



Source: Standard Specifications for Tunneling (Japan Society of Civil Engineers, 2016)

Figure 1.4.6 Components of EPB and Slurry Shield Tunnel Boring Machines

127. The general guidelines in selecting the more appropriate type of TBM, whether EPB or Slurry, will be based on the result of a ground permeability test that will be conducted during the detailed engineering phase of this section as shown in the **Figure 1.4.7** below.



Source: JICA Design Team

Figure 1.4.7 Ground Permeability Test for TBM-type Selection

128. Slurry Shield TBM works with sites where high groundwater pressures exist. The chamber containing the TBM cutter head is filled with pressurized slurry which applies pressure to the excavation face. The slurry acts as a ground support and transport medium for the excavated material, which is continuously circulated between the TBM and a slurry treatment plant (STP), where the excavated material is separated out for disposal or reuse.

(1) TBM Launching Area

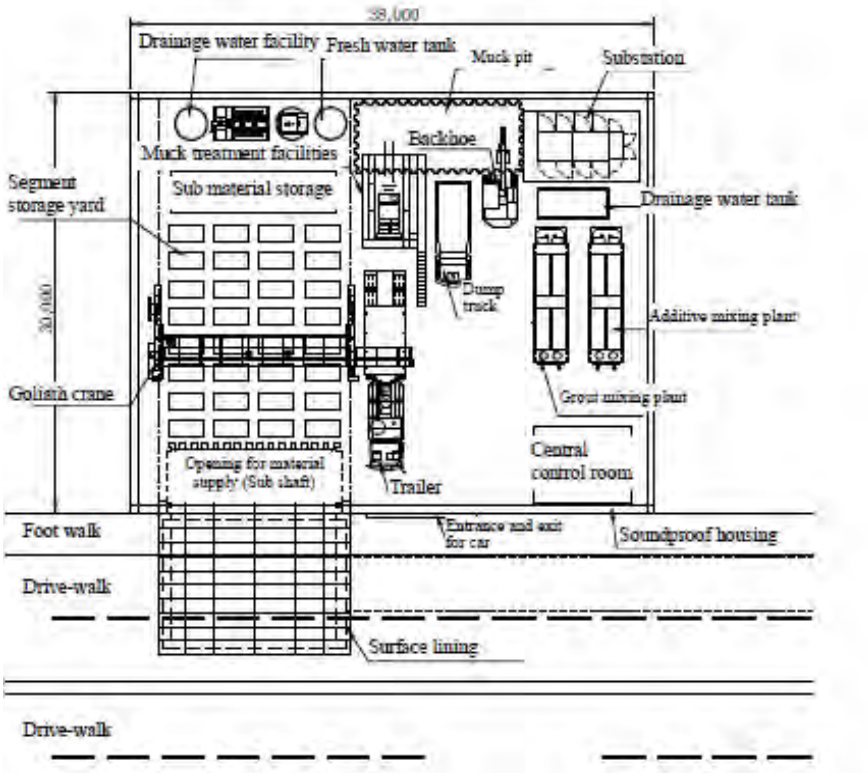
129. The TBMs require a sizeable area for the base of operations which may feature the following elements: equipment storage, soil disposal pits, and spaces for construction machinery. Overall an area of 3,500 m^2 may be required for the base of operation. For the interconnecting section, a TBM launching shaft may be located near the proposed FTI Station (**Figure 1.4.8**) and

proceed to tunneling activities towards Senate Station in Taguig City, with sections passing under Villamor Golf Course in Pasay. A typical site utilization plan for an EPBM generally includes the storage yard, muck removal facilities, material handling facility, electrical power facilities, light systems, communication facilities, ventilation facilities, combustible and harmful gas hazard protection facilities, passage ways, water supply and discharge facility, fire prevention and extinguishing systems, launching, arrival and turning facilities for the TBM, primarily lining, grouting facilities, secondary lining facilities and soundproofing facilities, as shown in **Figure 1.4.9**. Variation to these systems depend on ground condition as well as construction method. During the construction phase, generator sets, and mobile equipment will be used for the Senate-FTI tunnel section which will also likely be stationed at the TBM launching site.

Source: JICA Study Team

(Note: Blue rectangle area illustrates the extent of the proposed TBM launching site)

Figure 1.4.8 Proposed Location of TBM Launching Area near FTI Station

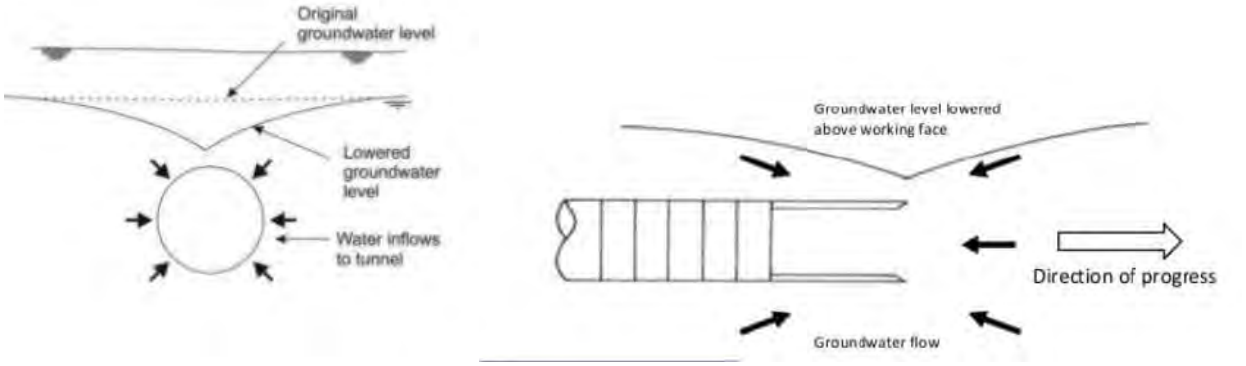


Source: Standard Specifications for Tunneling (Japan Society of Civil Engineers, 2016)

Figure 1.4.9 Sample surface site plan for EPBM tunneling works

130. Soil conditioning in EPBM tunneling will require addition of foam and/or additives. Depending on the ground type encountered this will make it possible to cut and support soil material at the same time. These foam and/or additives also reduce rock/soil permeability, water retention and minimize abrasion to the cutters. All these products will be environmentally acceptable concentrations and safe to handle with normal site precautions.

131. Tunneling will consider the results of the detailed hydrogeological study to minimize the effects of the activity to local groundwater. Any possible zones of groundwater inflow such as faults, sheared zones or geological discontinuities will be properly plugged to avoid tunnel instability and groundwater contamination. The possibility of temporary lowered groundwater line in the open face as can be seen in **Figure 1.4.10** below will be managed thru EPBMs system of counterbalance.



Source: Preene Groundwater Consulting, 2015

Figure 1.4.10 Sample geometry of the groundwater flow regime in tunneling works

(2) Slurry Treatment Plant (STP)

132. A Slurry Treatment Plant (STP) generally consists of six processes mainly (1) Separation of tunnel spoil from the slurry; (2) Dewatering; (3) Preparation of fresh slurry; (4) Storage of cleaned slurry; (5) Slurry conditioning; and (6) Water management. (Silvertown Tunnel. January 2017). Thus, the utilization of Slurry Shield TBM would require a large aboveground footprint for the construction of the STP for bentonite separation and treatment. The STP will be situated within the TBM launching area.

133. The dewatering unit of the STP removes excess water from the material arising from the de-sanding and de-silting processes, allowing it to be efficiently transported for disposal. The unit comprises a number of vibrating screens. The screens have grids with 0.5mm or 0.6mm openings. The screens also have filtering sides for larger material, up to 1.5 mm openings. Excess water will be recycled within the STP processes.

134. Storage tanks of 400m^3 capacity are required for both fresh water and filtrate water. As lime milk is used to dose the filtrate water, the STP would have a facility to neutralize this by injecting sulphuric acid. Storage, dosing and monitoring equipment within the STP is required for this purpose.

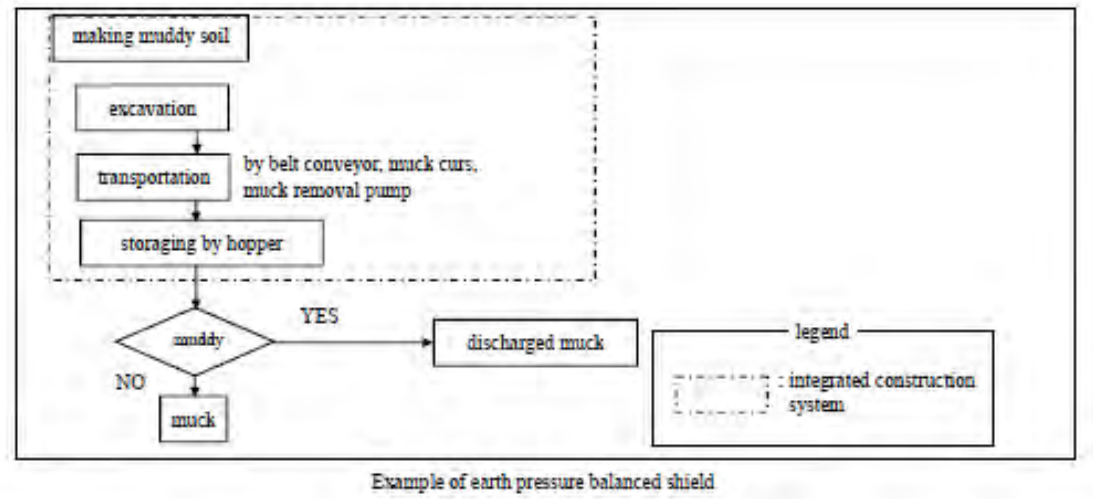
(3) Muck removal, storage and treatment facilities

135. Muck is a by-product of construction work which will be recycled as a useful resource to the maximum possible extent. This could either be used on-site, offered for sale, or sent for recycling.

136. The muck removal facilities will be figured according to the planned excavation cycle time and site conditions. Generally, the muck removal facilities include the system for hauling muck out of the tunnel which may include rail systems, a commonly used system for in-tunnel muck hauling specifically for Earth Pressure Balanced TBMs. This may also include a belt conveyor and screw system primarily for initial much hauling, as well as pipeline systems to enable continuous transportation of much from inside of the tunnel.

137. Muck hauling system at the shaft are carried out by muck cars and carries it up to the muck hopper or stockpile. Typical facilities may include goliath crane system, grab hopper system, skip tower system, vertical conveyor system. Adequate storage capacity for the expected volume of muck will be considered to avoid any obstruction from the planned driving process.

138. Muck may be treated using open bed drying or cement and lime treatment. The muck treatment facilities will also be situated within the TBM launching area. The decision flow for muck disposal is shown in **Figure 1.4.11**.



Source: Japan Society of Civil Engineers (2016)

Figure 1.4.11 Decision Flow for Muck Treatment

139. At this stage, discharged muck is considered to be transported to nominated disposal areas in Taytay Rizal via trucks. However, in the future, this may also consider the disposal of muck via the existing PNR operation to SDAs accessible via PNR alignment. **Figure 1.4.12** shows the potential transport route from the TBM launching area going to the SDAs.

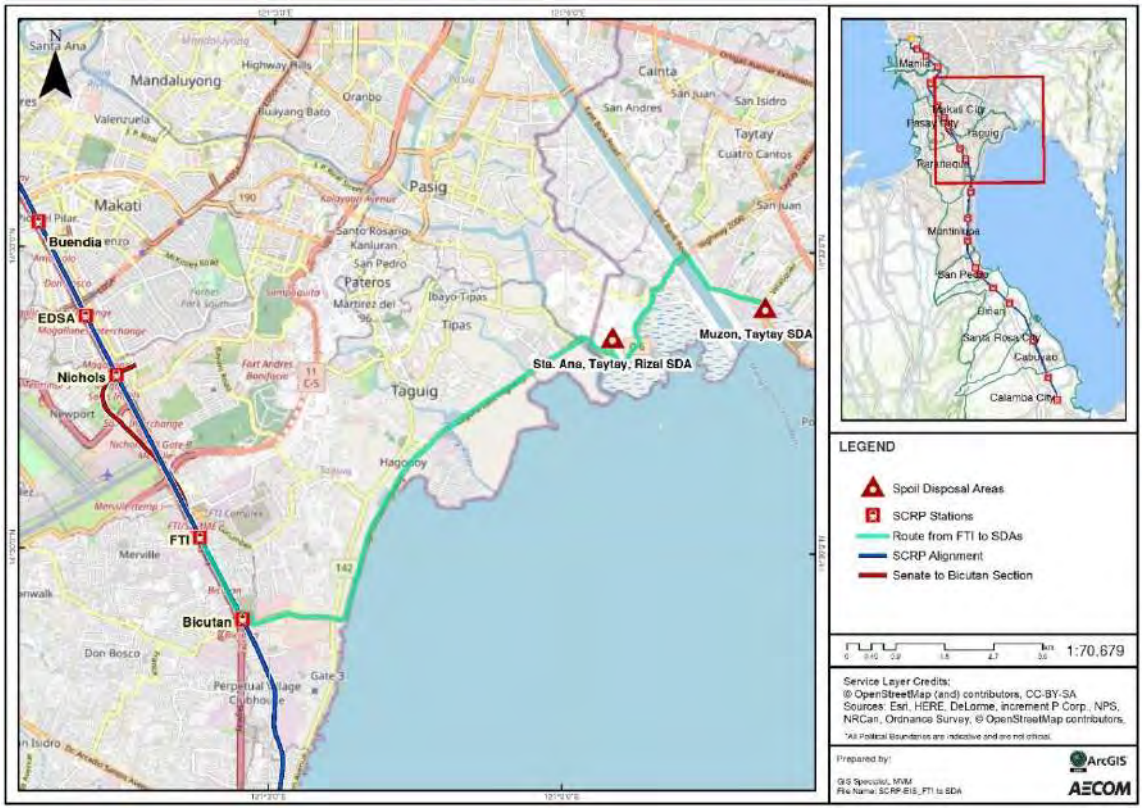


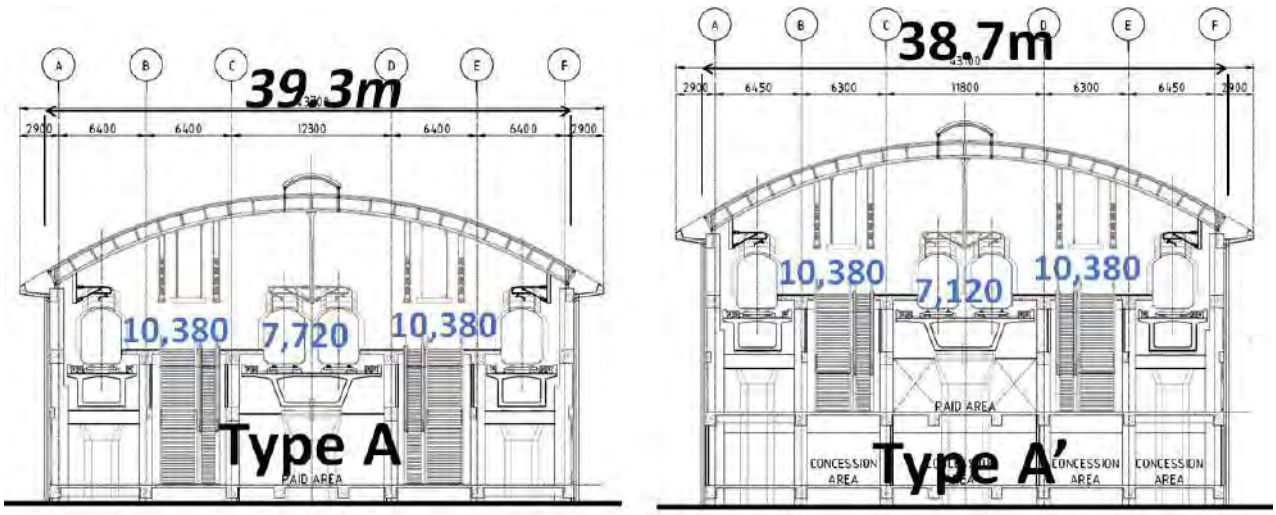
Figure 1.4.12 Transport route from TBM Launching Area to Spoil Disposal Area

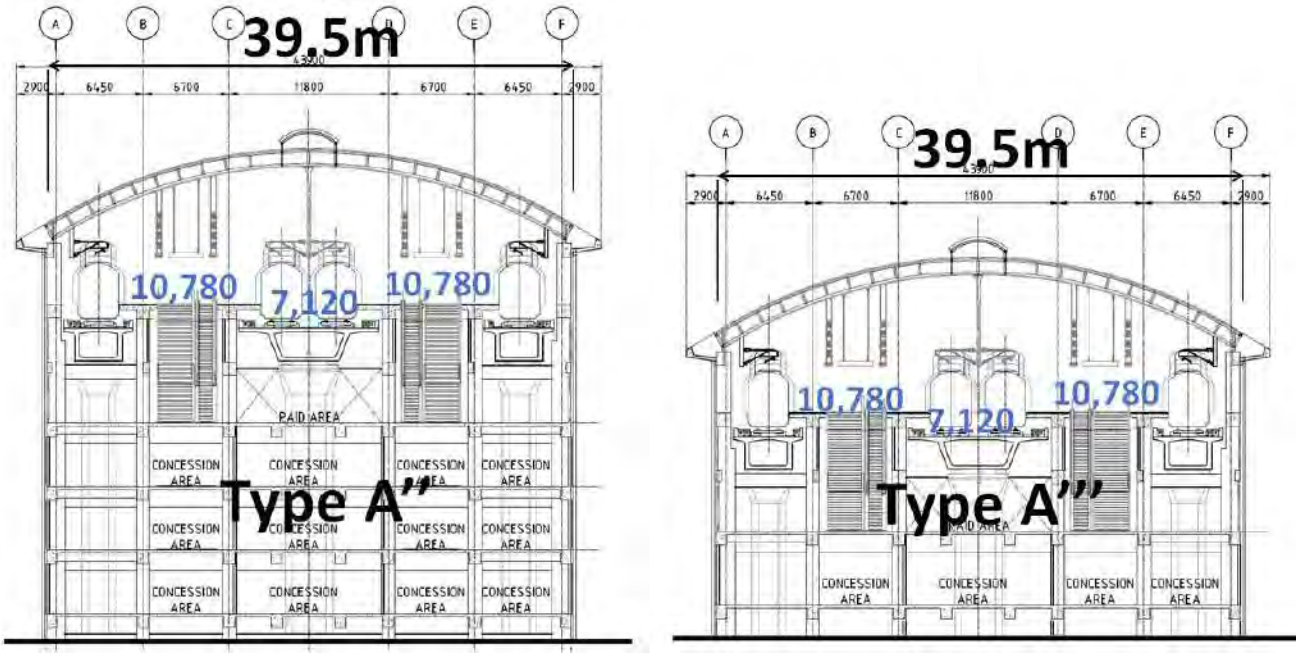
140. There will be nineteen (19) stations along the project alignment, sixteen (16) of which will be elevated and two (2) will be at grade; the FTI Station will have two platforms, one (1) elevated and one (1) underground. All stations will have a ROW width of 60 m (including the tracks), and a length of around 250 m. The station layout may be: two separate platforms serving two tracks, a single platform at the center, or two island platforms with four tracks at selected locations.

141. **Figure 1.4.13** shows the sample design of the station, **Figure 1.4.14** to **Figure 1.4.19** shows sample cross-sections of the alignment at the stations and **Table 1.4.7** shows the typical layout of the proposed train stations. It must be noted however that the detailed design for the FTI and Bicutan stations are yet to be initiated.

Source: JICA Design Team

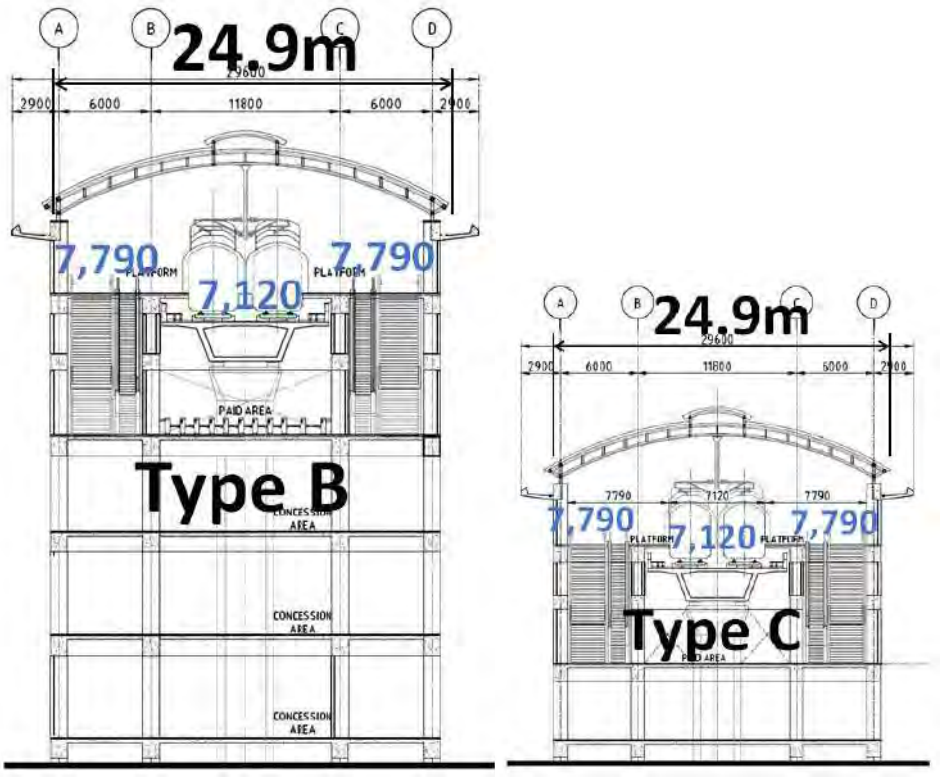
Figure 1.4.13 Sample Design of the Station





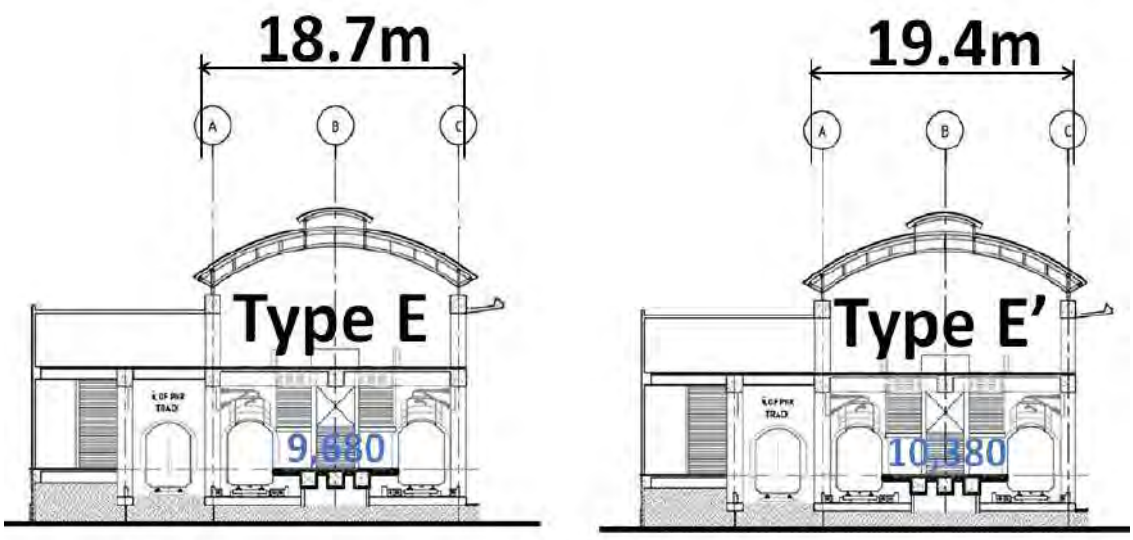
Source: JICA Design Team

Figure 1.4.14 Platform Plan (Type A)



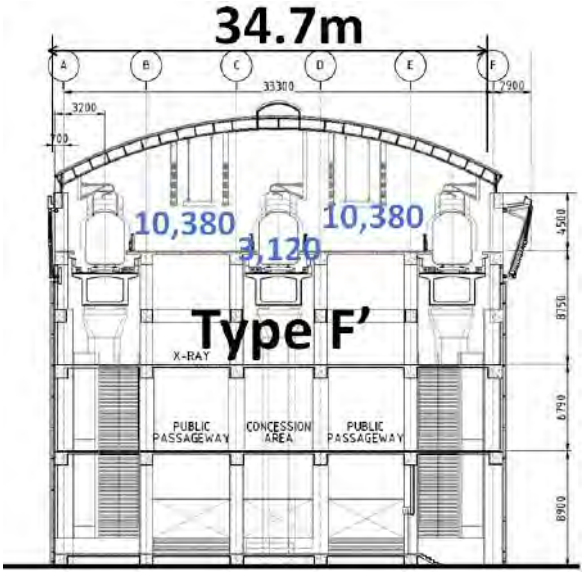
Source: JICA Design Team

Figure 1.4.15 Platform Plan (Type B & C)



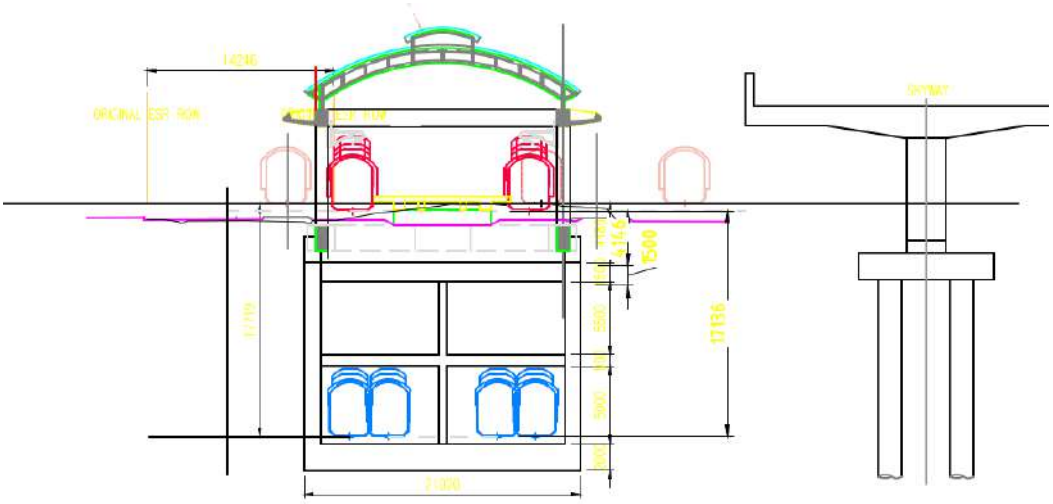
Source: JICA Design Team

Figure 1.4.16 Platform Plan (Type E)



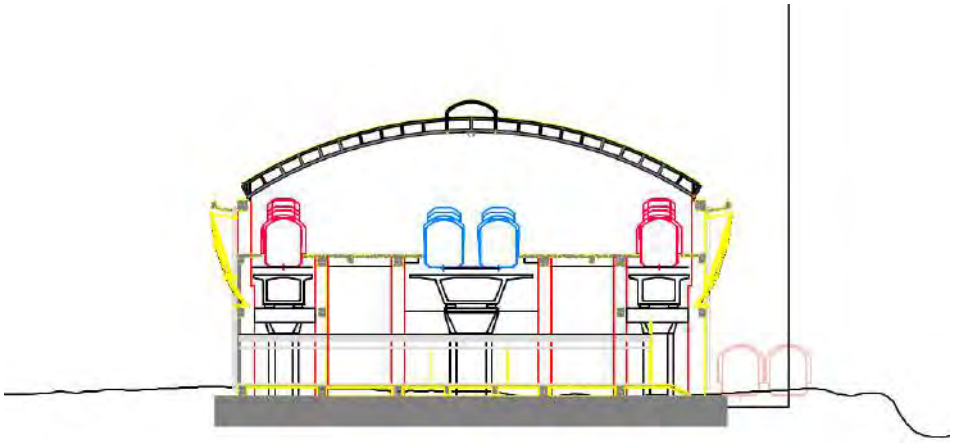
Source: JICA Design Team

Figure 1.4.17 Platform Plan (Type F)



Source: JICA Design Team

Figure 1.4.18 Basic Platform Design for FTI Station



Source: JICA Design Team

Figure 1.4.19 Basic Platform Design for Bicutan Station

Table 1.4.7 Station Matrix

Station		Solis (EX)	Blumentrit (EX)	Espana	Santa Mesa	Paco	Buendia (EX)	EDSA	Nichols	FTI (EX)	Bicutan	Sucat (EX)	Alabang (EX)
Chainage for (8 cars / 10 cars)		[illegible]	2km205m 2km225m	3km780m	5km951m	8km726m	12km139m	14km077m	15k302m	18km660m	20km354m	24km843m	28km534m 28km554m
Top of Railway Level (draft)		[illegible]	AMSL 25.45	AMSL 18.15	AMSL 31.65	AMSL 13.77	AMSL 30.47	AMSL 7.60	AMSL 8.59	AMSL 20.50	AMSL 41.80	AMSL 20.00	AMSL 21.40
		[illegible]	GL+23.25	GL+ 16.50	GL+ 28.85	GL+ 10.70	GL+ 27.57	GL+ 2.00	GL+ 2.05	GL+ 0.50	GL+ 10.80	GL+ 15.50	GL+ 15.60
Structure Type (draft)		[illegible]	Type F' Elevated 4 Levels	Type C Elevated 3 Levels	Type B Elevated 5 Levels	Type G Elevated 4 Levels	Type A'' Elevated 5 Levels	Type E At-grade 2 Levels	Type E At-grade 2 Levels	Type E' At-grade &UG 2 Levels	Type A Elevated 2 Levels	Type C Elevated 3 Levels	Type A' Elevated 3 Levels
Number of Platforms		1	2	2	2	2	2	1	1	1	2	2	2
Number of Tracks		2	3	2	2	4	4	2	2	2	4	2	4
Schematic		[illegible]											
Current Site Level		[illegible]	AMSL 2.20	AMSL 1.65	AMSL 2.80	AMSL 3.07	AMSL 2.90	AMSL 5.60	AMSL 6.54	AMSL 20.00	AMSL 31.00	AMSL 4.50	AMSL 5.80
Forecasted Flood Level by JDT		[illegible]	AMSL 3.70	AMSL 3.15	AMSL 4.30	AMSL 3.57	AMSL 4.40	AMSL 7.10	AMSL 8.09	N/A	N/A	AMSL 5.00	AMSL 6.30
Peak Hour Max Boarding Passenger (Target year)		[illegible]	3,532 (2022)	4,170 (2040)	9,673 (2040)	1,456 (2040)	9,270 (2040)	4,907 (2023)	1,590 (2040)	3,674 (2023)	9,751 (2040)	3,086 (2025)	6,044 (2040)
Designed platform Width		[illegible]	10.38	7.79	7.79	6.59	10.78	9.68	9.68	10.38	10.38	7.79	10.38
No. of Stairs/ESC on Platform		[illegible]	4	4	4	4	4	4	4	4	4	4	4
Station Width	Length of the eaves	[illegible]	2.2	2.35	2.35	N/A	2.2	2.4	2.4	2.4	2.2	2.35	2.2
	Clearance to building edge	[illegible]	5.41	1.1	1.1	1.1	5.41	4.51	4.51	4.51	5.41	1.1	5.41
	Platform width	[illegible]	10.38	7.79	7.79	6.59	10.78	9.68	9.68	10.38	10.38	7.79	10.38
	Track width	[illegible]	3.12	7.12	7.12	15.12	7.12	N/A	N/A	N/A	7.72	7.12	7.12
	Platform width	[illegible]	10.38	7.79	7.79	6.59	10.78	N/A	N/A	N/A	10.38	7.79	10.38
	Clearance to building edge	[illegible]	5.41	1.1	1.1	1.1	5.41	4.51	4.51	4.51	5.41	1.1	5.41
	Length of the eaves	[illegible]	0	2.35	2.35	N/A	2.2	2.4	2.4	2.4	2.2	2.35	2.2
	Station Width without eaves	[illegible]	34.7	24.9	24.9	N/A	39.5	18.7	18.7	19.4	39.3	24.9	38.7
	Total StationWidth	[illegible]	36.9	29.6	29.6	N/A	43.90	23.5	23.5	24.2	43.7	29.6	43.1

Station		Muntinlupa	San Pedro	Pacita	Binan	Santa Rosa	Cabuyao	Golez (Future Station)	Mamatid (Future Station)	Banlic	Calamba
Chainage for (8 cars / 10 cars)		31km449m	35km355m	36km429m	38km992m	42km044m	48km107m	[illegible]	[illegible]	53km511m	56km832m 56km812m
Top of Railway Level (draft)		AMSL 23.40	AMSL 22.90	AMSL 20.90	AMSL 24.90	AMSL 29.90	AMSL 27.50			AMSL 31.20	AMSL 32.60
		GL+ 15.50	GL+ 16.50	GL+ 15.50	GL+ 16.00	GL+ 20.00	GL+16.50			GL+ 16.00	GL+ 16.50
Structure Type (draft)		Type C Elevated 3 Levels	Type A' Elevated 3 Levels	Type C Elevated 3 Levels	Type C Elevated 3 Levels	Type C Elevated 3 Levels	Type A''' Elevated 3 Levels	[illegible]	[illegible]	Type C Elevated 3 Levels	Type A' Elevated 3 Levels
Number of Platforms		2	2	2	2	2	2	[illegible]	[illegible]	2	2
Number of Tracks		2	4	2	2	2	4	[illegible]	[illegible]	2	4
Schematic								[illegible]	[illegible]		
Current Site Level		AMSL 7.90	AMSL 6.40	AMSL 5.40	AMSL 8.90	AMSL 9.90	AMSL 11.00	[illegible]	[illegible]	AMSL 15.20	[illegible]
Forecasted Flood Level by JDT		AMSL 8.40	AMSL 6.90	AMSL 5.90	AMSL 9.90	AMSL 10.90	N/A	[illegible]	[illegible]	N/A	N/A
Peak Hour Max Boarding Passenger (Target year)		2,825 (2040)	2,833 (2040)	752 (2025)	2,937 (2040)	3,662 (2040)	4,627 (2040)	[illegible]	[illegible]	N/A	6,475 (2040)
Designed platform Width		7.79	10.38	7.79	7.79	7.79	10.78	[illegible]	[illegible]	7.79	10.38
No. of Stairs/ESC on Platform		4	4	4	4	4	4	[illegible]	[illegible]	4	4
Station Width	Length of the eaves	2.35	2.2	2.35	2.35	2.35	2.2	[illegible]	[illegible]	2.35	2.2
	Clearance to building edge	1.1	5.41	1.1	1.1	1.1	5.41	[illegible]	[illegible]	1.1	5.41
	Platform width	7.79	10.38	7.79	7.79	7.79	10.78	[illegible]	[illegible]	7.79	10.38
	Track width	7.12	7.12	7.12	7.12	7.12	7.12	[illegible]	[illegible]	7.12	7.12
	Platform width	7.79	10.38	7.79	7.79	7.79	10.78	[illegible]	[illegible]	7.79	10.38
	Clearance to building edge	1.1	5.41	1.1	1.1	1.1	5.41	[illegible]	[illegible]	1.1	5.41
	Length of the eaves	2.35	2.2	2.35	2.35	2.35	2.2	[illegible]	[illegible]	2.35	2.2
	Station Width without eaves	24.9	38.7	24.9	24.9	24.9	39.5	[illegible]	[illegible]	24.9	38.7
	Total StationWidth	29.6	43.1	29.6	29.6	29.6	43.9	[illegible]	[illegible]	29.6	43.1

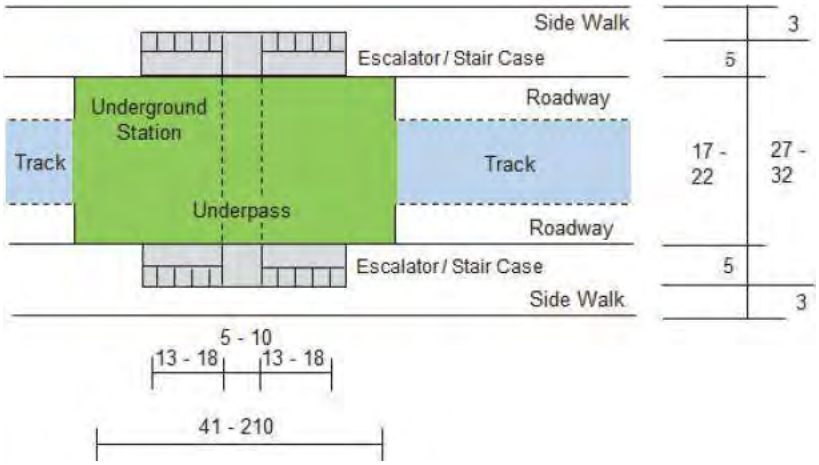
142. The estimated required space and major dimensions of the elevated / at-grade stations are shown in **Table 1.4.8**.

Table 1.4.8 Draft Specification of Proposed Station

Items	Description
Total required width for a station:	Total width is 18.7m– 50.5 m
Platform Length:	180 meters (platform length for 8 car train)
Platform width:	Varies per station (7.79 - 10.78 m)
Structure Type:	2 to 5 levels
Other facilities	• Stairs, Elevators and Escalators • Restrooms/toilets • Automatic Fare Control systems consisting of Ticket Vending Machines, Automatic Gates, Automatic Fare Adjustment Machines, Data Collecting Machines and office booking machines • Information Counter • Emergency exits • Staffroom, utility rooms, first aid room, security room, storage, generator room, back office, E&M room, etc. • Substation

143. As an interconnecting station, the integrated FTI Station will be designed as 3-storey with 2-layer island type platforms (at-grade and underground) and 1-layer underground concourse level. The station design, however, is yet to be finalized. The estimated space needed for the underground station is shown as follows and illustrated in **Figure 1.4.20**:

- Total required width for station: 27-32 m
- Width of an underground station: 17-22 m
- Platform length: 41-210 m, defined by passenger volume and train length.
- Escalator/Staircase: 2 meters for parallel installation of escalator and staircase with wall structure
- Sidewalk: 3 meters for wheelchairs passing at the narrowest part
- Typical width of underpass: 5-10 m, depending on the number of passengers
- Length of escalator/staircase: 13-18 m for 5-7.5 m gap



(Source: JICA Study Team)

Figure 1.4.20 Typical Required Area for an Underground Station

144. The facility areas of the station were based on the projected number of passengers for each station. The estimated lot area required for the FTI Station is 30,836 m^2. Within this area, about 30,375 m^2 will be used for construction yard while the total gross floor area is estimated at 26,996.0 m^2.

145. The type of stations for SCRP is presented in **Table 1.4.9**. Meanwhile, the planned station-related facilities are summarized in **Table 1.4.10**.

Table 1.4.9 Station Type of SCRP

No.	Station name	Platform type
1	Blumentritt	Two island platforms with three tracks
2	España	Two side platforms with two tracks served
3	Santa Mesa	Two side platforms with two tracks served
4	Paco	Two island platforms serving four tracks
5	Buendia	Two island platforms with four tracks
6	EDSA	One platform with two tracks served
7	Nichols	One platform with two tracks served
8	FTI	One platform with 2 tracks and one underground platform with 2 tracks
9	Bicutan	Two island platforms serving four tracks
10	Sucat	Two side platforms with two tracks served
11	Alabang	Two island platforms serving four tracks
12	Muntinlupa	Two side platforms with two tracks served
13	San Pedro	Two island platforms with 4 tracks
14	Pacita	Two side platforms with two tracks served
15	Biñan	Two side platforms with two tracks served
16	Santa Rosa	Two island platforms serving four tracks
17	Cabuyao	Two island platforms with four tracks
18	Banlic	Two side platforms with two tracks served
19	Calamba	Two island platforms serving four tracks

Source: JICA Study Team

Table 1.4.10 List of Planned Station related Facilities

Station		Station Related Facility		Contents	Land
1	Blumentritt	1)	Pedestrian Bridge	Old Antipolo St crossing and connect to LRT1 station	ROW of station
		2)	Pedestrian Deck	Connect to east side of the station	ROW of station
		3)	Intermodal Facility	East side of the station	ROW of station
2	España	1)	Pedestrian Bridge	España Blvd crossing	ROW of station
		2)	Pedestrian Deck	Connect to east side of the station	ROW of station
		3)	Elevators	España Blvd crossing	ROW of station
		4)	Intermodal Facility	West side of the station	ROW of station
		5)	Car Parking	Parking lots for station staff and shuttle transportation service	ROW of station
	Santa Mesa	1)	Pedestrian Bridge	Teresa crossing and connect to LRT2	ROW of station,

Station		Station Related Facility		Contents	Land
3				station	Road
		2)	Pedestrian Deck	Connect to west and east side of the station	ROW of station
		3)	Elevators	N/A	
		4)	Intermodal Facility	North and east side of the station	ROW of station, Road, Residence
		5)	Car Parking	Parking lots for station staff and shuttle transportation service	ROW of station
4	Paco	1)	Pedestrian Bridge	N/A	
		2)	Pedestrian Deck	N/A	
		3)	Elevators	N/A	
		4)	Intermodal Facility	North and west side of the station	ROW of station
		5)	Car Parking	Parikng lots for station staff and shuttle transportation service	
5	Buendia	1)	Pedestrian Bridge	Buendia Ave, Medina St and Osmeña Highway crossing (	ROW of station, Road
		2)	Pedestrian Deck	Connect to north side of the station	ROW of station
		3)	Elevators	Buendia Av and Osmeña Highway crossing	ROW of station, Road
		4)	Intermodal Facility	North, south and east side of the station	ROW of station
		5)	Car Parking	Parking lots for station staff and shuttle transportation service	ROW of station
6	EDSA	1)	Pedestrian Bridge	Abenida-Epifanio de los Santos Ave,	ROW of station, Road
				Connect to MRT3 station	
		2)	Pedestrian Deck	Connect to north side of the station	ROW of station
		3)	Elevators	N/A	
		4)	Intermodal Facility	West side of station	ROW of station
		5)	Car Parking	Parking lots for station staff and Shuttle transportation service	ROW of station
7	Nichols	1)	Pedestrian Bridge	N/A	
		2)	Pedestrian Deck	N/A	
		3)	Elevators	N/A	
		4)	Intermodal Facility	North and west side of the station	ROW of station,
		5)	Car Parking	Parking lots for station staff and shuttle transportation service	
8	FTI	1)	Underground Pedestrian Crossing	To be redesigned for integration with interconnecting line	
		2)	Pedestrian Deck		
		3)	Elevators		
		4)	Intermodal Facility		
		5)	Car Parking		
		6)	Vertical Transfer Facility	Concourse between main line and interconnecting line	ROW of station
9	Bicutan	1)	Pedestrian Bridge	To be redesigned for integration with interconnecting line	
		2)	Pedestrian Deck		
		3)	Elevators		
		4)	Intermodal Facility		
		5)	Car Parking		

Station		Station Related Facility		Contents	Land
10	Sucat	1)	Pedestrian Bridge	N/A	
		2)	Pedestrian Deck	N/A	
		3)	Elevators	N/A	
		4)	Intermodal Facility	North side of the station	ROW of station
		5)	Car Parking	Parking lots for station staff and shuttle transport service	ROW of station
11	Alabang	1)	Pedestrian Bridge	N/A	
		2)	Pedestrian Deck	N/A	
		3)	Elevators	N/A	
		4)	Intermodal Facility	North and south side of the station	ROW of station
		5)	Car Parking	Parking lots for station staff and shuttle transport service	ROW of station
12	Muntinlupa	1)	Pedestrian Bridge	N/A	
		2)	Pedestrian Deck	N/A	
		3)	Elevators	N/A	
		4)	Intermodal Facility	West and south side of the station	ROW of station,
		5)	Car Parking	Parking lots for station staff and shuttle transport service	ROW of Station
13	San Pedro	1)	Pedestrian Bridge	N/A	
		2)	Pedestrian Deck	N/A	
		3)	Elevators	N/A	
		4)	Intermodal Facility	North, west and south side of the station	ROW of station
		5)	Car Parking	Parking lots for station staff and shuttle transport service	ROW of station
14	Pacita	1)	Pedestrian Bridge	N/A	
		2)	Pedestrian Deck	N/A	
		3)	Elevators	N/A	
		4)	Intermodal Facility	West and south side of the station	ROW of station
		5)	Car Parking	Parking lots for station staff and shuttle transport service	ROW of station
15	Biñan	1)	Pedestrian Bridge	General Malvar St crossing	ROW of station
		2)	Pedestrian Deck	Connect to east side of the station	ROW of station
		3)	Elevators	General Malvar St. crossing	ROW of station
		4)	Intermodal Facility	West and south side of the station	ROW of station
		5)	Car Parking	Parking lots for station staff and shuttle transport service	ROW of station
16	Santa Rosa	1)	Pedestrian Bridge	Manila S. Rd. crossing	ROW of station
		2)	Pedestrian Deck	Connect to west side of the station	ROW of station
		3)	Elevators	Manila S. Rd. crossing	Road
		4)	Intermodal Facility	West and south side of the station	ROW of station
		5)	Car Parking	Parking lots for station staff and shuttle transport service	ROW of station
17	Cabuyao	1)	Pedestrian Bridge	N/A	
		2)	Pedestrian Deck	N/A	
		3)	Elevators	N/A	
		4)	Intermodal Facility	North, west and south side of the station	ROW of station

Station		Station Related Facility		Contents	Land
		5)	Car Parking	Parking lots for station staff and shuttle transport service	ROW of station
18	Banlic	1)	Pedestrian Bridge	N/A	
		2)	Pedestrian Deck	N/A	
		3)	Elevators	N/A	
		4)	Intermodal Facility	East and south side of the station	ROW of station
		5)	Car Parking	Parking lots for station staff and shuttle transport service	ROW of station
19	Calamba	1)	Pedestrian Bridge	N/A	
		2)	Pedestrian Deck	N/A	
		3)	Elevators	N/A	
		4)	Intermodal Facility	West and south side of the station (12,072m^2)	ROW of station
		5)	Car Parking	Parking lots for station staff and shuttle transport service	ROW of station

Note: "ROW of station" is within project ROW. All others are outside of project ROW.

Source: JICA Study Team

146. The final design of each of the stations has not yet been finalized as each station moves from the conceptual stage to the detailed design.

1.4.2.2. Integrated Stations

(1) Bicutan Station

147. The Bicutan Station will include four elevated tracks at the same level, which allows passengers to transfer between the main line and the interconnecting line leading to the Metro Manila Subway by crossing the platform. The proposed staggered station with 2+2 tracks in two elevated levels was first considered, but would have required passengers to change the platform level, which may be considered inconvenient and requiring a high number or stairs, elevators and escalators. **Figure 1.4.21** shows the indicative alignment of the Bicutan Station and how it will be connected towards the FTI Station.

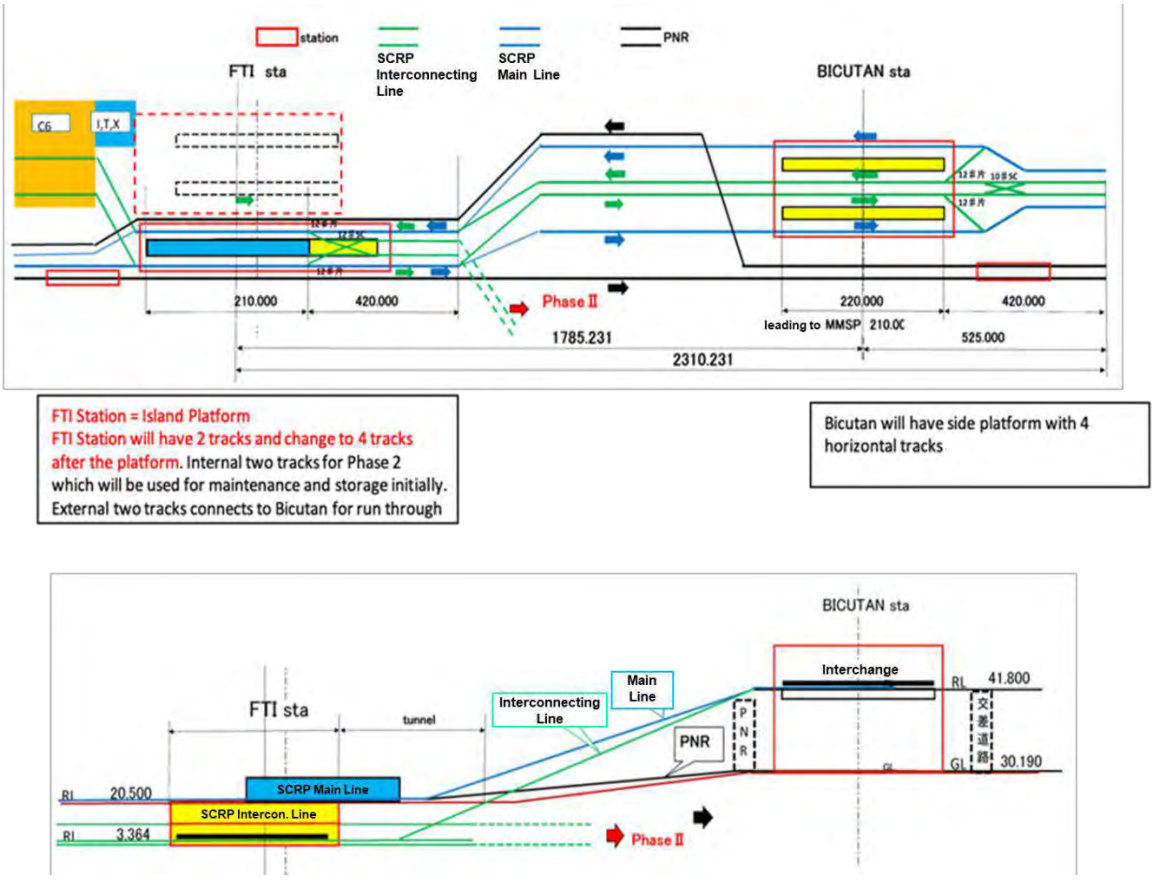


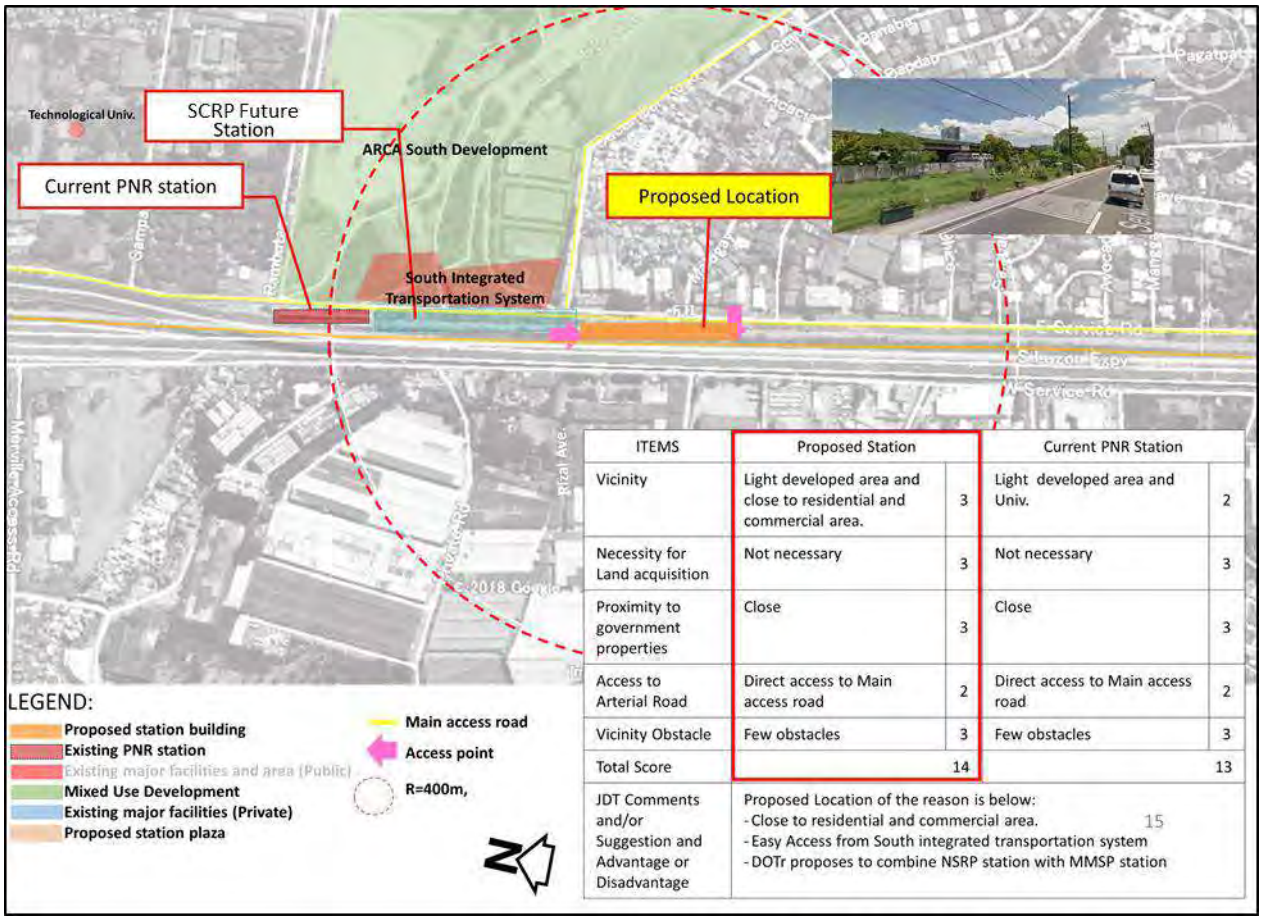
Figure 1.4.21 Integrated SCRP – MMSP Interoperability at Bicutan Station

(Note: Red dashed rectangle shows the old plan for FTI Station that has been disregarded.)

(2) FTI Station

148. Coming from the Bicutan Station, the FTI Station will be underground and is planned to be situated within the PNR ROW in order to minimize displacement and reduce the number of affected persons. Further, at most 14-meter land from the existing road may be necessary to be acquired to be able to reinstate East Service Road.

149. The current design for FTI Station includes two underground tracks for the interconnecting line and two at-grade tracks for the main line. This design was made to accommodate future two lines (i.e., the SCRP main line and the interconnecting line leading to MMSP) which will run as parallel tracks towards Bicutan Station to have a common station at the same level. This layout allows sufficient flexibility in case of any disruption or delay in operation and to avoid trains with passengers stopping in tunnels. The revised design with only 2 tracks will not allow such flexibility in the subway operations and may be less convenient for passengers in case of halted operation. **Figure 1.4.22** presents the indicative design of the FTI Station.



ITEMS	Proposed Station		Current PNR Station	
Vicinity	Light developed area and close to residential and commercial area.	3	Light developed area and Univ.	2
Necessity for Land acquisition	Not necessary	3	Not necessary	3
Proximity to government properties	Close	3	Close	3
Access to Arterial Road	Direct access to Main access road	2	Direct access to Main access road	2
Vicinity Obstacle	Few obstacles	3	Few obstacles	3
Total Score		14		13
JDT Comments and/or Suggestion and Advantage or Disadvantage	Proposed Location of the reason is below: - Close to residential and commercial area. 15 - Easy Access from South integrated transportation system - DOTr proposes to combine NSRP station with MMSP station			

Figure 1.4.22 Indicative design for FTI Station

150. Although there is no final design in place for the station, it is recommended that the station design incorporate the fire protection standards of NFPA130. The specific requirements of the standard are discussed through the remaining portion of this section of the report. Key requirements of NFPA130 are presented in Annex 1-1.

1.4.3. Maintenance Depot

1.4.3.1. Layout and Facilities

151. The south depot is located in Barangay Banlic in the province of Laguna, next to San Cristobal River and adjacent to the Laguna Gateway Inland Container Terminal. The lot area is approximately 22 hectares, with an additional 2 hectares of the access track, access road and future new underpass traversing the south depot access track and road. The depot serves as an area for stabling, maintenance, inspection, and train repair. Also, the depot functions mainly as a central command office which conducts the operation control of the main line and the integrated management of electricity, facilities for the crew, and the maintenance base for track, power supply system, signaling, communication systems, and civil and architectural facilities. The Banlic Depot Operations Control Center (OCC) will serve as the central command office during the projected Alabang - Calamba Sectional Operations. After which, control of the main line will be transferred to the Mabalacat Integrated OCC, and the Banlic OCC will serve as the local control center for the depot operations. The major equipment and machineries installed at the depot are listed below in **Table 1.4.11.**

152. There are a total of 20 buildings and facilities in the Depot with many types and sizes. Most of the depot buildings are be single-story buildings (basically 2.7m height), which the roof height varies depends on the usage. The largest building is the Light Repair Shop (LRS) and the tallest building is the OCC, which is the first basement floor above the fifth floor (partly the sixth floor) and is 27 m height.

153. The OCC Building will house the Administration and Operation Center, where the control rooms, offices, security/first aid, kitchen/dining, toilet/locker, workshop and consumables are located.

154. The South Depot count with 33 stabling tracks to park trains, and other tracks to access each maintenance facility counted in South Depot. Nine (9) internal roads are arranged inside depot and two (2) additional roads outside the premises of the South Depot, namely the access road connecting Banlic Station to the South Depot, and a new underpass for an existing road two grade separate the local road to that of the depot access road and depot access track. **Table 1.5.6** shows a list of building and facilities and **Figure 1.4.23** shows corresponding layout.

Table 1.4.11 Major Equipment and Types of machinery Installed at the Depot

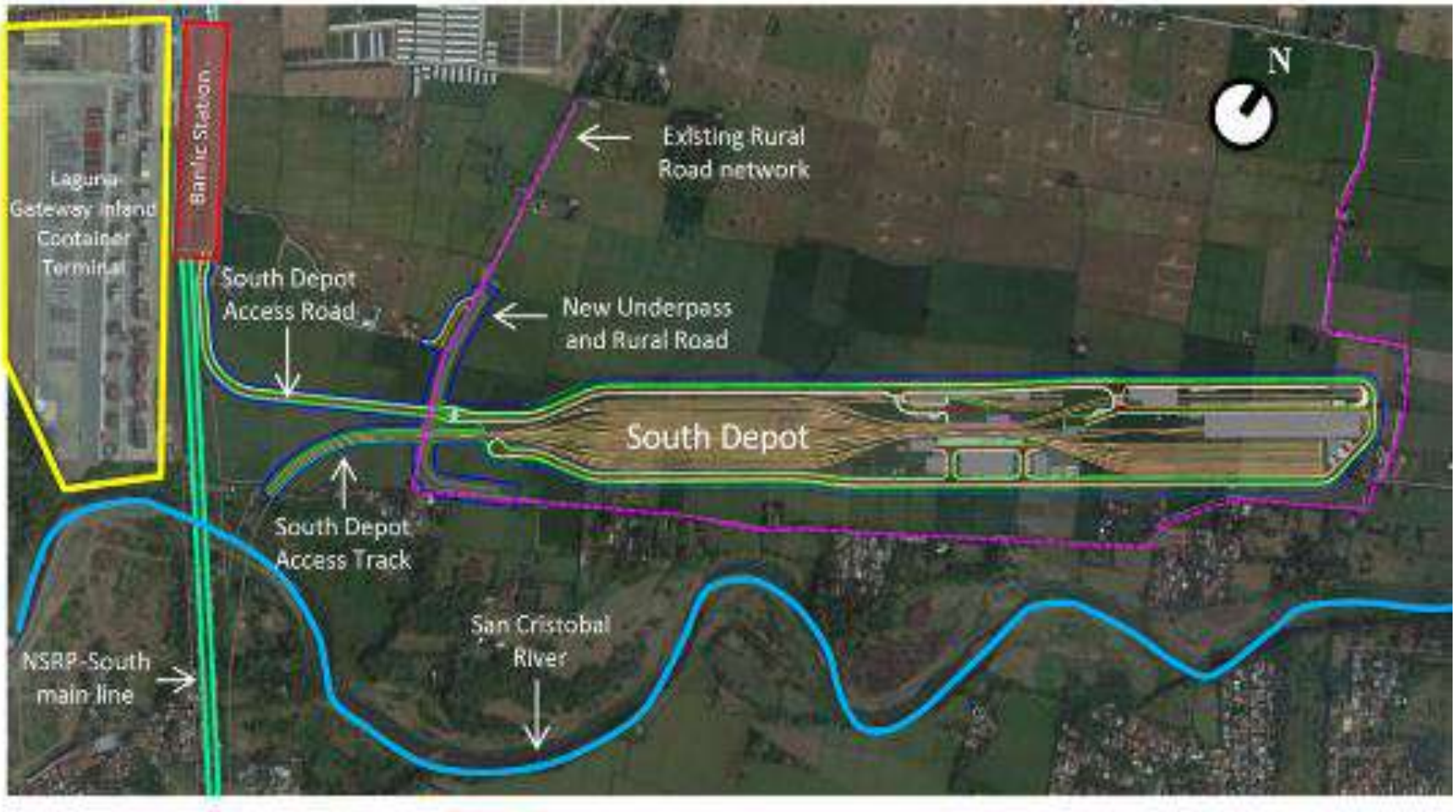
Function	Major items of facilities/equipment
Stabling	Stabling Tracks for 10 cars' length
Light Repair	(Light Repair Shop) Pit, Deck, Height scaffold, Front car maintenance platform, Disconnect switch
Unscheduled Repair	(Unscheduled Repair Shop) Bogie replacing equipment, Underfloor equipment lifter, Movable lifting platform, Overhead traveling crane
Wheel re-profiling	(Wheel Re-profiling Shop), Underfloor wheel re-profiling lathe, Shunting locomotive
Train Preparation	(Light Repair Shop) Deck, Sewage discharge pipe; (In Depot Area) Automatic car body washer

Source: JICA Design Team

Table 1.4.12 Facilities and Building necessary in the South Depot

List of Building and Facility	
● OCC Building ● Light Repair Shop ● Unscheduled Repair Shop ● Wheel Re-Profiling Shop ● Catenary Maintenance Vehicle Shop ● Fuel Pump House 1 ● Oil Storage for Light Repair Shop ● Hazardous Store ● Garbage Shed for Light Repair Shop ● Truck Garage ● Substation 1 ● Distribution Board Space 1 ● Maintenance Car Shop	● Fuel Pump and Tank for Maintenance ● Fire Water Tank ● Supply and Fire Water Tank ● Track Maintenance Office ● Security House 1 ● Security House 2 ● Car Washing Track ● Car Parking (Uncovered) ● Bicycle Parking Shed ● Motorcycle Shed ● Detention Basin 1 ● Detention Basin 2

Source: JICA Design Team

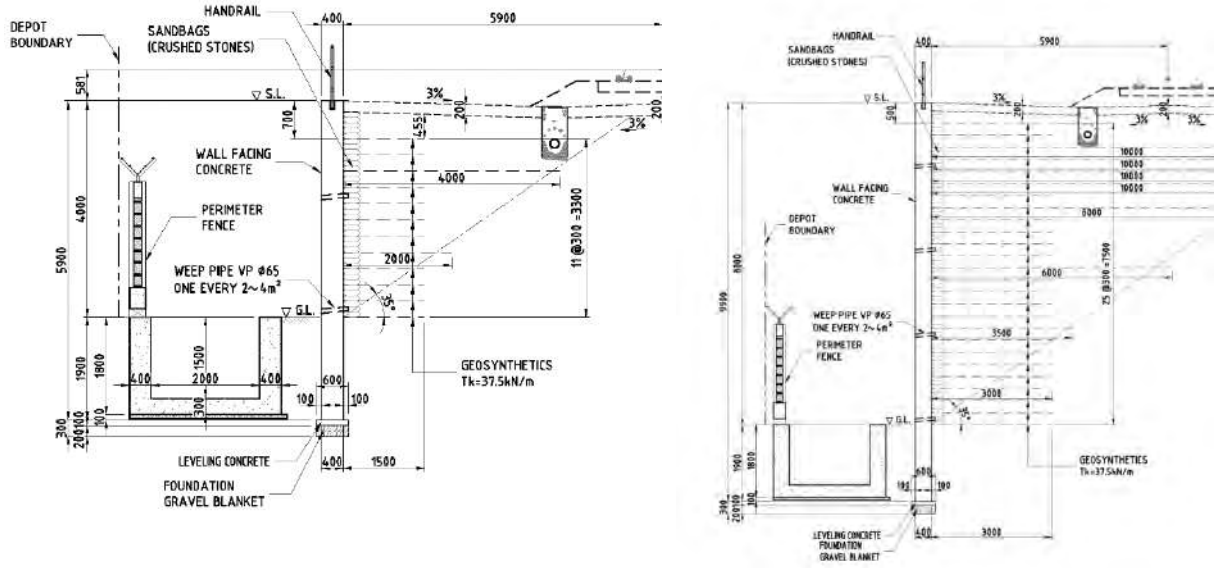


Source: JICA Design Team

Figure 1.4.23 South Depot Development Plan

1.4.3.2. Structure

155. The height of the rail at the South Depot is set as 15.5 masl in consideration of the existing terrain at the depot location, the highest flood level of the San Cristobal River and Barangay Banlic, and the profile of access track. The entire South Depot development area needs to be backfilled; the maximum height of the backfilling is around 10m therefore the backfilled section is retained by Geosynthetic Reinforced Soil Retaining Walls (GRS-RW) with a full height rigid (FHR) facing. Based on the geotechnical investigation and liquefaction analysis, it has been concluded that the soil improvement work for embankment subsoil is required. **Figure 1.4.24** shows the typical cross section of perimeter geosynthetic reinforced soil retaining wall with full height rigid facing.



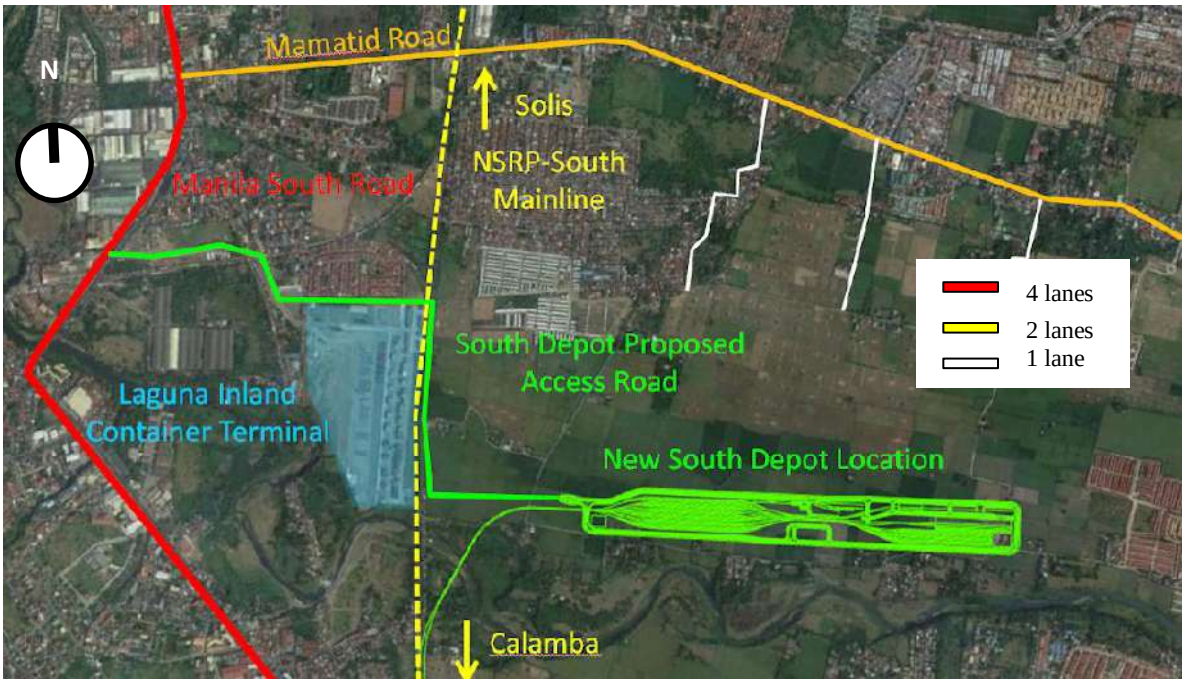
H=4m (from finish level) H=8m (from finish level)

Source: JICA Design Team

Figure 1.4.24 Typical Cross section of Perimeter Geosynthetic Reinforced Soil Retaining Wall (GRS-RW) with Full Height Rigid (FHR) Facing

1.4.3.3. Depot Access

156. The south depot counts with a single entrance from the future Banlic Station. The access to Banlic Station is planned to be from Mamatid Road, which is located north of the Banlic Station and the South Depot. Refer to **Figure 1.4.25** for the details of the access road. Since the South Depot only has a single entrance, this will serve to both regular and large vehicles.



Source: JICA Design Team

Figure 1.4.25 Access Roads to the South Depot from Manila South Road

1.4.3.4. Water Supply

157. The proposed deep well at the depot has to be drilled at a depth of least 100 meters in order to tap the deeper confined aquifers. The upper 40 meters should be blank casings wherein the upper 30 meters has to be sealed by sand-cement-grout mixtures in order not to influence and affect the shallow wells being used by the local residents. If required, a Geo-resistivity Survey can be conducted to determine the lateral and vertical extents of the water-bearing formation/s. Based on the results of this survey, a more precise well design can be made.

1.4.4. Railway System

158. Railway System refers to the train operation, rolling stocks, signaling system, power supply system, communication, etc., but not limited to the following:

Table 1.4.13 Technical Parameters of Railway System

	Item	Technical Specifications of SCRP	
1	Train Operation	General	Trains drive on right hand side. One-man train driver operation. Passenger Load factor is less than 100%. Working hour of drivers is about 4 hours/day.
2	Rolling Stock Design	General	Acceleration (Design): 3.3km/h/s (Weighting 20t/car, 1350V, 0~30km/h Instantaneous acceleration) or more Deceleration (Design): 4.2km/h/s (Max service brake, Instantaneous deceleration) 4.7 km/h/s (Emergency brake, Instantaneous deceleration) Design operation speed in SCRP; Max 120km/h
		Gauge	1,435mm (Standard Gauge)
		Electric Power Supply	DC1,500V overhead catenary
		Capacity of Train	Calculated by 7 person/m^2
		Rolling Stock Gauge	Refer to Detailed design
		Coupler	Leading car: tight lock coupler Intermediate car: semi-permanent coupler
		Body Structure	MAX:1,9500mm (Length)×2,950 mm (Width)×3,655 mm (Height)
			MAX Height 4,150mm, when pantograph is folded, 1,130～1,150 mm (Height of floor)
			Straight structure without hem aperture
			Maximum longitudinal compression force of rolling stock end is 490kN.
			Material used for the car body shall comply with the Japanese Ministerial Ordinance article 83
			Adopting front strengthened structure of the car, and Securing survival space of driver in case of an accident (common structure of Japanese commuter rolling stock)
			Driver unit: right side
		Maximum Axle Weight	16t
		Door Layout	4 doors for passengers per side of the train. 1 door on each side that will be used for the driver's cab.
		Standards	Technical Regulatory Standards on Japanese Railways, Japanese Industry Standards (JIS), Japanese Railway Industry Standards (JRIS), Japanese Electro Technical Committee and related standards would be used for the technical standards.
3	Rolling Stock Maintenance Facility	General	Common Design method
			Employing same designed maintenances facilities
			Basic way of Inspection and Repair for Rolling Stock
		Maintenance Category	Departure Inspection (Before departure), Daily Inspection (Within 6 days), Monthly Inspection (Within 3 months: 90 days), Semi Overhaul (Within 4 years or Within 600,000km), Overhaul (Within 8 years or Within 1,200,000km)
4	Signalling System	General	ETCS Level 2 is chosen for NSCR Signaling System
5	Power Supply System	General	Substation facilities comply with JIS, JEC etc. and NSCR specifications
		Voltage for Operation	1,500V

	Item	Technical Specifications of SCRP	
6	Power Distribution System	General	Distribution facilities comply with JIS, JEC etc. and NSCR specifications
		Voltage of Distribution Line	6.6kV
		Voltage of Supplying Loads	440V / 230V
7	Overhead Contact System	General	The OCS complies with JIS, JEC etc.
		Maximum Train Speed	160km/h
		Weather Conditions	Philippine's weather data
		Track gauge	Standard gauge (1,435mm)
8	Communication System	Radio System	150~400MHz
		others	Backbone system, Voice and Data system, Closed Circuit television system, Passenger information Display system, Public Address System, time server and master clock system, meteorological and seismic monitoring system, railway facility monitoring system
9	Automatic Fare Collection (AFC) System	General	The AFC system compliant with the AFC National Standard
10	Others	Platform Screen	Applicable
		Construction gauge	The same gauge of SCRP

Source: JICA Design Team

1.4.4.1. Train Operation

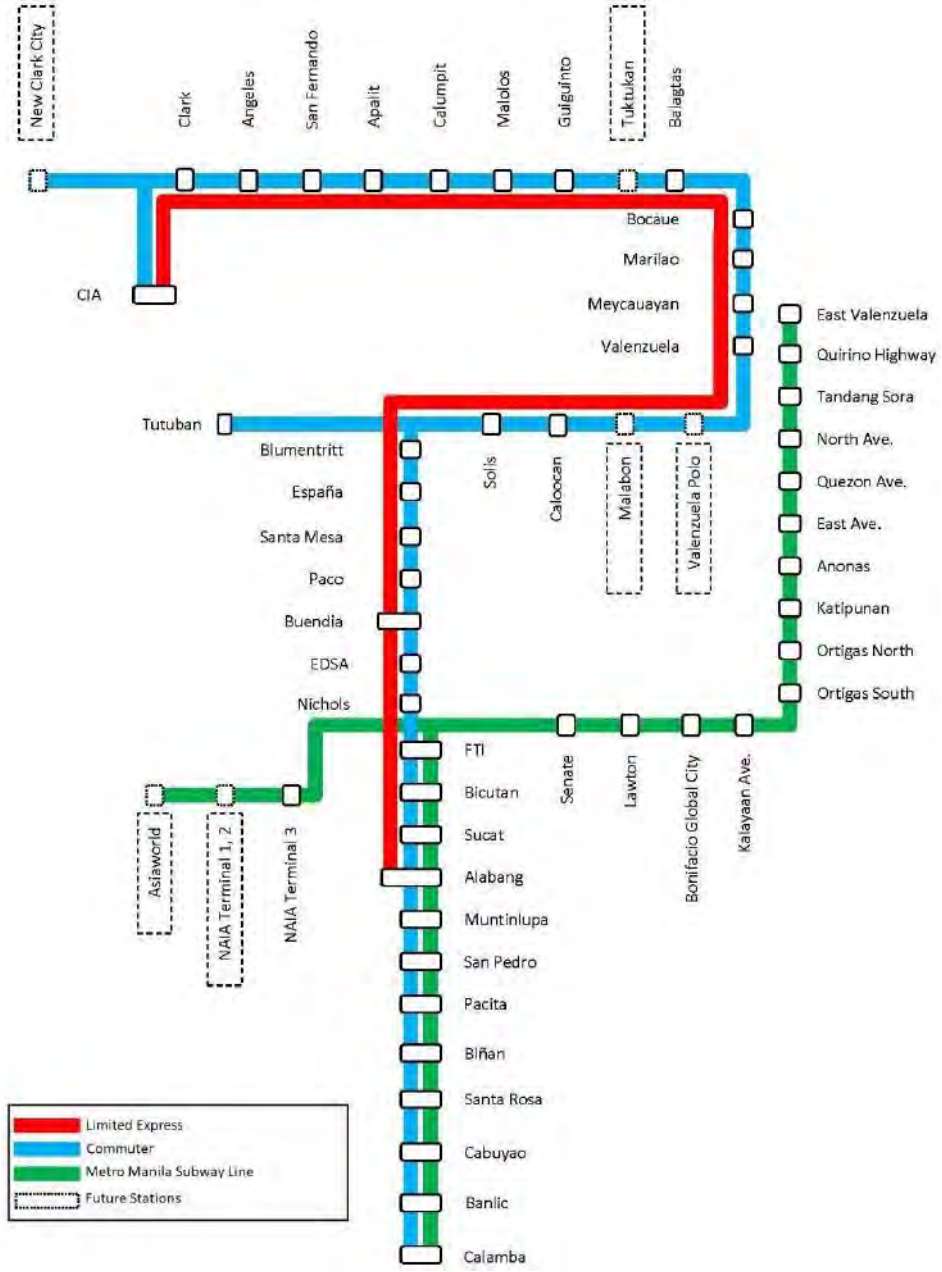
159. The DOTr has a plan to operate three (3) types of train service in this Project which are: 1) a commuter train; 2) an express train; and 3) the airport limited express train which can connect CIA and the center of Manila within 1 hour.

160. The SCRP interconnecting line will run along the alignment of the main line in the section between FTI and Bicutan stations. The FTI Station will consist of an underground level for the interconnecting line and an at-grade level for the main line. The line will transition to elevated level at Bicutan Station.

Table 1.4.14 Kilometric performance of each train in 2040 (tentative)

Type	Total Kilometric performance	Number of Train set for operation	Average of Kilometric performance for operation
Limited Express	9,048 km / day	8	1,131 km / day / train-set
Commuter (Include Commuter Express)	36,503 km / day	52	702 km / day / train-set

Source: JICA Design Team



Source: JICA Design Team

Figure 1.4.26 Route map and stops for each type of trains

161. The SCRP will operate for 18 hours per day (5 a.m. to 11 p.m.). After closure for the day, facilities and equipment maintenance will be conducted.

162. Peak hours and high demands are expected in the mornings and evenings. It is assumed that the peak hour of the passenger concentration is from 6 to 8 a.m. and from 5 to 7 p.m. in the morning and it is expected that about 12.5% of daily demand will be concentrated during peak hours.

1.4.4.2. Rolling Stock

163. The DOTr will utilize EMU Trains for the Project, for which a power supply system is required for train operation. An electric multiple unit or EMU is a multiple unit train consisting of self-propelled carriages, using electricity as the motive power. **Figure 1.4.28** shows the EMU train samples. The Commuter Rolling Stock will have a capacity of not less than 2,242 passengers (seating + standing) per train set, will have an operational speed of 120 km/hr, and will be fully air-conditioned. Whereas, the Limited Express Rolling Stock will have a total a capacity of 386 passengers (seated) per train set, with an operational speed of 160 km/hr, and will also be fully air-conditioned.

Figure 1.4.27 Sample of (left) Commuter Train and (right) Limited Express Train

Table 1.4.15 Train Capacity

Type of Train	Train composition	No. of passengers		
		Seated	Standing	Total
Express	8 cars	400	0	400
Commuter and Commuter Express	8 cars	414	1,828	2,242

Source: JICA Design Team

Table 1.4.16 Specifications and Performance of Commuter Train

No	Item	Specification, Performance
1	Basic	Commuter Train DC1,500V Tc: Trailer Car with driver's cab M: Motor car T: Trailer car
2	Basic Configuration	In case of 4M4T (Tc+M+M+T+T+M+M+Tc) (Empty weight 270t)
3	Performance	Acceleration(Design):3.3km/h/s (starting) Deceleration(Design):4.2km/h/s (Max service brake, Instantaneous deceleration) 4.7 km/h/s (Emergency brake, Instantaneous deceleration) Design operation Max speed:120km/h
4	Gauge	1,435mm(standard gauge) EN rail
5	Electric system	DC1,500V overhead catenary Subway section : Rigid catenary
6	Capacity	Leading car : 266(45), Intermediate car : 285(54) ( ):seat number calculated by 7persons/m2 (Standee)
7	Body	Material: Light weight stainless steel or Aluminium Standard:19,500mm (Length)×2,950 mm (Width)×3,655 mm (Height) MAX Height 4,150mm, when pantograph is folded, 1,130～1,150 mm(Height of floor)

No	Item	Specification, Performance
		Straight structure without hem aperture Driver unit : right side The length of leading cars may be longer than the above
8	Bogie	Bolster less or Bolster type, Max axle weight:16t
9	Coupler	Driver's cab side of leading-car, and between 4th intermediate-car and 5th intermediate-car : tight lock coupler Others : semi-permanent coupler Connectable with other trains without adapter
10	Current Collection	Single arm type 4 pantographs/1 train-set
11	Traction Motor	3-phased totally enclosed high efficiency induction motor 4 units / M car Non- disassembly bearing exchange type
12	Driving device	Parallel cardan Gear ratio 6:53(98/15) TD or WN
13	Propulsion system	VVVF inverter(Self cooling) 1C4M×4sets/train-set The device for VVVF inverter will be applied Hybrid-SiC due to more energy saving. Maximum current of train-set : Approx.4,000A (Powering) , Approx.4,500A (Regenerating)
14	Brake system	Electric command linked to ATP, combined type of electric and pneumatic, Security brake. Regenerative priority (Entire control, Rainy mode control) Parking brake(leading car), Slide control(Trailer car)
15	Compressor	With air drier 2 or 3 units/train-set Main power: 3-phase 440V・60Hz
16	Auxiliary Power Supply	SIV: 3-phase inverter with IGBT or Hybrid-SiC (self-cooling) 4 units/train-set DC1500V→3-phase 440V・60Hz, single-phase AC220V・60Hz, DC100V Maximum current of train-set : Approx.500A
17	Battery	Sintered alkaline storage battery: DC100V 2 units/train-set
18	Door system	Electric (With adjacent door control backup function) or Pneumatic (With weakened function)
19	Lighting system	Crew cab, Saloon, Headlight, Tail light, Door・Emergency car side light: LED type
20	Fun	Line flow fun
21	Air conditioner	ON/OFF type 3-phase 440V・60Hz Distribution mounting of 2 units /a car
22	Heater	Not mounted
23	PA system	Passenger broadcast: automatic volume control function with a variance amplification, automatic broadcast and outside speaker Broadcast simultaneously by the crew operating unit (Inside and outside) Intercom between crew cab, Interactive emergency communication equipment (with conversation function with the OCC and a broadcast function from the OCC)
24	Space Radio	Digital space radio
25	ATP	ETCS Level 2
26	Destination Display	Collective setting by TMS monitor, front and side display (with collar LED)
27	CCTV	Saloon security camera (4 units /a car) Aggregated each car HUB, displayed in TMS monitor and stored in memory in the cab via Ethernet
28	Saloon Display	LCD type (17 inch wide) 8 units/car various guidance display
29	Train Management System (TMS)	Control transmission for powering and service brake command, Monitor transmission for destination, guidance and air conditioner command etc. Trouble monitoring and memory with support guidance, inspection function on the train, On-board driving information system (24hour each device condition memorized) Display function for pressure gauge, ammeter, powering and braking conditions etc.

No	Item	Specification, Performance
		Ethernet type・Control transmission : duplex and loop system or duplex and ladder system with redundancy, Information of CCTV and Monitor transmission for guidance etc. : single system
30	Universal Design	Identification band (cleat) on the floor just before the door Indicator light and chime (inside and outside) at opening and closing doors Wheel chair (free) space
31	Others	Preparation for WiFi etc.

Source: JICA Design Team

Table 1.4.17 Specification and Performance of Express Train

No	Item	Specification, Performance
1	Basic	Limited Express Train DC1,500V Tc: Trailer Car with driver's cab M: Motor car
2	Basic Configuration	6M2T (Tc+M+M+M+M+M+Tc) (Empty weight 315t)
3	Performance	Acceleration (Design, starting):3.0km/h/s Deceleration (Design):4.2km/h/s(Max service brake, Instantaneous deceleration) 4.7 km/h/s(Emergency brake, Instantaneous deceleration) （In the design stage, it should be considered that deceleration of over 120km/h set lower than that of under 120km/h, and average deceleration must be satisfied the express specification of deceleration） Operation Max speed:160km/h
4	Gauge	1,435mm (standard gauge)
5	Electric system	DC1,500V overhead catenary
6	Capacity	More than386 (seats)
7	Body	Material: Aluminum Standard:19,500 mm (Length)×2,950 mm (Width)×3,655 mm (Height) Reading car length may be longer. MAX Height 4,150mm, when pantograph is folded, 1,130～1,150 mm(Height of floor)
8	Bogie	Bolster less type. Max axle weight:16t
9	Coupler	Leading car: tight lock coupler, Intermediate car: semi-permanent coupler Connectable with other train without adapter
10	Current Collection	Single arm type 5 pantographs/1 train-set (With high voltage train line)
11	Traction Motor	3-phased totally enclosed high efficiency induction motor 4 units / M car Non- disassembly bearing exchange type
12	Driving device	Parallel cardan
13	Propulsion system	VVVF inverter(Self cooling) 1C4M×6sets/train-set The device for VVVF inverter will be applied Hybrid-SiC due to more energy saving. Maximum current of train-set : Approx.4,000A (Powering), Approx. 5,350A (Regenerating)
14	Brake system	Electric command linked to ATP, combined type of electric and pneumatic, Security brake. Regenerative priority (Entire control, Rainy mode control) Parking brake(leading car), Slide control(all cars)
15	Compressor	With air drier 2 or 3 units/train-set Main power: 3-phase 440V・60Hz
16	Auxiliary Power Supply	SIV: 3-phase inverter with IGBT or Hybrid-SiC (self-cooling) 2 units/train-set DC1,500Vooling) 440V・60Hz, single-phase AC220V・60Hz, DC100V

No	Item	Specification, Performance
17	Battery	Sintered alkaline storage battery: DC100V 2 units/train-set
18	Door system	Pneumatic (With weakened function) , Airtight protecting mechanism is recommended
19	Lighting system	Crew cab, Saloon, Headlight, Tail light, Door・Emergency car side light: LED type
20	Fun	Not used, cooling air flow out from air duct directly
21	Air conditioner	ON/OFF type 3-phase 440V・60Hz
22	Heater	Not mounted
23	PA system	Passenger broadcast: automatic volume control function with a variance amplification, automatic broadcast and outside speaker Broadcast simultaneously by the crew operating unit (Inside and outside) Intercom between crew cab, Interactive emergency communication equipment (with conversation function with the OCC and a broadcast function from the OCC)
24	Space Radio	Digital space radio
25	ATP	ETCS Level 2
26	Destination Display	Collective setting by TMS monitor, front and side display (with collar LED)
27	CCTV	Saloon security camera Aggregated each car HUB, displayed in TMS monitor and stored in memory in the cab via Ethernet
28	Saloon Display	LCD type
29	Train Management System (TMS)	Control transmission for powering and service brake command, Monitor transmission for destination, guidance and air conditioner demand etc. Trouble monitoring and memory with support guidance, inspection function on the train, On-board driving information system (24hour each device condition memorized) Display function for pressure gage, ammeter, powering and braking conditions etc. Ethernet type・Control transmission : duplex and loop system or duplex and ladder system with redundancy, Information of CCTV and Monitor transmission for guidance etc. : single system
30	Barrier free	Identification band (cleat) on the floor just before the door Indicator light and chime (inside and outside) at opening and closing doors Wheel chair space
31	Toilet	2set per 8 cars train , One of them is a wheelchair accessible type
32	Others	220v 60Hz power supply and USB, preparation for Wi-Fi,

Source: JICA Design Team

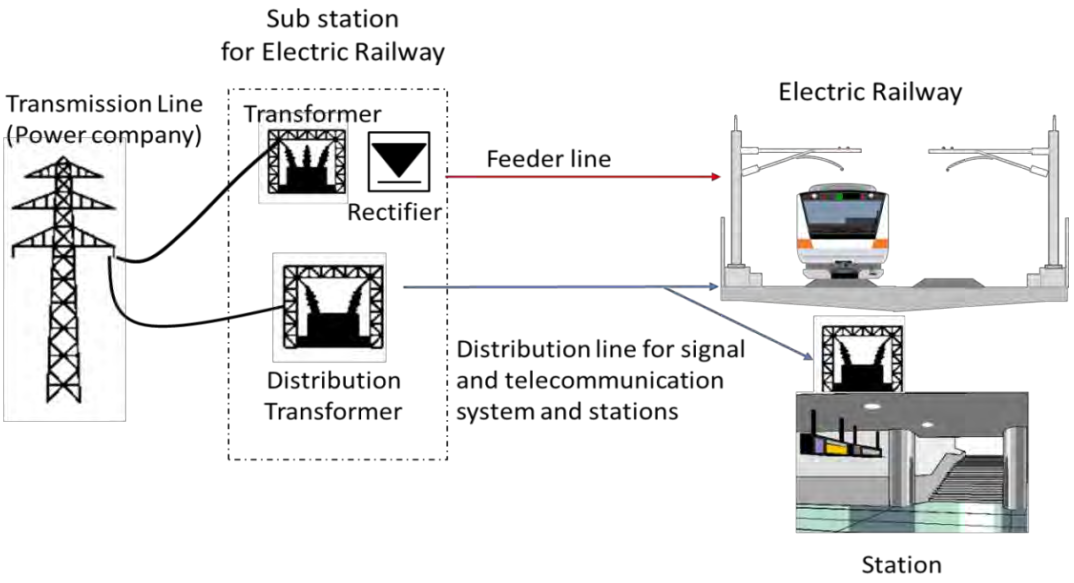
1.4.4.3. Signaling System

164. DOTr is to employ European Train Control System (ETCS) Level 2 (L2) signaling system. ETCS L2 uses a GSM-R-based communication system which exchanges information with trackside equipment to determine the position of the train and issuance of movement authority. ETCS L2 works with other functions such as (1) ATP (Automatic Train Protection), (2) Train Detection System, (3) Computer Based Interlocking System, and (4) Automatic Traffic Supervision System. Future provisions for integration of Automatic Train Operation (ATO) are also in place. ETCS L2 allows the trains to run at 160km/h enabling the system to reach the desired travel time of less than one hour between Manila and CIA.

1.4.4.4. Power Supply System

(1) Receiving Power Method

165. The Project adopts DC 1,500V supplying system for the following reasons: 1) Compatibility with the NSCR project; 2) Number of operating trains; 3) Interoperability; and 4) Total investment cost of rolling stocks and substations. It is necessary to obtain power distribution to the area from the five power companies (MERALCO) according to the Philippine franchise law. The power distribution voltage of 6.6 kV is employed. The receiving electric power at substation is three-phases for electric railway. **Figure 1.4.29** shows schematic chart of power supply system for electric railway



Source: JICA Design Team

Figure 1.4.29 Schematic Chart of Power Supply System (DC type)

(2) Substation

166. The location and plan of substation will be consulted and coordinated with Manila Electric Company (MERALCO) during detailed engineering design stage. The substations will be designed to be located under the viaduct and within the 30m ROW. Typical plan of substation is shown in **Figure 1.5.16**. Indicative locations are shown in **Table 1.4.18**.

Source: JICA Study Team

Figure 1.4.28 Typical Plan of Substation

Table 1.4.18 Indicative Location of Substations

Substation TSS No	**Location** (m)	**Nearest** Station	**Site**
No. S1	4km600	España	below the viaduct
No. S2	9km541	Paco	below the viaduct
No. S3	13km116	EDSA	below the viaduct
No. S4	16km280	Nichols	below the viaduct
No. S5	20km614	Bicutan	below the viaduct
No. S6	23km220	Sucat	below the viaduct
No. S7	25km730	Sucat	below the viaduct
No. S8	28km040	Alabang	below the viaduct
No. S9	31km209	Muntinlupa	below the viaduct
No. S10	34km229	San Pedro	below the viaduct
No. S11	36km892	Pacita	below the viaduct
No. S12	40km162	Biñan	below the viaduct
No. S13	43km105	Santa Rosa	below the viaduct
No. S14	45km675	Cabuyao	below the viaduct
No. S15	49km093	Cabuyao	below the viaduct
No. S16	51km603	Banlic	below the viaduct
No. S17	54km919	Banlic	below the viaduct
Depot SP	In the Depot	Banlic	on the ground
No. S18	56km104	Calamba	below the viaduct

Source: JICA Design Team

(3) Power Distribution

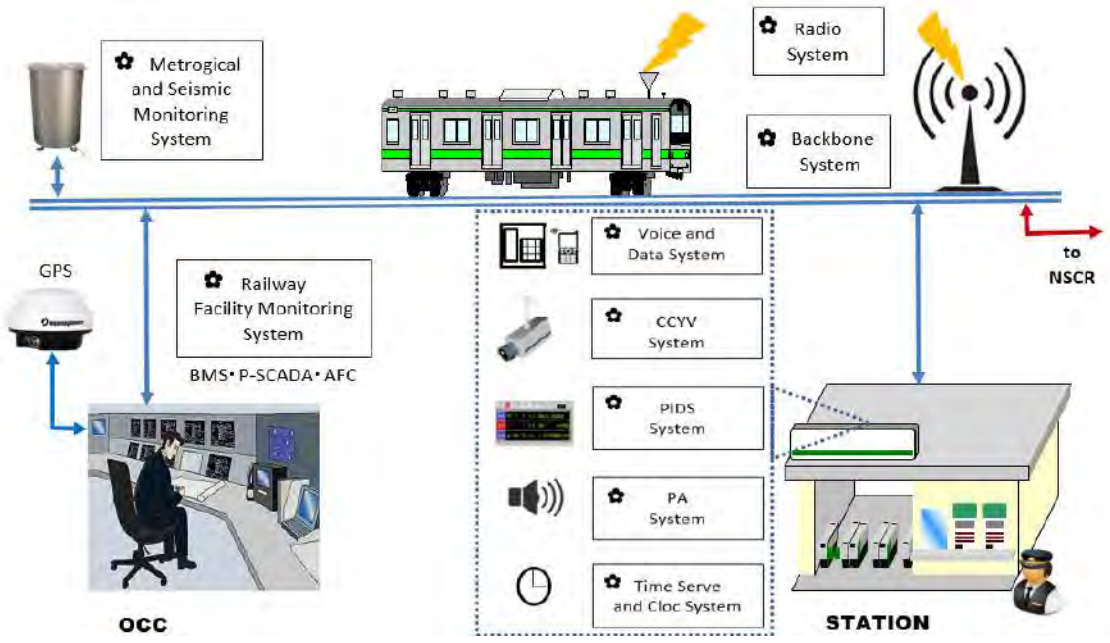
167. The power distribution system is installed along the track and supplies power to the station,

the signal equipment room, the communication equipment room, the depot, and other buildings involved in the operation of the train.

168. Procedures of the loss of primary power source resulting in stalled trains, loss of illumination, and availability of emergency power shall be included in an Emergency Response Plan for the operational phase of the Project. The plan shall follow the requirements of NFPA130 – Chapter 9 Emergency Procedures. Emergency power shall be provided in accordance with Article 700 of NFPA70 and Chapter 4 of NFPA110 or equivalent.[1,2]

1.4.4.5. Communication System (including Emergencies)

169. The Communication system is provided for safety and functionality of the train operation and convenience of passengers with connections among relevant railway facilities and systems. The Mabalacat Integrated OCC will act as the central command center of the whole NSCR, including the SCRP main line and interconnecting line. **Figure 1.4.29** presents the communication system overview.



Source: JICA Design Team

Figure 1.4.29 Communication System Overview

170. Emergency voice/alarm communications systems (EVACS) shall be designed, installed, inspected, tested, and maintained in accordance with NFPA72 or equivalent.[3] Enclosed stations shall be provided with a public radio enhancement system, two-way wired emergency services communication system and a one-way emergency communication system.

[1] NFPA70. National Electric Code. www.nfpa.org
[2] NFPA110. Standard for Emergency and Standby Power Systems. www.nfpa.org
[3] NFPA 72. National Fire Alarm and Signaling Code. www.nfpa.org

1.4.5. Supporting Facilities

1.4.5.1. Drainage Facilities

171. Drainage design objectives are to ensure that the Project structures (viaduct, embankment, at-grade track) take runoff from the rail area to the identified discharge points and introduce applicable improvement to rivers affected by the alignment and thus and not contribute to any increased flood risk. Further, it is to ensure that the project will not impede any drainage channels during construction. The drainage system of the station is considered a minor system while the drainage system of Depot is considered a major system.

172. The drainage systems of the project consist of exterior storm drainage and pavement surface drainage. Exterior storm drainage system functions include the collection and conveyance of surface discharge from building drain boxes and street or road drainage system. On the other hand, pavement surface drainage system functions include the collection and conveyance of surface runoff discharge roads or paved surfaces through curb inlet gullies and drainage pipelines.

(1) Location of Outfall Drainage Points

173. Outfall Drainage Points as shown in **Table 1.4.18** are nominated from the existing waterways which are crossing the alignment and have enough capacity as compared with inlet quantity of proposed drainage, for example, river, channel and drain. Those are also studied whether having adequate depth to connect the proposed drainage.

Table 1.4.18 Outfall Locations

Chainage	Station	Outfall	Remarks
2 + 193	Blumentritt	South Antipolo Realignment Canal	
3 + 770	España	España Street	
5 + 943	Santa Mesa	Pasig River	
8 + 709	Paco	Estero De Pandacan	
12 + 124	Buendia	PNR Canal	Unknown name
14 + 063	EDSA	Existing Drainage	Unknown name
15 + 387	Nichols	Maricaban Creek	
18 + 646	FTI	Existing Creek	Unknown name
20 + 340	Bicutan	Existing Creek	Unknown name
24 + 827	Sucat	Sucat River	
28 + 476	Alabang	Bayanan River	
31 + 391	Muntinlupa	Magdaong River	
35 + 296	San Pedro	San Isidro River	
36 + 370	Pacita	Existing Creek	Unknown name
38 + 928	Biñan	Biñan River	
41 + 980	Santa Rosa	Existing Creek	Unknown name
48 + 045	Cabuyao	Existing Creek	Unknown name
53 + 463	Banlic	San Cristobal River	
56 + 785	Calamba	Existing Drainage	Unknown name

Source: JICA Design Team

(2) Viaduct Section

174. Downpipes at the center of precast segment at the central portion are provided at a minimum spacing to suit the spacing of the track slab structure. The downpipes connect to a central longitudinal drainage pipe, which is suspended from the soffit of the top flange of the segment and concealed from view. The longitudinal drainage pipe then drains towards the nearest pier where it connects to the vertical drainage pipes embedded into the bridge pier. At the bridge piers, each vertical drainage pipe will drain into a catch pit at the ground level, from which it will be connected to the at-grade longitudinal drainage.

(3) Embankment Section

175. Rainwater will be collected by surface flow on the embankment and transferred to U-ditch/pipe installed in both sides along embankment. Catch basins are plotted at 40 m intervals along said U-ditch/pipe and connected to the down flow pipe to flow into the ground level drainage network and ultimately discharge it to the nearest outfall.

(4) At-Grade Drainage System

176. The design concept for at-grade drainage systems is divided into two types, based on the existing conditions.

Table 1.4.20 Basic Design Concept for Drainage

CASE	Existing Condition	Basic Design Concept
CASE 1	Areas with an existing drainage system	• New drainage systems should be designed with the same or higher capacity compared to other existing drainage systems • When existing crossing drain will be connected to new drainage, new drainage should be designed in consideration of additional flow volume assumed by existing drain section.
CASE 2	Areas without an existing drainage system	• New drainage systems should be designed to allow the draining water to flow smoothly. • The design of the catchment area is considered only in for the ROW.

Source: JICA Design Team

177. Drainage location in ROW: at-grade drainage is designed on one side of Project ROW only. It is made in consideration for the future construction of freight rail paralleled with the project planned by DOTr.

178. Crossing existing roads: the drainage is planned as an embedded culvert under the said road with the minimum cover 0.90m. However, the said road should have no heavy traffic and should be expected no lifeline installation, the above minimum cover may not be kept in consideration to avoid unnecessary depth of the drainage.

179. Crossing existing canal and ditch: the new drainage is designed to under the existing ones without connecting each other basically to avoid excess flow inlet. Because some of existing canals are utilized for irrigation, new drainage shall not be connected to them to prevent contaminated water from entering.

(5) Depot site

180. The drainage system of the facility consists of the following:

- Exterior storm drainage system – functions include the collection and conveyance of surface discharge from building drain boxes and street or road drainage system.
- Pavement surface drainage system – functions include the collection and conveyance of surface runoff discharge roads or paved surfaces through curb inlet manholes and drainage pipelines.

181. It should be noted that the Depot site is green space. After the Depot is built, the coefficient of run - off will rise. Therefore, the amount of runoff will increase. Therefore, a retarding basin will be provided for the purpose of suppressing outflow of rainwater. By setting up the adjustment Retarding Basin, the flooding of rivers of the discharge destination will be limited within the same amount of discharge as existing.

1.4.6. Emergency System

1.4.6.1. System application

182. The project incorporated into the project design safety principle material related below. Each expected failure mode is shown for the different systems, the expected failure effects will be calculated and respectively show the safe failure and hazard failure. In implementation, it will be required to be accompanied by the internal audit material by the contractor's organization or third-party specialist audit. A frequency allocation from the relevant authority will be obtained if necessary.

(1) Emergency generator

183. OCC Training and CIA station will install emergency generators for disaster prevention, fire and outage of an electric power company. The emergency generator automatically establishes power supply within 10 seconds after detecting a power failure and supplies emergency power.

184. Emergency power in accordance with Article 700 of NFPA 70 and Chapter 4 of NFPA 110, or equivalent, shall be provided for enclosed stations.

(2) Weather and Seismic Monitoring System

185. The Weather and Seismic Monitoring System is provided for prevention of possible damage suffered from potential natural disaster (Typhoon or earthquake) to the railway facilities and safety of passengers. The natural disaster is predicted by information from the sensor of Rain Gauge, Seismograph and Water Level.

(3) Public Address System

186. The Public Address System is provided for the announcement of train operation status, precaution against train approaching and incidental information from OCC and/or each local station for safety and convenience of passengers. Speech generating devices are used for pre-recorded message as needed. Other requirements for emergency communications are provided above in Section 1.4.5.5.

1.4.6.2. Design application

(1) Viaduct

187. The emergency stair is a facility provided on the viaduct to evacuate in an emergency if the distance between stations is large and it is impractical to walk back to the nearest station. It provides access from the viaduct to the ground and it will be a concrete structure with cast-in-place pile, and footings and pier. It will be constructed after completion of the viaduct erection, but the foundation and footing shall be constructed at the same time as the viaduct foundation work. The bridge piers and superstructures will be constructed after the completion of viaducts as they will interfere with temporary stock of viaduct segments.

(2) Station

188. In case of emergency, the station design has considered the Evacuation Plan, Fire Alarm and Detection System, CCTV/Surveillance system and Emergency Call system.

(3) Underground

189. The design criteria for the underground section of this project is still under discussion and will be finalized during the DED stage.

190. The underground section shall be equipped with mechanical systems including, but not limited to, plumbing, tunnel drainage systems, pumping systems, flood gates, tunnel ventilation, air conditioning, control units, emergency generators, and a fire protection and suppression system. Regular inspection of the underground facilities shall be conducted as a preventive measure for emergency situations.

191. Safety protocols and rescue procedures in case of emergency within the underground section shall be incorporated in the emergency procedural plan that shall be produced by the DOTr Project Management Office (SCRP PMO). The plan shall be consistent with the requirements for Emergency Response Plans per Chapter 9 of NFPA130.

(4) Underground Fire Safety

192. Fire safety measures for underground stations shall be in accordance with NFPA130 (2020). Provisions within the standard which shall be included within the Project design, construction and operational phases include at least the following:

- For Stations (Chapter 5):
    - Occupant Loading
    - Means of Egress and Egress Lighting
    - Ramps, Stairs, escalators, Doors, Gates and Exit Hatches
    - Automatic Fire Suppression
    - Portable Fire Fighting
    - Emergency Power
- For Trainways (Chapter 6):
    - Occupancy
    - Construction
    - Emergency Egress and Access
    - Emergency Lighting

    - Blue Light Stations
    - Automatic Fire Suppression
    - Portable Fire Fighting
    - Emergency Power
- For Emergency Ventilation Systems (Chapter 7):
    - Design Considerations
- For Emergency Procedures (Chapter 9):
    - Emergency Response Plans
    - Emergency Procedures
    - Control Center and Command Posts
    - Training, Drills, etc.
- For Emergency Communications (Chapter 10):
    - Control Center and Communications Systems

1.4.7. Universal Design

1.4.7.1. Design Applied for Stations

193. The easy and universal access for all types of passengers will be incorporated in the station design. The following universal design principles shall be applied to the stations:

- **Continuous Easy-transferred Path**: A safe passageway form the entrance on the ground to the platform is clearly specified priority implementation. Signage including guide tiles/textured paving blocks are necessary to support to move smoothly the above passageway.
- **Safety Plan**: Take thorough countermeasures to ensure safety plan, e.g. no steps on the floor or an appropriate alternative solution, equipment for fall prevention and crash prevention. Unconsidered steps are restricted for safe and secure.
- **Adequate Dimensions**: Adequate dimensions for space shall be decided after considering various action spaces, caring spaces, change in direction, the view height for signage and so on.
- **Economy, Efficiency & Flexibility**: No need to pay special consideration for the elderly and the physically-challenged but need to pay kind consideration for all. It is more economical, efficient and flexible.
- **Handle-ability & Visibility**: In principle, easy-understand station plan is a priority to aim. User-friendly design for multilingual guide supports this effectively.
- **Installation standards**: In considering the universal design in this project we should consider not only "BP 344 - Accessibility Law and its IRR" of the Philippines but also "Guideline of passenger facilities to improve ease of public transport use by the elderly and the disabled" of Japan.
- **Multipurpose toilet**: Installation of more than one multipurpose toilet for men and women who can use without any hesitations, including disabled, elderly, mother and baby, including LGBT (sexual minorities).

194. The stations shall also adopt universal design in the following ancillary facilities:

(1) Station Access and Egress

195. For the vertical movement of passengers from the ground level to the station underground or aboveground, escalator and elevators will be provided for the station. Similarly, the installation of escalators will also be considered for the stations for ease of access into and out of the station.

196. Elevators and escalators are also an effective means of giving comfortable access to the elderly, disabled and mobility impaired passengers. The installation of two-way elevators will be considered in stations with limited space. An image of a typical two-way escalator is shown in **Figure 1.4.30**. Balustrades along stairs shall also be installed with two levels for persons of different heights as shown in **Figure 1.4.31.**

(Source: JICA Study Team)

Figure 1.4.30 Typical Two-Way Elevator

(Source: Toyko Metro)

Figure 1.4.31 Two-Level Balustrade

197. To further the convenience of the elderly, disabled, and mobility impaired passengers, the following facilities shall also be considered:

- Flat access for passengers of wheelchairs by providing ramps and/or elevators, etc. (**Figure 1.4.32**);
- Wheelchair transport installed along stairs/escalators for stations without elevators due to limitations in space (**Figure 1.4.33**)
- Braille signage at the Ticket Vending Machine (**Figure 1.4.34**).

(Source: Tokyo Metro)

Figure 1.4.32 Sloped Ramp

(Source: Tokyo Metro)

Figure 1.4.33 Typical Escalator/Stairs Accommodating Wheelchair Transport

(Source: Tokyo Metro)

Figure 1.4.34 Braille Signage

198. Specific attention shall be paid to means of egress for underground stations. They shall be designed to account for evacuation times, travel distance and alternate egress as specified in NFPA130. In addition, underground stations shall meet egress requirements for elevators, doors, gates, exist hatches and fare barriers per NFPA130.

(2) Station Lighting

199. The lighting system level is designed for 200 – 300 lux for the station platform and concourse. The power supply plan for the lighting system will include the connection to the emergency power system in case of power outages. Emergency light fixtures and exit signs shall be wired separately from emergency distribution panels. Station lighting for egress in stations shall be in accordance with Section 7.8 of NFPA 101. Exit signs, essential signs, and emergency lights shall be included in the emergency lighting system in accordance with NFPA 70.

(3) Passenger Information Facilities and Terminals

200. The stations will be equipped with terminals that give passengers timely information on train schedules, train operation status and other relevant data at the passenger level. This system will be linked with SCADA and OCC.

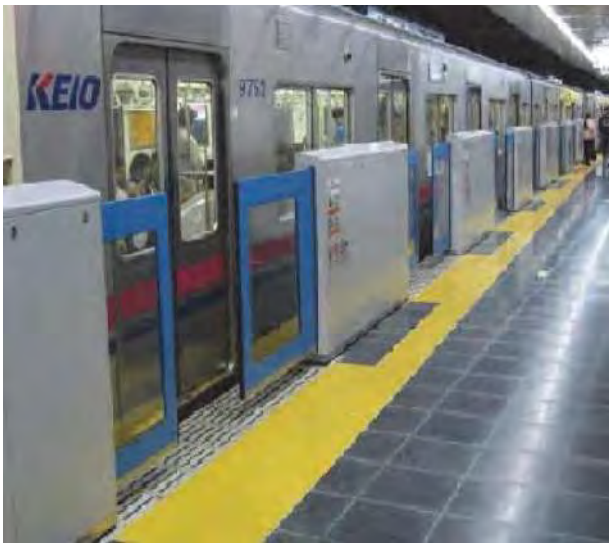
201. A video monitoring system will be employed to smooth out operations especially during rush hours by giving dispatches and controllers real time information from the platforms and concourses of the stations.

(4) Platform Screen Doors

202. All platforms will be installed with Platform Screen Door (PSD) for passenger safety. The stations will also adopt universal design, which incorporates the Barrier-Free Guidelines for elderly, children, and persons with disabilities by both the Philippines and Japan. Examples of PSDs are shown in **Figure 1.4.35** and **Figure 1.4.36.** Any doors shall meet the requirements of NFPA130.

(Source: JICA Study Team)

Figure 1.4.35 Full Height Type PSD



(Source: JICA Study Team)

Figure 1.4.36 Half Height Type PSD

1.4.7.2. Design Applied for Rolling Stock

203. The rolling stock shall also be applied with the following universal design principles:

- Identification band (cleat) on the floor just before the door
- Indicator light and chime (inside and outside) at opening and closing doors
- Women only cars which are exclusive use for women and small children either for the entire day or during peak hours (**Figure 1.4.37**);
- Cars with priority seating for the elderly, disabled and expectant mothers (**Figure 1.4.38**); and
- Wheelchair access and space in the car (**Figure 1.4.39**)

(Source: JICA Study Team)

Figure 1.4.37 Women Only Cars

(Source: JICA Study Team)

Figure 1.4.38 Priority Seating

(Source: Tokyo Metro)

Figure 1.4.39 Wheelchair Space

1.4.7.3. Emergency Walkway System

204. Emergency walkway system is included in the rail design in case of detrainment. The walkway, which will be designed in accordance with NFPA130, will run continuously along the whole main line on both sides of the track and shall incorporate a walking surface and handrail to enable passengers to safely evacuate the train at any point along the viaduct so that they can proceed to the nearest station, nearest cross-passageways or other point of safety.

1.4.8. Temporary Facilities

205. A survey for possible temporary facilities locations was carried out during DD phase for contractor's information. The actual sites will be selected by the contractors. If any land acquisition and resettlement will incur, the Project is to conduct the RAP. ECC will be separately obtained for construction yard and batching plant in accordance with the PEISS.

1.4.8.1. Construction yard

206. A temporary construction yard of approximately 83,000 m^2 will be located outside the ROW. The temporary facilities that will be installed within the temporary construction yard will consist of the following; 1) Office (Contractor and Engineer), 2) Laboratory, 3) Labor Quarter (1,000 workers), 4) Warehouse, 5) Rebar, Form Fabrication Yard, 6) Batching Plant, 7) Segment Fabrication Yard, and 8) Storage Area. Separate ECCs will be secured by the Contractor for the Rebar, Form Fabrication Yard, Batching Plant and Segment Fabrication Yard. Contractor will also be responsible for identifying sites for these facilities. Selecting sites for construction camps and other construction facilities will be at least 300m from sensitive receptors such as residential housing areas, hospitals, schools, religious and cultural sites.

207. A construction yard will consist of the following:

Table 1.4.19 Temporary Facilities

Temporary Facility	Area (m^2)
Office (Contractor & Engineer), Laboratory	2,000 m^2
Workers' Quarter (1,000 workers)	5,000 m^2
Warehouse	1,000 m^2
Rebar, Formwork Fabrication Yard	3,000 m^2
Batching Plant	7,000 m^2

Temporary Facility	Area (m^2)
Segment Casting Yard	42,000 m^2
Storage Area	23,000 m^2
Total	**83,000 m^2**

Source: JICA Design Team

1.4.8.2. Construction Access

208. All roads used for construction access including roads which run through urban areas and narrow areas must be always maintained in good condition. Flooded roads will affect the transport of equipment and materials. Thus, a drainage system must be carefully designed. At the planning stage, it is important to design durable roads, which won't be damaged during the dry and rainy seasons. Measures against dust will also be considered to protect local neighborhoods. Vehicle wheel washes will be installed at the exists from site.

209. Public roads will be used for the transportation of equipment and materials to the site from the suppliers or the port. Heavy machinery (piling machine, crane, and backhoe etc.) will be delivered to the site by trailers. A Traffic Impact Assessment was conducted and recommended routes and access points suitable for oversized vehicles. The identified access roads are described in **Table 1.4.22.**

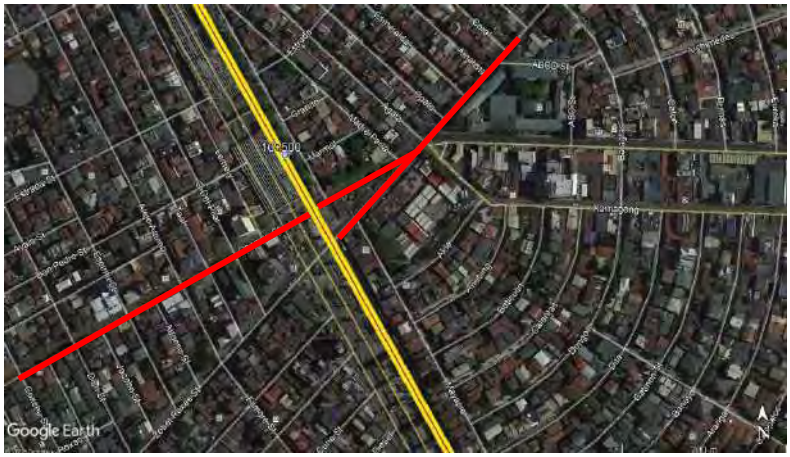
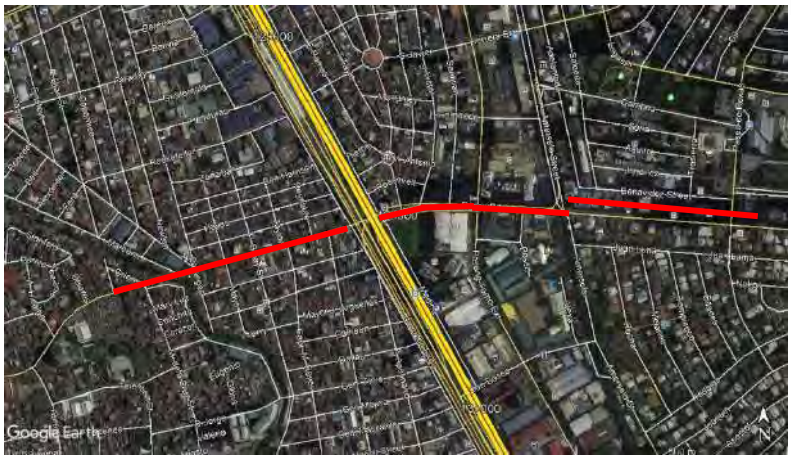
210. Oversized vehicles shall make deliveries at restricted times to avoid impact on the congested streets of Metro Manila. The contractor is required to coordinate with the traffic control department and if necessary, after obtaining permission from relevant organizations. Once the equipment and materials have been delivered to site, they will normally move on the site road which will run continuously along the ROW. However, when crossing rivers and large roads large vehicles will need to re-enter the public road system to make the crossing. When passing through residential areas or village roads, nuisance to residents will be avoided by coordinating with local traffic authorities the best times and providing traffic guards.

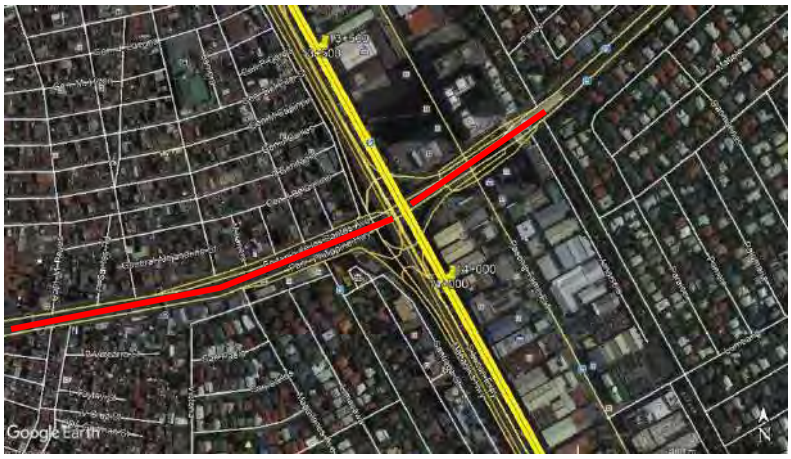
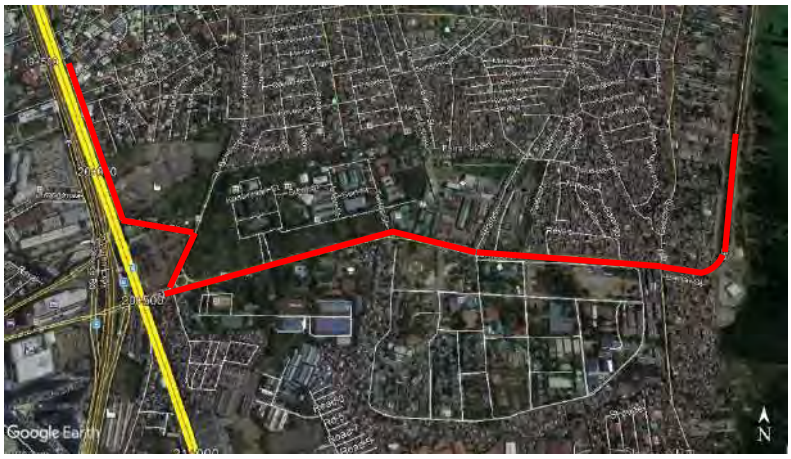
Table 1.4.20 Potential Access Roads (Public Roads)

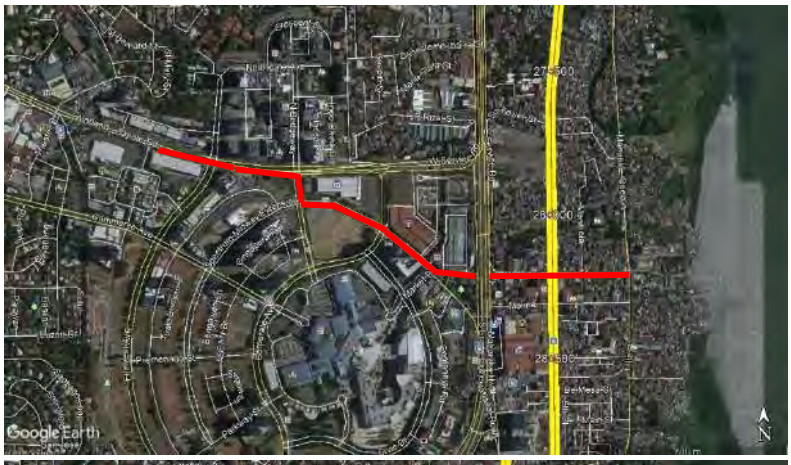
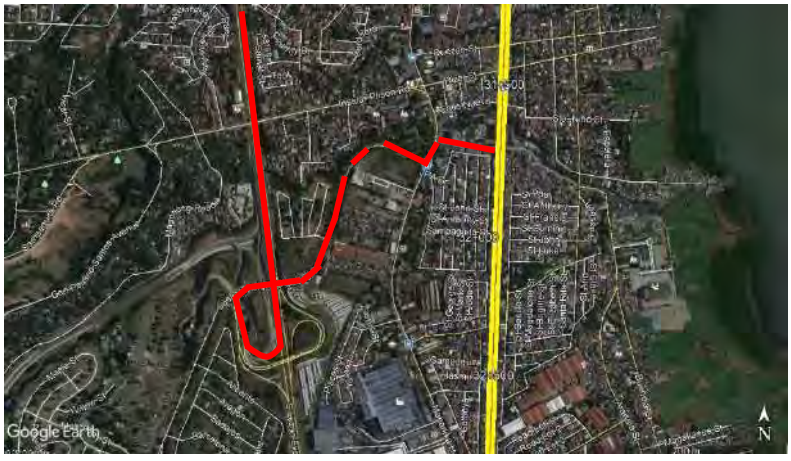
No.	Access Road/ Connection Road	Aerial Photograph	Land Requirement
1	Simoun Street, Maria Clara Street Laon Laan Street PNR Railway Sampaloc, Manila		Existing Road

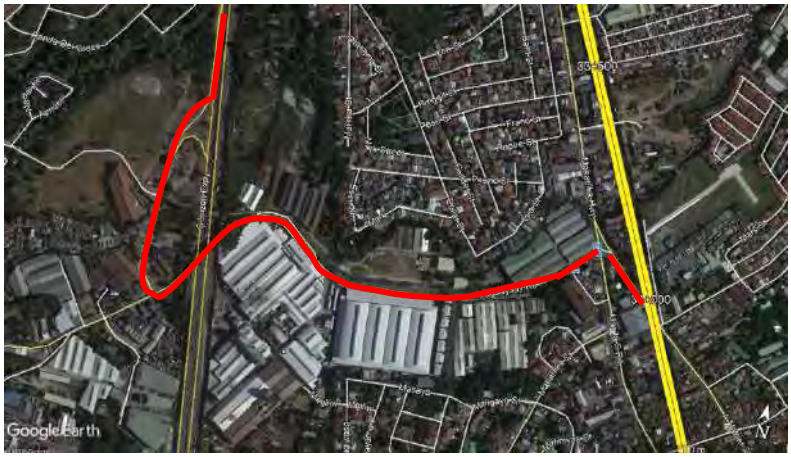
No.	Access Road/ Connection Road	Aerial Photograph	Land Requirement
2	España / Maceda Street Vicente Cruz Street España Sampaloc Manila		Existing Road
3	G. Tuazon Street V. Cruz Street, D. Santiago Street Sampaloc, Manila		Existing Road
4	Ramon Magsaysay Blvd. Pureza St.Extn. Old Sta. Mesa Rd Sta. Mesa Manila		Existing Road

No.	Access Road/ Connection Road	Aerial Photograph	Land Requirement
5	Paco-Sta Mesa Road, Old Sta. Mesa Road, Valenzuela Street Sta. Mesa, Manila		Existing Road
1 6	Quirino Ave., SLEX Quirino Avenue Extension Pandacan, Paco Manila		Existing Road
7	SLEX, San Andres Street, Quirino Avenue Diamante Street, Onyx Street SanAndres, & Malate Manila		Existing Road

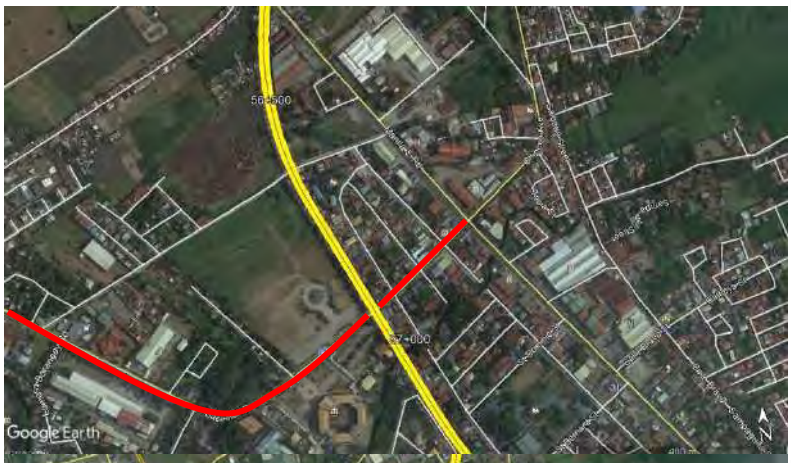
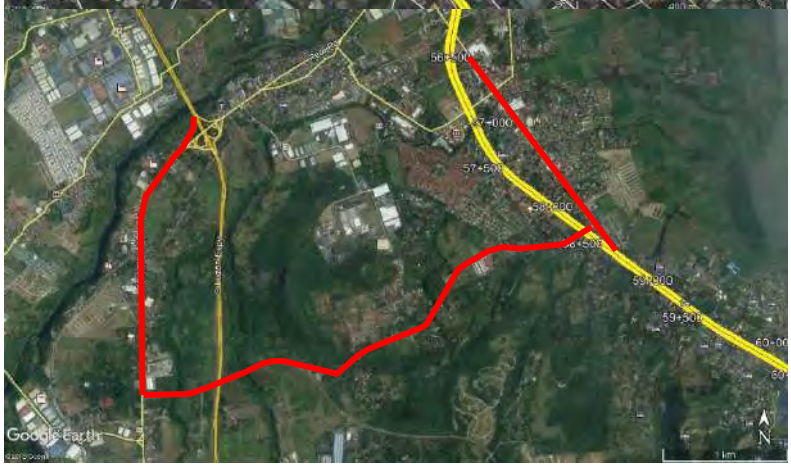
No.	Access Road/ Connection Road	Aerial Photograph	Land Requirement
8	SLEX, Ocampo Street, Radial Road 2 Zobel-Roxas Street, Kalayaan Ave. San Andres, & Malate Manila		Existing Road
9	SLEX, Osmeña Highway Buendia Avenue San Isidro and Pio del Pilar Makati City		Existing Road
10	SLEX, Osmeña Highway Pasay Road San Isidro and Pio del Pilar Makati City		Existing Road

No.	Access Road/ Connection Road	Aerial Photograph	Land Requirement
11	SLEX, EDSA Bangkal-Magallanes Makati City Metro Manila		Existing Road
12	SLEX. Sales Road, Avenida- Lawton Road Villamor, Taguig Metro Manila		Existing Road
13	C6 Road, General Santos Avenue East Service Road Bicutan, Parañaque-Bicutan, Taguig Metro Manila		Existing Road

No.	Access Road/ Connection Road	Aerial Photograph	Land Requirement
14	Dr. A.Bunye, Meralco Road Parañaque-Sucat Road, E Service Road Sucat, Parañaque		Existing Road
15	Alabang-Zapote Road Montillano Street Alabang, Muntinlupa		Existing Road
16	SLEX – Susana Heights Exit Manila South Road Tunansan, Muntinlupa		Existing Road

No.	Access Road/ Connection Road	Aerial Photograph	Land Requirement
17	SLEX, San Antonio Exit,Magsaysay Road,MSR,A. Mabini Street San Antonio, San Pedro, Laguna		Existing Road
18	Manila South Road Pacita Avenue San Pedro, Laguna		Existing Road
19	Manila South Road Gen. Malvar Street San Vicente, Biñan, Laguna		Existing Road

No.	Access Road/ Connection Road	Aerial Photograph	Land Requirement
20	Manila South Road Access Road Platero, Biñan, Laguna		Existing Road
21	Manila South Road Leon Arcillas Blvd. Tagapo, Sta Rosa, Laguna		Existing Road
22	Manila South Road, Rizal Blvd. Pook, Labas, Sta Rosa Laguna		Existing Road

No.	Access Road/ Connection Road	Aerial Photograph	Land Requirement
2 3	Manila South Road Jose P. Rizal Street Calamba, Laguna		Existing Road
2 4	Manila South Road, Real Road SLEX Bacnotan Road/Chipeco Ave. Extension Tagapo, Sta Rosa, Laguna		Existing Road
2 5	SLEX, Maharlika Highway, Manila South Road Ayala Greenfield Road La Mesa Calamba, Laguna		Existing Road

No.	Access Road/ Connection Road	Aerial Photograph	Land Requirement
26	Manila South Road New Road (access) Sucol, Calamba, Laguna		Existing Road
27	Manila South Road Junction Road Los Baños, Laguna		Existing Road
28	East Service Road Paranaque NCR		Existing Road

Source: JICA Study Team

1.4.8.3. Borrow Pit

211. Waste soil other than river sand contains gravel, and can be used as fill material for temporary roads, etc. All borrow pits are owned and managed by private companies, not by the government agencies based on the information gathered.

1.4.8.4. Spoils/Surplus Soil Disposal Area

212. For non-tunnel sections along the main line, areas designated by LGUs shall be used as soil disposal areas. All will be subject to ECC, to be secured by the relevant contractor.

213. As the construction of the interconnecting line will involve tunneling and excavation, it is expected that a large volume of soil will be generated hence, a separate disposal area will be necessary. With the estimated volume of excess soil to be generated, the proponent is looking at two proposed soil disposal areas located in the 1) Barangay Muzon, and 2) Barangay Sta. Ana, both in the Municipality of Taytay, Rizal. The proposed disposal areas are both owned by the Municipality of Taytay and is presented in **Plate 1.5.1**.

214. The proposed spoil disposal area in Barangay Muzon has a total area of 13 hectares and is located about 12 linear km from the proposed FTI Station. The area used to be a dumpsite of the municipality but it is currently hauled out as the LGU is planning on developing the area into a Sports Complex thereby, spoils coming from the proposed project is welcomed by the LGU**.** **Plate 1.5.2** shows the current condition of the area.

215. On the other hand, the proposed spoil disposal area in Barangay Sta. Ana has a total area of 9 hectares and is located beside the existing backfill area of the Pasig Marikina River Channel Project Phase III of DPWH and is about 9 linear km from the proposed FTI Station. The area is currently vegetated is being used by some people as fishpond/fishing area and/or propagation area for ducks from time to time due to its proximity to the Laguna Lake. **Plate 1.5.2** shows the current condition of the area.

Plate 1.4.1 Current view of the Proposed Spoil Disposal Area in Muzon, Taytay, Rizal

Plate 1.4.2 Current view of the Proposed Spoil Disposal Area in Sta. Ana, Taytay, Rizal

216. Due to the nature of the use of the area and its proximity to the Laguna Lake, the proponent, through its Contractor, shall to secure various clearances and permits from the Barangay, LLDA and DENR-EMB such as LLDA Clearance (LC), ECC, Shoreland Development Clearance, road occupancy, and traffic management before they can legally conduct any activity particularly the backfilling.

217. When any material, including surplus or unsuitable materials from excavation, are to be disposed of outside the right-of-way, the Contractor shall first obtain a written permit from the property owner of the proposed disposal site. He shall submit to the Engineer the said permit of certified copy thereof together with a written release by the property owner absolving DOTr from any and all responsibility in connection with the disposal of the material at sites.

218. Local communities must give their informed consent before any spoil disposal site shall be permitted. The Contractor shall supply the Engineer with a copy of his relevant agreements with any landowner when so directed.

1.4.9. Pollution Control Devices

1.4.9.1. Air Pollution Control Facilities

(1) Dust Control System

219. The air pollution by dust might generate temporary during the construction of the Project. Nonetheless, these will be appropriately mitigated. To minimize dust suspension, the following measures will be implemented:

- Minimize alteration of topography and removal of vegetation to minimize earthworks;
- Regular cleaning and clearing of construction access /sites of spoils and debris from construction equipment and vehicles and wetting of ground soil when necessary;
- Store excavated materials at designated disposal area. Construction materials and trucks loaded with spoils will be covered;
- Undertake daily cleaning of paved routes around the pier construction sites;
- Control vehicle movement maintaining the speed limit within the construction site to <10kph;
- Reseed bare ground as early as possible and create a vegetated buffer zone where possible.
- Regular preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standards. Wherever possible, use electrically-powered equipment;
- Minimize vehicle transport by maximizing the use of site-generated materials.
- Air quality will be monitored at identified baseline sampling points including nearby sensitive receptors (residential, school and hospital areas) and ecologically significant area/s (if any) likely to be affected by the operation of construction machines and evaluate effectiveness of the air pollution reduction measures provided.

(2) Air Conditioning and Ventilation system at the station

220. The air conditioning system is comprised of air-conditioning and mechanical ventilation for the elevated stations. For areas such as railway equipment rooms, individual air conditioning units shall be provided. Sufficient air exchange by means of mechanical ventilation will be also provided in accordance with local code requirements, or the design guidelines of the MILT-J (Ministry of

Land, Infrastructure, Transport and Tourism of Japan) and other authorized Japanese technical codes.

221. Emergency ventilation systems shall be provided in any enclosed station, or trainway that is greater than 305m in length. The emergency ventilation system shall be designed according to the requirements of NFPA130.

1.4.9.2. Noise Control System

(1) Construction Noise

222. The Noise will be generated during construction of the Project. The mitigation measures for construction are as follow:

- Plan construction activities in consideration of time and scale of construction to optimize the use of construction equipment, types of machinery, and vehicles to minimize nuisance noise. Schedule high noise-generating activities during daytime to reduce disturbance to nearby communities;
- Use temporary noise suppressing curtains around noisy activities when possible if noise level produced exceed legal limits at receptors.
- Installing 3-m high perimeter temporary wall around construction cut-and-cover construction site of the FTI underground station.
- Provision of noise control devices such as mufflers and noise suppressors for all construction equipment and types of machinery to help minimize the generation of noise. Use of electric instead of diesel-powered equipment and hydraulic tools instead of pneumatic tools;
- Regular inspection and preventive maintenance of heavy equipment, machinery and service vehicles to meet the DENR Emission Standard;
- Minimize vehicle transport by maximizing the use and recycling of materials generated on-site;
- Provision of training on noise mitigation and provide appropriate personal protective equipment (PPE), e.g. earmuffs to construction workers; and
- Monitor noise levels at identified sampling point including nearby sensitive receptors (residential, school and hospital areas) including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the noise reduction measures provided.

(2) Operation Noise

223. To mitigate the potential impacts of operation noise, a barrier will be installed at the edge of the viaduct as identified in the results and recommendations of the noise modelling report. Noise modeling carried out for the entire project section found that the projected noise levels from the railway project with the installation of a concrete noise barrier (continuous 1 m high concrete wall throughout alignment except for 773m length in 3 sections all in Makati City i.e. from chainage 7+682 to 7+804, north bound; from chainage 8+171 to 7+715, north bound; and from chainage 13+093 to 13+288, south bound. A composite noise protection wall with a vertical element of 3.0 m, and on top two elements of 0.25 m and slope of 45 degrees is provided at these three locations) coupled with the station walls is adequate to ensure no increase in background levels of more than 3 dB(A) by 2040 at the nearest receptor location off-site provided barriers are installed on both the northern and southern sides of the platform. The use of long rails and ballast-less track with elastic and absorbent sleeper supports will minimize the noise generation from train

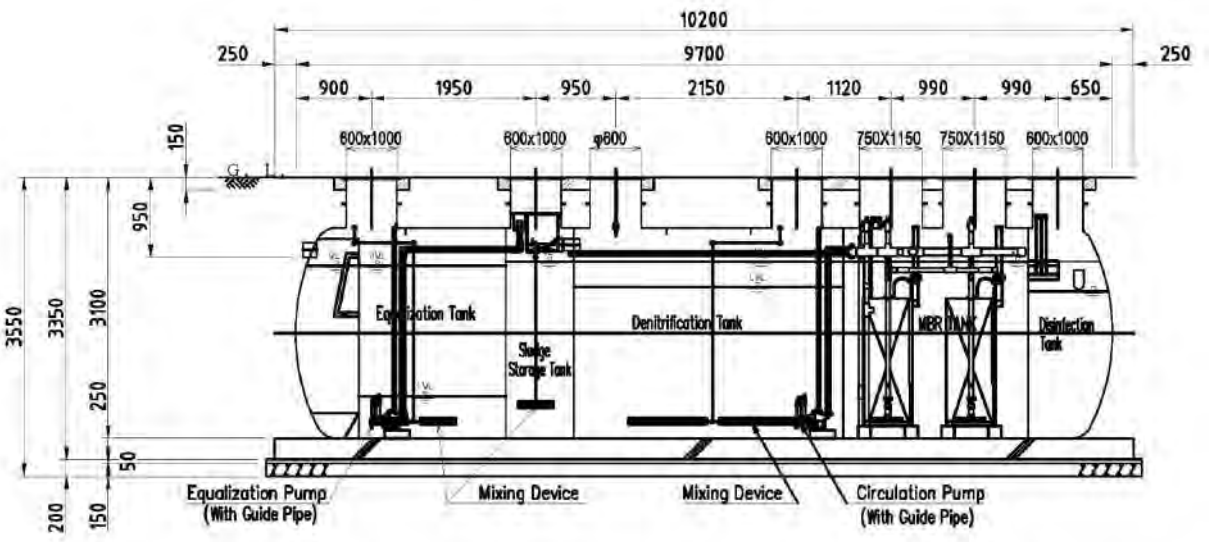
operation. All generator sets will be provided with mufflers. Provision for noise absorption panels will be installed in specific areas as required.

224. Specification of the parapet wall is as follows:

- Precast concrete parapet wall with specified 1.0 m height of the wall (except 773m length in 3 sections all in Makati City i.e. from chainage 7+682 to 7+804, north bound; from chainage 8+171 to 7+715, north bound; and from chainage 13+093 to 13+288, south bound. A composite noise protection wall with a vertical element of 3.0 m, and on top two elements of 0.25 m and slope of 45 degrees is provided at these three locations) from the base to the top of the wall;
- The nut shall be a self-locking type and shall be made of the same material with the anchorage bolt; and
- The base parapet wall shall be flat enough to place the precast concrete parapet wall. If not flat enough, it shall be finished using stiff mortar or non-shrinking grout within a thickness of 10 mm.

1.4.9.3. Water Pollution Control System

225. Wastewater from stations will be treated in a Sewage Treatment Plant (STP) prior to discharge into receiving body of water. Effluent from STP will be monitored to ensure that its quality meets the DAO 2016-08 or the Water Quality Guidelines and General Effluent Standards of 2016. The type of WTP that will be installed is a membrane bioreactor (MBR) process. **Figure 1.4.40** shows the cross-section of a Membrane Bioreactor.



Source: JICA Design Team

Figure 1.4.40 Cross-section of a Membrane Bioreactor

(1) Wastewater Management for the Senate-FTI Underground Section

226. Water is essential for any construction project as it is used during excavation, construction, cooling of machines, cleaning and septage. Wastewater resulting from these activities must be properly managed as well as properly treated prior to disposal. The management of wastewater

and the effluents standard to be complied with was decreed under DENR Standard as mentioned above. Wastewater must be treated to meet DAO 2016-08 standards prior to discharge into the environment.

227. The TBM contractor will be required to submit wastewater management plan. The submission of the wastewater management plan will be a requirement for contract bidding before any construction activities begin to ensure that proper wastewater management is observed. Temporary sanitation facilities such as portable toilets for use of the construction workers.

228. The proponent will be required to secure its Discharge Permit (DP) from either the Environmental Management Bureau (EMB) or Laguna Lake Development Authority (LLDA) before it can legally discharge treated effluent.

229. During the operation phase, it is foreseen that much of the wastewater to be generated by the interconnecting line will be from train maintenance and station operations (lavatories and station maintenance). The amount of wastewater to be treated in 2035 based on the number of passengers is estimated to be 0.50 MLD for the operation of FTI and Bicutan Stations.

230. As discussed above, wastewater treatment facilities will be installed in each station to treat the wastewater generated. Wastewater must be treated to meet DAO 2016-08 standards prior to discharge into the environment. Similar with the construction phase, the proponent will also be required to secure its DP from either the EMB or LLDA before it can legally discharge treated effluent.

1.4.9.4. Solid Waste Management System

231. Waste materials generated by the Project are classified as hazardous and non-hazardous wastes. Separate receptacles and storage areas will be established for each type of waste identified at the Project site.

232. Non-hazardous solid waste will be classified as compostable, reusable, recyclable, and residual. These will then be disposed of through the local waste streams, based on their classification.

233. DOTr will comply with disposal regulations as stipulated in the Ecological Solid Waste Management Act of 2000 or Republic Act 9003 and its Implementing Rules and Regulations (IRR), the DAO 2001 – 34. Hazardous waste will be classified based on Republic Act 6969 or the Toxic Substances and Nuclear Wastes Control Act 1990. The responsibility of getting hazardous wastes collected, treated and disposed belongs to the proponent/contractor. Similarly, the proponent/contractor will also be registered as a hazardous waste generator with DENR which requires the proponent to secure its Hazardous Waste Generator's ID (HWID).

234. Any hazardous wastes collected during the construction of the Project must be properly collected by a DENR accredited hauler, treated and disposed by a DENR accredited treater. Lime slurry wastes, if any are produced during the tunnel boring process, is considered hazardous if it has a pH above 12.5. Alkali wastes such as lime slurry will be neutralized and treated prior to disposal.

235. In general, during the construction, the solid wastes generated from the proposed Project will be of the following types: 1) Debris and other materials removed from construction activities such as spoils or excavated materials, 2) Domestic waste consisting of compostable waste

materials from food and recyclable or residual materials such as plastics, wrappers, crates or boxes for food supply of workers, 3) Industrial solid wastes, such as damaged vehicle and equipment parts, etc.; and 4) Hazardous wastes such as fuel/lube oil sludge, fluorescent and LED bulbs, and lime slurry wastes.

236. On the other hand, during operation, the solid wastes generated by the project will be of the following types; 1) domestic waste consisting of compostable waste materials from food and recyclable or residual materials such as plastics, wrappers, crates or boxes for food supply of employees and train passengers, 2) Industrial waste and 3) Hazardous wastes such as fuel/lube oil sludge, and bulbs will be generated.

237. **Table 1.5.15** shows estimated waste generated at Depot, Workshop, and Stations. Meanwhile, options for disposal of non-hazardous solid wastes and construction wastes are shown in **Table 1.5.16**. RA 9003 encourages the segregation of wastes, as such, appropriate waste containers must be provided during the operation phase.

Table 1.4.21 Wastes Generated by Rolling Stock Maintenance at the Depot, Stations and Workshop

Location	Waste generated from	Estimated kg /day
Depot	Train Preparation Works: Domestic waste generated by passengers	1,050
	Light Maintenance	20
	Unscheduled Repair	50
	Wheel Re-profiling	378.4
	Office Works for above related works: Domestic waste generated by workers and/or employees*	32.1
Workshop	Waste water	400
	paper	200
	Cloth	80
	Oil infused cloth	50
	Sealing materials	30
	plastic	20
	used oil	20
	rubber	50
	others	150
Main Line	Train passengers/ users (516,000 in 2025, based on demand forecast)	154,800
	Office Works (350 staff) *	105
Interconnecting Line	Train passengers/ users (14,800 in 2025, based on demand forecast)	4,440
Total		**161,875.5**

Note. 0.3 kg per person per day

Table 1.4.22 Options for Disposal for Different Types Solid Wastes and Construction Wastes

Waste Material	Options for Disposal
Recyclable Plastics	Recycle
Cardboards and Papers	Reuse or Recycle
Metals	Recycle
Organic Material/Waste Food	Composting
Wood	Mulch and biomass

Waste Material	Options for Disposal
Concrete	Crushed into gravel and used as backfill, reclamation, etc.
Dirt, Rock, Sand	Backfill, landfill cover, reclamation, etc.
Inerts	Road base
Residuals	Landfill

238. In addition to that, hazardous wastes are also expected to be generated during the operation phase. The types of common hazardous waste foreseen to be generated during the operation of the Project can be found in **Table 1.4.17.**

Table 1.4.23 Potential Hazardous Waste to be Generated during the Operation of the Project

Waste Material	Waste Number
Grease Wastes	H802
Used industrial oil including sludge	I101
Oil-contaminated materials	I104
Paints	M507
Busted fluorescent lamps	M507
Spray canisters	M507
Batteries	M507

239. As mentioned previously, the responsibility of getting hazardous wastes collected, treated and disposed belongs to the proponent. Also, the proponent will be registered as a hazardous waste generator with DENR which requires the proponent to secure its HWID.

(1) Spoils/Surplus Soil Management

240. As with any project involving excavation, surplus soil will be generated especially in the shield tunneling and cut and cover tunneling parts of the project. It was computed by the JICA Design Team that the construction of SCRP will generate at least about 2,368,288 m^3 of earth materials. With the assumption that soil and clay have a bulk density of 1.8 MT/m^3, it is estimated that 4,262,918 MT of surplus soil will be generated throughout the construction phase of the Project. This is equivalent to about 426,292 truckloads of soil assuming 10 m^3 trucks are used to haul the soil.

1) Main Line

241. The development of the main railway line is projected to produce at least 810,588 m^3 of spoil from excavation works which may increase in the actual activity. The sources of spoil will come from the construction of viaduct pile and pile cap, building and station, and drainage and roads. The summary of the estimated volume of spoils to be removed per contract package (please refer to Section 1.7.2 for contract package details) is presented in **Table 1.4.24**.

Table 1.4.24 Estimated Spoil Excavation during Construction Phase

Contract Package	Construction Works			Volume of Spoil Removed (m^3)
	Viaduct Pile and Pile Cap (m^3)	Buildings and Stations (m^3)	Drainage and Roads (m^3)	
CP S-01	25,211	See Note 1	8,755	33,966
CP S-02	91,927	See Note 1	48,925	140,852

Contract Package	Construction Works			Volume of Spoil Removed (m^3)
	Viaduct Pile and Pile Cap (m^3)	Buildings and Stations (m^3)	Drainage and Roads (m^3)	
CP S-03	See Note 2	See Note 2	See Note 2	See Note 2
CP S-04	94,238	See Note 1	46,564	140,802
CP S-05	137,596	See Note 1	68,996	206,592
CP S-07	131,734	See Note 1	69,075	200,809
CP S-07 (Depot)	51,867	See Note 1	35,700	87,567
Total				**810,588**

Note: 1) Building and Stations' excavations are utilized as backfill or embankment
2) To be estimated

Source: JICA Design Team

242. Ideally, the surplus soil within the main railway line can be used as fill material for temporary roads, etc. All borrow pits are owned and managed by private companies, not by the government agencies based on the information gathered. Excess spoils shall be disposed of in areas designated by the LGUs as mentioned previously.

2) Interconnecting Line

243. An estimated volume of 1,557,700 m^3 of surplus soil will be generated over the entire construction period of the new section, estimated at 4 years. Excavation through cut and cover is estimated to generate 130 m^3 of excavated soil per day per construction party, while excavation through TBM will approximately generate 200 m^3 of excavated soil per day for each TBM. Given this scenario, the estimated number of dump trucks needed to haul the surplus soil at a rate of 10 m^3/truckload is presented in **Table 1.4.27**.

Table 1.4.25 Estimated daily soil hauling requirement

Method	Estimate Rate of Extraction (m3/day)	No. of Hauling Trucks Needed (per day)
Cut and cover	130 (per construction party)	13 (per construction party)
Tunnel Boring Machine	200 (per TBM unit)	20 (per TBM unit)

244. The surplus soil to be produced by the tunneling in the Senate-FTI underground section will be disposed to the two identified Spoil Disposal Areas (SDA) in the Barangays of Muzon and Sta. Ana in the Municipality of Taytay, Rizal as shown in **Figure 1.4.13**.

(2) Recycling uses of excavated soils

245. All suitable excavated materials shall be used, insofar as it is practicable, in constructing the Works. Surplus and unsuitable materials whether from site clearing, excavations, cut or fill slopes, landslides or maintenance operations, shall be considered and termed as spoil. All excess soil generated by the project is either reused or disposed of at designated disposal sites.

246. If excavated materials are wasted, the volume involved shall be reported so that Quality Control requirements may be adjusted accordingly.

247. Any excavation carried out beyond the construction limits shown or described on the project drawings or beyond the dimensions resulting from adjustments made by the Project Engineer shall be backfilled with approved materials as directed by the Project Engineer, all at the Contractor's expense.

(3) Preparation of the disposal site

248. The Contractor shall prepare each approved disposal site by:

- Marking the boundaries of the site with white paint so that the perimeter is clearly visible;
- Erecting a sign at the entrance to the site with the words "Metro Manila Subway Project Disposal Area";
- Carrying out appropriate and effective drainage works to the satisfaction of the Project Engineer; and
- Constructing spoil retention structures around the perimeter as approved by the Project Engineer

249. Spoil shall be placed in shallow layers and compacted. The Contractor shall monitor the condition of each disposal site and shall submit a report to the Project Engineer at least monthly to include:

- Volume of materials disposed of at site;
- Any signs of movement or instability;
- Any movement of excavated wastes beyond the perimeter of the site; and
- Any erosion and sediment deposition caused by runoff from the site

(4) Closing the disposal site

250. The Contractor shall modify their disposal practice and/or carry out remedial works to prevent erosion, instability or uncontrolled runoff as directed by the Project Engineer. The Engineer may direct that a disposal site be closed to prevent possible or further environmental damage and will then agree an alternative disposal sites with the Contract.

251. When ordered by the Engineer that any disposal site shall be closed to prevent environmental damage or because, in the opinion of the Engineer, it has reached its capacity, the Contractor shall render the site permanently stable by means of shaping, drainage, structural conservation measures and planting to the satisfaction of the Engineer, and in addition restore the area so that it satisfies any agreement with the landowner and complies to applicable governing laws.

(5) Disposal of contaminated soils

252. If contaminated materials are encountered, this will be removed from the site to the satisfaction of the Engineer. Whenever materials of doubtful characteristics are discovered in any area where excavation is being performed, or at places where embankment will be formed which, in the opinion of the Engineer, are contaminated shall be treated by an DENR-EMB accredited Treatment, Storage and Disposal (TSD) Facility and only be disposed of to a disposal site approved by the Engineer once it is safe to dispose elsewhere.

1.5. UTILITY REQUIREMENTS

253. Utility requirements during construction and operation phase include fuel, power supply, and water supply and construction access. Discussion of detailed information for the construction and operation phases is presented below. Meanwhile, some of the discussions were based on the contract packages which is described in **Table 1.7.2**.

1.5.1. Fuel Requirement

1.5.1.1. During Construction

254. Fuel requirement during construction is estimated at 262,680 kL for the use of heavy equipment, transport and service vehicles. **Table 1.5.1** shows the estimated fuel consumption per contract package during construction.

Table 1.5.1 Estimated Fuel Consumption per Contract Package during Construction

Contract Package	Estimated Fuel Consumption (kL at 70% load factor)
CP S 01	4,465
CP S 02	42,298
CP S 03	36,200
CP S 03b	[5,663.70]
CP S 04	53,827
CP S 05	53,647
CP S 06	42,937
CP S 07	23,642
Total	**257,016**

Source: JICA Design Team

1.5.1.2. During Operation

255. During operation, fuel requirement for this phase involves the use of heavy equipment, transport and service vehicles. Fuel requirement during operation is estimated at 20,000 liter/year for the use of back-up generators at stations during power interruption and for the service vehicles.

1.5.2. Power Supply

1.5.2.1. During Construction

256. Power supply will be sourced either by tapping at the nearest electricity source or through a generator set. Contractor will be required to submit an environmental and safety management plan for the use of generator sets. The estimated power requirement during the construction phase is 23,786,067 kiloliters (**Table 1.5.2**).

Table 1.5.2 Estimated Fuel Consumption per Contract Package during Construction

Contract Package	Estimated Fuel Consumption (kL)
CP S 01	2,134,051
CP S 02	3,770,325
CP S 03	3,607,961
CP S 03b	[834.75 MWh/year]
CP S 04	3,867,609
CP S 05	4,072,465

Contract Package	Estimated Fuel Consumption (kL)
CP S 06	3,996,986
CP S 07	2,336,670
Total	23,786,067

Source: JICA Design Team

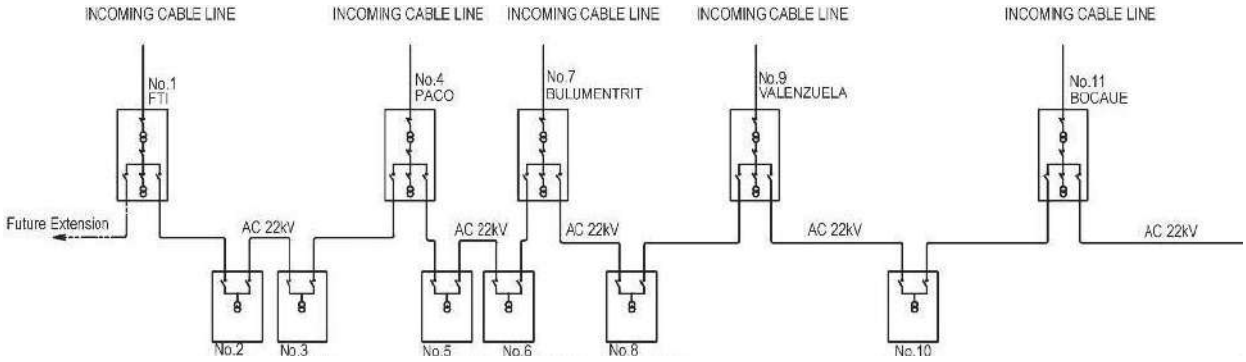
1.5.2.2. During Operation

257. To ensure high reliability of power supply during the operation, adequate redundancies in the transmission and distribution will be incorporated in the detail design stage. Power supply will be sourced out from MERALCO. The estimated power requirement during the operation phase is 303,419,025 kWh/year. MERALCO will construct the transmission line for connection between the grid and each train substation. Power distribution companies will calculate power demand impact simulation for the grid.

(1) Underground Station Power Supply

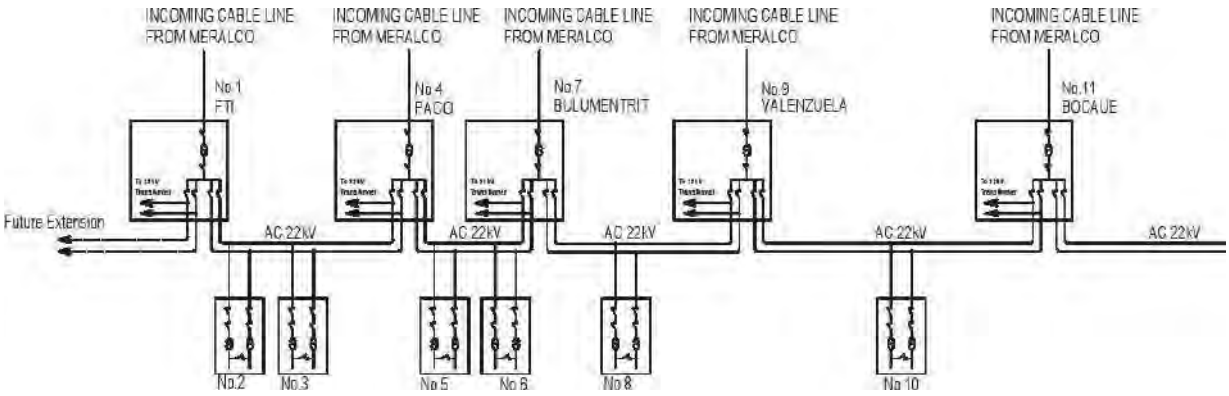
258. Auxiliary power supply for the underground station electrical facilities will be fed from an auxiliary substation by low voltage, either single phase 220V AC or three phase 480V AC. Power to auxiliary substation will be fed from the traction substation by two route power cables for redundancy. A transformer for the auxiliary substations changes high voltage to low voltage. For the underground stations and the tunnel sections, emergency diesel generator sets may be provided to supply emergency power case of prolonged power outage (JICA, 2015).

259. There are two types of power distribution systems being considered for the project, the loop system and the parallel system. The loop system is lower in cost and has previously been used in the country, but the parallel system is more reliable. The power distribution system to be used for the interconnecting line will be finalized in the detailed design stage. The diagrams of the loop and parallel power distribution systems are shown in **Figure 1.5.1** and **Figure 1.5.2**.



(Source: JICA Study Team)

Figure 1.5.1 Loop Type Power Distribution



(Source: JICA Study Team)

Figure 1.5.2 Parallel Type Power Distribution

260. Emergency power in accordance with Article 700 of NFPA 70 and Chapter 4 of NFPA 110, or equivalent, shall be provided for enclosed stations.

1.5.3. Water Supply

261. The estimated monthly water consumptions were calculated based on the different contract packages of the project.

1.5.3.1. During Construction

262. Based on the calculation during the detailed design, the estimated water consumptions during construction are presented in **Table 1.5.3**.

Table 1.5.3 Estimated Water Consumption during Construction

Description	CP S01	CPS 02	CP S 03	CP S 04	CP S 05	CP S 06	CP S 07	CP S 03b	Total
Site Usage, m³	96,075	340,194	340,194	348,080	361,653	341,765	144,457	A	1,972,418
Personal Consumption (Site), m³	56,876	201,395	201,395	206,063	214,099	202,325	85,519	A	1,972,418 1,167,672
Personal Consumption (Office), m³	1,344	1,344	1,344	1,344	1,344	1,344	1,344	A	9,408
Total Water Consumption, m³	154,295	542,933	542,933	555,487	577,096	545,434	231,320	A	3,149,498
Monthly Water Consumption, m³/month	3,214	11,311	11,311	11,573	12,023	11,363	4,819	A	65,614

Note: **CP – Contract Package**
A – Actual usage of water will depend on the contractor

Source: JICA Study Team

1.5.3.2. During Operation

263. Water supply during operational phase will be sourced from the local water districts. Water usage will be minimal and limited to domestic use only (e.g. for usage in and maintenance of comfort rooms, etc.). Estimated daily water consumption is 3,666 m³ as presented in **Table 1.5.4**.

Table 1.5.4 Estimated Water Consumption during Operation

Location	Water supply Daily maximum volume (m3/day)	Wastewater & Sewage Daily maximum volume (m3/day)	Total Daily maximum volume (m3/day)
Stations	2,039	1,477	3,516
Depot	150	150	150
Total	**2,189**	**1,627**	**3,666**

Source: JICA Design Team, (June 2019)

1.5.4. Construction Materials

264. The construction materials such as sand, steel, cement, etc. will be sourced locally. On the other hand, the railway tracks and the tension membrane for roofing will be sourced outside the Philippines.

1.5.5. Existing Utilities within the ROW

265. Existing Utilities within the ROW include overhead high voltage cables, telephone and communication cables exist inside and near the construction area. These cables need to be treated during construction planning stage, especially high voltage cables. Those cables which will obstruct the construction must be relocated. Sufficient time should be allocated for the relocation since it requires consultation with relevant utility agencies. Exact locations of underground water pipes need to be checked by gathering information and carrying out trial excavations etc.

1.6. PROJECT SIZE

266. The SCRP alignment is 64.2 km including the 58.6 km main line from south of Solis Station, Manila to Calamba station and the 5.6 km segment connecting the SCRP to the MMSP at Senate station. The required ROW width of the railway track is set 30 m all along the alignment. There will be 19 stations and each station has a maximum area of approximately 0.015 km2 (1.5 ha) with a width of 60 m and a length of 250 m. The proposed depot will have a total land area of 22 ha which is located in Barangay Banlic, Calamba City.

1.7. DEVELOPMENT PLAN, DESCRIPTION OF PROJECT PHASES AND CORRESPONDING TIMEFRAMES

1.7.1. Project Phases

267. This section describes the various activities to be undertaken during the pre-construction, construction, and operational phases of the Project. **Table 1.7.1** presents the list of activities by phase.

Table 1.7.1 List of activities by phases

Phases	Activities
Pre-Construction Phase Activities prior to construction include preparatory works like feasibility study and detailed engineering design.	• Land acquisition for the depot area and Project ROW • Resettlement of Project affected people • Bidding and selection of Contractors • Preparation of site-specific Contractor's Environmental Management Plan (CEMP) based on the EMP in the EIS including Construction Plan, Drainage Plan, Traffic Management Plan (TMP), Waste Management Plan, Soil Management Plan, Emergency Preparedness and Response Plan, Occupational Health and Safety Plan, Energy and Water Conservation Program • Utility Diversion Planning especially in open cut areas and viaduct sections if there is utility line. Overhead high voltage cables, telephone and communication cables exist inside and near the Project area. These cables need to be treated during construction planning stage especially high voltage cables. Those cables which will obstruct construction activities must be relocated. Sufficient time will be allocated for the relocation since it requires consultation with relevant utility agencies. Exact locations of underground water pipes will be checked as well by gathering information and carrying out trial excavations etc. • Acquisition of construction yard (outside ROW) • Identification old PNR buildings and other structures for preservation • Acquisition of approval on the archaeological impact assessment for relevant areas • Acquisition of CNO from NCIP • Acquisition of Permits (e.g. Tree Cutting Permit, Building Permit, etc.) • Procurement of construction materials, Rolling Stock and E&M • Implementation of mitigation measures for pre-construction activities. • Local establishments, local authorities and other stakeholders who are likely to be affected by the Project shall be informed on the construction schedule and activities, potential environmental impacts, mitigation measures and grievance redress procedure through public meetings • Establish the approved grievance redress mechanism • Public involvement activities will continue based on the framework for public involvement and disclosure
Construction Phase	• Preparation of the construction site which will involve clearing of existing vegetation, removal, of existing structures along the project alignment, and earth moving activities • Implementation of protection and conservation measures for the old PNR buildings and other structures for preservation • Transport of materials • Manufacturing of girder for elevated section • Construction of temporary facilities, depot, viaduct, embankment and at grade structures and station and deployment of TBM at FTI Station for the underground section for • Construction of underground section between Senate to FTI station using TBM for tunnel and cut and cover method for FTI station and the ramp toward Bicutan station. • Implementation of environment mitigation measures, monitoring of construction activities. • Implementation of Traffic Management Plan • Monitoring and reporting to EMB, JICA and ADB
Post Construction Phase	• Demolition of all temporary structures/ facilities

Phases	Activities
	• Decommissioning and removal of construction machinery and equipment from the site • Clean-up and restoration/rehabilitation activities • Selection of Operator • Monitoring and reporting to EMB, JICA and ADB
Operation Phase	• Test runs of the trains • Maintenance work of passenger facilities such as the station • Maintenance of rolling stock • Maintenance of E&M System including power supply system, Automatic ticketing system • Implement the EMP and EMoP • Commercial operation (optional) • Monitoring and reporting to EMB, JICA and ADB
Abandonment Phase	• In the unlikely event that the operation of the Project is no longer deemed feasible to operate and maintain, a decommissioning or abandonment plan will be prepared by the proponent. • The abandonment plan will specify the proposed studies to be conducted (e.g., site assessment), what equipment can be recovered, relocated, or sold, and the area that will be developed based on the next industrial use of the site. • If soil contamination is present, the area will be decontaminated through appropriate measures. The green buffer zone will have to be retained.

1.7.2. Construction Package

268. The building and civil engineering works were divided into eight (8) contract packages based on the size and nature of works taking into consideration the expected contract amount, required equipment, human resources as well as the financial standing of the expected eligible bidders. The outline of the construction contract packages is shown in **Table 1.7.2**.

Table 1.7.2 Contract Packages

Contract Package	Length	Main Track Structure	Stations		Major River, Road or Rail Crossing	
CP S-01	1 km	1 km of Viaduct	1 Elevated Station	• Blumentritt	3	• Jose Abad Santos Street • Rizal Avenue and LRT-1 • Dimasalang Road.
CP S-02	10 km	9 km of Viaduct and 1 km of At-grade track structure	4 Elevated Stations	• España • Santa Mesa • Paco • Buendia	5	• Dimasalang Road • R. Magsaysay Boulevard & LRT 2 • Pasig River, • Sen. Gil Puyat Avenue, • Dela Rosa Street.

Contract Package	Length	Main Track Structure	Stations		Major River, Road or Rail Crossing	
CP S-03	10 km	3 km of Viaduct and 7 km of At-grade track structure; ramp from FTI station to Bicutan Station	2 at-grade Stations, 2 integrated Stations (FTI, Bicutan)	• EDSA • Nichols • FTI • Bicutan	1	• Antonio Arnaiz Avenue
CP S-04	11 km	11 km of Viaduct	3 Elevated Stations	• Sucat • Alabang • Muntinlupa	1	• Manuel L Quezon
CP S-05	12 km	12 km of Viaduct	4 Elevated Stations	• San Pedro • Pacita • Biñan • Santa Rosa	4	• A Mabini Street • Maharlika Highway • Biñan River • Manila South Road
CP S-06	10 km	10 km of main line Viaduct and 1 km of depot access line	3 Elevated Stations	• Cabuyao • Banlic • Calamba	3	• San Cristobal River • Calamba River • Manila South Road
CP S-07	Depot	Overall area of depot: to be determined		•		

Note: All information will be updated with the progress of the Detail Design

Source: JICA Study Team

1.7.3. Construction Schedule

269. The schedule of the Project is presented in **Table 1.7.3**. The construction will commence upon securing all the needed regulatory requirements.

Table 1.7.3 Proposed Timeline by Package

Contract Package	2019				2020				2021				2022				2023				2024				2025				2026			
CP S-01 Construction									■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
CP S-02 Construction											■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■				
CP S-03 Construction													■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
CP S-04 Construction										■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■					
CP S-05 Construction										■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■					
CP S-06 Construction											■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■				
CP S-07 Construction								■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■				

Source: JICA Design Team

1.7.4. PNR Operation

270. It is necessary to be considered securing space for PNR operation during construction and after construction.

1.7.4.1. During Construction: Secure the space for the PNR temporary Operation

271. Basic concept and preconditions on PNR temporary track are as follow:

- Current Double Track Section (Tutuban-Sucat)
  - Use either of north or south-bound track as much as possible
- Current Single-Track Section (Sucat-Calamba)
  - Locate the project in the west side in the PNR ROW
  - New track installation work is necessary but track materials may be partially reused
- Work for the PNR temporary operation is done by PNR

1.7.4.2. After Construction: Secure the space for the PNR Operation

272. Basic concept and preconditions on PNR permanent track are as follow:

- Secure the space of double track (Tutuban-Calamba)
- Schematic Plan (Pasig River to Buendia)
- Discussion with PNR for Paco section is ongoing.

1.8. WORK FORCE

1.8.1. Required Work Force

273. The work force requirements during the pre-construction phase, construction phase, and operations phase of the Project is presented in **Table 1.8.1**. The Project will require a maximum of approximately 26,680 skilled and non-skilled laborers (peak) during construction. During operations, it is estimated that the Project will require about 3,850 employees for the operation and maintenance of the stations, and the maintenance of the trains at the depot. A portion of the technical personnel for the subway will be provided by Japanese consultants since Japanese technology will be employed.

Table 1.8.1 Work force Requirement (Peak)

Project Phase	Civil	E&M	Rolling Stock	Total	Mode of Hiring
Pre-construction	100	60	40	200	Direct Hire
Construction	22,575	3,079	1,026	26,680	Through Contractors
Operation		3,850		3,850	Direct Hire

Source: JICA Design Team

1.8.2. Policy on Job Opportunities

1.8.2.1. Priority Hiring of Locals

274. Work force requirements during the construction phase will be sourced through the local Contractors that will be hired for the Project. Work force during the pre-construction and operation phases will be hired directly by the DOTr. Hiring of workers through agencies is discouraged. In compliance to Republic Act No. 6685 (RA 6685), DOTr will hire at least 50% of unskilled workers

and 30% of the skilled labor requirement from the unemployed bonafide and actual residents of project affected cities, with priority given to the host barangays. The prioritization of project affected communities in terms of job opportunities are also required under the RAP of the Project. Local Contractors will be held to the policies set forth within the terms of reference and contracts to ensure compliance.

1.8.2.2. Policy on Equal Job Opportunities

275. DOTr is committed to provide equal employment opportunities to suitably qualified persons in compliance with the labor laws of the Philippines including but not limited to Presidential Decree No. 442 (PD 442) or the Labor Code of the Philippines, Republic Act No. 10911 (RA 10911), known as the Anti-Age Discrimination in Employment Act, and Republic Act No. 7277 (RA 7277), known as the Magna Carta for Disabled Persons. The hiring criteria for available jobs will be based on abilities, knowledge, skills, and qualifications rather than gender, age or disability.

276. Where possible, provisions to encourage women's participation in labor-based work during the construction phase will be included in the TORs and contracts of local Contractors (e.g. female hiring to comprise 20% of the total workforce in skilled and unskilled positions). Provisions to ensure equal payment for equal work between male and female workers and for the payment of benefits for women to be given directly to them will also be included in the TORs and contracts.

277. To ensure that no person will be discriminated or refused employment based on his/her disability or age, DOTr will coordinate with the respective Public Employment Service Office (PESO) of each LGU to develop and administer testing and evaluation instruments for effective job selection and training. For disabled persons, the Contractors may consider engaging in sheltered employment. Sheltered employment as defined in RA 7277 is the provision of productive work for disabled persons through workshop, providing special facilities, income-producing projects or homework schemes with a view to give them the opportunity to earn a living thus enabling them to acquire a working capacity required in open industry. In the placement of disabled persons in sheltered employment, the Contractors will be required to accord due regard to the individual qualities, vocational goals, and inclinations of the disabled persons to ensure a good working atmosphere and efficient production as required in Section 6 of RA 7277.

278. To encourage the participation of the contractor in promoting the welfare of disabled persons and to ensure gainful employment for qualified disabled persons, DOTr will assist the contractor in availing the following incentives as provided for in RA 7277:

279. Private entities that employ disabled persons who meet the required skills or qualifications, either as regular employee, apprentice or learner, will be entitled to an additional deduction, from their gross income, equivalent to twenty-five percent (25%) of the total amount paid as salaries and wages to disabled persons: Provided, however, that such entities present proof as certified by the Department of Labor and Employment that disabled persons are under their employ. Provided, further, that the disabled employee is accredited with the Department of Labor and Employment and the Department of Health as to his disability, skills and qualifications.

280. Private entities that improve or modify their physical facilities in order to provide reasonable accommodation for disabled persons will also be entitled to an additional deduction from their net taxable income, equivalent to fifty percent (50%) of the direct costs of the improvements or modifications. Note that this provision does not apply to improvements or modifications of facilities required under Batas Pambansa Bilang 344 (An Act to Enhance the

Mobility of Disabled Persons by Requiring Certain Buildings, Institutions, Establishments and Public Utilities to install Facilities and Other Devices).

281. The policy on hiring including the treatment of statutory benefits of the workers will be stipulated in the TORs and contracts with the local Contractors to ensure compliance.

1.9. INDICATIVE PROJECT INVESTMENT COST

282. The indicative financial cost of the Project is estimated at Three Hundred Forty-Four Billion Six Hundred Six Million Pesos (PhP 344,606,000,000.00). The breakdown of this cost is presented in **Table 1.9.1.**

Table 1.9.1 Estimated Construction Cost

Items	Cost (million PhP)
Civil Works	131,177
Depot	10,272
E&M	63,595
Rolling Stock	19,496
Price Contingency	10,764
Physical Contingency	11,765
Consulting	12,514
Construction Cost	259,583
Land acquisition & Resettlement	40,424
Administrative Cost	9,809
Vat	31,150
Import Tax	3,641
Total	**344,606**

Source: JICA Design Team

2. LEGAL AND INSTITUTIONAL FRAMEWORK ON ENVIRONMENTAL IMPACT ASSESSMENT

2.1. NATIONAL LAWS AND REGULATIONS OF ENVIRONMENTAL IMPACT ASSESSMENT

283. Private or public projects or activities which have the potential to result in adverse effects on the natural and social environments are subject to the Philippine Environmental Impact Statement System (PEISS). Relevant laws and guidelines related to the PEISS are shown in **Table 2.1.1**.

Table 2.1.1 Relevant Laws and Guidelines of the PEISS

Laws and Manuals	Stipulation
Presidential Decree No. 1152 (1977)	Philippines' environmental code. Comprehensive environmental management including mitigation measures was addressed and the concept of the environmental impact assessment was introduced for the first time.
Presidential Decree No. 1586 (1978)	The PEISS was established to conduct environmental impact assessment (EIA) study for environmentally critical projects (ECPs) and projects in environmentally critical areas (ECAs).
Presidential Proclamation No. 2146 (1981) and No. 803 (1996)	Proclamation of ECAs and types of ECPs within the scope of the PEISS were established under PD No. 1586.
DENR Administrative Order (DAO) 2003-30	Implementing rules and regulations for the PEISS of Presidential Decree (PD) No. 1586 were provided.
EMB Memorandum Circular (MC) 2007-002	Revised procedural manual for DAO 2003-30.
DENR MC 2010-14	Standardization of requirement and enhancement of public participation in the streamlined implementation of the PEISS.
EMB MC 2010-002	Clarification to the Department of Environment and Natural Resources (DENR) memorandum circular No. 2010-14 and other environmental impact statement (EIS) system policy issuances.
EMB MC 2010-004	Guideline for use of screening and ECA Mapping Systems.
EMB MC 2011-005	Incorporating disaster risk reduction (DRR) and climate change adaptation (CCA) concerns in the PEISS.
EMB MC 2014-005	Guidelines of coverage screening and standardized requirement under the PEISS amending relevant portions of Environmental Management Bureau (EMB) MC 2007-002.
DAO 2017-15	Guidelines on public participation under the PEISS.
DAO 2018-18	Establishing a centralized management and coordinative mechanism at the regional offices of the DENR, the Mines and Geosciences Bureau (MGB) and the EMB and designating the DENR regional director as the regional executive director providing overall command of regional operations.

Source: JICA Design Team

2.2. RESPONSIBLE GOVERNMENT AUTHORITIES

284. The Department of Environment and Natural Resources (DENR) is the government entity responsible for environmental administration in the Philippines. The Environmental Management Bureau (EMB) of the DENR (EMB-DENR) is responsible for the issuance of decision-making documents such as Environmental Compliance Certificates (ECCs) and Certificates of Non-coverage (CNCs) under the PEISS. EMB regional offices (ROs) are responsible for the conduct of public scoping of development projects in relation to ECC application. Likewise, EMB ROs are no longer members of the multipartite monitoring team (MMT).

2.3. ENVIRONMENTAL SAFEGUARD POLICIES OF JICA AND ADB

2.3.1. JICA Guidelines for Social and Environmental Considerations

285. As a matter of policy, JICA, as an implementing agency for Japanese official development assistance (ODA) adheres to the need to conduct environmental and social considerations for all forms of assistance—from technical cooperation to loan and grant aid projects. To complement this, JICA recognizes seven important principles: a) that projects must address a wide range of environmental and social impacts, b) measures for environmental and social considerations must be implemented from project conceptualization to monitoring phases, c) ensure accountability when implementing cooperation projects, d) ensure stakeholder participation in decision-making processes, e) appropriate disclosure of information, f) enhance organizational capacity of proponents, and g) promptness in project implementation. The JICA Guidelines for Social and Environmental Considerations (April 2010) were developed in 2002 and have evolved over time with the latest version revised and published in 2010. Projects are screened, scoped and are categorized (Category A, B, C, and F1) after proper information disclosure based on, among others, the project scale, nature and degree of impacts on the natural and social environments, the site or location, and the mitigation measures required. For this purpose, the railway projects are classified as Category A.

286. Proponents of projects, such as the governmental body that implements the project, bear responsibility for the environmental and social considerations (ESC). JICA is accountable for the ESC of projects it supports, and to this end, JICA confirms the implementation of the ESC by project proponents through environmental review and supervision of monitoring. JICA confirms compliance to the principles and procedures as contained in the Guidelines by thorough Environmental Review of environmental reports and ensures that all project impacts on the natural and social environments are identified and proper mitigating measures are discussed, and monitoring are supervised. Further, JICA confirms that projects should conform to the environmental laws and standards of host countries or other international financial organizations (such as the World Bank's Safeguard Policies) when appropriate—if the standards set by the host country differs from international standards, project proponents are advised to adopt the standards that better serves the purpose of attaining a higher level of the ESC. The independent Advisory Committee for Environmental and Social Considerations was established by JICA to provide expert advice on preparatory surveys, environmental review, and monitoring of projects under consideration. If the ESC is not appropriately undertaken or substantial compliance to establish environmental laws and standards is not met after its review, JICA may opt to suspend its assistance in accordance with the written agreement between JICA and project proponents.

2.3.2. ADB's Safeguard Policy Statement

287. The Asian Development Bank has defined its Safeguard requirements under its 'Safeguard Policy Statement 2009 (SPS 2009). The prime objectives of safeguard policy are to: (i) avoid adverse impacts of projects on the environment and affected people, where possible; and (ii) minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible. This policy requires assessment, mitigation and commitment towards environmental protection. The extent of assessment depends on the category of the project. ADB's SPS 2009 classify a project depending on following three categories.

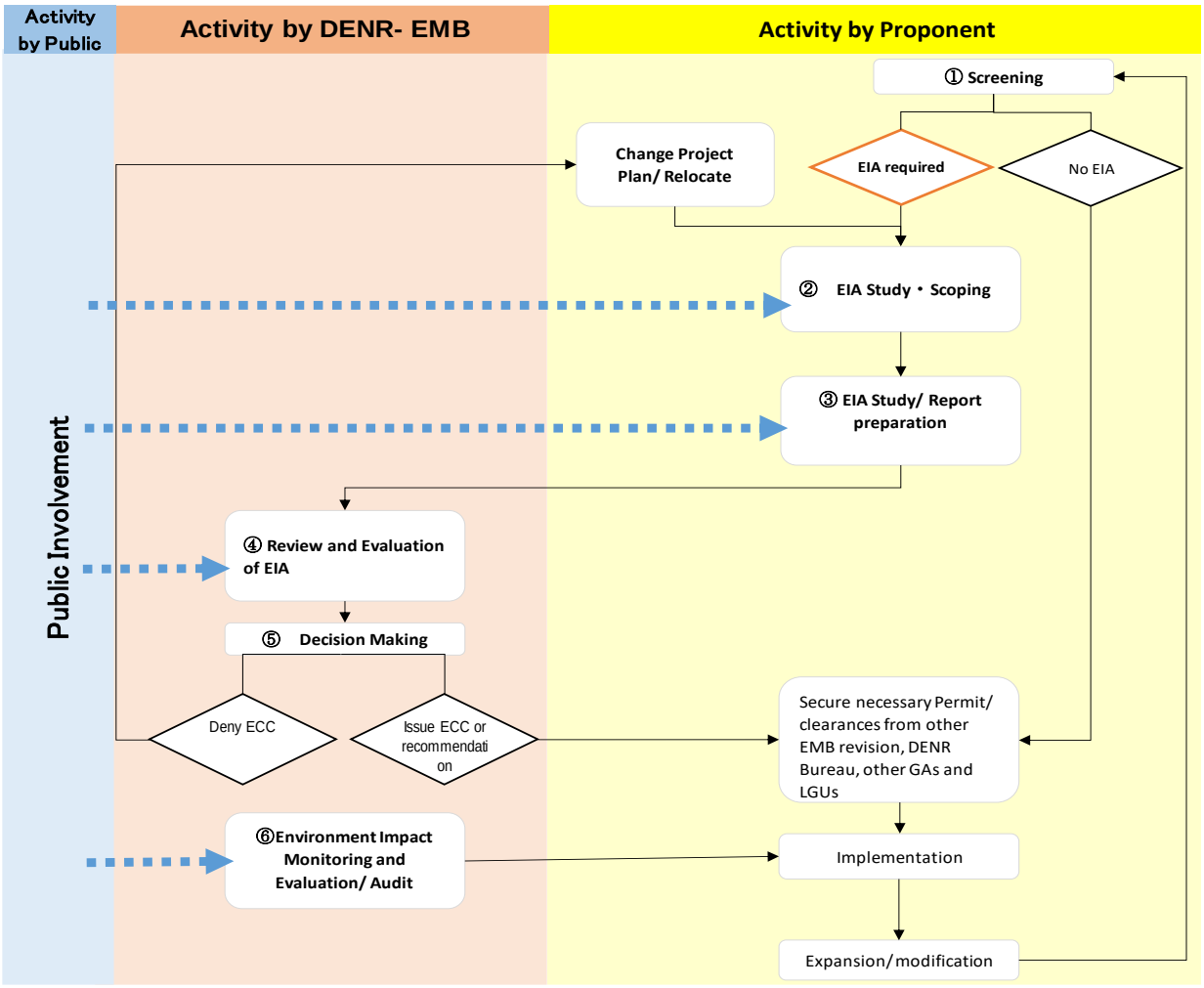
- **Category A:** A proposed project is classified as Category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment is required.

- **Category B:** A proposed project is classified as Category B if its potential adverse environmental impacts are less adverse than those of Category A projects. These impacts are site-specific, none or very few of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination is required.
- **Category C:** A proposed project is classified as Category C if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed.

288. Category of the Project: The project has been evaluated based on scope and extent of project activities, and considering the potential environmental impacts from the project, the Project is classified as environment Category A under ADB's SPS system of project categorization. Accordingly, a comprehensive environmental impact assessment study has been carried out and this EISR report has been prepared to comply also with ADB's SPS requirements. As required under SPS 2009, the draft EISR has been disclosed to the public through the ADB website, 120 days before the approval of project by ADB Board for financing. The draft EISR was also made available to all stakeholders as part of the consultation process required under the SPS 2009.

2.4. PHILIPPINE ENVIRONMENTAL IMPACT ASSESSMENT SYSTEM

289. The PEISS has six (6) sequential stages: 1) screening; 2) scoping; 3) EIA study and report preparation; 4) EIA review and evaluation; 5) decision-making; and 6) post-ECC monitoring, validation and evaluation/audit. A summary flowchart of the complete process is presented in **Figure 2.4.1**.



Source: Revised Procedural Manual for DENR Administrative Order No. 30 Series of 2003 (2008)

Figure 2.4.1 Summary Flowchart of EIA Process

2.4.1. Projects Requested to Implement EIA

290. During screening, the project is assessed whether it is subject to go through EIA process. Projects which have been originally declared as ECPs or projects in ECAs presumed to have significant impacts on the quality of the environment are subject to the PEISS. The projects have been classified into four (4) major groups as shown in **Table 2.4.1**.

Table 2.4.1 Project Groups for EIA under the PEISS

Category	Type and Location of the Project
Category A: ECPs	Projects or undertakings which are classified as ECPs under Presidential Proclamation No. 2146 (1981) and Proclamation No. 803 (1996) and any other projects that may later be declared as such by the President of the Philippines. Proponents of these projects implemented from 1982 onwards are required to secure an ECC.
Category B: Non-Environmentally Critical Projects (NECP) but Located in ECA	Projects or undertakings which are not classified as ECPs under Category A but which are likewise deemed to significantly affect the quality of the environment by virtue of being located in ECAs as declared under Proclamation 2146 and according to the parameters set forth in the succeeding sections. Proponents of these project implemented from 1982 onwards are required to secure an ECC.

Category	Type and Location of the Project
Category C: Environmental Enhancement or Direct Mitigation Project	Projects or undertakings not falling under Category A or B which are intended to directly enhance the quality of the environment or directly address existing environmental problems.
Category D: Non-Covered Project	Projects or undertakings that are deemed unlikely to cause significant adverse impacts on the quality of the environment according to the parameters set forth in the Screening Guidelines. These projects are not covered by the PEISS and are not required to secure an ECC. However, such non-coverage is not construed as an exemption from compliance with other environmental laws and government permitting requirements.

Source: Memorandum Circular No. 2014-005, Revised Guidelines for Coverage Screening and Standardized Requirements.

2.4.2. Types of Reports Required for ECC

291. The EIA-covered projects require any of the documents listed below depending on a project's type and location, the magnitude of potential impacts and a project threshold, which differ according to the level of EIA and EMB-DENR's decision-making process:

- Environmental Impact Statement (EIS);
- Programmatic Environmental Impact Statement (PEIS);
- Environmental Performance Report and Management Plan (EPRMP);
- Programmatic Environmental Performance Report and Management Plan (PEPRMP);
- Initial Environmental Examination (IEE) Checklist Report; or
- Project Description Report (PDR).

292. All documents should be prepared and submitted by a project proponent to EMB central office (CO) or the EIA Division of the respective EMB RO. The outcome of the EIA process within the PEISS administered by the EMB-DENR is the issuance of decision documents. Decision documents may be either an ECC, a CNC or a denial letter.

293. For Category A projects, ECC application documents need to be submitted to the EMB CO for the evaluation of the EMB Director or DENR Secretary. In contrast, ECC applications for Category B projects need to be submitted to the EMB RO for the evaluation of the EMB Regional Director. **Table 2.4.2** summarizes project groups, EIA report types, decision documents, deciding authorities and processing duration.

Table 2.4.2 Summary of Project Groups, EIA Report Types, Decision Documents, Deciding Authorities and Processing Duration

Project Groups		Project	Documents Required For ECC/CNC Application	Decision Document	Deciding Authority
Category A: Environmentally Critical Projects	A-1: New	Co-located	PEIS	ECC	EMB Central Office
		Single	EIS		
	A-2: Existing and to be expanded, modified and/or rehabilitated A-3: Operating without ECC	Co-located	PEPRMP in case programmatic monitoring data are available		
		Single	EPRMP in case monitoring data are available. EIS if no monitoring data are available.		

Project Groups		Project	Documents Required For ECC/CNC Application	Decision Document	Deciding Authority
Category B: Non-Environmentally Critical Projects (NECP) Located in ECA	B-1: New	Co-located	PEIS	ECC	EMB regional office in the region where the project is located
		Single	EIS, IEEC	ECC	
	B-2: Existing and to be expanded, modified and/or rehabilitated	Single	EPRMP, EPRMP Checklist	ECC	
	B-3: Operating without ECC	Co-located	PEPRMP	ECC	
Category C: Environmental Enhancement or Direct Mitigation Project		Co-located/ single	PDR (Part I and II)	CNC	EMB regional office in the region where the project is located
Category D: Non-Covered Project			PDR (Part 1 only)	CNC	EMB regional office in the region where the project is located

Note: () optional, subject to laws, rules and regulations.
Source: EMB Memorandum Circular No. 2014-005, Revised Guidelines for Coverage Screening and Standardized Requirements

2.4.3. Scope of Items to be Examined and Contents to be Assessed in the EIA

294. Depending on a project's type and location, the magnitude of potential impacts and a project threshold, a project proponent is required to prepare the EIS, PEIS, EPRMP, PEPRMP, IEE Checklist Report or PDR. Pursuant to DENR Memorandum Circular No. 2010-14 "Standardization of Requirements and Enhancement of Public Participation in the Streamlined Implementation of the Philippine EIS System" by the DENR (June 29, 2010), the outline for EIA Reports for proposed new single projects is shown in **Table 2.4.3.**

Table 2.4.3 Outline of EIS for Proposed (New) Single Projects

EXECUTIVE SUMMARY
1) Project Fact Sheet
2) Process Documentation
3) EIA Summary

MAIN REPORT
1. PROJECT DESCRIPTION
1.1. Project Location and Area
1.2. Project Rationale
1.3. Project Alternatives
1.4. Project Components
1.5. Process / Technology
1.6. Project Size
1.7. Development Plan, Description of Project Phases and Corresponding Timeframes
1.8. Manpower
1.9. Indicative Project Investment Cost

2. ASSESSMENT OF ENVIRONMENTAL IMPACTS
2.1. The Land
2.1.1. Land Use and Classification
2.1.1.1. Impact in Terms of Compatibility with Existing Land Use
2.1.1.2. Impact on Compatibility with Classification as an ECA

2.1.1.3. Impact in Existing Land Tenure Issue(s)
2.1.1.4. Impairment of Visual Aesthetics
2.1.1.5. Devaluation of Land Value as a Result of Improper Solid Waste Management and Other Related Impacts
2.1.2. Geology/Geomorphology
2.1.2.1. Change in Surface Landform/Geomorphology/Topography/Terrain/Slope
2.1.2.2. Change in Subsurface Geology/Underground Conditions
2.1.2.3. Inducement of Subsidence, Liquefaction, Landslide, Mud/Debris Flow, Etc.
2.1.3. Pedology
2.1.3.1. Soil Erosion/Loss of Topsoil/Overburden
2.1.3.2. Change in Soil Quality/Fertility
2.1.4. Terrestrial Ecology
2.1.4.1. Vegetation Removal and Loss of Habitat
2.1.4.2. Threat to Existence and/or Loss of Important Local Species
2.1.4.3. Threat to Abundance, Frequency and Distribution of Important Species
2.2. The Water
2.2.1. Hydrology/Hydrogeology
2.2.1.1. Change in Drainage Morphology/Inducement of Flooding/Reduction in Stream Volumetric Flow
2.2.1.2. Change in Stream, Lake Water Depth
2.2.1.3. Depletion of Water Resources/Competition in Water Use
2.2.2. Oceanography
2.2.2.1. Change/Disruption in Water Circulation Pattern, Littoral Current, and Coastal Erosion and Deposition
2.2.2.2. Change in Bathymetry
2.2.3. Water Quality
2.2.3.1. Degradation of Groundwater Quality
2.2.3.2. Degradation of Surface Water Quality
2.2.3.3. Degradation of Coastal/Marine Water Quality
2.2.4. Freshwater Ecology
2.2.4.1. Threat to Existence and/or Loss of Important Local Species and Habitat
2.2.4.2. Threat to Abundance, Frequency and Distribution of Species
2.2.5. Marine Ecology
2.2.5.1. Threat to Existence and/or Loss of Important Local Species and Habitat
2.2.5.2. Threat to Abundance, Frequency and Distribution of Species
2.3. The Air
2.3.1. Meteorology/Climatology
2.3.1.1. Change in The Local Micro-Climate E.G. Local Temperature
2.3.1.2. Contribution in Terms of Greenhouse Gas Emissions (or GHG Mitigation Potential)
2.3.2. Air Quality (Noise/Vibration)
2.3.2.1. Degradation of Air Quality
2.3.2.2. Increase in Ambient Noise Level
2.3.2.3. Vibration
2.4. People
2.4.1. Displacement of Settler(s)
2.4.2. In-migration
2.4.3. Cultural/Lifestyle Change (Especially on Indigenous People, If Any)
2.4.4. Impacts on Physical Cultural Resources
2.4.5. Threat to Delivery of Basic Services/Resources Competition
2.4.6. Threat to Public Health and Safety
2.4.7. Generation of Local Benefits from the Project
2.4.8. Traffic Congestion

3. ENVIRONMENTAL MANAGEMENT PLAN

4. ENVIRONMENTAL RISK ASSESSMENT (ERA) AND EMERGENCY RESPONSE POLICY AND GUIDELINES

5. SOCIAL DEVELOPMENT PLAN FRAMEWORK AND INFORMATION, EDUCATION AND COMMUNICATION FRAMEWORK
5.1. Social Development Plan (SDP)
5.2. Information, Education and Communication (IEC) Campaign
6. ENVIRONMENTAL COMPLIANCE MONITORING
6.1. Self-Monitoring Plan
6.2. Multi-Sectoral Monitoring Framework
6.3. Environmental Guarantee and Monitoring Fund Commitments
7. ABANDONMENT/DECOMMISSIONING/REHABILITATION POLICIES AND GENERIC GUIDELINES
8. INSTITUTIONAL PLAN FOR EMP IMPLEMENTATION FOR THE ENTIRE OPERATION
9. ANNEXES

Source: DENR Memorandum Circular No. 2010-14, Annex 1-A, June 2010

2.4.4. Public Participation, Public Consultation and Information Disclosure

2.4.4.1. Public Participation and Consultation

295. The PEISS places importance on public participation. According to DAO 2017-15, from the early stage of project, the public who has potential to have direct/indirect impacts is provided with accurate project information and involved in a series of public discussion. Public participation is demonstrated through the following activities at different stages of the EIA process.

Table 2.4.4 Outline of Public Consultation Requirements under the PEISS

EIA Step	Type of Public Participation Activity	Objective	Participants and Facilitators	Requirements	Output
Scoping (Initial Stakeholder Identification)	Social preparation/IEC with initial perception survey through any of the following means: Field visits Meetings Informal dialogues with community members Community meeting or "talakayang barangay" KIIs Use of IEC materials (e.g., video, print, radio, and leaflets/flyers)	To identify stakeholders and issues in preparation for public scoping	<Participants> Local government units (LGUs) with jurisdiction over the project area National Government Agencies (NGAs) with related mandate on the type of project and its impacts Interest groups (NGOs/people`s organizations (POs)) with missions specifically related to the type of the project and its impacts Affected households and businesses/industry owners/employees Vulnerable groups (e.g. indigenous peoples (IPs)) Local institutions <Facilitators> The implementing agency (IA), or the proponent	IA to conduct prior to public scoping	Proof of the conduct of IEC - Focus group discussion (FGD) documentation - IEC documentation with proof of the receipt of IEC materials Initial perception survey results - baseline knowledge about the project - concerns/questions about the description of project alternatives - concerns on environmental impacts of the project List of initially identified stakeholders
Scoping (Public Scoping with Community)	Public scoping (PS) with the following agenda: Brief presentation by EMB representative of the EIA process focused on the scoping process and PS objective presentation by the project proponent of the project description Open forum Presentation of the summary of concerns raised during the open forum by the EMB representative	To gather issues of community sectors that need to be addressed by EIA study	<Participants> LGUs with jurisdiction over the project area NGAs with related mandate on the type of the project and its impacts Interest groups (NGOs/POs) with missions specifically related to the type of the project and its impacts Affected households and businesses/industry owners/employees Vulnerable groups (e.g. IPs) Local institutions Other project stakeholders and/or the general public	IA to submit the following to and request the conduct of public scoping from EMB within 3 months from the conduct of social preparation/IEC: - Proof of conduct of IEC - Initial perception survey results - Project description for scoping (PDS) - Proposed list of invitees for public scoping - Draft invitation letter to be signed by the EMB and IEC materials in preparation for the public scoping	Public scoping report (PSR) Attendance of stakeholders and the general public Segregated comments, stakeholder issues and suggestions based on EIA modules with proponent's response Proposed design of public participation and analysis of issues raised by stakeholders using appropriate methods

EIA Step	Type of Public Participation Activity	Objective	Participants and Facilitators	Requirements	Output
	The proponent's response regarding which concerns can be integrated in the EIA and how these concerns will be tackled including possible modes of participation of stakeholders in the actual conduct of the EIA Summary of agreements and next steps		<Facilitators> The EMB	- Draft presentation of the project during public scoping The EMB to approve IA's request within 5 working days The EMB to post an announcement in the EMB website at least 10 days before public scoping containing the following information along with the e-copy of the PDS which shall remain in the website until the submission of the ECC application: - Importance of EIA particularly the scoping process - Date and venue of public scoping - Instructions and deadline for the registration of intent to comment - Instructions and deadline for submitting comments The IA to submit the PSR to the EMB for approval within 7 working days after public scoping The EMB to evaluate and decide on the completeness of the PSR within 3 working days The EMB to convene technical scoping with the EIA Review Committee (EIARC) within 7 working days after the PSR approval which includes an evaluation of attendance of stakeholders during public scoping The EMB to post an announcement in the EMB website on the completion of scoping and start of EIA study together with the PSR	

EIA Step	Type of Public Participation Activity	Objective	Participants and Facilitators	Requirements	Output
EIA Study and Report Preparation	Stakeholder Involvement through any of the following means: Baseline data gathering through rapid appraisals, perception surveys, etc. Participatory methods such as consultations, FGDs and group meetings	To integrate local and indigenous knowledge into the EIA study	<Participants> Communities that have their own formal and informal rules for public access to resources, conflict resolution and governance (e.g., IPs) <Facilitator> The IA, or the proponent	Requirements vary by types of affected communities (e.g., National Commission on Indigenous People (NCIP)'s free and prior informed consent (FPIC) requirement)	Outputs vary by types of affected communities
EIA Report Review and Evaluation Substantive Review	Public hearing (PH) with the following agenda: Briefing and orientation on the purpose of the PH and the PEISS Rules on the conduct of the PH Presentation on the description of the project including alternatives Presentation on the EIA Study process and results Open forum Recapitulation of issues raised and the proponent's response Next steps	To facilitate efficient exchange of information and views among an IA, the EMB, NGAs, LGUs and other stakeholders on environmental impact assessment, management and monitoring for the project applying for an ECC	<Participants> LGUs with jurisdiction over the project area NGAs with related mandate on the type of project and its impacts Interest groups (NGOs/POs) with missions specifically related to the type of the project and its impacts Affected households and businesses/industry owners/employees Vulnerable groups (e.g., IPs) Local institutions Other project stakeholders and/or the general public <Facilitators> The EMB through PH officer designated by its director	Post draft EIS for review and the EIS Summary for the Public (ESP) on the EMB website at least 20 days before a public hearing along with the notice of the PH (NPH) Publish the NPH on a newspaper for general circulation upon EMB's approval once a week for 2 consecutive weeks; (publication of 2nd notice at least 7 days before the scheduled public hearing) Post the NPH at conspicuous places in affected cities/municipalities and barangays at least 15 days prior to the scheduled hearing Distribute flyers especially in places where reading newspapers is not a common practice If there are identified primary stakeholders who have no access to written means of information, the IA, in addition, has to disseminate information through non-written means such as radio, public address system or other similar means for 2 consecutive days at least 7 days before a public hearing. Revised EIS incorporating the key aspects of the public hearing	ESP The NPH Full documentation of the public hearing prepared by the Department of Transportation (DOTr) and validated by the EMB: - Attendance of stakeholders and the general public - Segregated comments, issues raised and suggestions based on EIA modules of stakeholders along with the DOTr's/DENR's response - Summary of issues raised that are beyond the mandate of the EMB, identifying agencies with mandate on these issues - Transcription of the proceedings - Video documentation of the proceedings of the public hearing

EIA Step	Type of Public Participation Activity	Objective	Participants and Facilitators	Requirements	Output
				documentation is posted on the EMB Website for 7 days for further public comments. Comments submitted after this 7-day period are no longer considered in the review of the ECC application.	

Source: DAO 2003-30 and DAO 2017-15

2.4.4.2. Information Disclosure

296. To enable meaningful public participation in the review of the EIA report, the following activities constitute the required information for disclosure to the public based on DAO 2017-15:

Table 2.4.5 Outline of Information Disclosure requirements under PEISS

Document	Information for Disclosure	Activity	Duration
1) Draft EIS for Review and 2) English and Filipino Version of the ESP	Project description* Proposed location Project proponent Projected timeframe of project implementation Concise integrated summary of the major impacts and residual effects after mitigation Identified stakeholders Proponent's statement of commitment and capability to implement necessary measures to prevent negative adverse impacts Information on where to get a copy of the EIS for further information	Posting on the EMB website along with the NPH	At least 20 days before the public hearing
NPH	Objectives of the public hearing Necessity of the project and its goals and objectives Brief description of the project's components and size and its proposed location A project proponent A date and venue of a public hearing Instructions and a deadline for the registration of intent to attend the public hearing and/or give comment(s) or position papers Instructions and a deadline for submitting comments or position papers Contact person(s) for further inquiries	Posting on the EMB website along with draft EIS and ESP Publish the NPH in a newspaper for general circulation upon EMB's approval Posting of NPH at conspicuous places in the affected cities/municipalities and barangays	At least 20 days before the public hearing Once a week for 2 consecutive weeks (publication of 2nd NPH at least 7 days before the scheduled public hearing) At least 15 days prior to the scheduled hearing
IEC Materials	Purpose of EIA as stipulated in PD 1151 and 1586 Necessity of the project and its goals and objectives Project alternatives Proposed locations of project facilities / components and alternatives considered prior to the selection Project proponent (indicating incorporators and subsidiaries) Projected timeframe of the project phases Preliminarily identified environmental aspects for each alternative	Distribute flyers in places where reading newspapers is not a common practice	-
		Disseminate information through non-written means such as radio, public address system or other similar means if there are identified primary stakeholders who have no access to written means of information	2 consecutive days, at least 7 days before the public hearing
Revised EIS	Incorporated with key aspects of the public hearing documentation	Posting on the EMB website for further public comments	7 days (comments received after the 7-day period are no longer considered in the review of the ECC application)
Copies of the ECC, the EMP (IMP & EMoP) and the Documentation of Public Participation	Chronology of public participation (PP) activities conducted Key issues raised and how these were responded by the project proponent and considered in the review of the ECC application indicating the stage of the EIA process when these issues were raised	Posting on the EMB website	-

Document	Information for Disclosure	Activity	Duration
	Related issues that were raised but are beyond the mandate of the EMB-DENR		

EMoP = environmental monitoring plan, IMP = impact mitigation plan.
Note: It should include discussion on the process and criteria for choosing from alternatives including how the public/stakeholders influence the selection.

Source: DAO 2017-15

2.4.5. Formulation of Environmental Management and Monitoring Plans

2.4.5.1. Objectives

297. Under the PEISS, the primary purpose of monitoring, validation and evaluation/auditing is to ensure judicious implementation of sound environmental management within a company/corporation and its areas of operation as stipulated in the ECC and other related documents. Specifically, it aims to ensure the following:

- Compliance with the conditions set in the ECC;
- Compliance with the EMP commitments;
- Effectiveness of environmental measures on prevention or mitigation of actual project impacts vis-a-vis the predicted impacts used as the basis for the EMP design; and
  Continuous updating of the EMP for sustained responsiveness in addressing environmental impacts of undertakings.

2.4.5.2. Responsible organization

(1) Project proponent

298. Proponents with issued ECCs are primarily responsible for monitoring their projects. A proponent is required to submit an ECC compliance monitoring report (CMR) to the designated monitoring EMB office on a semi-annual basis. The detailed report on the compliance to environmental standards specific to environmental laws is submitted through a self-monitoring report (SMR) on a quarterly basis to the concerned EMB office.

(2) Multi-partite Monitoring Team

299. The MMT is primarily responsible for validating the proponent's environmental performance and submits findings/recommendations through a compliance monitoring and validation report (CMVR) to the concerned EMB office semi-annually.

(3) Environmental Management Bureau

300. The EMB is primarily responsible for ECC issuance and the overall evaluation/auditing of the proponent's monitoring and the MMT's validation.

2.4.5.3. Disclosure of Monitoring Results

301. During operation, project proponents are required to continue public participation, public consultation and information disclosure. The CMR, SMR, MMT and CMVR are subject to public disclosure. The project proponent has full accountability to stakeholders on the latest Environmental Management and Monitoring Plan, any modifications of the project and any activities against the ECC conditions.

2.5. COMPARISON OF THE PEISS, JICA GUIDELINES, AND ADB SAFEGUARD POLICY STATEMENT

302. An analysis of the current relevant regulations in the Philippines and the JICA Guidelines and ADB Safeguard Policy Statement (SPS) has been carried out. The results of the gap analysis including recommended countermeasures to fill the gaps are summarised in **Table 2.5.1**.

Table 2.5.1 Gap between JICA Environmental Guidelines, ADB SPS 2009 and Relevant Regulations in the Philippines on EIA

Topic	JICA Environmental Guideline	ADB SPS 2009	Relevant Regulations in the Philippines	Main Gap	Counter-measures for Filling Gaps
EIA	JICA supports and examines appropriate environmental and social considerations undertaken by project proponents, etc. to avoid or minimize development projects' impacts on the environment and local communities and to prevent the occurrence of unacceptable adverse impacts.	A set of specific safeguard requirements that borrowers/clients are expected to meet when addressing social and environmental impacts and risks through their due diligence, review, and supervision. ADB ensures that borrowers/clients comply with these requirements during project preparation and implementation. Over time, ADB may adopt additional safeguard requirements or update existing requirements to enhance effectiveness, respond to changing needs and reflect evolving best practices.	EIA is a process that involves predicting and evaluating the likely impacts of a project (including cumulative impacts) on the environment during construction, commissioning, operation and abandonment. It also includes designing appropriate preventive, mitigating and enhancement measures addressing these consequences to protect the environment and the community's welfare (Revised Procedural Manual for DAO 2003-30,1.0,2).	There is no gap between harmonized policies and the Philippines' laws.	Not applicable
Compliance with National Legislations and International Treaties	Projects comply with the laws or standards related to the environment and local communities in the central and local governments of host countries. It also confirms that projects conform to those governments' policies and plans on the environment and local communities. Projects do not deviate significantly from the World Bank's Safeguard Policies and refers as a benchmark to the standards of international financial organizations, to internationally recognized standards or international standards, treaties and declarations, etc. and to the good practices, etc. of developed nations including Japan, when appropriate (Sec.2/2.6/2, 3).	Apply pollution prevention and control technologies and practices consistent with international good practices, as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety (EHS) Guidelines.	Proposals for activities which are outside the scope of the management plan for protected areas are subject to environmental impact assessment as required by law before they are adopted, and the results thereof are taken into consideration in the decision-making process. No actual implementation of such activities is allowed without the required ECC under the PEISS. In instances where such activities are allowed to be undertaken, the proponent carries them out in such a manner as to minimize any adverse effects and take preventive and remedial actions when appropriate. The proponent is liable for any damage due to lack of caution or indiscretion.	No significant gap.	Not applicable
Impacts to be Assessed	The impacts to be assessed with regard to environmental and social considerations include impacts on human health and safety as	Avoid, minimize, mitigate and/or offset adverse impacts and enhance positive	The country's statutory framework requiring EIA for all projects that affect	No gap in environment items and	International standards such as WB-IFC's

Topic	JICA Environmental Guideline	ADB SPS 2009	Relevant Regulations in the Philippines	Main Gap	Counter-measures for Filling Gaps
	well as the natural environment, e.g., air, water, soil, waste, accidents, water usage, climate change, ecosystems, fauna and flora, including transboundary or global scale impacts. These also include social impacts including migration of populations and involuntary resettlement, a local economy such as employment and livelihood, utilization of land and local resources, social institutions such as social capital and local decision-making institutions, existing social infrastructure and services, vulnerable social groups such as poor and indigenous peoples, equality of benefits and losses and equality in the development process, gender, children's rights, cultural heritage, local conflicts of interest, infectious diseases such as HIV/AIDS and working conditions including occupational safety. Items to be addressed in the specific project are narrowed down to the needed ones through the scoping process. In addition to direct and immediate impacts of projects, derivative, secondary and cumulative impacts as well as impacts associated with indivisible projects are also assessed with regard to environmental and social considerations, so far as it is rational. Project impacts throughout the life cycle are also considered. Various kinds of relevant information are needed in order to assess impacts on the environment and local communities. There are, however, uncertainties in predicting such impacts caused by the incomplete understanding of impact mechanisms and the limited information available. Therefore, if the scale of uncertainty is considered to be large, project proponents, etc. provide environmental	impacts through environmental planning and management. Conduct environmental assessment for each proposed project to identify potential direct, indirect, cumulative and induced impacts and risks to physical, biological, socioeconomic (including impacts on the livelihood through environmental media, health and safety, vulnerable groups and gender issues), physical and cultural resources in the context of the project's area of influence. Assess potential transboundary and global impacts including climate change. Use strategic environmental assessment where appropriate.	environmental quality is embodied in PD 1151 of 1977. Under the EIA process, the proponent assesses direct and indirect impacts of a project on biophysical and human environments, ensuring that these impacts are addressed by appropriate environmental protection and enhancement measures (DAO 2003-30).	contents. However, standards on soil, bottom sediment and vibration have yet to be prepared.	and developed countries' standards are referred to in order to evaluate these items.

Topic	JICA Environmental Guideline	ADB SPS 2009	Relevant Regulations in the Philippines	Main Gap	Counter-measures for Filling Gaps
	and social considerations that include preventive measures as much as possible.				
Alternatives	Environmental impacts must be assessed and examined from the earliest possible planning stage. Alternatives or mitigation measures to avoid or minimize adverse impact must be examined and incorporated into the project plan.	Examine alternatives depending on the project's location, design, technology and components and their potential environmental and social impacts Document the rationale for selecting the particular alternative proposed. Consider the "no project" alternative.	The PEISS manual requires that the proponent should implement the alternative analysis and incorporate it into EIS at the feasibility study stage. The PEISS process manual (2008) by the DENR requires that the proponent should consider environmental and social impacts of the project and implement the initial scoping at the pre-feasibility study stage.	No gap identified	Not applicable
EMP	Impact examination must include an analysis of E&S costs and benefits in the most quantitative terms possible as well as a qualitative analysis, and they must be conducted in close harmony with economic, financial, institutional, social and technical analysis of projects. The findings of the examination must include alternatives and mitigation measures and be recorded as separate documents or include mitigation of potential adverse impacts to the level of no significant harm to third parties and the polluter pays principle. The EMP also provides workers with safe and healthy working conditions and prevents accidents, injuries and diseases. Establish preventive and emergency preparedness and response measures to avoid and minimize adverse impacts and risks on health and safety of local communities.	Avoid, where avoidance is not possible, minimize, mitigate, and/or offset adverse impacts and enhance positive impacts by means of environmental planning and management. Prepare an EMP that includes the proposed mitigation measures, environmental monitoring and reporting requirements, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates and performance indicators. Key considerations for EMP preparation include mitigation of potential adverse impacts to the level of no significant harm to third parties and the polluter pays principle.	Specifying an impact mitigation plan, areas of public information, education and communication, a social development program proposal, an environmental monitoring plan (with multi-sectoral public participation for EIS-based projects) and the corresponding institutional and financial requirements/arrangements.	No gap identified	Not applicable
Consultation	Project proponents, etc. consult with local stakeholders through means that induce broad public participation to a reasonable extent in order to take into consideration environmental and social factors which are most suitable to local situations and reach an appropriate consensus.	Carry out meaningful consultations with affected people and facilitate their informed participation. Ensure women's participation in consultation. Involve stakeholders including affected people and concerned	As part of the social preparation process at pre-scoping, the IEC is now explicitly required at the minimum of PEIS/EIS-based applications for which public scoping is a requirement. The IEC serves as the basis for preliminary identification of stakeholders and related issues in	No gap identified	Not applicable

Topic	JICA Environmental Guideline	ADB SPS 2009	Relevant Regulations in the Philippines	Main Gap	Counter-measures for Filling Gaps
	Project proponents, etc. publicize in advance that they plan to consult with local stakeholders with particular attention to directly affected people in order to have meaningful meetings. In the case of Category A projects, project proponents, etc. are encouraged to consult with local stakeholders regarding their understanding of development needs, the likely adverse impacts on the environment and the society and the analysis of alternatives at an early stage of the project, and they are assisted as needed. Consultations with relevant stakeholders such as local residents should take place, if necessary, throughout the preparation and implementation stages of a project. Holding consultations is highly desirable, especially when the items to be considered in the EIA are being selected, and when a draft report is being prepared (Appendix 2).	nongovernment organizations early in the project preparation process and ensure that their views and concerns are made known to and understood by decision makers and taken into account. Continue consultations with stakeholders throughout project implementation as necessary to address issues related to environmental assessment. Establish a grievance redress mechanism to receive and facilitate a resolution of the affected people's concerns and grievances regarding the project's environmental performance. For Category A projects, ADB ensures that the borrower or private sector sponsor carries out public consultation at least twice: (a) once during the early stages of EIA's field works; and (b) once when a draft EIA report is available and before loan appraisal by ADB.	preparation for proper scoping. The conduct of the EIA study engages local stakeholders who may serve as local expert sources, aides/guides and resource persons for primary data collection to optimize the access to indigenous knowledge of the environment. As a form of disclosure of the EIA findings, a public hearing is required for all new ECPs for which public scoping was undertaken and for PEIS-based applications. If necessary, the EMB should conduct public consultations.		
Information Disclosure	In principle, project proponents, etc. disclose information about environmental and social considerations of their projects. JICA encourages project proponents, etc. to disclose and present information about environmental and social considerations to local stakeholders (Sec.2/2.1/1, 6). Project proponents, etc. in the preparation of documents in an official or a widely used language and in a form understandable to local people (2.1/1, 6,7). For Category A projects, JICA publishes the status of host countries' submission of major documents on environmental and social	Disclose a draft environmental assessment (including the EMP) in a timely manner, before project appraisal, in an accessible place and in a form and language(s) understandable to affected people and other stakeholders. Disclose the final environmental assessment and its updates if any, to affected people and other stakeholders.	As a form of disclosure of the EIA findings, a public hearing is required for all new ECPs for which public scoping was undertaken and for PEIS-based applications. Before the PH, relevant documents have to be opened to the public. A full copy of the EIA report is made accessible at the concerned EMB offices, libraries/development council offices of host municipalities. Concerned barangays are also provided with the executive summary of the EIA report. A copy of the ECC is also submitted to	There is no gap between harmonized policies and the Philippines' laws.	Not applicable

Topic	JICA Environmental Guideline	ADB SPS 2009	Relevant Regulations in the Philippines	Main Gap	Counter-measures for Filling Gaps
	considerations on its website. Prior to its environmental review, JICA also discloses EIA reports and environmental permit certifications 120 days prior to concluding agreement documents. JICA discloses a translated version of EIA reports, subject to approval by project proponents, etc.		other permitting agencies including funding institutions.		
Monitoring and Disclosure	JICA confirms with project proponents, etc. the results of monitoring the items that have significant environmental impacts. This is done in order to confirm that project proponents, etc. are undertaking environmental and social considerations for projects that fall under Categories A, B and FI. The information necessary for JICA's confirmation on monitoring must be provided by project proponents, etc. via appropriate means including in writing. When necessary, JICA may also conduct its own investigations. JICA discloses the results of monitoring conducted by project proponents, etc. on its website to the extent that they are made public to project proponents, etc. (Sec.3/3.2/3.2.2/1, 7).	Implement the EMP and monitor its effectiveness. Document monitoring results including the development and implementation of corrective actions and disclose monitoring reports.	The proponents with issued ECCs are primarily responsible for monitoring their projects. They are required to submit two kinds of monitoring reports, the ECC CMR on a semi-annual basis and the SMR on a quarterly basis to the concerned EMB RO. During project implementation, LGUs are represented in the MMT, or the team consisting of various stakeholders who generally form the pillar for local vigilance to project performance. Major features of the MMT are the following: (i) providing appropriate checks and balances in monitoring of project implementation; (ii) validating the proponent's performance; (iii) recommending courses of action to the EMB through the CMVR. The EMB-DENR remains to be the primary actor for the overall evaluation of the proponents' monitoring and the MMTs' validation.	There is no gap between harmonized policies and the Philippines' laws.	Not applicable
Site Selection	Projects must, in principle, be undertaken outside protected areas that are specifically designated by laws or ordinances for the conservation of the nature or cultural heritages (excluding projects whose primary objectives are to promote the protection or restoration of such areas). Projects are also not to impose significant adverse impacts on designated conservation areas (Appendix 1. 4-2).	Do not implement project activities in areas of critical habitats unless (i) there are no measurable adverse impact on the critical habitat that could impair its ability to function, (ii) there is no reduction in the population of any recognized endangered or critically endangered species and (iii) any lesser impacts are mitigated. If a	All designated and critical habitats are protected in coordination with local government units and other concerned groups from any form of exploitation or destruction which may be detrimental to the survival of the threatened species dependent therein. For such purpose, the secretary may acquire, by purchase, donation or expropriation, lands, or	No significant gap	Not applicable

Topic	JICA Environmental Guideline	ADB SPS 2009	Relevant Regulations in the Philippines	Main Gap	Counter-measures for Filling Gaps
		project is located within a legally protected area, implement additional programs to promote and enhance the conservation aims of the protected area. In an area of natural habitats, there must be no significant conversion or degradation unless (i) alternatives are not available, (ii) the overall benefits from the project substantially outweigh environmental costs, and (iii) any conversion or degradation is appropriately mitigated. Use a precautionary approach for the use, development and management of renewable natural resources.	interests therein, including the acquisition of usufruct, establishment of easements or other undertakings appropriate in protecting the critical habitat (RA 9147).		

Source: JICA Design Team

2.6. ENVIRONMENTAL STANDARDS

2.6.1. Approach

303. Presidential Decree 1152, otherwise known as the "Philippine Environment Code (1977)", recognizes the establishment of specific environment management policies and prescribes environmental quality standards. The law is supplemented by the Office of the President Executive Order 192 (1987), which mandates the EMB, among others, 1) to formulate environmental quality standards such as the quality standards for water, air, land, noise and radiation, 2) to recommend rules and regulations for environmental impact assessment and provide technical assistance for their implementation and monitoring and 3) to formulate rules and regulations for the proper disposal of solid wastes, toxic and hazardous substances.

304. JICA and ADB generally recognize national environmental standards for projects. If national environmental standards do not exist or are considered inappropriate, internationally recognized standards are used for reference purposes. If national environmental standards differ from international standards, moreover, more stringent standards are adopted. However, if sufficient justification exists, the country's national standards are applied. The environment standards that are applied for the project are shown below.

Table 2.6.1 Environmental Standards Applied to the Project

Item	Revised Standard
Ambient Air Quality	• DAO 2000-81, Ambient Air Quality and Emission Standards • DAO 2013-13, Provisional National Ambient Air Quality Guideline Values for Particulate Matter 2.5 microns (PM2.5)
Surface and Effluent water Quality	• DAO 2016-08, Water Quality Guidelines and General Effluent Standards of 2016
Groundwater Quality	• Department of Health Administrative Order No. 2017-0010, "Philippine National Standards for Drinking Water (PNSDW)" • DAO 2016-08, Water Quality Guidelines and General Effluent Standards
Ambient Noise Quality	• World Bank-International Finance Corporation's (WB-IFC) EHS Guidelines of 2007
Ambient Vibration Quality	• U.S. Federal Transit Administration Noise and Vibration Manual 2006 (FTA-VA-90-1003-06)
Soil Quality	• The Bureau of Soils and Water Management Soil Fertility Rating • DAO 2013-22
Soil Contamination	• Dutch Target and Intervention Values (2000)

Source: JICA Design Team

2.6.2. Ambient Air Quality Standards

305. The DAO 2000-81, otherwise known as the Implementing Rules and Regulations of Republic Act (RA) No. 8749, Clean Air Act of 1999, establishes the national ambient air quality standards for total suspended particulate (TSP), particulate matters (PM_{10}), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3) and lead (Pb), while DAO 2013-13 establishes the provisional national ambient air quality guideline for $PM_{2.5}$ values.

306. **Table 2.6.2** shows the applicable national standards on ambient air quality.

Table 2.6.2 National Ambient Air Quality Standards

Parameter	Averaging Time	Philippines DAO 2000-81, DAO 2013-13*
TSP	24 Hours	230 µg/NCM
PM_{10}	24 Hours	150 µg/NCM
$PM_{2.5*}$	24 Hours	50 µg/NCM
SO_2	24 Hours	180 µg/NCM
NO_2	24 Hours	150 µg/NCM
CO	1 Hour	35 mg/NCM
O_3	1 Hour	140 µg/NCM
Lead (Pb)	24 Hours	1.5 µg/NCM

Note; the asterisk connotes that the standard value used for PM2.5 is based on DAO 2013-13

Source: DAO 2000-81 and DAO 2013-13

2.6.3. Surface and Effluent Water Quality Standards

307. The DAO 2016-08 provides the water usage and classification as well as water quality guidelines and general effluent standards in the Philippines. **Table 2.6.3** shows the descriptions of the various water body classifications under DAO 2016-08, while

308. **Table 2.6.4** and **Table 2.6.5** present the Water Quality Guidelines (WQG) for freshwater and General Effluent Standards (GES), respectively.

Table 2.6.3 Water Body Classification and Usage of Freshwater

Class	Intended Beneficial Use
Class AA	Public Water Supply Class I – Intended primarily for waters having watersheds, which are uninhabited and/or otherwise declared as protected areas, and which require only approved disinfection to meet the latest PNSDW
Class A	Public Water Supply Class II – Intended as sources of water supply requiring conventional treatment (coagulation, sedimentation, filtration and disinfection) to meet the PNSDW
Class B	Recreational Water Class I – Intended for primary contact recreation (bathing, swimming, etc.)
Class C	1) Fishery Water for the propagation and growth of fish and other aquatic resources 2) Recreational Water Class II – for boating, fishing, or similar activities 3) For agriculture, irrigation, and livestock watering
Class D	Navigable waters

For unclassified water bodies, classification shall be based on the beneficial use as determined by the Environmental Management Bureau (EMB)

Source: DAO 2016-08

Table 2.6.4 Water Quality Guidelines for Freshwater

Parameter	DAO 2016-08			
	Class A	Class B	Class C	Class D
Color	50 TCU	50 TCU	75 TCU	150 TCU
Temperature	26-30°C	26-30°C	25-31°C	25-32°C
pH (Range)	6.5-8.5	6.5-8.5	6.5-9.0	6.5-9.0
Dissolved Oxygen (DO) (minimum)	5 mg/L	5 mg/L	5 mg/L	2 mg/L
Biochemical Oxygen Demand (BOD)	3 mg/L	5 mg/L	7 mg/L	15 mg/L
Total Suspended Solids (TSS)	50 mg/L	65 mg/L	80 mg/L	110 mg/L

Parameter	DAO 2016-08			
	Class A	Class B	Class C	Class D
Surfactants (MBAS)	0.2 mg/L	0.3 mg/L	1.5 mg/L	3 mg/L
Oil and Grease (Petroleum Ether Extracts)	1 mg/L	1 mg/L	2 mg/L	5 mg/L
Nitrate as Nitrogen	7 mg/L	7 mg/L	7 mg/L	15 mg/L
Phosphate as Phosphorus	0.5 mg/L	0.5 mg/L	0.5 mg/L	5 mg/L
Phenolic Substances and Phenols	<0.001 mg/L	<0.001 mg/L	0.05 mg/L	0.5 mg/L
Total Coliforms	-	-	-	-
Fecal Coliforms	<1.1 MPN/100mL	100 MPN/100mL	200 MPN/100mL	400 MPN/100mL
Chloride as Cl	250 mg/L	250 mg/L	350 mg/L	400 mg/L
Copper (Dissolved Copper)	0.02 mg/L	0.02 mg/L	0.02 mg/L	0.04 mg/L
Arsenic (As)	0.01 mg/L	0.01 mg/L	0.02 mg/L	0.04 mg/L
Cadmium (Cd)	0.003 mg/L	0.003 mg/L	0.005 mg/L	0.01 mg/L
Chromium (Hexavalent)	0.01 mg/L	0.01 mg/L	0.01 mg/L	0.02 mg/L
Cyanide (CN-)	0.07 mg/L	0.07 mg/L	0.1 mg/L	0.2 mg/L
Lead (Pb)	0.01 mg/L	0.01 mg/L	0.05 mg/L	0.1 mg/L
Total Mercury (Hg)	0.001 mg/L	0.001 mg/L	0.002 mg/L	0.004 mg/L
Organophosphate as Malathion	1 µg/L	1 µg/L	3 µg/L	6 µg/L

Source: DAO 2016-08

Table 2.6.5 General Effluent Standards

Parameter	DAO 2016-08			
	Class A	Class B	Class C	Class D
Color	100 TCU	100 TCU	150 TCU	300 TCU
Temperature	3 ºC change	3 ºC change	3 ºC change	3 ºC change
pH (Range)	6.0-9.0	6.0-9.0	6.0-9.5	5.5-9.5
Dissolved Oxygen (DO)	-	-	-	-
Biochemical Oxygen Demand (BOD)	20 mg/L	30 mg/L	50 mg/L	120 mg/L
Total Suspended Solids (TSS)	70 mg/L	85 mg/L	100 mg/L	150 mg/L
Surfactants (MBAS)	2 mg/L	3 mg/L	15 mg/L	30 mg/L
Oil and Grease (Petroleum Ether Extracts)	5 mg/L	5 mg/L	5 mg/L	15 mg/L
Nitrate as Nitrogen	14 mg/L	14 mg/L	14 mg/L	30 mg/L
Phosphate as Phosphorus	1 mg/L	1 mg/L	1 mg/L	10 mg/L
Phenolic Substances and Phenols	0. 01 mg/L	0.01 mg/L	0.5 mg/L	5 mg/L
Total Coliforms	3,000 MPN/100mL	3,000 MPN/100mL	10,000 MPN/100mL	15,000 MPN/100mL
Fecal Coliforms	4 MPN/100mL	200 MPN/100mL	400 MPN/100mL	800 MPN/100mL
Chloride as Cl	350 mg/L	350 mg/L	450 mg/L	500 mg/L
Copper (Dissolved Copper)	0.04 mg/L	0.04 mg/L	0.04 mg/L	0.08 mg/L
Arsenic (As)	0.02 mg/L	0.02 mg/L	0.04 mg/L	0.08 mg/L

Parameter	DAO 2016-08			
	Class A	Class B	Class C	Class D
Cadmium (Cd)	0.006 mg/L	0.006 mg/L	0.01 mg/L	0.02 mg/L
Chromium (Hexavalent)	0.02 mg/L	0.02 mg/L	0.02 mg/L	0.04 mg/L
Cyanide (CN-)	0.14 mg/L	0.14 mg/L	0.2 mg/L	0.4 mg/L
Lead (Pb)	0.02 mg/L	0.02 mg/L	0.1 mg/L	0.2 mg/L
Total Mercury (Hg)	0.002 mg/L	0.002 mg/L	0.004 mg/L	0.008 mg/L
Organophosphate as Malathion	1 µg/L	1 µg/L	3 µg/L	6 µg/L

Source: DAO 2016-08

2.6.4. Groundwater Quality Standards

309. The Department of Health (DOH) AO 2017-0010, otherwise known as the PNSDW of 2017 establishes the criteria for drinking water quality. In cases where the criteria for certain parameters are not available in the PNSDW, the guideline values from DAO 2016-08 Water Quality Guidelines (WQG) for Class AA Waters are used. **Table 2.6.6** shows the comparison of applicable national standards on groundwater quality.

Table 2.6.6 Groundwater Quality Standards

Parameter	Holding Time	PNSDW
Physical Characteristics		
pH	Not to exceed 6 hours	6.5-8.5
Color	24 hours	10 CU
Temperature	-	26-30°C
Cations and Anions		
Sodium (Na)	28 days	200 mg/L
Potassium (K)	-	-
Calcium (Ca)	-	-
Magnesium (Mg)	-	-
Bicarbonate (HCO3-)	-	-
Chloride (Cl-)	28 days	250 mg/L
Sulphate (SO-2)	28 days	250 mg/L
Nitrate (NO3-)	24 hours	50.00 mg/L
Toxic and Other Deleterious Substances		
Arsenic (As)	28 days	0.01 mg/L
Cadmium (Cd)	28 days	0.003 mg/L
Chromium (Cr)	28 days	0.05 mg/L
Cyanide (CN-)	24 hours	0.05 mg/L
Lead (Pb)	28 days	0.01 mg/L
Mercury, total (Hg)	28 days	0.001 mg/L
Total Coliforms	<1.1 MPN/100mL	<1.1 MPN/100mL
Fecal Coliforms	<1.1 MPN/100mL	<1.1 MPN/100mL

Source: DOH AO 2007-012 and DAO 2016-08.

2.6.5. Ambient Noise Quality Standards

310. The measured noise levels are compared to the World Bank Group's (WBG) Environment, Health and Safety (EHS) Guidelines of 2007 (**Table 2.6.7**). These standards are applied during construction and operation for all project-affected areas.

Table 2.6.7 Guidelines for Community Noise of World Bank Group EHS Guidelines of 2007

Receptor	One Hour LAeq (dBA) [1]	
	Day Time (0700 H – 2200 H)	Night Time (2200 H – 0700 H)
Residential, institutional and educational [2]	55	45
Industrial and commercial	70	70

Notes:
[1] Guideline values are for noise levels measured out of doors.
[2] Acceptable indoor noise levels for residential, institutional and educational settings refer to WB-EHS (2007). Noise impacts should not exceed the levels presented in **Table 2.6.7**, or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

Source: WBG Guidelines for Community Noise, 2007.

2.6.6. Ambient Vibration Quality Standards

311. Due to the absence of a national standard/criteria for vibration in the Philippines, the project adopted the vibration criteria and generalized assessment procedure of the U.S. Federal Transit Administration (U.S. FTA), specifically the "Transit Noise and Vibration Impact Assessment" dated May 2006.

2.6.6.1. Standard for Construction

312. There are two (2) types of impacts related to construction vibrations presented by the FTA (2016)—1) human annoyance and 2) building damage. According to the FTA (2016), the same vibration criteria for general assessment can be applied for the evaluation of annoyance or interference with vibration-sensitive activities. These annoyances can occur when construction vibration rises above the threshold of human perception over extended periods. Often, the primary concern regarding construction vibration is its potential damage effects. Damages to buildings can be cosmetic or structural.

313. Historical structures which are fragile are commonly vulnerable to damages caused by ground vibration. While normal buildings which are not fragile would not experience cosmetic damages at reasonable distances. The distances can considerably vary depending on soil composition and subsurface conditions. Further, buildings have different responses to vibration generated by construction equipment. The FTA's construction vibration criteria are presented in **Table 2.6.8**.

Table 2.6.8 Construction Vibration Damage Criteria

Building Category	Peak Particle Velocity (PPV) (in/s)
i. Reinforced-concrete, steel or timber (no plaster)	0.5
ii. Engineered concrete and masonry (no plaster)	0.3
iii. Non-engineered timber and masonry buildings	0.2
iv. Buildings extremely susceptible to vibration damage	0.12

Source: FTA, 2006

2.6.6.2. Standard for Operation

314. Railway operations have the potential to induce high vibration levels. This is because the rolling contact between rigid steel rails and wheels creates vibratory motions that are transmitted into the track support system. The magnitude of vibration is highly dependent on the smoothness of wheels and rails as well as the suspension system of the vehicle. The vibration energy of track structures in contact with the ground generates vibration, which is propagated through different soil and rock strata and into the foundation of nearby structures. Buildings, structures and their inhabitants are the receivers. The focus of this study is to determine if vibration would cause disruption or annoyance to people inside buildings and whether vibration interferes their activities based on U.S. FTA guidelines (2006).

315. Ground vibration can be described in terms of displacement, velocity or acceleration. However, human responses by monitoring instruments and other objects are most accurately described with velocity. Therefore, the FTA (2006) recommends the use of the velocity level to assess vibration impacts from transit projects.

316. Vibration amplitude is the magnitude of the motion of the system under study and is usually expressed as either peak particle velocity (PPV) or the root mean square (RMS) velocity. The PPV is the maximum instantaneous peak of the vibration signal. It is considered as the most appropriate parameter for the evaluation of the potential to cause building damages. On the other hand, the RMS is the average of the squared amplitude of the signal and is typically used to assess human responses to vibration. The RMS amplitude is always less than the PPV and is always positive (FTA, 2006). PPV and RMS velocities can be expressed in inches per second.

317. **Table 2.6.9** shows the vibration criteria in evaluating ground-borne vibration impacts associated with train traffic at nearby receptors. The vibration criteria are based on Table 8-1 and Table 8-2 of the U.S. FTA (2016), which specify ground-borne vibration (GBV) impact criteria for general assessment and those for special buildings. The FTA criteria are based on the RMS vertical vibration velocity in terms of decibel units (VdB) relative to one (1) micro inch per second. The limits are also absolute levels and do not increase relative to the existing ambient vibration conditions. Hence, the assessment in comparison with the FTA criteria (2016) does not require background ambient vibration levels.

Table 2.6.9 FTA Ground-Borne Vibration Impact Criteria

Receptor Land Use		RMS Vibration Levels (VdB)		
Category	**Description**	**Frequent Events [1]**	**Occasional Events [2]**	**Infrequent Events [3]**
1	Building where low vibration is essential for interior operations	65 [4]	65 [4]	65 [4]
2	Residences and buildings where people normally sleep	72	75	80
3	Daytime institutional and office use including schools, churches and other institutions	75	78	83
Specific Buildings	TV/ Recording Studios/ Concert Halls	65	65	65
	Auditoriums	72	80	80
	Theaters	72	80	80

Notes:
[1] Defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.
[2] Defined as between 30 and 70 vibration events of the same source per day. Most commuter trunk lines have many operations.

[3] Defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.
[4] This standard limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration-sensitive manufacturing or research require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.

Source: FTA, 2006.

2.6.7. Soil Quality and Contamination

2.6.7.1. Soil Quality/Fertility

318. The Bureau of Soils and Water Management (BSWM) provides a standard soil fertility rating for certain parameters such as levels of pH, organic matters, primary nutrients (nitrogen, phosphorus and potassium), secondary nutrients (calcium and manganese), micronutrients (copper, zinc, iron and manganese) and trace metals (lead, arsenic, mercury, cadmium and chromium hexavalent). **Table 2.6.10** presents the soil fertility/quality standards and **Table 2.6.11** shows the soil fertility evaluation criteria standards.

Table 2.6.10 Soil Fertility/Quality Standards

Parameter	Philippine National Standards	
	PNS/ BAFS 40:2016 (Organic Soil Amendments)	BSWM Standards[1]
pH	-	5.5-8.5
Organic Matter	≥ 20%	1-8; >3[2]
Primary Nutrients		
Total Kjeldahl Nitrogen	-	-
Phosphorus	-	>10; >20*
Potassium	-	>0.25
Total NPK (N, P, K were analyzed separately)	5-10%	-
Secondary Nutrients		
Calcium	-	-
Magnesium	-	>0.50
Micronutrients		
Available Iron	-	>4.5
Available Copper	300 mg/kg	>0.2
Available Manganese	-	>1.0
Available Zinc	5 mg/kg	>1.5; >1.0*
Trace Metals		
Lead	50 mg/kg	-
Arsenic	20 mg/kg	-
Mercury	2 mg/kg	-
Cadmium	5 mg/kg	-
Chromium Hexavalent	150 mg/kg	-

Notes:
[1] Adopted from General Guidelines for the Fertility Rating of Soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy.
[2] Limits applicable to dry land crops.

Source: PNS, BSWM

Table 2.6.11 Soil Fertility Evaluation Criteria Standards

Parameter	High/ Adequate	Medium/ Moderate	Low/ Deficient
pH	5.6-6.7	5.6-4.6	>6.8; <4.5 *
Organic Matter	>4.6%	2.1-4.5%	<2
Available Phosphorus	>10	2.1-9.9	<2
Extractable Potassium	>151	76-150	<75

Note: pH 4.5 and 6.8 are considered a problem in soil for rice.

Source: BSWM

2.6.7.2. Soil Contamination

319. For soil contamination, the Dutch Target and Intervention Values (2000) for soil remediation are adopted for the project due to the absence of national standards. The target values and soil remediation intervention values are presented in **Table 2.6.12**.

320. The soil remediation intervention values indicate when functional properties of the soil for humans, plants and animals are seriously impaired or threatened. They are representative of the level of contamination above which there is a serious case of soil contamination. In addition, they are based on extensive studies of the Netherlands' National Institute for Public Health and Environmental Protection regarding both human and ecotoxicological effects of soil contaminants.

Table 2.6.12 Target Values and Soil Remediation Intervention Values

Parameters	Target Value (mg/kg)	Intervention Value (mg/kg)
Arsenic	29	55
Barium	160	625
Copper	36	190
Zinc	140	720
Cadmium	0.8	12
Chromium	100	380
Lead	85	530
Mercury	0.3	10
Selenium	0.7	100
Nickel	35	210
Cyanide (pH≥5)	5	50
Polychlorinated Biphenyls (PCB) *	-	1
Oil and Grease	-	-

Note: Ecotoxicological HC50-values (hazardous concentration 50% that is to say concentration at **which 50% of the species and processes in an ecosystem are completely protected) in mg/kg soil/sediment (dry weight). The HC50-values are given for standard soil (10% organic substance and 25% clay).**

Source: Dutch Target and Intervention Values (2000) for soil remediation

2.7. OTHER ENVIRONMENTAL LAWS AND REGULATIONS CONCERNING THE PROJECT

2.7.1. International Treaties, Agreements and Related Documents

321. **Table 2.7.1** shows the list of international regulations/agreements that the Philippines has ratified.

Table 2.7.1 Ratified International Treaties/Agreements in the Philippines

Category	Name of Treaty	Year Ratified
Biodiversity	Convention on Biological Diversity, 1992	June 1992
	Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973	November 1981
	Convention on Wetlands of International Importance, 1971	November 1994
	Convention on the conservation of Migratory Species of Wild Animals, 1983	February 1994
	Cartagena Protocol on Biosafety, 2000 (to the Convention on Biological Diversity)	October 2006
	Nagoya Protocol on Access to Genetic Resources & the Fair & Equitable Sharing of Benefits Arising from their Utilization-Supplementary Agreement to the Convention of Biological Diversity	September 2015
Climate Change	Montreal Protocol on Substances that Deplete the Ozone Layer, 1987	July 1991
	Vienna Convention for the Protection of the Ozone Layer, 1985	July 1991
	London Amendment (to the Montreal Protocol), 1990	August 1993
	United Nations Framework Convention on Climate Change, 1994	November 2003
	Kyoto Protocol to the United Nations Convention on Climate Change 1998	2003
	Paris Agreement Adopted in the 21st Session of the Conference of Parties to the United Nations Framework Convention on Climate Change, 2015	December 2017 RP Accession
	United Nations Convention to Combat Desertification, 1994	February 2000
Pollution	Basel Convention on the Control of Transboundary Movements of Hazardous wastes and their Disposal, 1992	October 1993
	Stockholm Convention on Persistent Organic Pollutants 2001	May 2004
	Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemical and Pesticides in International Trade, 2004	July 2006
Historical/ Cultural Heritage	UNESCO Convention Concerning the Protection of the World Cultural and National Heritage, 1972	May 1985
Forestry	International Tropical Timber Agreement, 1994	November 1983
Social	Convention on the Elimination of all Forms of Discrimination against Women, 1979	1981
	International Convention on the Elimination of all forms of racial discrimination 1965	September 1967
	International Covenant on Civil and Political Rights 1976	1986
	International Covenant on Economic, Social and Cultural Rights 1976	June 1974
	Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment 1987	June 1986
	Convention on the Rights of the Child 1990	July 1990

Category	Name of Treaty	Year Ratified
	International Convention on the Protection of the Rights of all migrant Workers and members of their families, 1996	July 1995
	International convention for protection of all persons from enforced Disappearance 2010	December 2010
	Convention on the Rights of Persons with Disabilities 2008	April 2008

Source: JICA Design Team.

2.7.2. National Strategy and Plan Relevant to Environment and Social Considerations

322. The following are national-level action plans and strategies (including systems) on various natural resources components and environmental management which impact on projects and activities (**Table 2.7.2**). These are implemented by national government agencies and instrumentalities in coordination with appropriate stakeholders and partners, which reflects the cross-sectoral approach to environmental management concerns.

Table 2.7.2 National Strategy and Plan Relevant to the ESC

Category	Name
Biodiversity	Philippines: National Biodiversity Strategy and Action Plan (NBSAO), 1997
	Philippine Biodiversity Conservation Priorities, 2002
	A National Wetland Action Plan for Philippines 2011-2016
	Philippine Plant Conservation Strategy and Action Plan, 2003
Pollution	DAO 2007-22 Guidelines on the Requirements for Continuous Emission Monitoring System
	DAO 2000-82 Integrated Air Quality Improvement Framework-Air Quality Control Action Plan
	Adopt an Estero/Water body Program, 2010
	DAO's Implementing Sec. 5 of RA 9275 on the Designation of Certain Areas as Water Quality Management Areas
	Integrated Persistent Organic Pollutants Management Project
	Adoption of a National Strategy for the Management of POP's Contaminated Sites in the Philippines, EMB Memorandum February, 2016
	National Solid Waste Management Framework, 2004
Social	Philippine Development Plan 2017-2022
	Philippine Environmental Partnership Program
	Government Poverty Reduction Programs and Plans
	Philippine Plan for Gender Responsive Development Plan 1995-2025
	National Plan of Action for Children, 1991
	22 Point Platform and Policy Pronouncements on Labor and Employment, 2010
Climate Change	Second National Communication Plan on Climate Change
	Philippine Energy Plan 2009- 2030
	Philippine Strategy on Climate Change Adaptation 2010-2022
	National Framework Strategy on Climate Change 2010 – 2022
	National Climate Change Action Plan, DILG

Source: JICA Study Team

2.7.3. Other Related Laws and Regulations

323. The PEISS states obligations to strictly comply with environmental laws, rules, regulations and standards, which have been established by the Philippine government as presented in **Table 2.7.3**.

Table 2.7.3 The Philippines' Environmental Laws, Regulations and Environmental Quality Standards

Items	Environmental Laws, Regulations and Environmental Quality Standards
Biodiversity	RA No.7586 (1992), National Integrated Protected Areas System (NIPAS) Act
	RA No. 11038 (2018), Expanded National Integrated Protected Areas System Act of 2018
	RA No. 9147 (2001), Wildlife Resources Conservation and Protection Act
	Executive Order (EO) 247 s. 1995, Prescribing Guidelines and Establishing a Regulatory Framework for the Prospecting of Biological and Genetic Resources, There By-products and Derivatives for Scientific Purposes and for Other Purposes
	DAO 2004-15, Establishing the List of Terrestrial Threatened Species and Their Categories and the List of Other Wildlife Species Pursuant to RA 9147 Otherwise known as the Wildlife Resources and Conservation Act of 2001
	DAO 2007-24, Establishing the National List of Threatened Plants and Their Categories and the List of Other Wildlife Species
	DAO 2017-11, Updated National List of Threatened Philippine Plants and their Categories
	DAO 2019-09, Updated National List of Threatened Philippine Fauna and their Categories
Forestry	PD No. 705 (1975), Forestry Reform Code
	PD 953 (1976), Requiring the Planting of Trees in Certain Places and Penalizing the Unauthorized Cutting, Destruction, Damaging and Injury of Certain Trees, Plants, and Vegetation
	EO No. 193 s. 2015, Expanding the Coverage of the National Greening Program (NGP)
	DENR MC (DMC) No. 2011-01, Guidelines, and Procedures in the implementation of the National Greening Program (March 8, 2011)
	DAO 2016-20, Implementing Rules and Regulations of EO 193. (June 29, 2016)
Pollution Control (Water)	PD No. 1067 (1976), Water Code
	DAO 2016-08, Water Quality Guidelines and General Effluent Standards of 2016
	RA No. 9275 (2004), Clean Water Act
	RA No. 4850 (1966), Laguna Lake Development Authority Act of 1966
	DAO 2018-12, Las Piñas-Parañaque River System Water Quality Management Area
	DAO 2005-10, Implementing Rules and Regulations of the Clean Water Act
	DOH AO 2017-0010, PNSDW
Pollution Control (Air)	RA No. 8749 (1999), Clean Air Act of 1999
	DAO 2000-81, Ambient Air Quality and Emission Standards
	DAO 2013-13, Provisional National Ambient Air Quality Guideline Values for Particulate Matter 2.5 ($PM_{2.5}$)
Pollution Control (Waste)	RA No. 6969 (1990), Toxic Substances, Hazardous and Nuclear Wastes Control Act
	PD No. 856 (1975), Sanitation Code
	DAO 2006-10, Guidelines on the Categorized Final Disposal Facilities
	DAO 2006-09, General Guidelines on the Closure and Rehabilitation of Open Dumpsites and Controlled Disposal Facilities
	DAO 2013-22, Implementing Rules and Regulations of RA 6969
	RA No. 9003 (2001), Ecological Solid Waste Management Act

Items	Environmental Laws, Regulations and Environmental Quality Standards
	DAO 1994-28, Interim Guidelines for the Importation of Recyclable Materials containing Hazardous Substances
	DAO 1997-28, Amending Annex A of DAO 1994-28
	DAO 2001-34, IRR of RA 9003
Pollution Control (Noise)	National Pollution Control Commission (NPCC) MC No. 1980-02, Section 78, Noise Environment Standards
Historical/ Cultural Heritage	RA No. 10066 (2009), National Cultural Heritage Act of 2009, Providing for the Protection and Conservation of the National Cultural Heritage, Strengthening the National Commission for Culture and Arts (NCCA) and its Affiliated Cultural Agencies and for Other Purposes
	RA No. 10086 (2010), Strengthening Peoples' Nationalism through Philippine History by Changing the Nomenclature of the National Historical Institute into the National Historical Commission of the Philippines (NHCP), Strengthening its Powers and Functions, and for Other Purposes
	RA No. 4846 (1966), Cultural Properties Preservation and Protection Act of 1966
	PD 374 (1974), Amending Certain Sections of Republic Act No. 4846, Otherwise Known as the "Cultural Properties Preservation and Protection Act"
Ancestral Domain, Indigenous People	RA No. 8371 (1997), Indigenous Peoples Rights Act
	NCIP AO No. 1998-01, Rules and Regulations Implementing RA 8371 otherwise known as “Indigenous Peoples Rights Act of 1997
	NCIP AO No. 2004-01, Guidelines on the Formulation of the Ancestral Domain Sustainable Development and Protection Plan
	NCIP AO No. 2006-01, the Free and Prior Informed Consent Guidelines of 2006
	NCIP AO No. 2012-03, Revised Guidelines on Free and Prior Informed Consent and Related Processes
Climate Change and Disaster Risk Reduction	RA No. 9729 (2009), Climate Change Act
	Climate Change Commission (CCC) AO No. 2010-01, IRR of RA 9729
	EO No. 174 s. 2014, Institutionalizing Philippine Greenhouse Gas Inventory Management and Reporting System
	RA No. 10121 (2010), Philippine Disaster Risk and Management Act
	RA No. 10174 (2012), People’s Survival Fund
	EMB MC 2011-005, EIA Technical Guidelines Incorporating DRR and CCA Concerns
Geology and Geohazard	MGB MC 2000-33, Guidelines and Outline/Checklist for the Preparation of an Engineering Geological and Geohazard Assessment Report (EGGAR) as per DAO 2000-28
	DAO 2000-28, Implementing Guidelines on Engineering Geological and Geohazard Assessment as additional Requirement for ECC Applications covering Subdivision, Housing and other Land Development and Infrastructure Projects

Source: JICA Study Team

324. Further, the Fire Safety Enforcement Manual of the Bureau of Fire Protection of the Philippines will be principally used as the design criteria of the Project as well as any recommendations made by them. All design aspects of the SCRP interconnecting line including stations, trainways and railway tracks, ventilation systems, vehicles, communications, control systems, escalators and elevators, egress routes, and alarm systems shall adhere to the relevant international design standards such as the NFPA 130 (Standard for Fixed Guideway Transit and Passenger Rail Systems), Japan Fire Prevention Standards for Underground Stations, Technical Regulatory Standards on Japanese Railways. The final design criteria will be identified during the DED stage of the project, including that of the interconnecting line of SCRP which is currently in its basic design stage.

325. The Risk Management Chapter of this report lists the specific codes and standards for the design considerations of the SCRP components including its underground segment.

2.7.4. Permits to be Obtained for the Project Operation

326. Prior to project implementation, the DOTr is required to obtain project-related permits in a timely manner.

2.7.4.1. Tree Cutting Permit

327. All projects that require cutting of trees must secure a tree cutting permit from the DENR and the Philippine Coconut Authority (PCA) (for coconut trees). Discussed below are the relevant laws, regulations and the procedure for applying a tree cutting permit.

(1) Relevant Laws and Regulations

328. **Table 2.7.4** presents the issuances on and guidelines for obtaining a tree cutting permit.

Table 2.7.4 Issuances and Guidelines Related to Tree Cutting Permits

	Relevant Policies/Guidelines
1	DENR Memorandum on Guidelines and Procedures on the Planting, Maintenance, and Removal of Trees in Urban Areas and in Areas Affected by Government Infrastructure Projects (November 27, 2009)
2	DENR Memorandum Order (DMO) 2012-02, Uniform Replacement Ratio for Cut or Relocated Trees (November 5, 2012)
3	Forest Management Bureau (FMB) Technical Bulletin No.3, Measurement Standards, and Procedures in the conduct of inventory for standing trees (April 2014)
4	RA No. 8048, Coconut Preservation Act of 1995 (July 25, 2005)
5	RA No. 10593, An Act Amending Certain Sections of Republic Act No. 8048 (July 23, 2012)
6	DAO 2018-16, Guidelines in the Processing and Issuance of Permits on the Removal and Relocation of Trees Affected by DPWH BBB Projects (expanded by DAO 2020-06 which includes other agencies' BBB Projects) (July 2018)

Source: DENR, PCA

(2) Application Procedure

329. The application procedure for the issuance of a tree cutting permit is shown in **Table 2.7.5**. On average, the process of tree cutting permit application takes about two (2) months from the day of application, due to a number of government entities involved in the procedure. Once issued, a tree cutting permit is usually valid for sixty (60) days after its issuance. The proponent can claim to extend its validity through justification on the cause of delay. If coconut trees are affected, tree cutting guidelines of the PCA, pursuant to RA No. 10593, are applied.

Table 2.7.5 DENR Procedure to Obtain Tree Cutting Permits

	Procedure	Responsible Entity
1	Submit application documents to the concerned City Environment and Natural Resources Office (CENRO): LGU endorsement/certificate of no objection Land owners' Letters of No Objections (LNOs) Appropriate infrastructure plan with tree charting (e.g. Road Alignment Plan, Building Plan) indicating geotagged location of individual trees affected by the project, to be numbered sequentially, and shall be vetted by the DPWH as basis of validation by the DENR during actual cutting operations Appropriate Environmental Clearance (CNC/ECC)	DOTr

	Procedure	Responsible Entity
	Endorsement from the concerned LGUs Waiver/Consent corresponding to appropriate infrastructure plan in the case of tree cutting within private lands Appropriate Land Tenure Instruments (LTIs) for tree cutting within forestlands	
2	Review the submitted requirements, assign an inspecting officer and issue an order of payment. The concerned CENR Office shall issue the corresponding Tree Cutting Permit and/or Earth Balling Permit (TCP/EP) within three (3) working days indicating the number of trees based on the analysis of the appropriate infrastructure plan with tree charting or if necessary, on the result of actual ocular inspection	CENRO
3	Conduct ocular inspection to verify correctness of the submitted requirements on coordination with the DPWH before issuance of the TCP/EP.	CENRO, DPWH
4	Receive the order of payment and pay tree inventory fees but no payment required for less than 20 trees	DOTr
5	Conduct 100% inventory or inspection of the area and prepare an inspection report with geotagged photos. Determine number, location and its species nomenclature/common name. Classification if naturally grown or planted, and corresponding volume shall be verified determined upon the conduct of geotagging and tree scaling by CENRO concerned during the actual tree cutting activities.	CENRO (Inspection Personnel)
6	a. Review and approve the inspection report b. Sign endorsement to the Provincial Environment and Natural Resources Officer (PENRO)	CENRO
7	a. Review and approve CENRO recommendations b. Sign the endorsement to the Regional Director (RD)	PENRO
8	a. Review and approve the endorsement to the FMB b. Furnish a copy to the USEC for field operations/ c. Release the endorsement to the FMB	DENR Regional Office/Regional Director
9	a. Review, evaluate and conduct data analysis b. Prepare a memorandum of endorsement to the USEC for field operations c. Draft clearance for the issuance of a tree cutting permit d. Review and sign the memorandum of endorsement to the USEC for staff bureaus	FMB
10	Review and forward it to the USEC for field operations	USEC for Staff Bureaus
11	Review and approve/sign clearance to issue the permit to cut	USEC for Field Operations
12	a. Receive clearance to issue the permit to cut b. Transmit to the concerned regional office	FMB
13	Prepare and sign the tree cutting permit	DENR RO/RD
14	Receive the tree cutting permit.	DOTr
15	Tree removal and relocation operation, including turnover and transport of logs, shall be done under the presence and close supervision of the DENR.	DENR, DOTr

Source: DAO 2018-16 (expanded by DAO 2020-06)

Table 2.7.6 Procedure to Obtain Permit-to-Cut for Coconut Trees

	Procedure	Responsible Entity
1	Submit application documents to the concerned CENRO: Prescribed application form Valid identification of an applicant Proof of ownership	DOTr

	Procedure	Responsible Entity
	Affidavit of non-encumbrance Additional requirements may include any of the following: • Special Power of Attorney (SPA) if a representative of an applicant • duly approved board resolution for a corporation • notarized consent of co-owners • Sangguniang Barangay Resolution/certification for endangerment for those hazardous to life and property • final conversion order issued by the Department of Agrarian Reform (DAR) • certification of conversion to other crops by the Department of Agriculture • affidavit of marking and identification of trees to be cut • certificate of field planting by Barangay Chairman indicating the number of trees planted and the location of planted areas	
2	Examine and scrutinize the accomplished forms	Agriculturist
3	Sign the application	Concerned Provincial Coconut Development Manager/Division Chief
4	Pay the permit-to-cut (PTC) issued with an official receipt	DOTr
5	a. Inspect the site and coconut trees to be cut b. Verify the authenticity of submitted documents c. Post them at the barangay hall and at the site (7 days) d. Consult with the concerned person or group on the said cutting of coconut trees (1 day) e. Inspect the site (1 day)	Agriculturist (Coconut Development Officer)
6	Prepare the PTC	Agriculturist
7	Sign the PTC and issue it to the applicant	• Division Chief I for 100-1,000 trees • Regional Manager for 1,001-2.500 trees • the Administrator or the Chairman of Task Force for more than 2,500
8	Receive the PTC	DOTr

Source: PCA Quality Management System Manual, Resolution No. 151-2017.

2.7.4.2. Endorsement of the Philippine Cultural Agencies on Historic Structures and Buildings

330. The endorsement of the Philippines' cultural agencies in relation to the preservation of historic structures is necessary prior to project implementation to ensure that proposed project activities conform with acceptable cultural and historical standards and procedures.

(1) Relevant Laws and Regulations

331. **Table 2.7.7** shows the guidelines and procedures to obtain the endorsement from cultural agencies including the NCCA, the NHCP and the National Museum (NM).

Table 2.7.7 Policies and Guidelines of Philippine Cultural Agencies

	Relevant Policies/Guidelines
1	NHCP Guidelines on the Identification, Classification and Recognition of Historic Sites and Structures in the Philippines (2011)
2	NHCP Universal Guidelines of the Restoration and Preservation of Monuments and Historic Sites

Relevant Policies/Guidelines	
3	NHCP Process of Architectural Restoration
4	NHCP Techniques involved in the Restoration of Historic Structures
5	NHCP Standards and Guidelines in Maintaining Historic Sites and Structures (2010)
6	RA No. 10086, An Act Strengthening People's Nationalism Through Philippine History by Changing Nomenclature of the National Historical Institute into the NHCP, Strengthening its Powers and Functions and for Other Purposes
7	RA No. 10066, An Act Providing for the Protection and Conservation of the National Cultural Heritage, Strengthening the NCCA and its Affiliated Cultural Agencies and for Other Purposes
8	RA No. 8492, An Act Establishing a National Museum System Providing for its Permanent Home and for Other Purposes, Otherwise Known as the "National Museum Act of 1998"
9	RA No. 4846, Cultural Properties Preservation and Protection Act of 1966
10	PD No. 374 amending certain sections of RA 4849 in 1974
11	PD 1096 Adopting a National Building Code of the Philippines (NBCP) thereby Revising RA 6541
12	International Standards on Conservation: The Venice Charter: International Charter for the Conservation and Restoration of Monuments and Sites (1964) The Washington Charter: Charter on the Conservation of Historic Towns and Urban Areas (1987) The Nara Document on Authenticity (1994)

Source: JICA Design Team

(2) Procedure Applied

332. The process for establishing guidelines for the protection and conservation of historic structures and building including PNR structures is presented in **Table 2.7.8**.

333. To obtain the endorsement of cultural agencies, protection and conservation procedure for historical structures are to be prepared by the DOTr and the PNR. The Procedure covers the following: measures for the protection of historical structures during project construction; program for the preservation of sites and structures during operation; dismantling, storage and rebuilding of structures at a new location during construction; demolition/partial demolition of structures with concurrence of PNR; and monitoring and protection of historic structures adjacent, or close to the PROW and other construction facilities. The plans have to be submitted to and deliberated on by the three agencies concerned on historical and cultural heritages, i.e., the NHCP, the NM and the NCCA.

Table 2.7.8 Procedure for Historic Structure Assessment

Procedure		Responsible Entity	Timeline
1	List potential historic PNR structures and other structures along the SCRP alignment (including Senate-FTI-Bicutan interconnecting line)	PNR/JICA Design Team (JDT)	FS
2	Joint inventory (verification)	PNR/DOTr/JDT	
3	Prepare a JDT design proposal on PNR and other structures	PNR/DOTr/JDT	
4	Review/update/approve the JDT proposal	PNR/DOTr/NCCA, NHCP and NM	DD
5	Conduct a measurement survey on protected buildings	JDT	

Procedure		Responsible Entity	Timeline
6	Develop outline protection measures prior to construction	JDT	
7	Review and approve protection measures by the NHCP, the NM and the NCCA	PNR/DOTr/JDT	
8	Conduct a building condition survey on handover	DOTr, contractor and General Consultant (GC)	CS
9	Review and update protection measures by a contractor	DOTr, contractor and GC	
10	Monitor vibration levels at old PNR structures and those with historical markers during construction	DOTr, contractor and GC	
11	Appropriate courses of action in case of any archaeological finds	DOTr, contractor and GC	

Source: JICA Design Team based on consultations with the NCCA, the NHCP and the NM

2.7.4.3. Archeological Site

334. Since the project involves land clearing, excavation and tunnelling, possible unearthing of artefacts and archaeological remains is inevitable. In the event that an archaeological asset is discovered during construction, the following regulations and procedures are applied.

(1) Relevant Laws and Regulations

335. Presented in **Table 2.7.9** are the policies and guidelines related to archaeological impact assessment (AIA) mandated by the National Museum of the Philippines.

Table 2.7.9 Policies and Guidelines Related to Archaeological Impact Assessment

Relevant Policies/Guidelines	
1	RA No. 8492, An Act Establishing a National Museum, Providing for its Permanent Home and for Other Purposes.
2	RA No. 10066, National Cultural Heritage Act 2009, Outlining the Definitions and Protections Afforded to Cultural Property.
3	National Museum Office Order 2108-126, Permit to Conduct Land Archeological Research Exploration and Excavation, Outlining the Procedures to Carry Out Excavations.

Source: UP-ASP, Scope of Work in the Conduct of AIA

(2) Procedure Applied

336. Presented in **Table 2.7.10** is the procedure followed in the conduct of the AIA. Meanwhile, **Table 2.7.11** shows the summary of procedure the proponent should follow in the event of accidental find pursuant to the Heritage Accidental Find procedure of the National Museum.

Table 2.7.10 Procedure for Archaeological Impact Assessment

Procedure	
1	Apply and acquire an appropriate permit from the national museum to undertake the AIA
2	Review the past archaeological studies and other related literature of the proposed affected area of the project
3	Conduct coordinative meetings with project managers, engineers and other consultants of the project and ensure compliance with the work standards

Procedure	
4	Conduct actual archaeological excavation on the project site
5	Document soil stratification and scientific recording of the vertical profile of the site
6	Carry out proper documentation such as portable (artifacts and ecofacts) and non-portable (features) data
7	Record and assess the collected materials following the National Museum of the Philippines' procedure
8	Identify and/or classify cultural and historical materials
9	Implement technical discussion with the National Museum of the Philippines
10	Submit the final report

Source: UP-ASP, Scope of Work in the Conduct of AIA

Table 2.7.11 Procedure for Heritage Accidental Find

Procedure	
1	DOTr must preserve the potential archaeological finds and report it immediately to the National Museum
2	Closely coordinate with the National Museum on the appropriate course of action in protecting the archaeological finds
3	Cease immediately all construction activities in the vicinity of the find/feature/site
4	Hire an archaeologist, recognized by the National Museum, to ensure the following are carried out: • Delineate the discovered find/feature/site; • Record the coordinates of the find location, and all remains are to be left in place; • Secure the area to prevent any damage or loss of removable objects; • Assess, record and photograph the find/feature/site; • Undertake the inspection process in accordance with all project health and safety protocols under direction of the Health and Safety Officer; • Conduct all investigation of archaeological soils by hand; • Keep all finds, osteological remains and samples and submit to the National Museum as required; • In the event that any artefacts need to be conserved, secure approval from the National Museum; • Provide an on-site office and finds storage area to allow storage of any artefacts or other archaeological material recovered during the monitoring process; • In the case of human remains, in addition to the above, contact the National Museum and adhere to the guidelines for the treatment of human remains; and • If skeletal remains are identified, consult an osteo-archaeologist to examine the remains.
5	The proponent will implement the following process for conservation of objects found: • Hire a conservator, if required; • The consulting archaeologist completes a report on the findings and submits to the National Museum; and • National Museum reviews the report and informs when works can resume

Source: National Museum (2020)

2.7.4.4. Unexploded Ordnance

337. In case that there are reports of the suspected or detected presence of unexploded ordnance (UXO) at the project area, the Philippine National Police (PNP) may respond to UXO reports in accordance with the following international guidelines and procedures.

(1) Relevant Laws and Regulations

338. The Philippines has no established regulation regarding the UXO, but the following international guidelines have been referred in establishing a guideline for UXO assessment (**Table 2.7.12**).

Table 2.7.12 Relevant International Guidelines on Unexploded Ordnance

Relevant International Guidelines on Unexploded Ordnance	
1	CIRIA C681: UXO. A Guide for the Construction Industry, London, 2009.
2	Protocol on Explosive Remnants of War (Protocol V to the 1980 Convention), November 28, 2003.

Source: JICA Design Team

(2) Procedure Applied

339. A guideline has been formulated to provide a framework specifying responsibilities and procedures to assess, mitigate and eliminate any UXO-related hazards (see **Table 2.7.13** and **Table 2.7.14**). It provides guidance on the management of any UXO hazards associated with any development activity carried out by the DOTr. Meanwhile, **Table 2.7.15** summarizes the chance find procedure to be undertaken by the Contractor as advised by the PNP.

Table 2.7.13 Guideline for UXO Preliminary Risk Assessment

Procedure		Responsible Entity	Duration
1	Examine existing historical data	Proponent	Prior to construction
2	Carry out interviews with surrounding local communities regarding past occurrences with UXOs	Proponent	Prior to construction
3	Assess the potential of threats	Proponent	Prior to construction
4	Recommend further steps	Proponent	Prior to construction

Source: JICA Design Team

Table 2.7.14 Procedure to be Carried Out by the Explosive Ordnance Disposal Contractor

Procedure	
1	Conduct UXO surveys at the project site including affected areas outside the project site but related to the project
2	Arrange and carry out safe removal of all UXOs from the project site
3	Responsibly dispose UXOs in coordination with the PAF/PNP
4	Ensure that strategies and resources are in place to manage unintended accidents and explosions
5	Provide a report confirming the completion of UXO surveys, detection, removal and disposal
6	Provide necessary documentation to the PNP/ PAF and other relevant agencies for clearance issuance, when necessary
7	Continuously monitor, document and report to the IA/ PMO and the PNP/ PAF concerning any residual UXO threats arising during project implementation

Source: JICA Design Team

Table 2.7.15 Chance Find Procedure for UXOs

Procedure	
1	When a metal object is found during excavation activities, Contractors are advised do not mine/remove it; cordon shall be placed within the area for safety
2	Such event shall be reported to the nearest PNP District in the area. The PNP District will immediately report this to the PNP EOD Unit which will be attending to the matter
3	The PNP EOD Unit will identify the metal object first upon the arrival on the site. If found to be an UXO, they will conduct the removal
4	Recovered UXOs are temporarily put in an explosive magazine in an undisclosed area. Once full, they will transfer it to Crow Valley for final disposal

2.7.4.5. Spoil Disposal Area

340. The acquisition of relevant permits and clearances for the Spoil Disposal Area to be used for the excess soils from excavation and tunnelling works is expected to be borne by the Contractor in accordance with the target timeline with the management and supervision of DOTr and its GC.

(1) Relevant Laws and Regulations

341. Prior the operation and use of a spoil disposal the following permits and clearances are needed to be secured from its respective offices, meanwhile, **Table 2.7.16** presents the issuances on and guidelines for obtaining these permits.

- ECC for the spoil disposal area/site as required under the PEISS;
- Laguna Lake Development Authority (LLDA) Clearance. As empowered through the EO 927, the LLDA was given authority to manage any development within the Laguna de Bay Region including the imposition of requirements and application of permits prior to any activities done by the government and private offices. The LLDA Clearance is one of the permits to be secured to ensure that the proponent adheres to the list of activities allowed within the LLDA Region.
- LLDA Discharge Permit Exemption, if applicable. Any development activities within the Laguna de Bay Region is expected to discharge wastewater due to its operation and will be required to secure a Laguna de Bay Discharge Permit. Since the Spoil Disposal Area will be used as the containment of the spoils to be produced and no wastewater is expected to be produced, it is important to secure an exemption permit for compliance.
- Shoreland Development Clearance (SDC). This clearance shall apply to strip of the lakebed along the Laguna de Bay's shores below elevation 12.50 meters as referred to datum 10.00 meters below mean lower low water (MLLW). Areas within the said location are required to be secured within the immediate shore areas of the Laguna de Bay. Any development without such permit will lead to penalties and charges.
- Hazardous Waste Generator ID (if the soil is found to be contaminated based on analytical testing and classifying as hazardous waste per DAO 2013-22 (on Hazardous Waste. Management)).
- Traffic clearance and excavation permit.

Table 2.7.16 Issuances and Guidelines Related to Spoil Disposal Area

	Relevant Policies/Guidelines
1	DAO 2003-30 / EMB MC 2007-002: Revised procedural manual for DENR Administrative Order (DAO) 03-30
2	EMB MC 2014-005: Revised guidelines of coverage screening and standardized requirement under the PEISS amending relevant portions of Environmental Management Bureau EMB MC 2007-002
3	LLDA Board Resolution No. 408, Series of 2011: Approving the Revised Definition of Developmental Activities Required to Secure LLDA Clearance and Its Implementing Rules and Regulations, and for this Purpose, Amending Board Resolution No. 223, Series of 2004 and Board Resolution No. 286, Series of 2006
4	LLDA MC No. 2017-01: Guidelines in the Processing of Applications for Discharge Permit Exemption
5	LLDA Board Resolution No. 248, Series of 2005: Resolution Amending Board Resolution No. 23, Series of 1996, Providing Guidelines on the Use of Shoreland Areas Surrounding the Laguna De Bay
6	DAO 2013-22: Revised Procedures and Standards for the Management of Hazardous Wastes
7	MMDA Regulation No. 11-002 Series of 2011: Adopting a Revise Schedule of Administrative Fees, Charges, Restoration and Maintenance Deposits, Fines and Penalties on Road Digging/Excavations and Restorations in Metropolitan Manila

(2) Application Procedure

342. As there are various permits and clearances needed prior the use of the proposed spoil disposal area/site, application procedures and timeline will also vary. The summary of the processes needed to be undertaken is presented in **Table 2.7.17**.

Table 2.7.17 Overview of the Procedure to Obtain Permits and Clearances for the Spoil Disposal Area

	Procedure	Responsible Entity
1	ECC: Upon the finalization of the location and size of the spoil disposal area to be used, securing of ECC shall be undertaken. Based on EMB MC 2007-002, use of land for spoil disposal area (classified under reclamation and other land restoration projects) with ≥ 5 has but < 25 has is categorized as "B" and will be required to prepare an EIS under the DENR-EMB Region 4A.	Contractor in coordination with the DOTr and GC
2	LLDA Clearance (LC) and LLDA Discharge Permit (DP) Exemption: LLDA Clearance will also be required before the use of the spoil disposal area. The ECC, its EIA report, and its SDC will be needed as attachments to its application. Consequently, application for the exemption of the DP from LLDA is also needed as the spoil disposal are is not expected to generate and discharge any wastewater.	Contractor in coordination with the DOTr and GC
3	Shoreland Development Clearance: LLDA requires that any activities and development such as backfilling within their immediate shoreland area be applied first with SDC. The Contractor shall coordinate with the LLDA to clarify whether the proposed spoil disposal area is within their shoreland area. An EIA document will also be needed for this application. Meanwhile the SDC will be needed for the application of the LC.	Contractor in coordination with the DOTr and GC
4	Hazardous Waste Generator ID: Prior the disposal of the spoils to be generated, it is important to have it tested for its toxicity. If the result of the laboratory test shows that the soil is contaminated, then these shall be characterized, and must comply with the limits provided in DAO 2013-22 or the IRR of RA No. 6969. If soils are categorized as hazardous waste, then transport and disposal must comply with the requirements of RA No. 6969 (i.e., soils must be disposed to an accredited TSD facility by an accredited hazardous waste transporter). The TSD facility, depending on their treatment process, may have an existing discharge permit. The Contractor and its proponent shall apply for a Hazardous Waste Generator ID for all the present chemical and its estimated amount to be generated. Non-impacted/contaminated soils which are non-hazardous may be disposed of to the target spoil disposal area	Contractor in coordination with the DOTr and GC
5	Traffic clearance and excavation permit: All excavation activities to be done within Metro Manila shall be secured with permission and permit first with the Metropolitan Manila Development Authority (MMDA). Further, the hauling of spoil towards its disposal area in Taytay, Rizal may cause traffic congestion during its operation. With this, the Contractor, in coordination with the proponent shall secure a Traffic Clearance and Excavation Permit from their Traffic Engineering Center and provide requirements such as, but not limited to, the detailed plan with vicinity/location plan, program of works or bill of quantities, contract or notice of award, and traffic management plan and/or re-routing plan.	Contractor in coordination with the DOTr and GC

Table 2.7.18 Permits Required for the Project

Permit	Authority	Laws and regulations	Required documents	Responsible party	Timeline
Permit for a Project to Construct Structure over Water Body	DPWH	• PD No. 1067, "Water Code of the Philippines of 1976" • Water Code of Philippines "Amended Implementing Rules and Regulations 2005" • DPWH Department Order No. 179 Series of 2015, Dec. 3.2015 "Design Guideline, Criteria and Standards, 2015 Edition"	• Letter request (attach requirements below) • Vicinity map • Cross-section of structure(s) with cross-section of the river at the location of the structure showing the minimum water level, the maximum flood level without the structure(s) and the maximum flood level with structure(s) • Plan showing the extent of the maximum flooded area without structure(s) and the maximum flooded area with the structure(s) • Schemes and details of provisions for passage of watercrafts • Construction schedule	DOTr/contractor	Secured prior to construction
Wastewater Discharge Permit	EMB-National Capital Region (NCR) and Region 4-A (R4A) and the Laguna Lake Development Authority (LLDA)	• RA 9275, Philippine Clean Water Act of 2004, DAO 2016-08	• Letter request, attaching requirements below and supporting documents • Application form including sources of water and wastewater generation, product information and vicinity map	DOTr/contractor	Secured prior to construction of wastewater treatment facility
LLDA Discharge Permit Exemption for Spoil Disposal Area	LLDA	• LLDA MC No. 2017-01	• Letter request • Copy of the approved LLDA Clearance • Proof exception	Contractor/DOTr	Secured prior to hauling activities
Shoreland Development Clearance (for Spoil Disposal Area)	LLDA	• LLDA Board Resolution No. 23, Series of 2005	• Copy of EIA Report • Project proposal including cost estimate • Engineering plans and technical maps • Time table • Solid and liquid waste management plan	Contractor/DOTr	Secured prior to hauling activities
Tree Removal Permit	EMB-NCR and R4A	• Memorandum from DENR Secretary (November 27, 2009) "Guidelines and Procedures on the Planting, Maintenance and	• Letter request, attaching requirements below • Original copy of barangay/city mayor's clearance/barangay certification re: interposing no objection to the removal of trees • Proof of land ownership	DOTr/tree contractor	Secured prior to site clearing

Permit	Authority	Laws and regulations	Required documents	Responsible party	Timeline
		Removal of Trees in Urban Areas and in Areas Affected by Government Infrastructure Projects." • DENR Memorandum Order No. 2012-2 (November 5, 2012) "Uniform Replacement Ratio for cut or Relocated Trees"	• Geotagged photos • Layout plan/site development plan indicating location of existing tree(s) • Transplanting site of trees within the area • Copy of the ECC • Copy of the results of public consultations during EIS • Brief/summary of description of the project • Perspective plan (soft landscape plan) • Cutting/balling/IEC plan • Recommendation report from the Forestry Utilization Section (FUS) personnel in the form of a memorandum		
Permit to Operate for Generator/Sub-station [Air Pollution Source Installation (APSI)]	DENR-Region NCR and R4A	• RA 8749, Philippine Clean Air Act of 1999 and DAO 2000-81	• Letter request, attaching requirements below and supporting documents • General information • Raw materials and product information • List of the APSI, etc.	DOTr/contractor	Secured prior to operation of the APSI
Collection of Solid Wastes	LGU	• RA 9003 and DAO 2001-34	• Wastes collectors are usually accredited by the LGU where they operate their business	The DOTr should require solid wastes collectors to show their accreditation.	Secured prior to collection of solid wastes
Hazardous Waste Generator ID No.	DENR-Region NCR and R4A	• RA 6969 and DAO 2013-22	• Registration online, copy of the ECC	DOTr	Secured prior to construction
Hazardous Wastes Transport Record (Manifest system)	DENR-Region NCR and R4A	• RA 6969 and DAO 2013-22	• Manifest system for transport and disposal of prescribed hazardous wastes, the transport permit	DOTr	Secured prior to transport/disposal of hazardous wastes
ECC for Batching Plants/Construction Work Areas/Temporary Facilities	DENR-Region NCR and R4A	• PD 1152, PD 1586, DAO 03-30, EMB MC 2007-002 (RPM of DAO 03-30) and EMB MC 2011-005	• Initial environmental examination checklist (online application)	DOTr/contractor	Secured prior to operation of batching plants/construction work areas/temporary facilities

Permit	Authority	Laws and regulations	Required documents	Responsible party	Timeline
ECC for Spoil Disposal Area	DENR-Region R4A	• PD 1152, PD 1586, DAO 03-30, EMB MC 2007-002 (RPM of DAO 03-30) and EMB MC 2011-005	• Environmental Impact Statement Report	Contractor	Secured prior to hauling activities
Pollution Control Officer (PCO) Accreditation	DENR-Region NCR and R4A and LLDA	• LOI 588, PD 1586, EO 192, RA 9275 and DAO 2014-02	• Letter of request • Application form • Basic qualifications and minimum competency requirements as contained in Sec. 6 of DAO 2014-02	DOTr/contractor	Secured during pre-construction
Quarry Permit	LGU where quarry is located and Provincial Mining Regulatory Board (PMRB)	• PD 1586, RPM of DAO 03-30, RA 7076 and DMC 97-05	• Application form	Contractor	Secured prior to construction
LGU Permit	LGU	• RA 7160 (Local Govt. Code) and AO 270 (1992)	• Application form • Property title • Tax declaration • Examples of permits: building permits and barangay clearance	DOTr/contractor	Secured prior to construction
Permit to Conduct Archaeological Exploration and Excavation	National Museum (NM)	• RA 10066	• Letter of request addressed to the Director of the National Museum of the Philippines (NMP) indicating an intention including the detailed information relative to the request • Resume of favorable recommendations from Katipunan Arkeologist ng Pilipinas, Inc. (KAPI), a copy of technical proposal	DOTr/contractor	Secured prior to construction
Clearance/ Endorsement on Built Heritage Concerns	Tripartite (NCCA-NHCP-NM) Technical Working Council (TWC) on built heritage issues and concerns through NCCA chairman on behalf of the board of commissioners	• RA 10066	• Protection plan (the procedure for historic structures/buildings during construction) • Conservation plan	DOTr/PNR	Secured prior to construction

Permit	Authority	Laws and regulations	Required documents	Responsible party	Timeline
Traffic clearance and excavation permit for tunneling and hauling its spoils (for the subway)	Metropolitan Manila Development Authority (MMDA)	• MMDA Regulation No. 11-002 Series of 2011	• Letter request • Approved construction/detailed plans with vicinity map or location plan • Approved program of works/bill of quantities • Copy of contract/notice of award, or Notice to Proceed (if contract is still being processed) • Traffic management plan and/or re-routing plan with informative signage's • Approved bar chart or PERT-CPM or S-Cure	Contractor	Secured prior to tunneling and hauling
Water Permit for depot deep well construction	National Water Resources Board	• Water Code of the Philippines	• Proof of land ownership or right to use • Certificate of Registration from relevant agencies • Vicinity Map/Location Plan • Brief description of the Project • Well drilling data • ECC/CNC		
Sanitary Permits for stations and depot	LGU City Health Offices	• Sanitation Code of the Philippines	• Accomplished application form • Barangay Clearance/ Business Permit • Environmental Permits/ ECC/ CNC		

Source: JICA Design Team

Permit	Authority	Laws and regulations	Required documents	Responsible party	Timeline
ECC for Spoil Disposal Area	DENR-Region R4A	• PD 1152, PD 1586, DAO 03-30, EMB MC 2007-002 (RPM of DAO 03-30) and EMB MC 2011-005	• Environmental Impact Statement Report	Contractor	Secured prior to hauling activities
Pollution Control Officer (PCO) Accreditation	DENR-Region NCR and R4A and LLDA	• LOI 588, PD 1586, EO 192, RA 9275 and DAO 2014-02	• Letter of request • Application form • Basic qualifications and minimum competency requirements as contained in Sec. 6 of DAO 2014-02	DOTr/contractor	Secured during pre-construction
Quarry Permit	LGU where quarry is located and Provincial Mining Regulatory Board (PMRB)	• PD 1586, RPM of DAO 03-30, RA 7076 and DMC 97-05	• Application form	Contractor	Secured prior to construction
LGU Permit	LGU	• RA 7160 (Local Govt. Code) and AO 270 (1992)	• Application form • Property title • Tax declaration • Examples of permits: building permits and barangay clearance	DOTr/contractor	Secured prior to construction
Permit to Conduct Archaeological Exploration and Excavation	National Museum (NM)	• RA 10066	• Letter of request addressed to the Director of the National Museum of the Philippines (NMP) indicating an intention including the detailed information relative to the request • Resume of favorable recommendations from Katipunan Arkeologist ng Pilipinas, Inc. (KAPI), a copy of technical proposal	DOTr/contractor	Secured prior to construction
Clearance/ Endorsement on Built Heritage Concerns	Tripartite (NCCA-NHCP-NM) Technical Working Council (TWC) on built heritage issues and concerns through NCCA chairman on behalf of the board of commissioners	• RA 10066	• Protection plan (the procedure for historic structures/buildings during construction) • Conservation plan	DOTr/PNR	Secured prior to construction

Permit	Authority	Laws and regulations	Required documents	Responsible party	Timeline
Traffic clearance and excavation permit for tunneling and hauling its spoils (for the subway)	Metropolitan Manila Development Authority (MMDA)	• MMDA Regulation No. 11-002 Series of 2011	• Letter request • Approved construction/detailed plans with vicinity map or location plan • Approved program of works/bill of quantities • Copy of contract/notice of award, or Notice to Proceed (if contract is still being processed) • Traffic management plan and/or re-routing plan with informative signage's • Approved bar chart or PERT-CPM or S-Cure	Contractor	Secured prior to tunneling and hauling
Water Permit for depot deep well construction	National Water Resources Board	• Water Code of the Philippines	• Proof of land ownership or right to use • Certificate of Registration from relevant agencies • Vicinity Map/Location Plan • Brief description of the Project • Well drilling data • ECC/CNC		
Sanitary Permits for stations and depot	LGU City Health Offices	• Sanitation Code of the Philippines	• Accomplished application form • Barangay Clearance/ Business Permit • Environmental Permits/ ECC/ CNC		

Source: JICA Design Team

3. BASELINE ENVIRONMENTAL CONDITIONS, IMPACT ASSESSMENT AND MITIGATION

343. This chapter discusses the state of the existing environment before the onset of the Project. The baseline data presented in this section are based on primary and secondary data collection conducted during FS (December 2017 - August 2018) and DED Phase (September 2018 - July 2019). Field surveys for the underground SCRP interconnection section were conducted during June – July 2019, and February – March 2020. Primary data were obtained through field surveys, consultation meetings, interviews with key stakeholders, and sampling and analyses of environmental parameters.

344. For this study, the field surveys were conducted during dry (January - February 2018/March - April 2019 and February – March 2020) and wet seasons (June - July 2018 and June – July 2019). The sampling stations were chosen based on the following criteria:

- Distribution of sampling stations along the entire alignment;
- Proximity to sensitive receptors; and
- Access to the locations for the duration of the Project.

345. Secondary data were collected from the Comprehensive Land Use Plan (CLUP) of the host LGUs and relevant data sources from various government authorities (e.g. MGB, PHIVOLCS, PAGASA, DENR, etc.). Geotechnical investigation results for the SCRP interconnecting line were provided by Soil Philippines Index Testing Inc. At the end of each section, impact identification, prediction, assessment, and mitigation are summarized in **Table 3.1.42, Table 3.2.41, Table 3.3.54, and Table 3.5.1**.

3.1. LAND

3.1.1. Land Use and Classification

346. The Project alignment will mainly utilize the existing Right-of-Way (ROW) of the Philippine National Railways (PNR). The majority of the Project will traverse 11 cities including Manila, Makati, Taguig, Parañaque, Pasay and Muntinlupa in the National Capital Region (NCR); and San Pedro, Biñan, Santa Rosa, Cabuyao, and Calamba in the Province of Laguna. For the segment from Solis Station to Sta. Mesa Station, DOTr will acquire a private land adjacent to PNR ROW since the NLEx-SLEx Connector Road Project of the DPWH was designed to utilize the existing PNR ROW. Additionally, approximately 22 ha of agricultural land in Banlic, Calamba will be acquired for the Depot.

3.1.1.1. Existing Land Use

347. The Project will utilize the existing PNR ROW except for the alignment from Solis Station to Sta. Mesa Station and the depot site in Banlic, Calamba. Additionally, the 19 stations of the Project will be extended to 30 m from the existing width of the PNR ROW of 30 m or a total of 60 m at a length of 220 m. The land use within the vicinity of the PNR ROW includes commercial, agricultural, industrial, institutional, residential, etc. and the areas become more densely built-up within urban centers of the host cities. Hence, land uses and development conditions within the vicinity of the Project are predominantly built-up areas. Meanwhile, the SCRP interconnecting line has an existing land use of institutional, commercial, and residential. Since the SCRP interconnecting line is mostly underground this would involve minimal disturbance to the existing land uses. **Figure 3.1.6** shows the consolidated land use maps of the city of Taguig, Makati, Pasay and Paranaque. It focuses on the chainage from Senate Building, FTI Station, and the interconnectivity hub/station in Bicutan. Summary of the existing land uses by host LGU is presented below.

(1) Manila City

348. Based on the 2005-2050 Manila City Comprehensive Land Use Plan and Zoning Ordinance (MCLUPZO), the City has six (6) major land use allocations, namely: residential (20.7%), commercial (41.0%), institutional (2.3%), industrial (18.6%), public open space (6.2%) and transport/ utilities and unclassified lands (11.2%). The land use and zoning map of the City of Manila is provided in **Figure 3.1.1.** From this map, it may be gleaned that the City is already congested with commercial and business-related developments.

349. The NLEx-SLEx Connector Road Project of the DPWH was designed to utilize the PNR ROW from Solis Station to Sta. Mesa Station. Based on this project alignment, a private land adjacent to PNR ROW which will be acquired by DOTr will be utilized.

350. Four (4) stations will be located in the City of Manila including Blumentritt, España, Sta. Mesa and Paco. From the existing PNR Solis Station, the project alignment will utilize a private land of about 8.0 km in length up to Zobel Roxas Street. Predominantly, the land uses adjacent to the PNR ROW are high and medium intensity commercial areas, university cluster zone, and high-density residential areas. The land use within the proposed Blumentritt and España Stations is a high intensity commercial area while the proposed Sta. Mesa Station will be located adjacent to the university cluster zone and high-density residential area. The land use at the immediate vicinity of the proposed Paco Station is a high-density residential area. The alignment will pass through the Pasig River between the districts of Sta. Mesa and Pandacan going to Paco Station.

(2) Makati City

351. Based on the Makati Land Use Plan 2001-2011 (adopted in 2001), residential areas accounted for the largest land use in the City of Makati at 35.0% of its total land area. Special mixed-use and commercial uses ranked next at 14.6% and 14.8%, respectively. The rest of Makati's land area is shared by institutional, recreational, parks and open spaces, cemetery, government center, and riverside development. Roads comprise 23.6% of the total land area. **Figure 3.1.2** shows the existing land use map of the City of Makati.

352. The project alignment will utilize approximately 4.4 km of the PNR ROW passing through Barangays San Antonio, Pio del Pilar, Bangkal, and Magallanes. The major land uses adjacent to the project alignment are residential and commercial. The land uses at the immediate vicinity of the proposed Buendia Station are intended for commercial and residential uses. For the proposed EDSA Station, the immediate land use of the area is for commercial use. The NLEx-SLEx Connector Road of the DPWH is parallel to the project alignment in Makati City.

(3) Taguig City

353. Based on the Taguig Land Use Plan 2000-2020, an area classified as General Residential Development Area – 1 (GRDA-1)[1] accounted for the largest land use in Taguig City, accounting for more than one third (40.4%) of the total land area. The institutional zone and urban core zone rank next at 9.6% and 7.6%, respectively. The rest of Taguig's land area is shared by General Residential Development Area – 2 (GRDA-2)[2], light industrial zone, socialized housing zone, low-

[1] **General Residential Development Area** - 1 (GRDA-1) are neighbourhood-type communities that are evenly distributed throughout the city. These are mainly characterized by high-density mixed-use neighbourhoods that are closely compacted and pre-dominated by residences and small-scale neighbourhood service establishments and community facilities. Future development potentials in most parts of the GDA are limited due to the existence of heavily built-up areas and the presence of very narrow roads.

[2] **General Residential Development Area** - 2 (GRDA - 2) includes the areas presently occupied by the Bonifacio Naval Station, Marines Corps, Navy Officers Village, Philippine Army (PA) Support Command, PA Dental Dispensary and JUSMAG. This area is being earmarked for re-development as a master-planned medium density residential area. It shall complement the predominantly commercial and business developments in the Global City by accommodating the increasing demands for residential spaces in the city.

density residential development zone, tourism development zone, entertainment zone, military zone and open space zone. The creek, and easement land uses comprise 9.3% of the total land area. **Figure 3.1.3** shows the existing zoning map of the City of Taguig.

354. The project alignment will utilize approximately 5.8 km of the PNR ROW passing through Barangays of Fort Bonifacio, Western Bicutan, North Daang Hari, South Daang Hari, Bagumbayan, and Bagong Tanyag. The major land uses adjacent to the project alignment are institutional, low-density development, general residential development-1, low-density development, open space, controlled growth corridor, and light industrial. The land uses at the immediate vicinity of the proposed stations are: (1) Nichols Station at Low-Density Development and Institutional; (2) FTI Station at Light Industrial; and (3) Bicutan Station at GRDA-1.

355. The alignment of the SCRP interconnection would pass through Barangays Fort Bonifacio and Western Bicutan which intersects above-ground land uses such as an open space, controlled growth corridor, light industrial zone, institutional zone and an urban core zone.

(4) Parañaque City

356. The total land area of Parañaque City is 46.6 km^2 (4,660 hectares). As of the calendar year 2012, residential area 2 accounted for the largest land use in Parañaque City at 44.5% of the total land area. This was followed by Planned Unit Development (PUD), commercial 3 and industrial 2 at 17.8%, 8.4%, and 8.0%, respectively. The rest of Parañaque's land area is shared by residential 1, 3 & 4, commercial 1 & 2, industrial 1, institutional, parks & playground, cemetery and utilities. About 0.8% of the land area of Parañaque is comprise of creeks and rivers. **Figure 3.1.4** shows the 2007 land use map of the City of Parañaque.

357. The project alignment will utilize approximately 2.1 km of the existing PNR ROW passing through Barangay San Martin de Porres. Majority of the land adjacent to the project alignment are commercial 2 with patch of residential 3, commercial 1, and commercial 3. The land uses at the immediate vicinity of the proposed Bicutan Station are commercial 3 and industrial 2. Moreover, the establishment of the FTI station would affect above-ground land use classifications such as residential, commercial, and industrial.

(5) Muntinlupa City

358. Based on the Land Use Plan 2001-2011, about 56.4% of the total land area of Muntinlupa City is allocated for residential use and about 22.5% is allocated for commercial use. The rest of Muntinlupa's land area is allocated for industrial, institution, parks and recreation, utilities, open spaces, urban corridor, tourism zone, specialized housing site and cemetery uses. **Figure 3.1.5** shows the existing land use map of the City of Muntinlupa.

359. The project alignment will utilize approximately 11.1 km of the PNR ROW passing through Barangays of Sucat, Buli, Cupang, Alabang, Bayanan, Putatan, Poblacion and Tunasan. Majority of the land use along the project alignment are residential with sections located in industrial and commercial areas. Notable institutional structures situated in the vicinity of the proposed railway are: Miraculous Medal School in Sucat; San Roque Catholic School and San Roque Parish Church in Alabang; Department of Education ALS Center and Library Hub, Mary Mother of God Parish Church and The Church of Jesus Christ of Latter-day Saints in Bayanan; Christ the King College of Science and Technology in Putatan and Divine Mercy Viewing Chapel in Tunasan.

360. The proposed Sucat Station will be located at the decommissioned Sucat Thermal Power Plant (STPP) area. Presently, the government, under the Power Sector Assets and Liabilities Management Corporation (PSALM), has an existing contract with a private firm to dismantle the STPP site. According to the existing land use map of Parañaque, the project is located in a utility type of land use. The proposed Alabang Station will be located adjacent to the Starmall Alabang

which is designated as a commercial area with residential areas at the east. The immediate vicinity of the proposed Muntinlupa Station is residential area.

(6) Pasay City

361. According to the 2014-2022 City CLUP, Pasay City has a total land area of 18.3 km^2. A large portion of its total land area is used for transportation and utilities (32.09%), NCRA 2 (26.01%), residential (13.57%), and commercial (12.56%). **Figure 3.1.6** shows the land use above the SCRP interconnecting line of the project in Pasay is an institutional zone given its nature of falling within the Villamor Airbase.

(7) San Pedro City

362. The Municipality of San Pedro has a total land area of 22.6 km^2 where it is following land uses: residential, commercial, institutional, industrial, tourism, agriculture, cemeteries, abattoirs, and infrastructure & utilities. Non-built up areas are 8.3 km^2 (825.3 hectares) or 36.5% of total land area, composed of open spaces & idle lands, roads, landfill, dumpsite, water zone, and parks & recreation. **Figure 3.1.7** shows the existing land use map of the City of San Pedro.

363. The project alignment will utilize approximately 3.2 km of the PNR ROW passing the Barangays of San Antonio, San Vicente and Nueva. The areas adjacent to the project alignment are being utilized as residential and commercial areas. The land uses at the vicinity of the proposed San Pedro and Pacita Stations are residential and commercial.

(8) Biñan City

364. Biñan City has a total land area of 43.5 km^2, which represents 2.5% of the entire Laguna area. Of the 11 land use classifications illustrated in **Figure 3.1.8**, a large portion of the city's land area is dedicated for residential purposes. Open grasslands with scattered trees also represent a substantial space in the city. The remaining portions of the city are subdivided to other uses such as commercial, institutional, industrial, mixed-use, recreational, infrastructure, utilities and cemetery.

365. The project alignment will utilize approximately 4.2 km of the PNR ROW passing the Barangays of Canlalay, San Vicente, Sto. Niño, and Platero. The areas adjacent to the project alignment are being utilized as residential and commercial areas. The land uses at the vicinity of the proposed Biñan Station are residential and commercial.

(9) Sta. Rosa City

366. The area distribution of land uses of Santa Rosa City's total land area of 55.52 km^2 are as follows: residential (40.5%), idle (24.5%), agricultural (12.0%), industrial (10.2%), tourism (4.0%), infrastructure (3.8%), commercial (2.7%), institutional (0.9%), cemetery (0.5%), waterways (0.5%), and pond (0.3%). Thus, it is seen that residential land use dominates the spatial extent of the city, i.e., with two-fifths of the city being devoted to high, medium-and low-density housing establishments. Significantly, around one-fourth of the city is indicated as idle in its relatively less accessible southern section. A tenth of the city is still holding out as agricultural ricelands in its northern half. The industrial land use category is also significant, i.e., occupying around one-tenth of the city's areal extent. The industrial district has establishments ranging from light to medium and heavy industries. **Figure 3.1.9** shows the land use map of Sta. Rosa City.

367. The project alignment will utilize approximately 5.1 km of the PNR ROW passing the Barangays of Tagapo, Labas Pooc, Dila, and Dita. The areas adjacent to the project alignment are agricultural land, mostly rice fields, and residential areas. The notable institutions within the vicinity of the project alignment are New Sinai MDI Hospital and Cañosa School in Brgy. Tagapo, Labas Elementary School, and Colegio de Sta. Rosa de Lima, Inc. in Brgy. Labas and Queen

Ann School of Sta. Rosa Inc. in Brgy. Dita. The land uses at the vicinity of the proposed Sta. Rosa Station are residential and agricultural.

(10) Cabuyao City

368. Cabuyao City has a total land area of 43.30 km². A large portion of the city's land area is dedicated for industrial purposes. Agricultural lands also represent a substantial space in the city. The remaining portions of the city are subdivided to other utilizations such residential, commercial, special development, Cabuyao Investment and Development Authority Growth Centers, and other zones.

369. The project alignment will extend approximately 6.5 km of the PNR ROW passing the Barangays of Poblacion 1 and 2, Bigaa, Sala, Niugan, Banay-Banay, San Isidro, Pulo and Mamatid. The areas adjacent to the project alignment are residential, commercial, agricultural (ricefields), light industrial zone, Cabuyao Enterprise City 1, and institutional. Notable institutions at the Project vicinity are Cabuyao Central School, MCGI Ang Dating Daan Cabuyao, and University of Cabuyao. The land uses at the vicinity of the proposed Cabuyao Station are low- to medium-density residential and high-density commercial areas. **Figure 3.1.10** shows the land use map of Cabuyao City.

(11) Calamba City

370. Calamba City has a total land area of 144.8 km². A large portion of the City's land area is allocated as growth management area. Urban development, upland conservation, and agricultural development areas also represent a substantial space in the City. The remaining portions of the City are subdivided to other utilizations such forest buffer and Makiling Forest Reservation. **Figure 3.1.11** shows the zoning map of Calamba City.

371. The project alignment will utilize approximately 3.2 km of the PNR ROW passing the Barangays of San Cristobal, Parian, Poblacion 1, Lecheria, Halang, Bucal, Pansol, Sucol, Masili, Banlic, Real, and La Mesa. The areas adjacent to the project alignment are utilized for urban redevelopment and agricultural development areas. The land use at the vicinity of the proposed Calamba Station is urban redevelopment area. The proposed Banlic Station and depot will be constructed on an agricultural land in Banlic, Calamba.

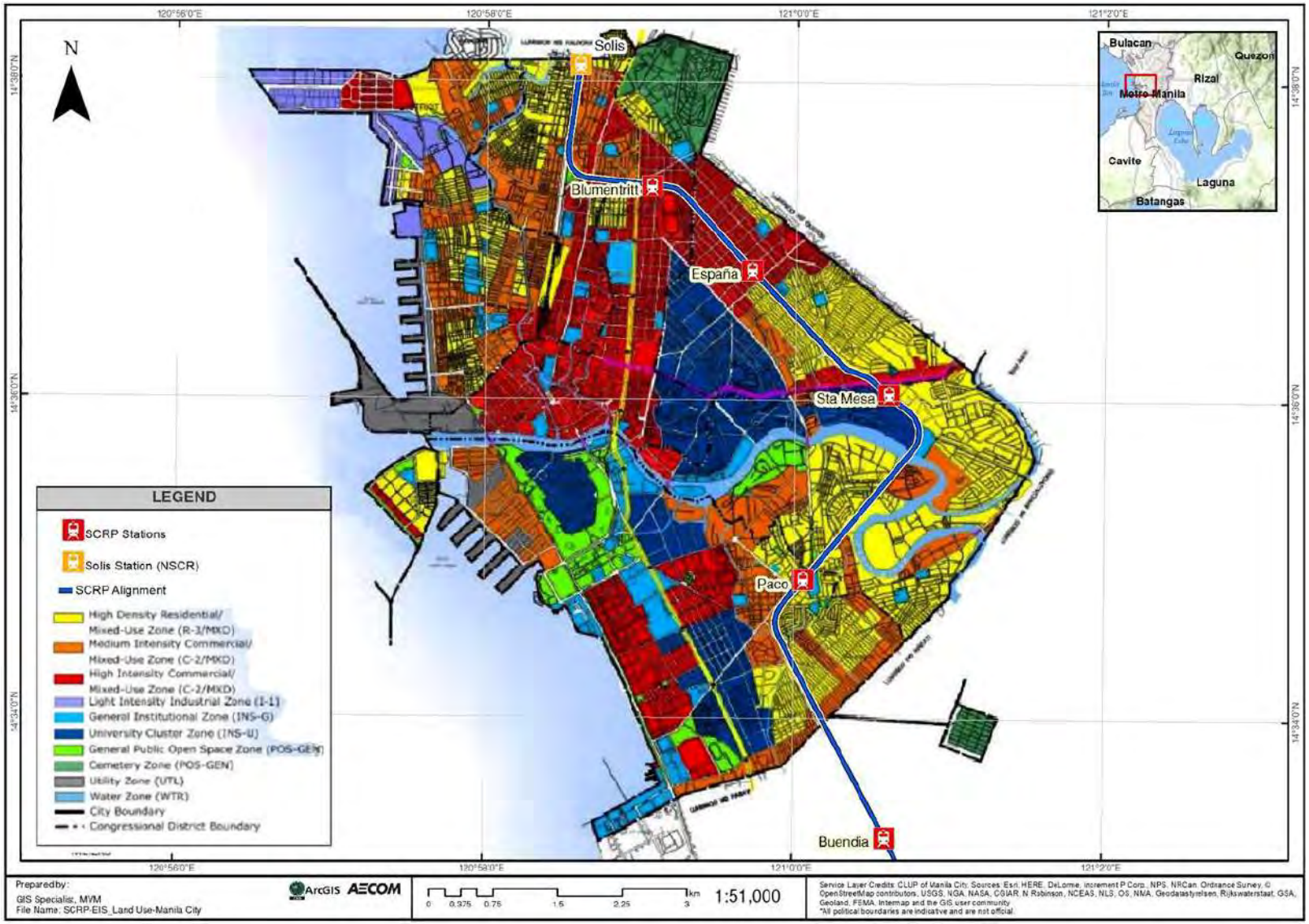


Figure 3.1.1 Land Use of the City of Manila showing Project Alignment

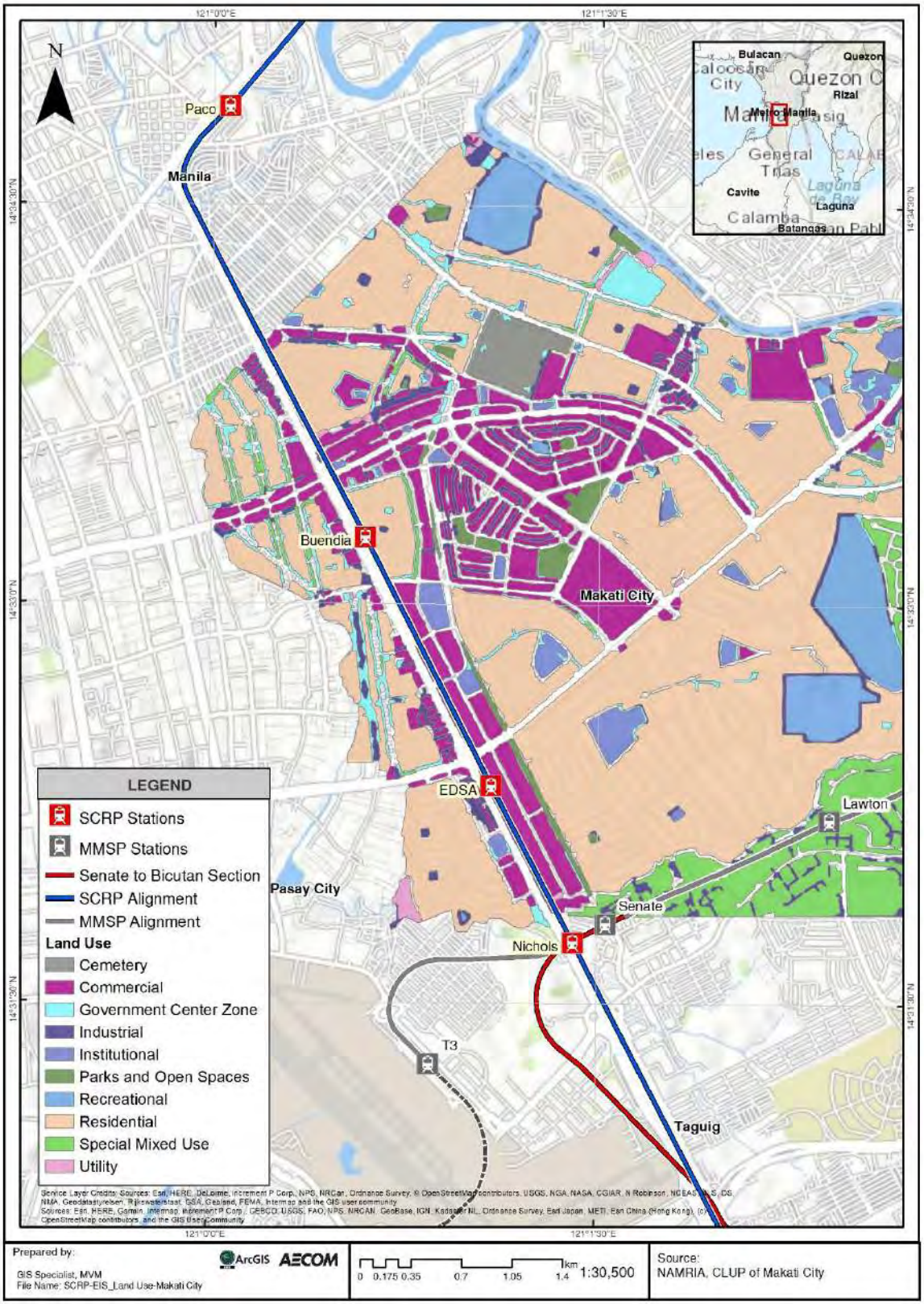


Figure 3.1.2 Land Use of the City of Makati showing Project Alignment

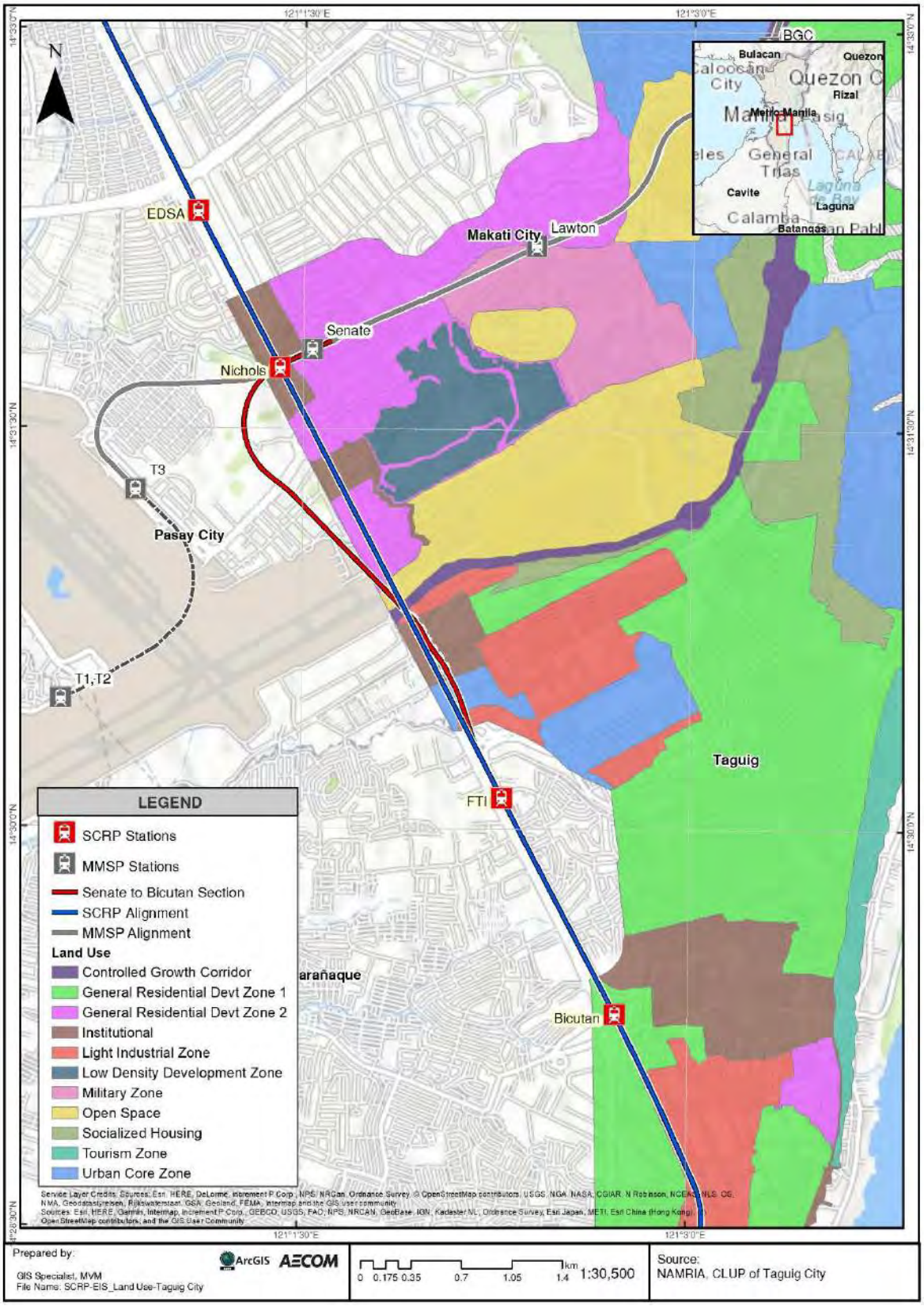


Figure 3.1.3 Land Use of the City of Taguig showing Project Alignment

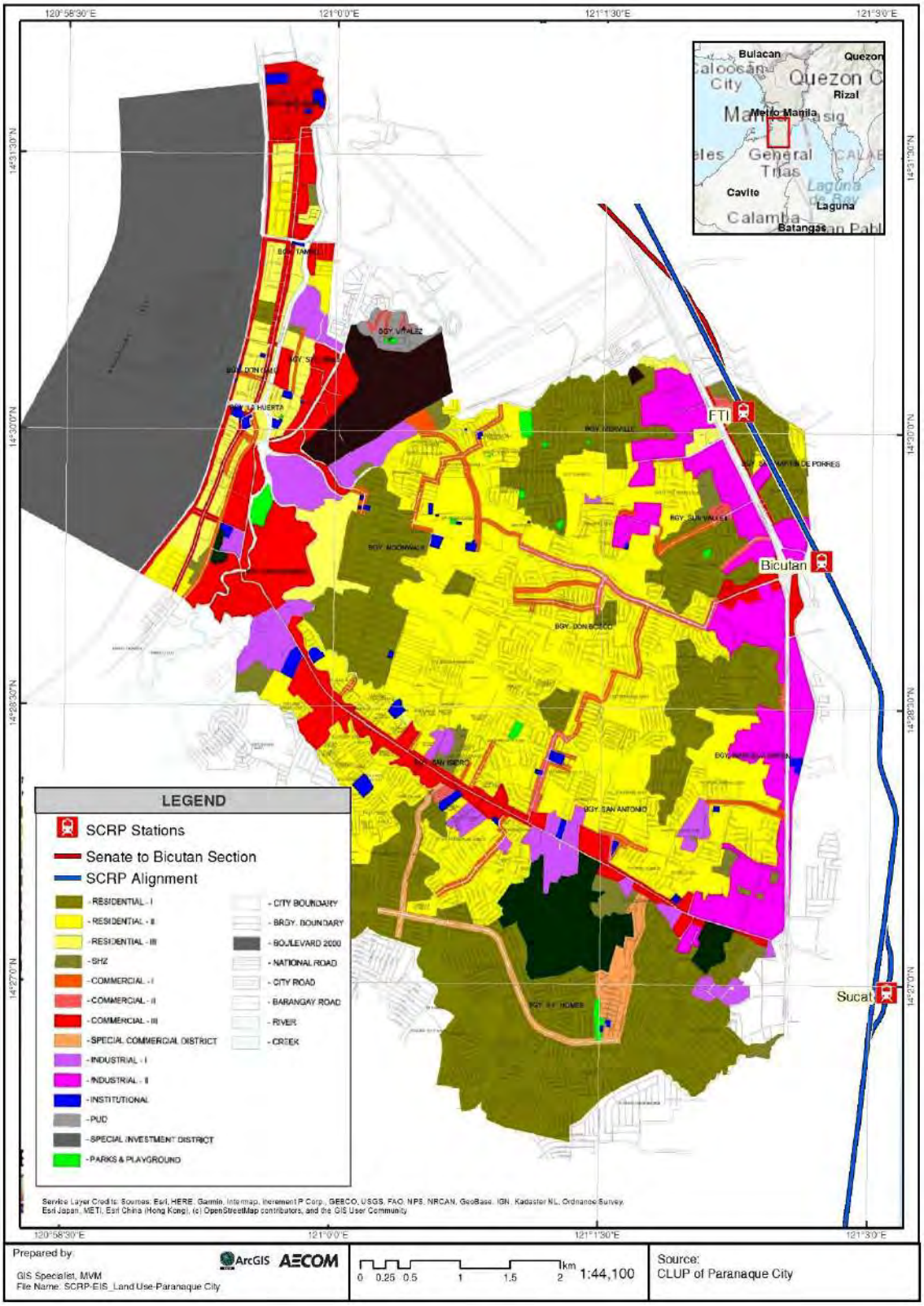


Figure 3.1.4 Land Use of the City of Parañaque showing Project Alignment

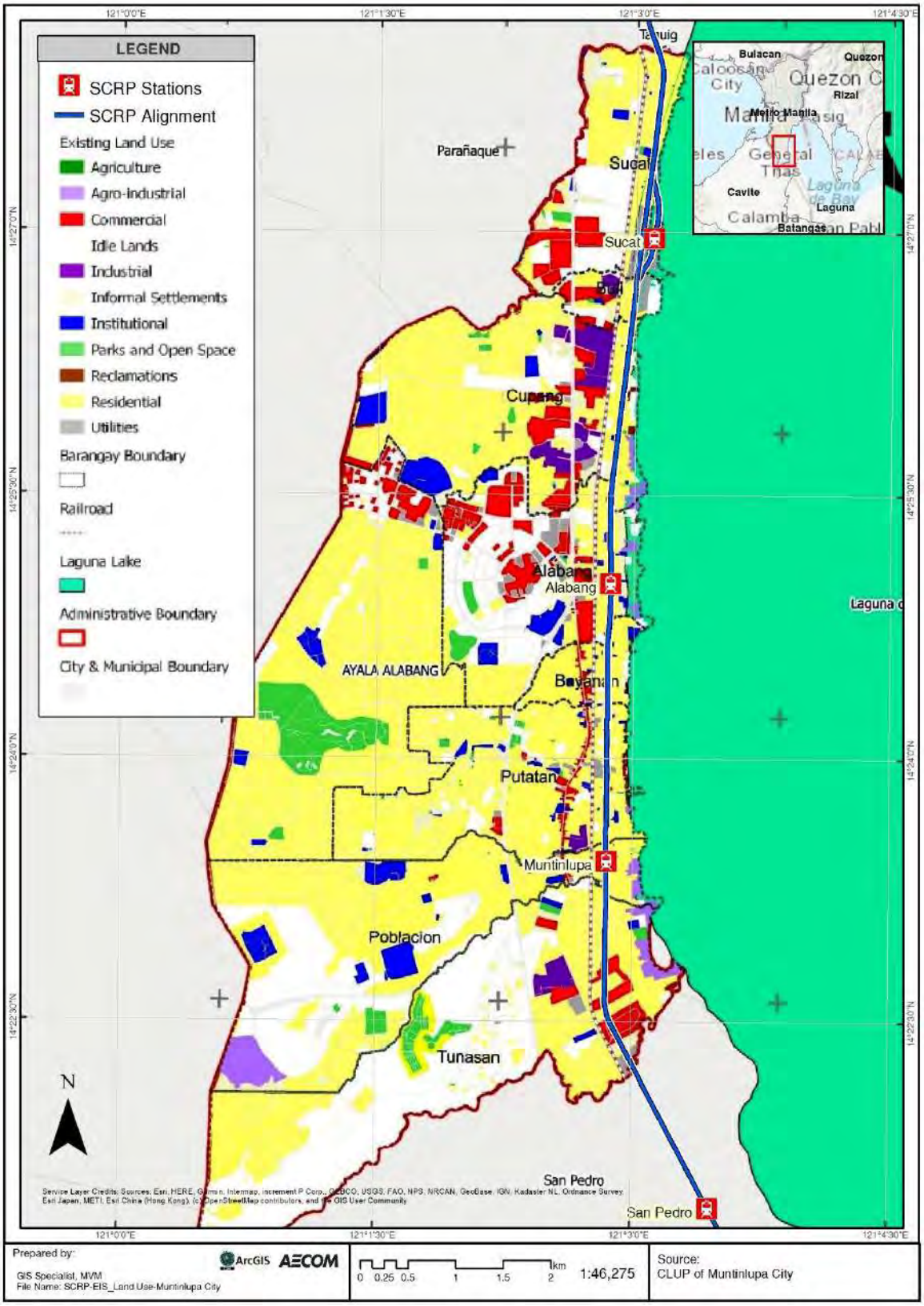


Figure 3.1.5 Land Use of the City of Muntinlupa showing Project Alignment

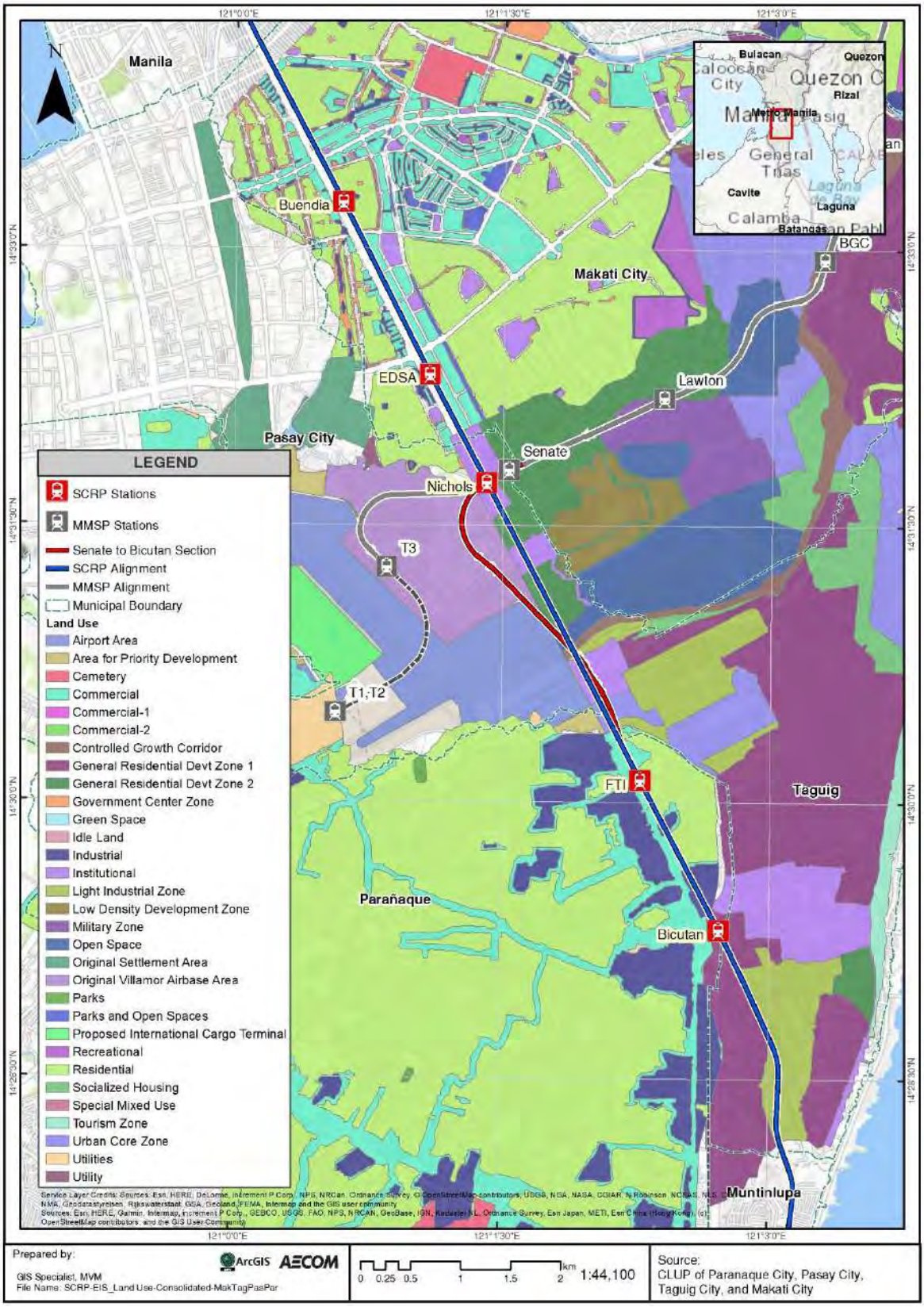


Figure 3.1.6 Consolidated Land Use of the City of Taguig, Makati, Pasay, and Paranaque

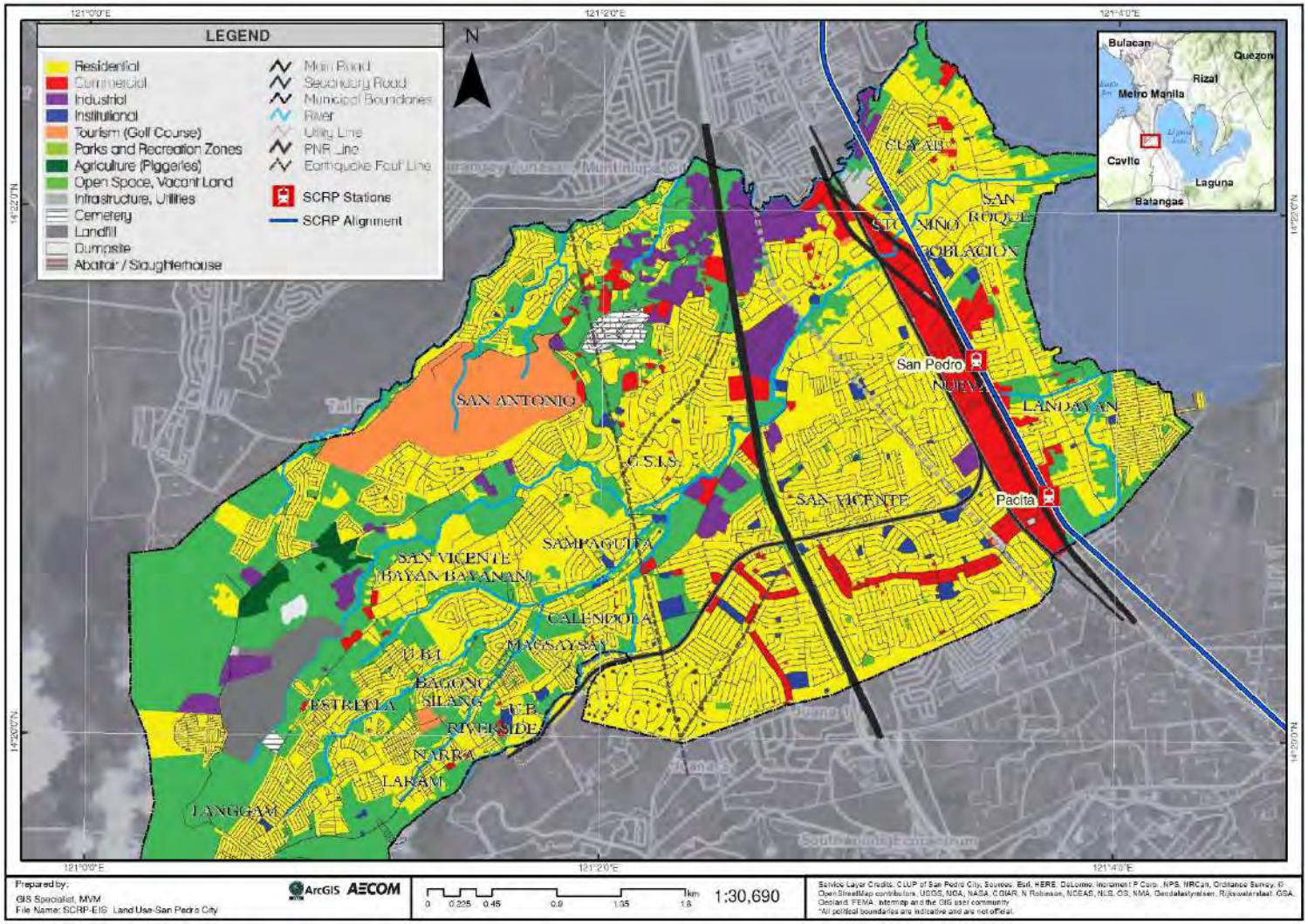


Figure 3.1.7 Land Use of the City of San Pedro showing Project Alignment

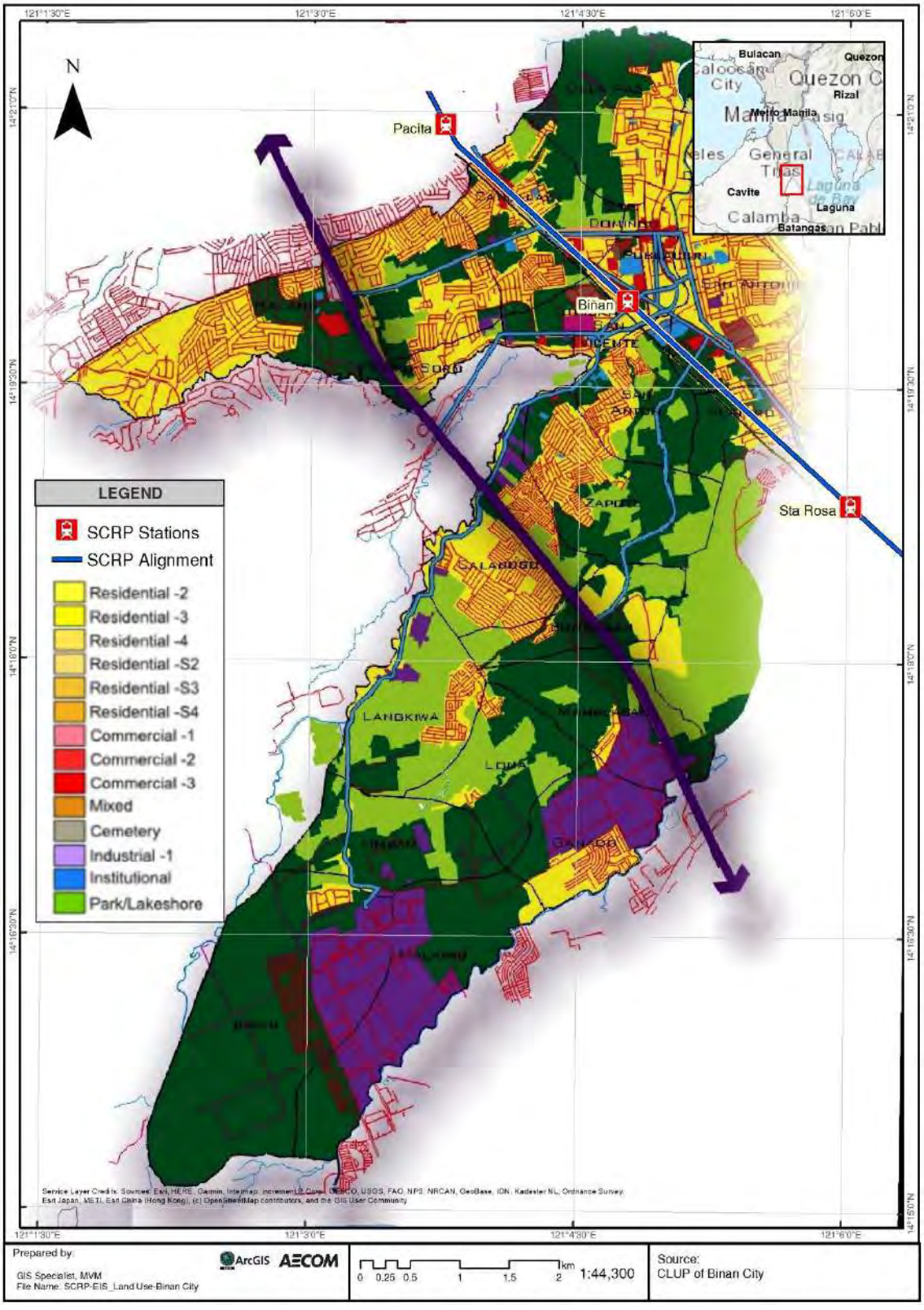


Figure 3.1.8 Land Use Map of the City of Biñan showing Project Alignment

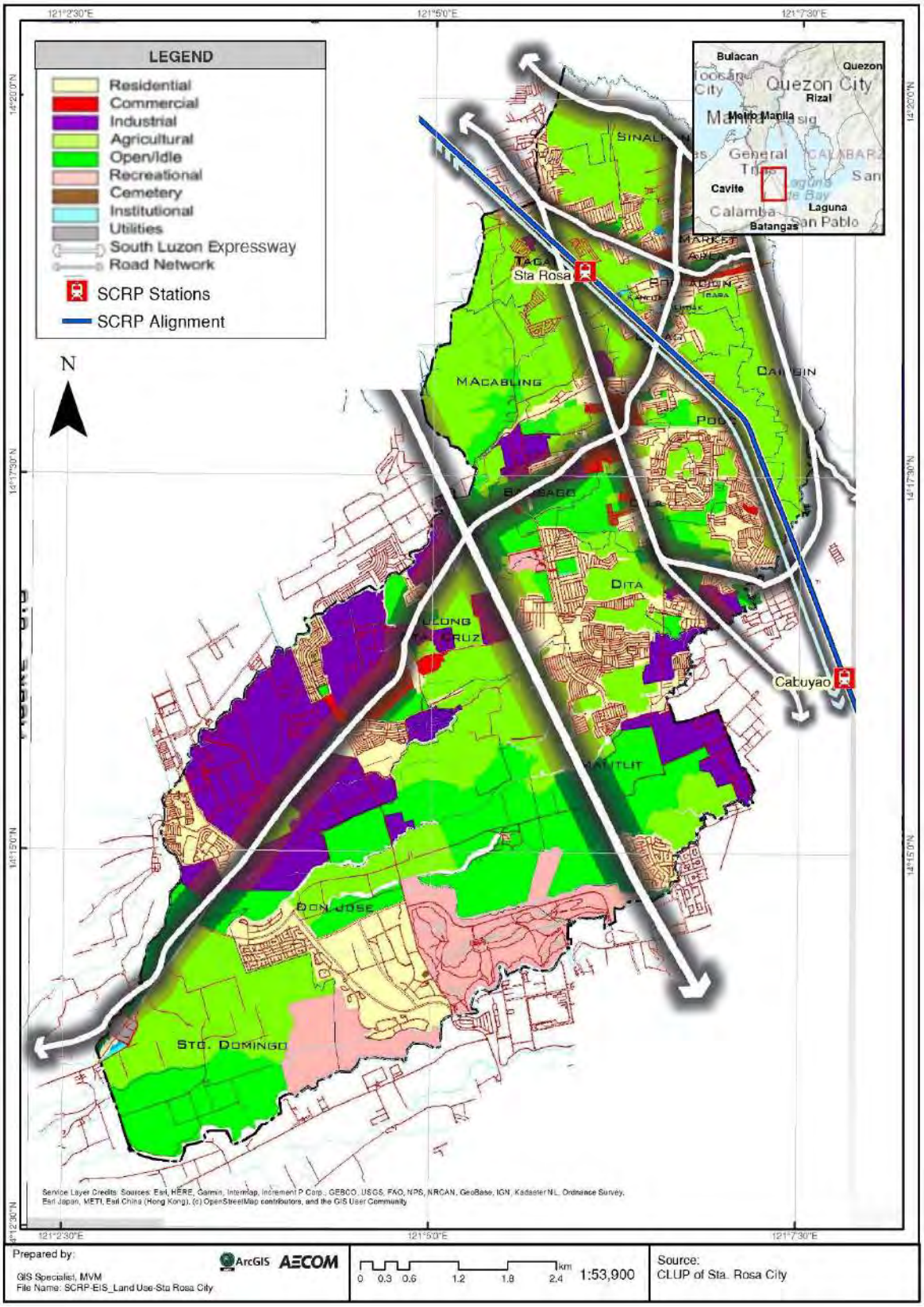


Figure 3.1.9 Land Use Map of the City of Sta. Rosa showing Project Alignment

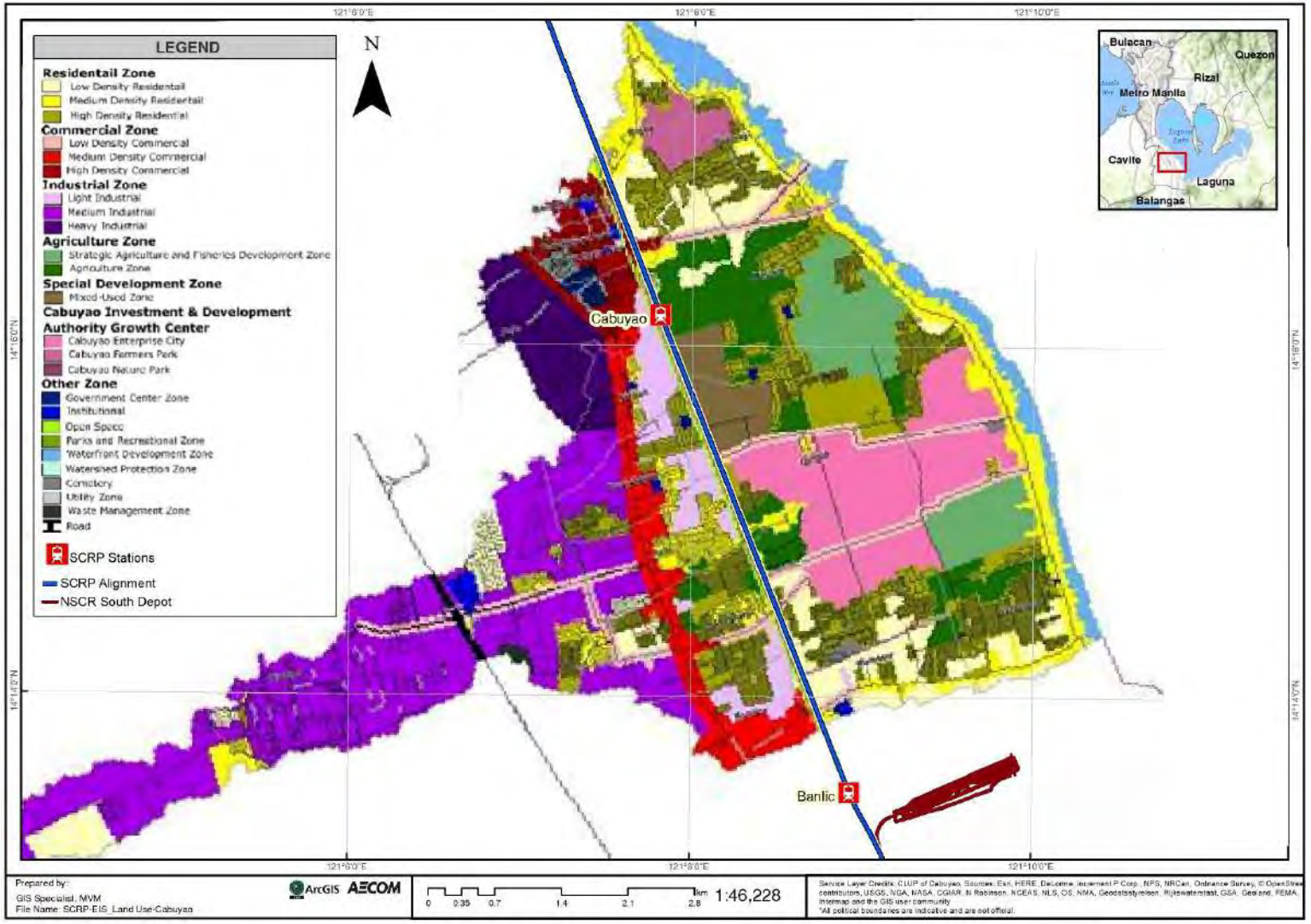


Figure 3.1.10 Land Use Map of the City of Cabuyao showing Project Alignment

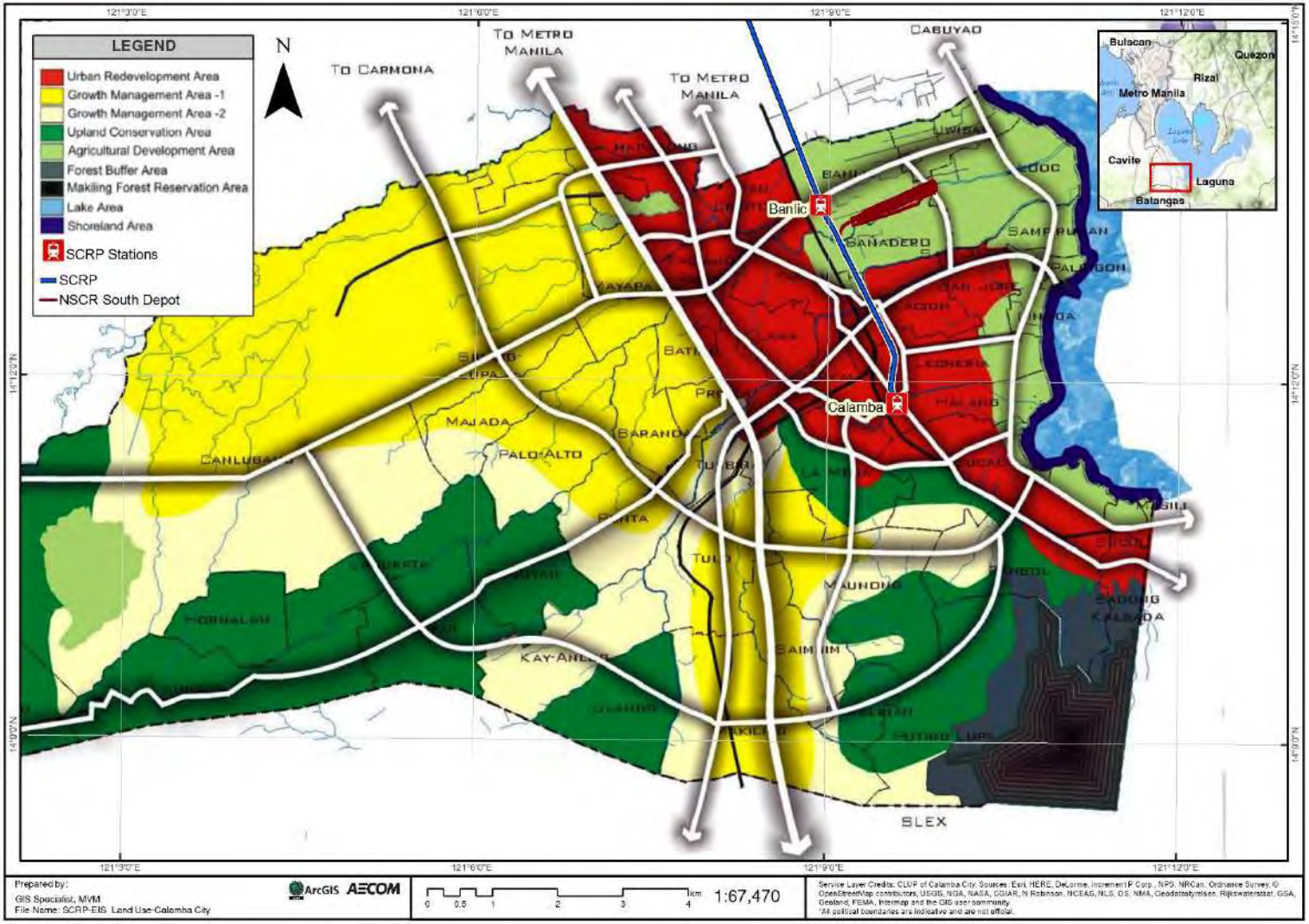


Figure 3.1.11 Land Use Map of the City of Calamba showing Project Alignment

3.1.1.2. Environmentally Critical Area

372. Environmentally Critical Areas (ECAs) are environmentally sensitive areas declared under Presidential Proclamation No. 2146 of 1981 where significant environmental impacts are expected if certain types/ thresholds of the Project are located, developed, or implemented within these areas. **Table 3.1.1** presents the list of ECAs and its relevance to the Project site.

Table 3.1.1 List of ECA and relevance to the Project Site

Environmentally Critical Areas		Relevance to the Project Site
1	All areas declared by law as national parks, watershed reserves, wildlife preserves and sanctuaries	The Project will not traverse any national parks, watershed reserves, wildlife preserves and sanctuaries. Identified nearest protected area is the Mount Makiling Forest Reserve (MMFR) approximately 3 km away. The Ninoy Aquino Parks and Wildlife Center (NAPWC) is approximately 7 km away from the Project alignment. The Las Piñas-Parañaque Critical Habitat and Ecotourism Area (LPPCHEA) is about 5.3 km away from the Project alignment.
2	Areas set aside as aesthetic, potential tourist spots.	No identified nearby areas set aside for aesthetic, potential tourist spot.
3	Areas which constitute the habitat for any endangered or threatened species of Indigenous Philippine wildlife (Flora and Fauna)	The Project will not traverse any habitat of endangered or threatened species of Indigenous Philippine wildlife. Identified nearest protected area is the Mount Makiling Forest Reserve (MMFR) (3 km from alignment). The nearest protected area from the Project alignment is the Ninoy Aquino Parks and Wildlife Center (NAPWC). It is approximately 7 km from the Project alignment.
4	Areas of unique historic, archaeological, geological, or scientific interests	Identified old PNR structures to be maintained will be conserved agreed with cultural agencies (the National Historical Commission of the Philippines (NHCP), National Museum (NA) and National Commission for Culture and the Arts (NCCA) There are seven (7) historical and cultural heritage sites located in close proximity to the Project. These are: Manuel Acuña Roxas Marker; Associacion de Damas de Filipinas, Inc. Settlement House; Philippine Columbian Association; Lord Justo Ukon Takayama Monument (Plaza Dilao, Paco, and Manila); PNR Paco Station; La Concordia College for Girls; and Rizal Monument (Calamba). Alberto Rizal House, house of Rizal's mother, was locally declared by Biñan as a heritage site. Additional structures listed in the Philippine Registry of Cultural Property include: Paaralang Legarda; Maria Paz Mendoza-Guazon Marker; Yulo Townhomes; Galleria de Magallanes Townhomes; Chapel of St. Alphonsus Liguori; Garden of the Risen Christ; Nutrition Center of the Philippines; Philippine Center for Population Development; Asian Center for Training and Research for Social Welfare; Our Lady of Miraculous Medal Shrine; Our Lady of the Abandoned Church; Ang Magpipinipig Monument; and Sarmiento Ancestral House.

Environmentally Critical Areas		Relevance to the Project Site
5	Areas which are traditionally occupied by cultural communities or tribes	The proposed project alignment will not traverse CADT/CADC.
6	Areas frequently visited and or hard hit by natural calamities (geologic hazards, floods, typhoons, volcanic activity, etc.)	The Project will traverse an area with High Risk to typhoon passage and geologic hazard. Segments from Manila City to San Pedro City have high susceptibility to flooding.
7	Areas with critical slope: All lands with slope of 50% or more classified as geohazard by MGB	The Project area is generally flat and will not traverse areas with critical slope.
8	Areas classified as prime agricultural lands	The Project will traverse agricultural areas in Sta. Rosa, Cabuyao, and Calamba Cities. The proposed Depot will be located in an agricultural land in Calamba City.
9	Recharge areas of aquifers	No identified recharge areas of aquifers along the project alignment.
10	Water bodies characterized by one or any combination of the following conditions: tapped for domestic purposes; within the controlled and/or protected areas declared by appropriate authorities; which support wildlife and fishery activities.	This type of ECA is not relevant for the Project. Although there are fishery activities in Laguna and Tadlac Lakes, these lakes will not be encroached by the Project.
11	Mangrove areas characterized by one or any combination of the following conditions: with primary pristine and dense young growth; adjoining mouth or major river systems; near or adjacent to traditional productive fry or fishing grounds; areas which act as natural buffers against shore erosion, strong winds and storm floods; areas on which people are dependent for their livelihood.	The Project will not traverse mangrove areas. The Las Piñas-Parañaque Critical Habitat and Ecotourism Area (LPPCHEA) is about 5.3 km away from the Project alignment.
12	Coral reefs characterized by one or any combination of the following conditions: With 50% and above live coralline cover; Spawning and nursery grounds for fish; Act as natural breakwater of coastlines.	This type of ECA is not relevant for the Project.

Source: Presidential Proclamation No. 2146 (1982)

(1) Areas Declared by Law as National Parks, Watershed Reserves, Wildlife Preserves and Sanctuaries

373. The proposed project alignment does not traverse any international/local protected areas, important bird areas or key biodiversity areas, however, it is located approximately 3 km from the Mount Makiling Forest Reserve. The reserve was designated in 1993 under the Republic Act No. 552 as a National park, which in 1963 under Republic Act No. 3523 and Republic Act No. 6967, management was delegated to the University of the Philippines, to administer and conserve the area primarily as a training laboratory for the advancement of scientific and technical knowledge particularly in the preservation, conservation and development of the country's forest, flora and fauna, and natural resources.

1) Protected Areas based on International Laws

374. International Union for Conservation of Nature (IUCN) protected area management categories classify protected areas according to their management objectives (**Table 3.1.2**). The

categories are recognized by international bodies such as the United Nations and by many national governments as the global standard for defining and recording protected areas and as such are increasingly being incorporated into government legislation.

375. Based on the IUCN, Philippines has a total of 390 protected areas composed of National Parks (37), Natural Monuments or Features (8), Habitat/Species Management Areas (17), Protected Landscapes/ Seascapes (145), and Protected areas with sustainable use of natural resources (183).

Table 3.1.2 Classification of IUCN Protected Area

	Classification	Feature	Number of Protected Area in Philippines
I	Strict Nature Reserve/ Wilderness Area	Areas set aside to protect biodiversity and also possibly geological/geomorphic features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values / protected areas are usually large unmodified or slightly modified areas, retaining their natural character and influence without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition	0
II	National Park	To protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible, spiritual, scientific, educational, recreational, and visitor opportunities	37
III	Natural Monument or Feature	To protect a specific natural monument, which can be a landform, sea mount, submarine cavern, geological feature such as a cave or even a living feature such as an ancient grove	8
IV	Habitat/Species Management Area	To protect particular species or habitats and management reflects this priority	17
V	Protected Landscape/ Seascape	Area where the interaction of people and nature over time has produced an area of distinct character with significant, ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values	145
VI	Protected area with sustainable use of natural resources	Areas conserve ecosystems and habitats together with associated cultural values and traditional natural resource management systems	183

Source: IUCN http://www.iucn.jp/park/protection/reserve/reserve (Access in January 2018)

376. Listed in **Table 3.1.3** are the protected areas within the 50-km from the project alignment. The closest protected area is Mount Makiling National Park which is approximately 4 km from the project alignment.

Table 3.1.3 International Protected Area nearby Project Area

Category	Protected area	Location	Area (ha)	Distance from the project alignment (km)
II	Mount Makiling National Park	Los Baños, Bay and Calamba City in the Province of Laguna and Santo Tomas, Batangas	4,244	4
III	Mts. Banahaw- San Cristobal Protected Landscape	Lucban, Tayabas, Sariaya, Candelaria & Dolores, Quezon Rizal, Nagcarlan, Liliw, Majayjay and San Pablo City, Laguna	10,900	29
V	Hinulugang Taktak protected landscape	Antipolo City, Rizal	3.2	17
V	Taal Volcano Protected Landscape	Taal, Batangas	62,000	27
V	Mts. Palay-palay-Mataas-na-Gulod National Park	Ternate and Maragondon Cavite & Nasugbu, Batangas	3,973	43
V	Pamitinan Protected Landscape	Antipolo and Rodriguez, Rizal	600	24
V	Upper Marikina River Basin Protected Landscape	Antipolo and Rodriguez, Rizal	26,125	25
V	Ninoy Aquino Parks and Wildlife Centre	Quezon City, NCR	65	7
V	Unnamed National Park, Wildlife Sanctuary and Game Preserve (PD 1636)	Portion of Bulacan, Rizal, Laguna and Quezon Provinces	27,613	25
Not reported	Las Piñas-Parañaque Critical Habitat and Ecotourism Area	Las Pinas and Paranaque	175	5.3

Source: IUCN, https://protectedplanet.net/search?q=Philippines (accessed in March 2020)

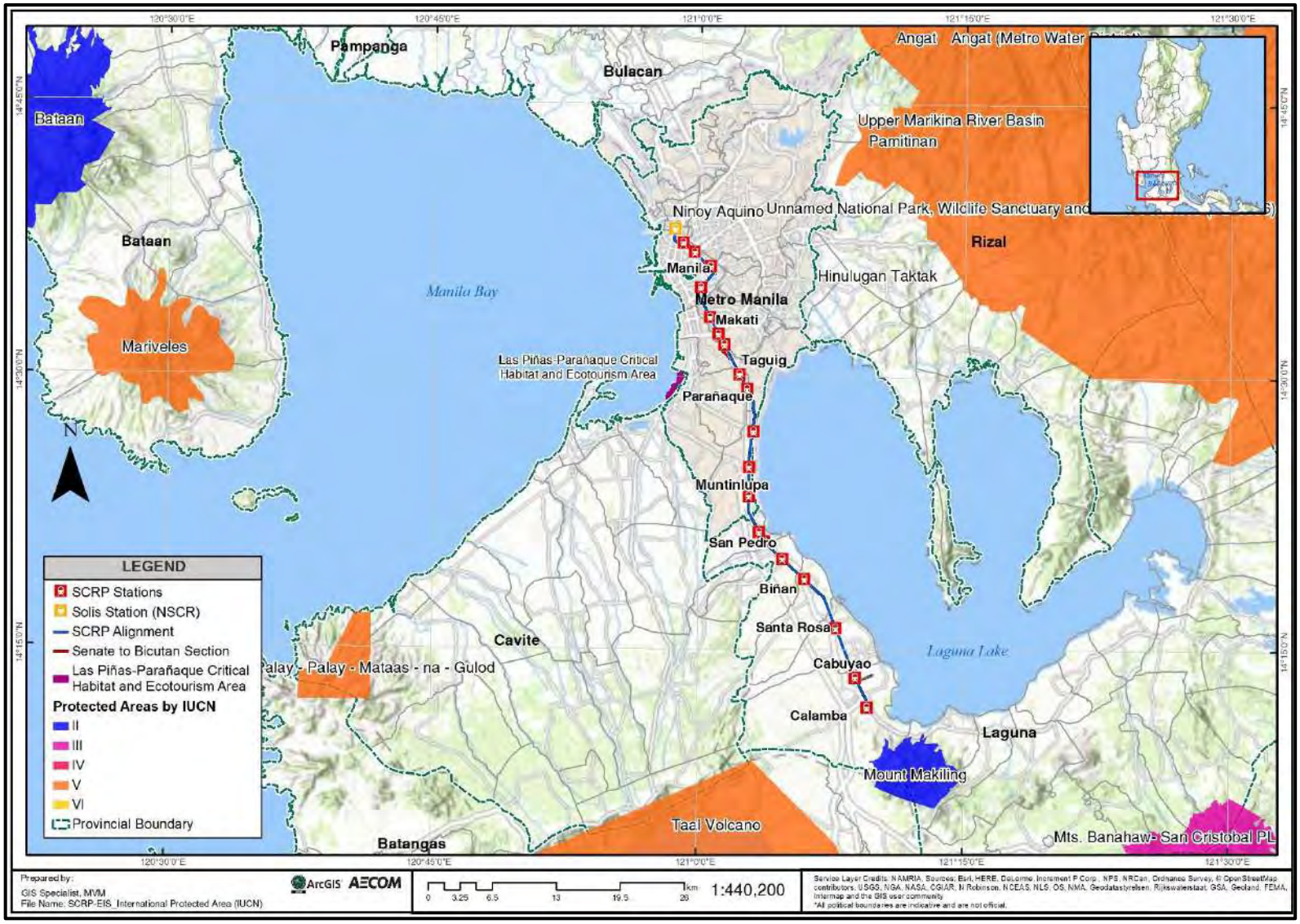


Figure 3.1.12 International Protected Area (IUCN)

2) Protected Area under the Philippine Law

377. The National Integrated Protected Areas System (NIPAS) Act of 1992 (Republic Act No. 7586) and its Implementing Rules and Regulations (DAO No. 92-25) as amended by DAO 2008-26 (2009) provides the legal framework for the establishment and management of protected areas in the Philippines. The Expanded National Integrated Protected Areas System (ENIPAS) Act of 2018 (Republic Act No. 11038) is an amendment of Republic Act No. 7586 which created 94 new protected areas in addition to those previously declared by NIPAS. There are eight (8) categories of protected areas under the NIPAS; Strict Nature Reserve, Natural Park, Natural Monument/Natural Landmark, Wildlife Sanctuary, Protected Landscape and Seascapes, Resource Reserve Natural Biotic Areas/ Anthropological Reserve, and Other categories (**Table 3.1.4**). Protected areas located within 50 km from the project alignment are shown in **Table 3.1.5** and **Figure 3.1.13** Protected Area under NIPAS. The proposed project alignment does not traverse any protected area.

Table 3.1.4 Classification of NIPAS

	Category	Features	Number of Protected Area in Philippines*
1	Strict Nature Reserve	SNR is an area possessing some outstanding ecosystem, features, and/or species of flora and fauna of national scientific importance, maintained to protect nature and maintain processes in an undisturbed state in order to have ecologically representative examples of the natural environmental monitoring, education and for maintenance of genetic resources in a dynamic and evolutionary state.	0
2	Natural Park	NP is a relatively large area not materially altered by human activity where extractive resource uses are not allowed and which are maintained to protect outstanding natural and scenic areas of national or international significance for scientific, educational, and recreational use.	27
3	Natural Monument/Natural Landmark	NM/NL is a relatively small area focused on protection of small features to preserve nationally significant natural features on account of their special interest or unique characteristics.	4
4	Wildlife Sanctuary	WS comprises an area which assures the natural conditions necessary to protect nationally significant species, groups of species, biotic communities, or physical features of the environment where these may require specific human manipulation for their perpetuation.	10
5	Protected Landscape and Seascapes	PL/S are areas of national significance which are characterized by the harmonious interaction of man and land while providing opportunities for public enjoyment through recreation and tourism within the normal lifestyles and economic activity of these areas.	57
6	Resource Reserve	RS is an extensive and relatively isolated and uninhabited area normally with difficult access designated as such to protect natural resources of the area for future use and prevent or contain development activities that could affect the resources pending the establishment of objectives which are based upon appropriate knowledge and planning.	5
7	Natural Biotic Areas/ Anthropological Reserve	Natural Biotic Areas/Anthropological Reserve is an area set aside to allow the way of life of societies living in harmony with the environment to adopt to modern technology at their pace.	4

	Category	Features	Number of Protected Area in Philippines*
8	Other categories	This refers to those areas established by law, conventions, or international agreements which the Philippine Government is a signatory.	-

Note: *As of December 2008

Source: A. La Viña, et al., Legal Framework for Protected Areas: Philippines (2010)

Table 3.1.5 Protected Area nearby the Project

Category	Protected area	Location	Area (ha)	Distance from the project alignment (km)
Natural Park	Ninoy Aquino Parks and Wildlife Centre	Quezon Avenue Diliman, Quezon City	65	7
Wildlife Sanctuary	Las Piñas-Parañaque Critical Habitat and Ecotourism Area	Freedom Island, Parañaque & Long Island, Las Piñas	175	5.3
Protected Landscape and Seascapes	Hinulugang Taktak Protected Landscape	Antipolo, Rizal	3	17
	Taal Volcano Protected Landscape	Batangas	62,000	27
	Mts. Palay-palay-Mataas-na-Gulod	Ternate and Maragondon Cavite & Nasugbu, Batangas	3,973	43
	Mts. Banahaw- San Cristobal Protected Landscape	Lucban, Tayabas, Sariaya, Candelaria & Dolores, Quezon Rizal, Nagcarlan, Liliw, Majayjay and San Pablo City, Laguna	10,900	29
Other categories	Pamitinan Protected Landscape under Marikina Watershed Reservation	Antipolo and Rodriguez, Rizal	600	24
	Kaliwa Watershed Forest Reserve	Tanay, Rizal	35,150	25

Sources: Protected Areas and Wildlife Bureau, DENR

Figure 3.1.13 Protected Area under NIPAS

3) Important Bird Areas and Key Biodiversity Areas

378. In 2006, DENR defended the terrestrial Key Biodiversity Areas (KBAs) using data from the Important Bird Areas Program (IBAs), the 2004 IUCN Red List, as well as point locality data from published literature, experts and scientists, and museum collections. Based on the above-mentioned protected area and other important areas for biodiversity, it clarifies that the Project is neither located within the international nor the national protected area. The closet IBAs/ KBAs is 4,244 ha of Mount Makiling National Park (Los Baños, Bay and Calamba City in the Province of Laguna and Santo Tomas, Batangas), which is 4 km from the proposed alignment. The location map is shown in **Figure 3.1.14**.

379. Although it is not under IBAs/ KBAs, Tadlac Lake (also known as Alligator Lake) was also included in the area of study to assess the biodiversity in its surroundings. The lake which is approximately 5.5 km from the proposed project alignment is located in Barangay Tadlac, Los Baños near the border of Calamba City in the province of Laguna. The lake is contained in a piece of land jutting out to the Laguna de Bay known as Malilimbas Point and is directly situated below the northeastern slope of Mount Makiling, the highest mountain in the Laguna Volcanic Field. Because of its origin, the lake has no outlet and is replenished only by rainfall.

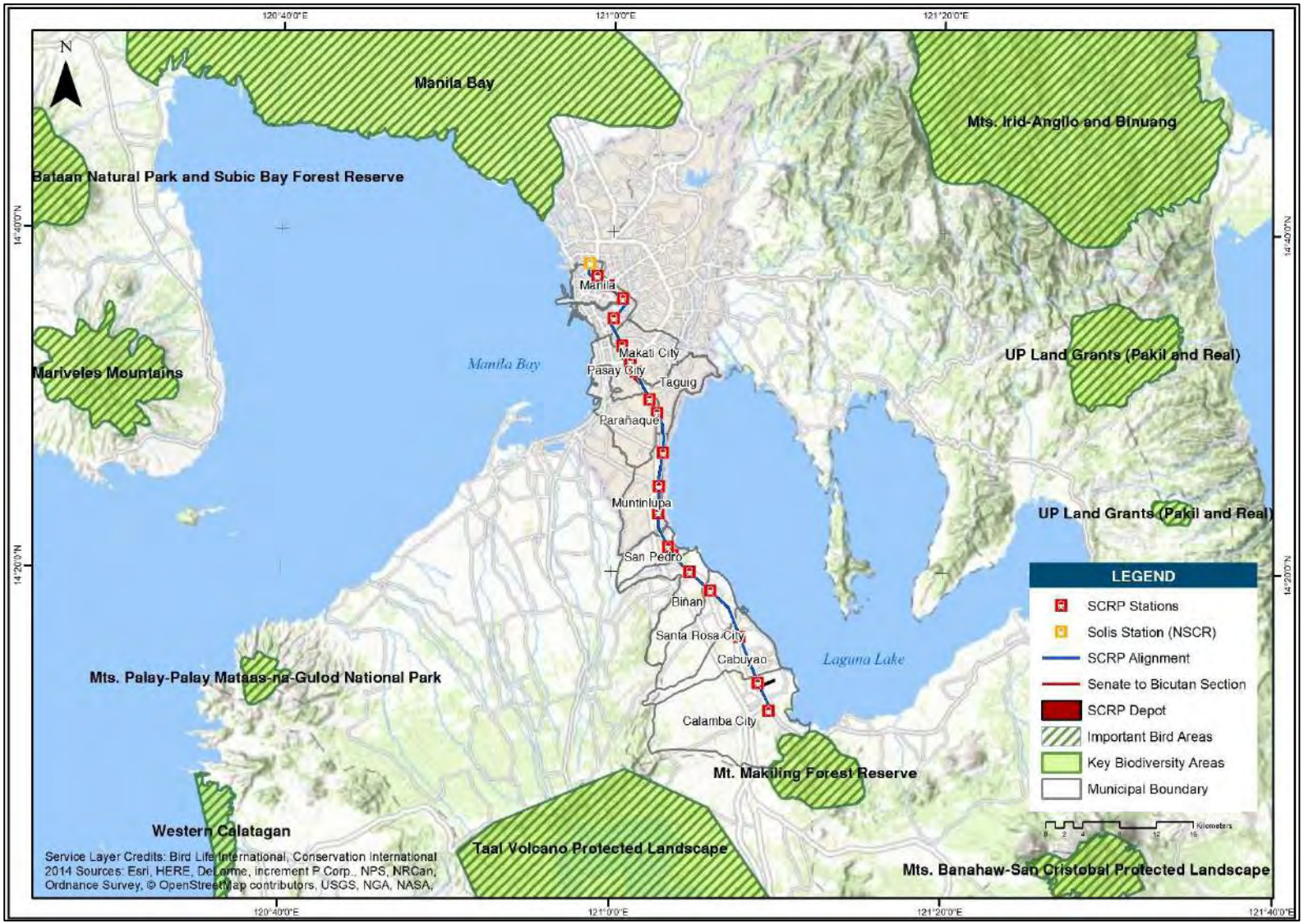


Figure 3.1.14 IBAs and KBAs Location Map

(2) Areas of Unique Historic, Archaeological, or Scientific Interests

380. In the Philippines, National Historical Commission of the Philippines (NHCP) declares the heritage in accordance with NHCP Guideline on the Identification, Classification, and Recognition of Historic Sites and Structures in the Philippines (2011) under RA 10066 (2009). Structures and sites which: 1) Possess demonstrable historical significance; 2) be at least fifty (50) years old; and 3) seventy (70) percent authentic, are qualified for consideration. There are seven (7) historical and cultural heritage sites located in close proximity to the Project. These are: Manuel Acuña Roxas Marker; Associacion de Damas de Filipinas, Inc. Settlement House; Philippine Columbian Association; Lord Justo Ukon Takayama Monument (Plaza Dilao, Paco, and Manila); PNR Paco Station; La Concordia College for Girls; and Rizal Monument (Calamba). Alberto Rizal House, the house of Rizal's mother, was locally declared by Biñan as a heritage site.

381. Within the project area, fifteen (15) 50-year old PNR stations and Railway Bridges were dotted along the proposed project alignment and these are listed **Chapter 3.4.4**. These structures may need preservation and DOTr will consult Cultural Agencies (NCCA, NHCP, NM) for the qualification of these structures for the provision of necessary protection measures during construction.

382. Additional structures listed in the Philippine Registry of Cultural Property include: Paaralang Legarda; Maria Paz Mendoza-Guazon Marker; Yulo Townhomes; Galleria de Magallanes Townhomes; Chapel of St. Alphonsus Liguori; Garden of the Risen Christ; Nutrition Center of the Philippines; Philippine Center for Population Development; Asian Center for Training and Research for Social Welfare; Our Lady of Miraculous Medal Shrine; Our Lady of the Abandoned Church; Ang Magpipinipig Monument; and Sarmiento Ancestral House.

(3) Areas Frequently Visited and/or Hard Hit by Natural Calamities

383. Philippines is prone to natural hazards such as typhoons, earthquakes, volcanic eruptions, landslides, and tsunamis. The whole stretch of the alignment is prone to geologic (i.e. ground shaking) and typhoon hazards while only portions of the alignment located in Metro Manila are prone to periodic flooding during the rainy season. The alignment is not prone to volcanic activity. The geologic hazards, floods, typhoons, and volcanic activity are discussed in **Section 3.1.2.3**.

(4) Areas Classified as Prime Agricultural Land

384. Prime agricultural land refers to the land that can be used for various or specific agricultural activities and can provide optimum and suitable yield with minimum inputs and development costs as determined by the Department of Agriculture (DAR AO No. 01 Series of 2002). These areas are non-negotiable for conversion which include all irrigated lands, as delineated by the DA and/or the National Irrigation Administration (NIA), where water is available to support rice and other crop production, and all irrigated lands where water is not available for rice and other crop production but are within areas programmed for irrigation facility rehabilitation by the government. Portions of the project alignment will pass through agricultural areas (i.e. rice field) in Sta. Rosa, Cabuyao, and Calamba. The site being considered for the Depot is a 22-ha agricultural lot in Banlic, Calamba.

385. Except for the 30 m extension of the proposed stations, the agricultural land in Sta. Rosa and Cabuyao will not be affected since the Project will utilize the existing PNR ROW. Additionally, the prime agricultural land in Banlic, Calamba needs to be converted into an Infrastructure/Utilities, Transportation and Services land use for the construction of the Depot. The site will only be developed upon grant of conversion. If this is rejected, DOTr will find another location.

(5) Water Bodies

386. Laguna de Bay is the main hydrologic feature which affects the project alignment. It is a freshwater lake with a surface area ranging from 911 to 949 km^2 and a watershed area of 3,820 km^2. The lake is currently used for fisheries, as a source for domestic water supplies, and industrial cooling, as a transport route, as a source for power generation and irrigation, and as a place for recreation[3]. With its many uses, the lake is facing environment issues that are being addressed up to the present. Data shows that 60% of the estimated 8.4 million people staying around the Laguna de Bay dumped their solid and liquid wastes indirectly to the lake through its 21 tributaries. Of the total wastes going into the lake, 40% comes from agricultural wastes, 30% from domestic wastes, and 30 % from industrial wastes[4].

387. There are 35 waterways crossing at the project alignment. These include Pasig River, Sucat River, Alabang River, Bayanan Creek, Poblacion River (Muntinlupa), Magdaong River (Muntinlupa), Tunasan River, San Isidro River (San Pedro River), Biñan River, San Cristobal River and Calamba River. However, none of these rivers are being utilized for drinking water. The pollution in these rivers is *extreme* and will be subjected to regular water quality monitoring at identified monitoring stations during the project implementation. Discussion of the rivers is presented in the hydrology section of this report.

388. **Table 3.1.6** shows the summary list of ECAs per City that will be traversed or within the proximity of the project alignment.

[3] http://www.greenpeace.org/seasia/ph/What-we-do/Toxics/Water-Patrol/The-problem/Laguna-Lake/

[4] http://fmds.upou.edu.ph/index.php/27-fmds-community/178-lagunalake

Table 3.1.6 ECA Traversed by Project alignment

Environmentally Critical Areas		Manila	Makati	Taguig	Parañaque	Muntinlupa	Pasay	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba
1	All areas declared by law as national parks, watershed reserves, wildlife preserves and sanctuaries	None	None	None	None	None	None	None	None	None	None	None
2	Areas set aside as aesthetic, potential tourist spots	None	None	None	None	None	None	None	None	None	None	None
3	Areas which constitute the habitat for any endangered or threatened species of Indigenous Philippine wildlife (Flora and Fauna)	None	None	None	None	None	None	None	None	None	None	None
4	Areas of unique historic, archaeological, geological, or scientific interests	Yes	Yes	Yes	None	Yes	None	Yes	Yes	Yes	Yes	Yes
5	Areas which are traditionally occupied by cultural communities or tribes	None	None	None	None	None	None	None	None	None	None	None
6	Areas frequently visited and or hard hit by natural calamities											
	- geologic hazard	Yes	Yes	Yes	Yes	Yes	None	Yes	Yes	Yes	Yes	Yes
	- floods	Yes	Yes	Yes	Yes	Yes	None	Yes	None	None	None	None
	- typhoons	Yes	Yes	Yes	Yes	Yes	None	Yes	Yes	Yes	Yes	Yes
	- volcanic activity	None	None	None	None	None	None	None	None	None	None	None
7	Areas with critical slope: All lands with slope of 50% or more classified as geohazard by MGB	None	None	None	None	None	None	None	None	None	None	None
8	Areas classified as prime agricultural lands	None	None	None	None	None	None	None	None	Yes	Yes	Yes
9	Recharge areas of aquifers	None	None	None	None	None	None	None	None	None	None	None
10	Water bodies characterized by one or any combination of the following conditions: tapped for	None	None	None	None	Yes	None	None	None	None	None	None

Environmentally Critical Areas		Manila	Makati	Taguig	Parañaque	Muntinlupa	Pasay	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba
	domestic purposes; within the controlled and/or protected areas declared by appropriate authorities; which support wildlife and fishery activities.											
11	Mangrove areas characterized by one or any combination of the following conditions: with primary pristine and dense young growth; adjoining mouth or major river systems; near or adjacent to traditional productive fry or fishing grounds; areas which act as natural buffers against shore erosion, strong winds and storm floods; areas on which people are dependent for their livelihood.	None	None	None	None	None	None	None	None	None	None	None
12	Coral reefs characterized by one or any combination of the following conditions: With 50% and above live coralline cover; Spawning and nursery grounds for fish; Act as natural breakwater of coastlines.	None	None	None	None	None	None	None	None	None	None	None

3.1.1.3. Land Tenure Issue/s

389. The entire PNR alignment and ROW is the property of the Philippine National Railway, an attached agency of the DOTr. Hence, there are no tenurial issues (i.e. CARP or with CADC/ CADT/ CALC/ CALT) with regards to ownership of the alignment. However, there are portions of the alignment that are still encroached by informal settlers and these will be addressed in the Resettlement Action Plan.

(1) PNR Operation

390. PNR operation will not be affected by the Project during its implementation. The Project will not share the tracks of the proposed freight and long-haul trains. PNR line will continue its operation while the Project is being constructed. Existing tracks will be reused for the freight and long-haul trains operation. In addition, the project plans to connect to the MMSP line at FTI station.

(2) NLEx/ SLEx Connector Road Project

391. NLEx/ SLEx Connector Road Project, being implemented by the Department of Public Works and Highways (DPWH), is an 8 km all elevated 4-lane toll expressway which will extend the NLEx southward from the end of Segment 10 in C3 Road Caloocan City to PUP Sta. Mesa, Manila. It will connect to the Skyway Stage 3 and traversed mainly the PNR rail track. This includes two (2) interchanges located at C3 Road, Caloocan and España, Manila. The connector road project will be funded by the Manila North Tollways Corporation (MNTC) with an estimated project cost of PhP 23.302 Billion. Construction is on-going and expected to be completed by April 2021.

392. The alignment of the Project from Solis Station to Sta. Mesa Station will utilize a private land adjacent to the PNR ROW which will be acquired by DOTr. This is because the NLEx/SLEx Connector Road of the DPWH from Solis to Sta. Mesa has been designed to utilize majority of the PNR ROW.

(3) Private Landowners

393. The DOTr will acquire the private lands for the project alignment from Solis Station to Sta. Mesa Station; the 30 m extension for each station and the depot site in Banlic, Calamba. As required in the design of the project, DOTr will also acquire private lands some in Manila and in the area of Makati, Paranaque and some in Brgy. Sucat in Muntinlupa City.

(4) Informal Settlers

394. PNR ROW has been proliferated by Informal Settler Families (ISFs) disregarding the hazard of living along the PNR ROW. Informal settler families and their structures can be found within the bounds of the proposed 30m ROW for the Project. Most of the structures located at approximately 2 to 10 meters from the track are a mixture of concrete and light materials with 2 or more families sharing in a structure. These families take the risk of living in what is considered as a danger area due to free or low rental cost and proximity to their livelihood and other services.

(5) Sucat Thermal Power Plant

395. The government, under the Power Sector Assets and Liabilities Management Corporation (PSALM), has an existing contract with a private firm to dismantle the Sucat Thermal Power Plant (STPP) site. The proposed Sucat Station will be located at the decommissioned STPP area.

(6) Pasig River Ferry Service

396. The Pasig River Ferry Service is the only water-based transportation in Metro Manila that cruises the Pasig River from Pinagbuhatan in Pasig to Intramuros in the City of Manila. The system is owned and operated by a private company, SCC Nautical Transport Services Incorporated. Although commonly referred to as a ferry, it is more similar to a water bus.

397. The latest Pasig Ferry Service, operated by SCC Nautical Transport Services Incorporated, was reactivated on April 28, 2014 to alleviate the traffic situation in Metro Manila in light of the infrastructure projects being constructed simultaneously. The ferry service is operated by Metro Manila Development Authority until a private investor takes over.

398. There is a possibility that the Project might affect the ferry operation during its construction traversing Pasig River. Appropriate measures will be implemented by DOTr including coordination with the concerned parties.

3.1.1.4. Visual Aesthetics

399. The existing PNR operates along the Laguna de Bay which is the largest freshwater lake in the Philippines, and the third largest in Southeast Asia.

400. The Laguna de Bay region is rich in history, natural beauty, and biodiversity. The Laguna de Bay lakeshore has been inhabited for many thousands of years, which can be seen in the Angono petroglyphs in the lakeshore town of Binangonan, Rizal. Due to the many years of Spanish influence, there are several old churches around the region.

401. The lake is also part of the flyway for migratory birds. Mount Makiling National Park is located south of the lake. The mountain is ideal for hiking, camping, trekking, mountain biking, and bird watching. The Mount Makiling Forest Reserve has a total of 2,048 plant species, many of which are exotic flowers.

402. The existing PNR lines being at grade structure are not visible from Laguna de Bay coast line. However, they could be visible from Mount Makiling.

403. The SCRP interconnecting line of the Project has no effect to any visually important structures or landforms.

3.1.1.5. Land Value

404. Discussed in this section are the solid waste management information and schemes of each LGUs traversed by the Project.

(1) City of Manila

405. Based on the Manila Comprehensive Land Use Plan and Zoning Ordinance (Book 1, 2005-2020), the total volume of garbage generated per day in Manila City is approximately 6,498.94 cubic meters for the year 2000. This includes wet and dry household waste, industrial waste, commercial waste, and some hospital waste. The highest percentage of the solid waste generated is of food waste contributing to 45% of the total solid waste generated. The second and third type of solid waste are dry paper/cardboard and plastic/Styrofoam/rubber which contributes 19% and 16% to the total generation, respectively. On the other hand, the total volume of garbage collected per day within the city is approximately 6,409.15 cubic meters. This consisted of 46% food waste, 12% dry paper/cardboard, and 12% plastic/Styrofoam/rubber. The total waste collected consisted mostly of food waste amounting to 46% and fine and inert contribute the least amount.

406. At present, the LGUs collect city/municipal solid waste in Metro Manila either through private contracts or through the LGU's own sanitation services departments. Manila City has 100% coverage of solid waste collection through a private contract with Leonel Waste Management wherein 250 compactors and heavy equipment are used for collection on a daily basis.

407. Waste collection is done through house-to-house or via curb side wherein wastes are placed in plastic bags, rattan baskets, or in various types of bins usually provided by the residents themselves. These are loaded onto a garbage truck. Since the city has no final disposal facility, waste collected is brought to a transfer station (Vitas Transfer Station, 10-hectare facility) situated at Pier 18, NHA Compound, Tondo. Waste is brought to either the Tanza Facility located in Tanza, Navotas, or the Rodriguez Facility located in Marikina Valley.

(2) City of Makati

408. Based on the CLUP of Makati City (2013-2023), the estimated total solid waste generation of Makati in 1994 was 502.78 tons per day or 2,654.2 m^3 per day. Generated waste account to 45.0% from residential, 12.2% from market, 13.5% from commercial, 0.7% from construction and demolition, 12.5% from roads and streets, 8.3% from institutional, and 8.0% from other sources.

409. The city's Solid Waste Management Division handles solid waste collection. Five garbage collection service providers have been contracted by the city to collect and haul off wastes. The contractors are required to make about 153 trips daily throughout 27 barangays of the city. Each collection truck is required to make two daily trips. Overall collection efficiency has been estimated at 86% efficiency, based on the 1994 data.

410. Solid waste collection in the CBD and in six residential villages surrounding the business district is handled by the private sector.

411. Solid waste is collected through a cell system. One cell is estimated to contain from 12 to 15 m^3 of waste. These are collected along the road/street at curbside. Residents and owners of establishments are required to discharge wastes in plastic bags or trash receptacles prior to the arrival of the collection trucks.

412. Three types of collection trucks are used: 10-wheeler, 6-wheeler, and compactors, with 15, 10, and 8 m^3 minimum capacity, respectively. Handcarts are utilized where narrow streets do not allow the access of collection trucks, and collection points are designated for systematic collection.

(3) City of Taguig

413. For solid waste disposal in the City of Taguig, the assumed unit is taken as 0.5 kg per capita per day[5]. For the predicted population, total solid waste is estimated to be 1009 tons/day. The volume of solid waste generated per day is 149.1 tons per day (MMDA). The collection rate is at 56.79%.

414. Localized collection of solid waste could be provided by the city or a private service contractor may be employed. Collected waste would be compacted and loaded into containers for transfer to sanitary landfill sites.

415. The Solid Waste Management Office (7 staff), together with the Clean and Green Office (324 staff, including 262 street sweepers), the Agriculture Office (7 staff), and the General Services Office (50 staff), are all under the Environment Maintenance Group headed by the Environment and Natural Resources Officer (ENRO).

[5] Source: Metro Manila Solid Waste Management (TA 3848-PHI) Final Report, Report No.1, Summary Report (September 2003)

416. The city uses the services of a private contractor (IPM Construction) for waste collection with the contract renewed every six months dependant on the satisfactory performance of the contractor. The 'Clean and Green' area checkers (lead persons of street sweepers) seek to enforce requirements that no waste is left uncollected within their respective areas of jurisdiction. Uncollected waste is reported to the Office who, in turn, notifies the contractor.

417. The Waste Management Division mainly performs monitoring functions with "one-stop outposts" manned by personnel on a 24-hour basis, serving as multi-purpose monitors. Illegal disposal from other LGUs, by either contractors or residents, is prevalent in Taguig due to the availability of vacant land.

418. The LGU collects non-medical waste from hospitals but does not monitor if hospitals comply with the proper handling and disposal of medical waste. Regulation of handling, collection, and disposal of medical waste from other establishments such as funeral parlours and private clinics is the responsibility of the City Health Office through their sanitary inspectors.

(4) City of Parañaque

419. Based on the 2012 Socioeconomic Profile of Parañaque, the projected waste diversion and disposal targets of the City of Parañaque in 2021 is 51% and 432.9 tons/day, respectively. The solid waste management of the City of Parañaque is described below.

420. The segregation of wastes will primarily be conducted at source to include residential households, industrial, commercial, institutions, and agricultural sources. Barangays will provide a schedule on the collection of biodegradables and non-biodegradable waste to impose the segregated collection scheme. All waste that will not be collected by the barangays will be regarded as residual waste.

421. The different types of vehicles, ranging from 10-wheeler dump trucks to smaller ones will be utilized depending on the area of collection. There will be daily collection of segregated waste along the main thoroughfares and markets. A weekly collection will be instituted for households or residences. For stationary sources like government offices and other institutional entities, three times a week collection will be provided. Further, for bulky and yard waste generated within the barangay, collection will be upon request.

422. Door to door collection of solid waste will be utilized in accessible areas. However, for inaccessible areas, push carts will be used.

423. The recyclables and compostable will be collected by the barangay eco-aides. This is in compliance with Section 6 Rule VI of the Implementing Rules and Regulations of RA 9003. These collected recyclables and compostable will be brought to the MRF for further segregation and composting. The residuals will be collected by the City Private Hauler and brought to a sanitary landfill identified by MMDA.

(5) City of Muntinlupa[6]

424. The City of Muntinlupa generates a total of 80,400 tonnes/year of waste. It is composed of paper (10.2%), glass (3.1%), metals (3.9%), plastic (28.1%), and kitchen/food waste (29.1%), other organic (20.4%), other inorganic (5.0%), and hazardous/special (0.2%) (Spring 2003).

425. The City uses the services of a private contractor (REN Transport Corporation) for waste collection with 85% coverage. The waste disposal sites are in Rodriguez, Rizal, and San Pedro, Laguna.

[6] Source: Metro Manila Solid Waste Management Project (TA 3848-PHI) Final Report, Report No.1, Summary Report (September 2003)

(6) City of Pasay

426. According to the 2014-2022 City CLUP, Pasay City does not have its own disposal facility for solid waste. Garbage is disposed in the Rodriguez Landfill in Rizal. The city government contracts out the services for collection and disposal. The inhabited portion of the city is covered by the solid waste collection service.

(7) City of San Pedro

427. Based on the 2013-2023 City CLUP, San Pedro generates 238,609.67 kg or 263.02 tons of solid waste per day in 2007. Garbage collection is managed by a garbage contractor covering 20 barangays, catering to almost 65% of the total population. Garbage is currently being disposed in Pilotage Sanitary Landfill, a 32-hectare facility found in Narra Road, Barangay San Antonio.

428. There is also a two-hectare materials recovery facility in the area, the only MRF in the city. Additional MRFs should be established per barangay in order to comply with the Ecological Solid Waste Management Act of 2000 (RA 9003).

(8) City of Biñan[7]

429. Solid waste remains a problem for Biñan City due to increasing urbanization. The 1992 Projection of solid waste generation for the year 2000 stands at 124,538 kg/day. At present, two dump trucks service the market area while three Isuzu Elf trucks service 13 barangays. The remaining barangays resort to open burning, dumping, burying, and disposing into waterways. Solid waste management in the city can be considered inefficient.

(9) City of Sta. Rosa[8]

430. The estimated volume of waste generated in the city in 2015 is about 246,570 kgs per day. An estimated 62% of the total wastes generated are biodegradable, 20% are residual waste, 17% are recyclable waste, and about 1% is special or hazardous waste.

431. Household waste contributes to about 65% of the solid waste generation in the City, while the remaining 35% come from non-household sources.

432. The City Government, through the supervision of the City ENRO, is providing daily garbage collection to the 18 barangays, including almost all private subdivisions. It is spending Php 54 million per year for the collection and hauling of garbage (City ENRO, 2008).

433. Pilotage Trading and Construction (PTAC), a private contractor that owns a sanitary landfill located in San Pedro, Laguna is in charge of the everyday garbage collection of the city. PTAC is using 29 dump trucks tracking different routes per day. (Excerpt from the 10-Year City Solid Waste Management Plan)

(10) City of Cabuyao[9]

434. Solid waste disposal of the City of Cabuyao is done at the sanitary landfill operated by the City of Calamba.

[7] Source: 2018 Biñan Eco Profile and Sectoral Situational Analysis Volume 2

[8] Source: http://santarosacity.gov.ph/about-sta-rosa/waste-management/ (Date Retrieved: April 6, 2018)

[9] Source: Cabuyao City Socioeconomic, CLUP (2000-2010)

(11) City of Calamba[10]

435. In the City of Calamba, solid wastes are usually generated by 80,661 households, about 289 industrial firms, more than 6,000 commercial establishments, and a number of institutional houses scattered in the entire area.

436. It is estimated that the 387,876 projected population in the year 2006 generate as much as 232 tons of garbage per day (computed at 0.6 kg/day/capita). Of this figure, the city government of Calamba was collecting 67% in 2004 from only 37 % in 2001. This is supported by barangay owned garbage trucks that collect 14% of the consolidated wastes. The remaining 19% on the other hand is left uncollected and excluded in the 81% total wastes being disposed daily in San Pedro, Laguna.

437. Remarkably, collection via garbage trucks increased significantly between 1990 & 2000. This posted an annual average increase of 55%. This development is caused by the efforts of local authorities in expanding the garbage collection scheme to completely eradicate erroneous manners of wastes disposal, thus freeing rivers and streets of dumped materials.

438. For the collection, generators are advised to bring out their garbage at the designated schedules. Included in the rounds are several subdivisions, commercial areas, markets, hospitals, and institutions. Main roads and parks are maintained by street cleaners.

439. In parallel, barangays such as San Cristobal, Paciano Rizal, Parian, Barandal, Real, Lawa, Pansol, Canlubang and Villa de Calamba in Barangay Lamesa had acquired their own garbage trucks, thus the load was lessened and attention of the City ENRO for garbage collections was diverted to other barangays in need of the service.

3.1.1.6. Impact Identification, Prediction and Assessment, and Mitigation

(1) Pre-Construction and Construction Phase

1) Impact in terms of Compatibility with Existing Land Use

440. Along the PNR ROW from Paco Station to Calamba Station, the impact of the Project on the land use is not significant during the pre-construction and construction phases due to a large portion of land being owned by PNR. However, the project alignment from Solis Station to Sta. Mesa Station will be located outside the existing PNR ROW to give way to the NLEx/SLEx Connector Road of the DPWH which has been designed to utilize the existing PNR ROW. Based on this, about 8 km of land parallel to the PNR ROW will be aquired by DOTr for the project alignment which is predominantly built-up area. This means that the land use of 8.0 km x 30 m (24 ha) of private land will be permanently changed for the ROW of the Project thereby, resulting to a permanent loss of various commercial, residential and other establishments, and other uses of the area.

441. Similarly, the existing land use of the 22 ha depot in Banlic, Calamba and the area for the 30 m extension at 19 stations, approximately the exiting land use of 18 ha will be changed permanently from its existing land use for utilization by the Project. Whenever finalized, the land use for the depot site at Banlic, Calamba will likewise be changed. Accordingly, food production from the 22 ha agricultural lot will be permanently lost.

442. The area for the Senate Station is about 420 m north of Lawton Ave., where most of the traffic is from Taguig to Pasay, Makati and Manila area and vice versa. The development area is generally within an Institutional space. Moreover, the underground station would traverse beneath

[10] Source: Calamba City Socioeconomic Profile (2007)

the Low-density Naval Military/ Residential. The area for the development would also affect the National Nutrition Council.

443. The area utilized for the SCRP FTI Station include new Public Utility Vehicle (PUV) hubs. This station is foreseen to be an interconnection to other transportation types such as PUVs and the PNR Station. Below this station is the FTI subway station. The stations are surrounded by residential areas, particularly the United Hills Parañaque. Displacement of residents within the development area is presumed.

444. The direct impact on land use and development would be a function of the plans, zoning ordinances, and economic development programs of the affected LGUs. Overall, the Project is compatible with local government plans that support rail systems and transit-oriented development. Existing land use policies and zoning ordinances support the development of the proposed railway.

445. Information on the Project has been shared with the affected LGUs from time to time, so that LGUs adopt the Project in their CLUP to accommodate its implementation, and the Project will be in accordance with the future land use plans. DOTr cooperates with the urban planners of LGUs to identify their future land use of the surrounding areas that will result in a significant increase of transportation-oriented developments. DOTr also considered the station recommendations of the LGUs and have been coordinating with DAR for the conversion of agricultural land for the proposed depot.

2) Impact on Compatibility with Classification as an ECA

446. Impacts on compatibility with ECA are expected to be less significant. DOTr plan, design and construct the Project including temporary facilities such as construction yards and related access to ensure sufficient distance, etc. from the location of ECA such as: 1) areas of unique historic, archaeological, geological of scientific interest; 2) areas frequently visited by and/or hard hit by natural calamities (geologic hazards, floods and typhoons); and 3) areas classified as prime agricultural lands.

Areas of unique historic, archaeological, geological, or scientific interest

447. The Project is expected to enhance the existing old PNR structures of over 50 years that are located close to the Project. The DOTr has coordinated with cultural agencies (National Commission for the Culture and the Arts (NCCA), National Historical Commission of the Philippines (NHCP), National Museum (NM)), PNR and LGUs. For those qualified as historical structures/ sites, DOTr prepared a protection and conservation plan to maintain the structures and to provide necessary protection measures during construction. This also includes the protection of identified heritage sites which have great potential as tourist spots. The administrative procedure for the preservation of historic structures and/or buildings during construction has already been approved by the cultural agencies.

Areas frequently visited and/or hard hit by natural calamities

448. The impacts to the Project of geologic hazards such as ground shaking and ground rupture; and typhoon hazards and flooding for the alignment from Sta. Mesa Station to Paco Station and FTI Station to San Pedro Station which have high susceptibility to inundation during heavy rains will be addressed by the following measures: a) Ground shaking can be mitigated through appropriate foundation design based on the recommendations in the geotechnical and seismicity studies and in coordination with the Philippine Institute of Volcanology and Seismology (PHIVOLCS) during earthquake events so that adjustment on construction schedule can be instituted; b) Risk to ground rupture which applies to the alignment from Taguig to Muntinlupa as traversed by the active West Valley Fault can be managed thru conduct of detailed seismological and geotechnical study and gather data needed to formulate design measures which will mitigate the likelihood of ground rupture; c) Typhoon impacts may be mitigated through regular

coordination with PAGASA and adjustment of construction schedules in relation to bulletins issued; d) Drainage systems will be installed in accordance to the comprehensive hydrological study to address flooding; and e) Implementation of an Emergency Response Plan for the construction phase.

Areas classified as prime agricultural lands

449. The significant impact of the Project depot is the possible loss of about 22 ha agricultural land. Accordingly, food production from this land will be permanently lost. The Depot area will be subjected to land conversion. The site will only be developed upon grant of conversion. If this is rejected, DOTr will find another location. DOTr will coordinate with lot owners and other concerned stakeholders for its intent of just compensation in acquiring the land and/or securing the ROW.

3) Impact in Existing Land Tenure Issue/s

450. The impact of the Project to the existing land tenure is significant in areas outside the PNR ROW particularly from the Solis Station up to the east of PNR Santa Mesa Station wherein about 8.0 km of built-up area (residential, commercial, etc.) parallel to the PNR ROW will be acquired since NLEx-SLEx Connector Road Project of the DPWH will utilize the PNR ROW. The DOTr will, however, coordinate with DPWH to optimize the utilization of existing PNR ROW so as to minimize land acquisition.

451. DOTr will coordinate with lot owners, PSALM for Sucat Thermal Power Plant, LGUs, and other concerned stakeholders on its intent for a just compensation in acquiring the land and/or securing ROW for the alignment outside the PNR ROW including station and depot. For the proposed depot site, DOTr will require land conversion of irrigable land which will require prior consent from land landowner.

452. There is also a possibility that during construction, the Project will affect the ferry operation particularly for the alignment that traverses Pasig River. The DOTr will, however, coordinate with the concerned agencies and other stakeholders to minimize the disruption of the ferry operation and ensure the safety of both commuters and workers of the Project. This impact is expected to be temporary and moderately significant.

453. There are portions of the alignment that still have encroachments by informal settlements, and these will be addressed in the Resettlement Action Plan for land acquisition and relocation of informal settlers in line with JICA Guidelines (2010) and ADB Safeguard Policy Statement (2009).

4) Impairment of visual aesthetics

454. The impact on visual aesthetics during construction of the Project at grade structures of about 6.0 km will not be significant since there are already existing at grade PNR structures. However, the elevated structures of about 49.6 km will have a significant impact on aesthetics, particularly in the Province of Laguna where only few high-rise structures are present. This, however, is temporary and structures will be designed in consideration of size, shape and color to mitigate the visual impact from local community and viewpoints. In addition, tree planting along the alignment will mitigate the visual impact of the hard structure and provide natural screening.

455. Areas within the ROW that will not be developed will be planted with trees to act as a buffer zone, green corridor and to lessen the aesthetic sore brought about by construction activities.

456. During construction, improper handling and disposal of construction and domestic wastes may result in visual pollution and will have an aesthetic impact on the landscape. In order to reduce, if not eliminate, the environmental impacts of the solid wastes, the construction plans, operating instructions and solid waste management plan will be strictly implemented. DOTr will ensure that contractors maintain the construction site tidy and clean and that temporary

screens/walls are provided to minimize visual clatter. During the demobilization of construction activities, construction yards will be rehabilitated to its previous condition.

5) Devaluation of land value as a result of improper solid waste management

457. Waste generation and improper waste disposal during pre-construction and construction phases may affect the soil quality, which will result in the devaluation of land value. The Project will generate domestic wastes such as paper, cartons, plastics, bottles, food leftovers, etc. Municipal solid waste generation during construction period is estimated at 16 tons per day assuming 26,680 number of workers generate waste of 0.6 kg/person[11]. Some hazardous solid wastes that will be generated include busted fluorescent lamps and spent batteries. Residual construction materials such as aggregates, sand, cement, steel materials, timber, precast components, among others will be procured according to the schedule of the construction progress. Since the Project requires a huge quantity of materials, it is expected that residual construction materials may inevitably be left over. Permeation of lime or cement into the ground with water will result in soil hardening, higher pH value, and groundwater pollution. The polluted land will lose productivity and the valuable land resources will be wasted.

458. During DED Phase, initial waste management plan has been developed. Based on which, prior to construction, DOTr will formulate and implement a comprehensive Solid and Hazardous Waste Management Plan which include the following: (1) Acquisition of adequate quantities of construction materials to avoid wastage; (2) Reuse of excess construction materials for road and other infrastructures of the host LGUs; (3) Provision of adequately sized waste bins for recyclable, biodegradable and hazardous waste; (4) Strict implementation of waste segregation by the construction personnel; (5) coordination with the LGUs for the regular monitoring of the generated waste for eventual disposal to the LGUs' designated disposal facility. Hazardous wastes will be stored properly and will be treated and disposed by a DENR accredited transporter and treater in accordance with RA 6969.

459. An Emergency Response Plan and a Health and Safety Management Plan will likewise be implemented in case of accidental spills. Also, regular training of workers on environment and workplace management will be provided.

(2) Operation Phase

1) Impact in terms of compatibility with existing land use

460. The Project will have no impact on the compatibility with the land use during the operation phase. Affected LGUs will adopt the Project in their CLUPs. Moreover, the Project is anticipated to provide a more efficient and safer transportation facility due to reduced travel time, traffic congestion, safety concerns, and energy consumption. As a result of this improvement, land development would be expected to increase along or near the corridor through the conversion of low-density residential areas to higher density residential and commercial uses.

2) Impact on compatibility with classification as an ECA

461. During the operation phase, typhoon impacts may be mitigated through regular coordination with PAGASA and adjustment of train schedules in relation to bulletins issued by the said weather agency. Drainage systems will be properly inspected and maintained to address flooding. An Emergency Response Plan for the operation phase will be prepared and implemented.

462. Although only low ground shaking impact is expected of the Project, maintaining close coordination with the Philippine Institute of Volcanology and Seismology (PHIVOLCS) during

[11] Based on the estimated peak manpower requirement per contract package

earthquake events to make necessary adjustments on its operation will be required, as the Project will be connected to a network of transit developments.

463. DOTr will also coordinate with cultural agencies, PNR, LGU, and relevant authorities for the continuous conservation of identified old PNR structures.

3) Impact in existing land tenure issue/s

464. The Project will have no impact on the existing land tenure issue during the operation phase.

4) Impairment of visual aesthetics

465. During DED Phase, the existing landscape of the project area was analysed by zoning through visual characteristics. Three zones were identified: a) Urban landscape comprising dense population, highrise buildings, wider roads and viaducts, b) Suburban landscape comprising low rise housing and narrow roads, lacks in landmarks and c) Rural landscape, which farmlands are dominant.

466. The impact to the existing landscape by the project was considered in the detailed design of viaducts and stations. The objective is to balance and integrate the detail of the design into the existing landscape. In an surban setting, the viaduct will be simple to avoid further visual clatter. In suburban and farmland setting, the viaduct is designed to provide statement.

467. As above, the structures (viaducts and stations) are well designed (size, shape and colour), which will be complimentary to the urban/ surburban/ farmland landscape and will not be unpleasing to the visual aesthetics of the natural urban and rural landscape. Thus, the Project will have no impact on the visual aesthetic during operation, yet it will be different from the occurring landscape along the alignment.

468. As additional measures, tree planting activities and maintenance within the ROW, Depot, and around the stations will be done to minimize the visual impact of the railway structures and harmonize with the surrounding environments by creating green corridors. This will also be beneficial to the local community and will reduce GHG emission.

5) Devaluation of land value as a result of improper solid waste management

469. The Project will generate domestic wastes such as papers, cartons, plastics, bottles, food leftovers, etc. the Project will generate an estimated amount of 4,232 kgs. of solid waste per day during operation. Some hazardous wastes that will also be generated include busted fluorescent lamps, spent batteries, used oils, etc. Improper disposal of generated solid and hazardous wastes particularly at the stations and depot could pose health and sanitation hazards to the operations personnel and railway passengers. Additionally, it may affect the soil quality at the area which will result to the devaluation of land value.

470. A Solid Waste Management Plan will be implemented in accordance with RA 9003 at the stations and depot of the Project. This includes waste minimization, segregation, and proper disposal. Properly sized bins will be provided for recyclable, biodegradable and hazardous waste. The Project management will coordinate with the host LGUs for the regular collection of the waste and their disposal to the DENR designated site. Bulk hazardous wastes will be stored in an impermeable area and with an appropriate secondary containment. Hazardous wastes will be stored properly and will be transported, treated, and disposed of by a DENR Accredited transporter and treater in accordance with RA 6969.

471. An Emergency Response Plan and a Health and Safety Management Plan will be implemented in case of accidental spills. Regular training of employees will also be provided with regards to keeping the workplace and surrounding environment in good condition.

3.1.2. Geology/Geomorphology

472. Primary geologic data were gathered and analyzed through inspection of the major stations and key segments of the Project route. The field surveys and analysis were guided through the use of Google images, topographic maps and Shuttle Radar Topography Mission (SRTM) digital elevation data of Southern Luzon**.**

473. Topographic, geologic, and seismologic data were accessed from the National Mapping and Resource Information Authority (NAMRIA), Mines and Geosciences Bureau (MGB), and Philippine Institute of Volcanology and Seismology (PHIVOLCS), respectively. **Table 3.1.7** presents the data accessed and gathered from these agencies.

474. Geotechnical tests such as borehole logging, standard penetration testing, borehole permeability, unconfined compression testing, and borehole scanning were conducted by Soil Philippines Index Testing, Inc. from September – October 2018 to gather information about the ground conditions. Multiple parameters such as moisture content, Atterberg limits, particle size, and specific gravity were evaluated to assess the soil-structure interaction and susceptibility to various geological hazards.

475. Borehole logs along the SCRP interconnecting line were produced, showing the free water level and lithologies that will be traversed by the Project.

Table 3.1.7 Secondary Data Gathered from NAMRIA, MGB and PHIVOLCS

Data Source	Nature of Data
National Mapping and Resource Information Authority	1:50,000 scale topographic maps
Mines and Geosciences Bureau	2010 edition of the Geologic and Tectonic Map of the Philippines
	1980 and 2010 editions of the Geology and Mineral Resources of the Philippines
	Landslide and Flood Susceptibility Map of Parts of Region 4
Philippine Institute of Volcanology and Seismology	Earthquake Data
	Map of Major Earthquake Generators
	Liquefaction Potential Map
	Map of Active and Potentially Active Volcanoes
	Map of the Intersection of the West Valley Fault with the project alignment
Philippine Institute of Volcanology and Seismology and US Geological Survey	Peak Ground Acceleration Maps

Source: Geosphere 2018

3.1.2.1. Surface Landform/Geomorphology/Topography/Terrain/Slope

(1) Geomorphology

1) Southwest Luzon

476. **Figure 3.1.15** shows the regional geomorphologic map of Southwest Luzon and the location of the Project with respect to the mapped terrain units. The Sierra Madre Range corresponds to a long mountain chain which extends from Cagayan in the north to the Bicol Region in the south. In the SW Luzon Area, it is characterized by steep and dissected slopes which serve as the eastern border of Laguna de Bay. The steep slopes favour erosion and

dissection by west flowing rivers and streams. The eroded sediments are subsequently deposited into the adjacent lake.

477. The Taal-Makiling-Banahaw Volcanic Chain corresponds to a west to east line of volcanoes. It serves as the western and southern boundary of Laguna de Bay. The terrain is characterized by a radial drainage system flowing southward to Laguna de Bay in the case of Mt. Makiling and Mt. Banahaw and to Manila Bay in the case of Cavite.

478. The Cavite Manila Coastal Zone corresponds to the southernmost extension of the Central Plain of Luzon. It receives eroded sediments from the rivers draining the long Cavite slope and from Pasig River. The segment from Solis Station to Bicutan Station traverses this terrain unit.

479. The Laguna Lakeshore corresponds to the gently sloping to flat area which serves as an immediate border of Laguna de Bay. The low elevation makes this area susceptible to flooding when the lake overflows.

480. Based on this classification, the segment from Solis Station to Bicutan Station traverses the Cavite-Manila Coastal Zone while the segment from Sucat Station to the depot in Banlic Calamba is located within the Laguna Lakeshore.

481. **Table 3.1.8** enumerates the features of the intersected terrain units and links the geology, hydrology, and hazards prevailing within the individual or combination of the route segments.

Table 3.1.8 Features of Terrain Units which can affect the Project Alignment

Terrain Class	SCRP Segments	Features
Cavite-Manila Coastal Zone	Solis Station to Bicutan Station	Flat to gently sloping; vulnerable to flooding due to storm surges near the coastal edge; swampy conditions present; main river channel correspond to the meandering Pasig River and the lower reaches of rivers draining the long slopes of Cavite.
Laguna Lakeshore	Sucat Station to Banlic (Calamba) Depot	Flat to gently sloping; abuts against Laguna de Bay; vulnerable to flooding

2) Metropolitan Manila

482. The geomorphology of Metropolitan Manila can be classified into three major forms: Coastal Lowland, Central Plateau, and Marikina Valley (Miura, Midorikawa, Fujimoto, Pacheko, & Yamanaka, 2008). The elevation rises from the Manila Bay coastline to the edge of the Central Plateau, then a sudden drop in elevation is observed along the margin of Marikina Valley.

483. The Coastal Lowland is generally a flat and low plain facing Manila Bay, with elevations from 0 to 5 m. Soft sand and clay deposits up to 40 m thick underlie the plain. Landforms identified include sand bars, back marshes, Pasig River deltas, and reclaimed land.

484. The Central Plateau is a north-south trending plateau with elevations ranging from 20 to 40 m. The northwestern portion reaches elevations over 100 m. The Pasig River transects the central part of the plateau. The plateau is comprised of stiff soils and volcanic deposits.

485. The Marikina Valley is located in between the Central Plateau and part of the Sierra Mountain Range in Rizal and Bulacan. Elevations range from 2 m near Laguna Lake at the southern end up to 30 m on the northern end, near Montalban, Rizal. Landforms associated with the valley are deltas, levees, and floodplains.

486. Based on the classification by Miura et al. (2008), the segment of the Project alignment from Solis Station to Buendia Station is located within the Coastal Lowland. Meanwhile, the

segments from EDSA Station to Bicutan Station and the SCRP interconnecting line are within the Central Plateau. Additionally, the segment from Sucat Station to Muntinlupa Station is within the Marikina Valley.

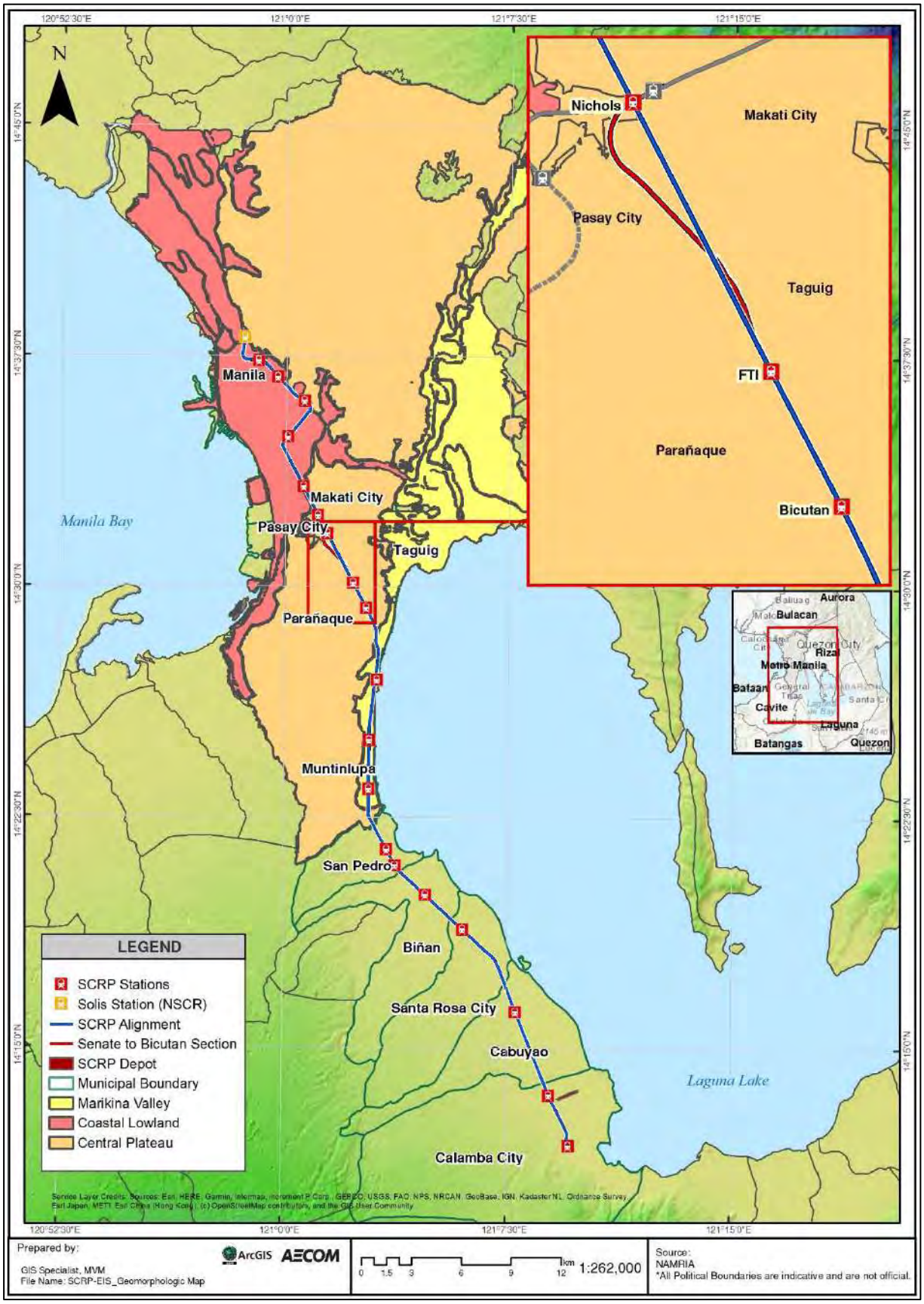


Figure 3.1.15 Geomorphologic Classification of Southwest Luzon and Metropolitan Manila

(2) Elevation and Slope

487. Metropolitan Manila has elevations ranging from 0 masl along Manila Bay and Laguna Lake coastlines, to 160 masl in the La Mesa Watershed. The elevation gradually rises eastward from the Manila Bay coastline to the edge of the Central Plateau, after which a sudden drop is observed along the margin of Marikina Valley.

488. Elevations along the Project alignment range from 4 to 31 masl as shown in **Figure 3.1.16**. The station with the lowest elevation is the Blumentritt Station, at 4 masl.

489. Most of Metropolitan Manila is relatively flat to gently sloping, having slope gradients that range from 0 to 8%. Meanwhile, Southwest Luzon is level to nearly level along the Laguna Lake coastline, with slope gradients from 0 to 3%.

490. **Figure 3.1.17** shows that the area traversed by the Project alignment is relatively flat to gently sloping, with slope gradients from 0 to 8%.

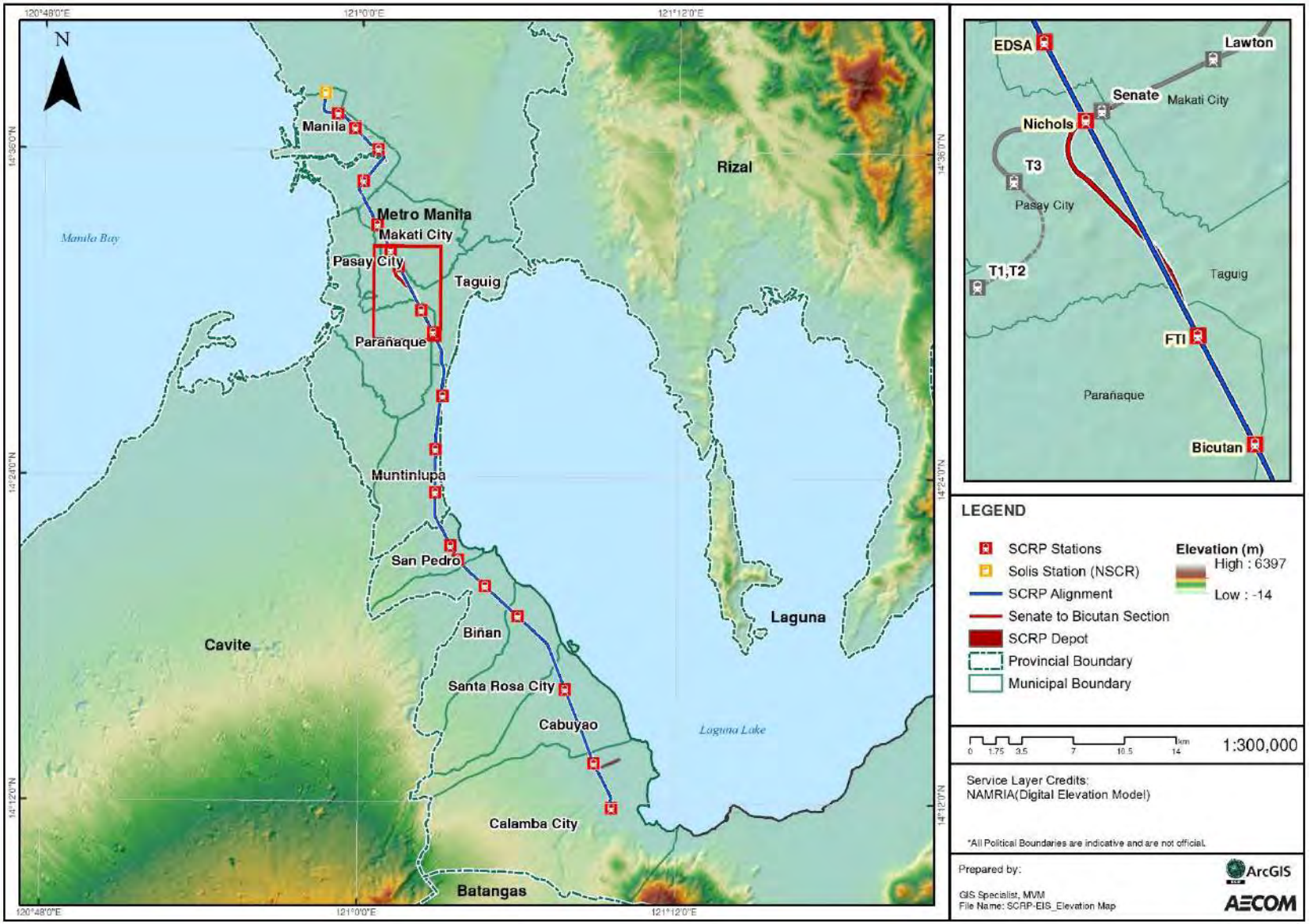


Figure 3.1.16 Elevation of the Project Alignment

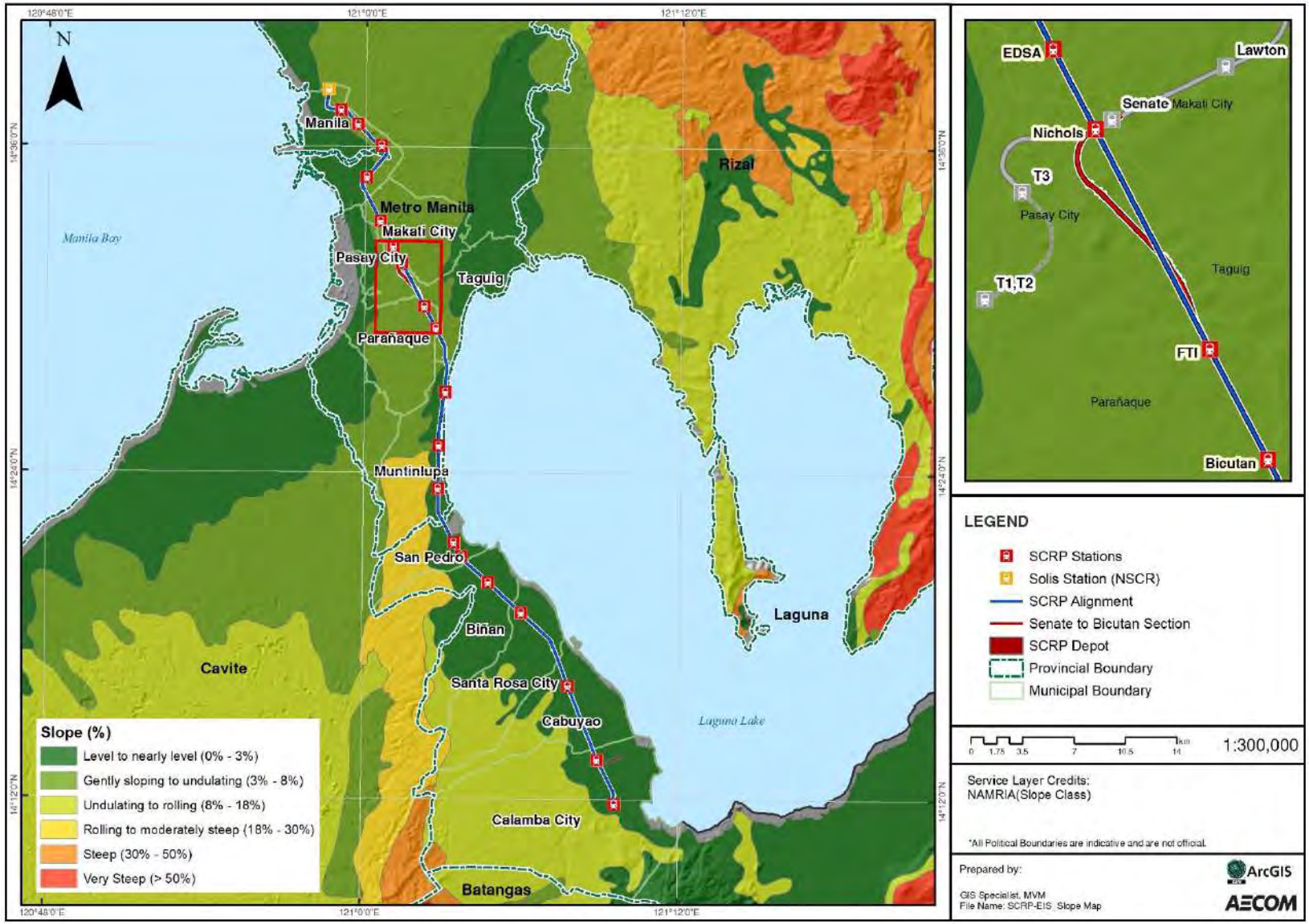


Figure 3.1.17 Slope Map of the Project Alignment

3.1.2.2. Sub-surface Geology/Underground Conditions

(1) Regional Tectonic Setting

491. The Philippines is located in a tectonically active region near the boundary between the Philippine Sea Plate and the south-eastern edge of the Eurasian Plate. The active zone of deformation between these two (2) plates is referred to as the Philippine Mobile Belt (Gervasio, 1966) and is characterized by a complex system of subduction zones, collision zones, and marginal sea basin openings (Geology of the Philippines, 2002). The island of Luzon where the Project is located occupies the northern section of the Philippine Mobile Belt.

492. The major earthquake generators relevant to the Project include the Philippine Trench, the Philippine Fault, West Valley Fault, Lubang-Verde Passage Fault, and the Manila Trench.

1) Philippine Trench

493. The Philippine Trench corresponds to the morphological expression of the subduction of the Philippine Sea Plate beneath the eastern Philippine Arc (Geology of the Philippines, 2002; Cardwell and others, 1980; Fitch, 1970; Hamburger and others, 1983).

2) **Manila Trench**

494. The Manila Trench is a broadly arcuate geological structure located west of the island of Luzon and spans the length from 13° north to 22° north latitude. This trench is located approximately 202 km west of the San Pedro Station.

3) **Philippine Fault**

495. The Philippine Fault is a left-lateral fault which transects the Philippine Mobile Belt from Luzon through Visayas to Mindanao over a length of more than 1,200 km. PHIVOLCS attributed the occurrence of earthquakes in Ragay (1973, M 7.0), Northern Luzon (1990, M 7.7) and Masbate (2003, M6.2) to movement along segments of the Philippine Fault[12]. The projected trace of the fault in Luzon in Quezon is approximately 60 km east of the Sta. Rosa Station.

4) **West Valley Fault**

496. The West Valley Fault is a right-lateral geological structure which traverses a distance of about 135 km from Bulacan in the north to as far south as Tagaytay area. Its trace intersects the Project between the Muntinlupa and Alabang Stations.

5) **Lubang-Verde Passage Fault**

497. The Lubang-Verde Passage Fault System is located offshore between Batangas peninsula and Mindoro Island. It is a strike-slip (left-lateral) fault with has a northwest-southeast alignment. The tectonic and structural features which can potentially affect the Project are presented in Figure 3.1.18**.**

[12] http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=379&Itemid=500023

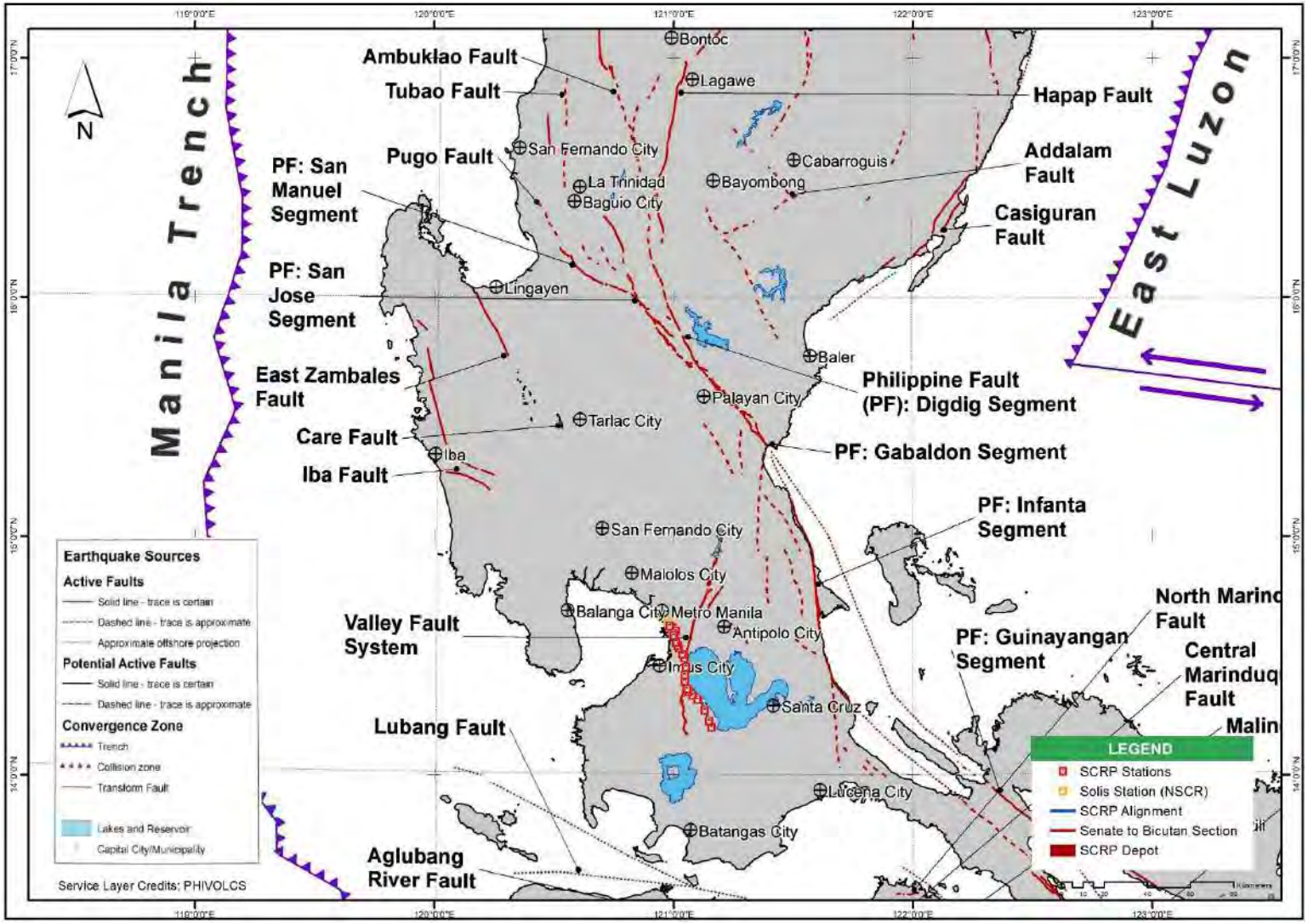


Figure 3.1.18 Tectonic Map of Southwest Luzon

(2) Regional Geology

498. The geologic formations within a 10-km corridor which could potentially affect the proposed railway were identified and delineated using available geologic and topographic maps (**Figure 3.1.19**). Within this corridor, two (2) geologic formations were identified namely Quaternary Alluvium (QA) and Guadalupe Formation (QV).

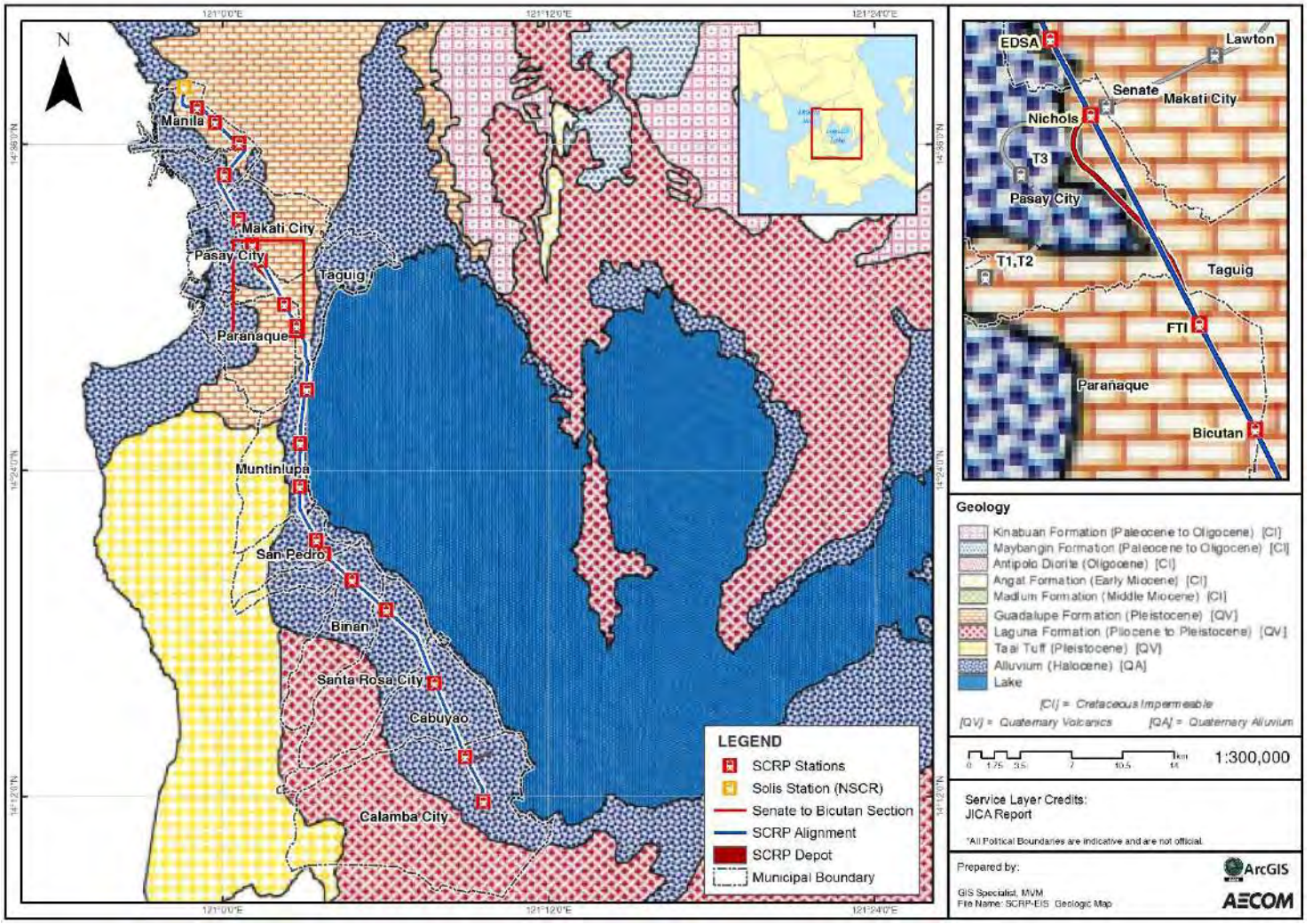


Figure 3.1.19 Regional Geology of Southwest Luzon showing the Project Line

499. Quaternary alluvium refers to the heterogeneous mixture of sands, clays, silts, and gravels of varying degrees of consolidation. This kind of deposit is greatly affected by the provenance of the sediments. Occurrence of these deposits is usually found on the end slopes of the terrain. The deposits within the Cavite – Manila Coastal Zone represent the mixture of sediments from alluvial and marine environments. The deposits within the Laguna Lakeshore area show characteristics of sediments from alluvial and lacustrine environments. In the project area, these deposits area found in Solis Station to Buendia Station, and Muntinlupa Station to Banlic Depot.

500. Where the project line passes through built up areas, these Quaternary deposits are locally covered by pavements, embankments, or partially consolidated fill.

501. Guadalupe Formation (Marl, Reworked Tuff, Pyroclastic), dated Pliocene to Pleistocene, refers to the tuff sequence that is found cropping along Pasig River in Guadalupe, Makati, Metro Manila. It has two members – the Alat Conglomerate and the Diliman Tuff.

502. The Alat Conglomerate is predominantly sedimentary. It is an extensive belt of conglomerate, sandstone, and mudstone. The conglomerate is massive, poorly sorted with well-rounded pebbles and small boulders of older rocks cemented by calcareous and sandy matrix. The sandstone is massive to poorly bedded, tuffaceous, and friable. Meanwhile, mudstone is silty and tuffaceous.

503. The Diliman Tuff is made up of consolidated pyroclastic ejecta. The sequence consists of fine-grained vitric tuffs and welded pyroclastic breccias with minor tuffaceous sandstone (Peña, 2008). These materials and their weathered derivatives underlie the gently sloping SCRP interconnecting line.

Table 3.1.9 Stratigraphic Succession of the Rock Formations Traversed by the Project Line

Epoch	Geologic formation	Formation name	General lithology	Distribution
Holocene	Recent deposits (Qh)	Quaternary Alluvium	Unconsolidated, heterogeneous aggregate of gravels, boulders, sands, silts and clays	Solis Station to Buendia Station; Muntinlupa Station to Calamba Station
Pliocene - Pleistocene	Tuf and pyroclastic ($N_3 + Q_1$)	Guadalupe Formation	Tuff and tuffaceous sedimentary rocks	Pasay Road Station to Bicutan Station; SCRP interconnecting line

Source: Geosphere 2018

(3) Local Geology

504. Geotechnical investigation along the SCRP interconnecting line of of the Project was done by Soil Philippines Index Testing, Inc. Tests from September – October 2018. Tests conducted include borehole logging, standard penetration testing, borehole permeability, unconfined compression testing, and borehole scanning. Soil profiles were created for a better grasp of the subsurface properties and conditions. **Figure 3.1.20** shows the location of boreholes along the SCRP interconnecting line of the Project.

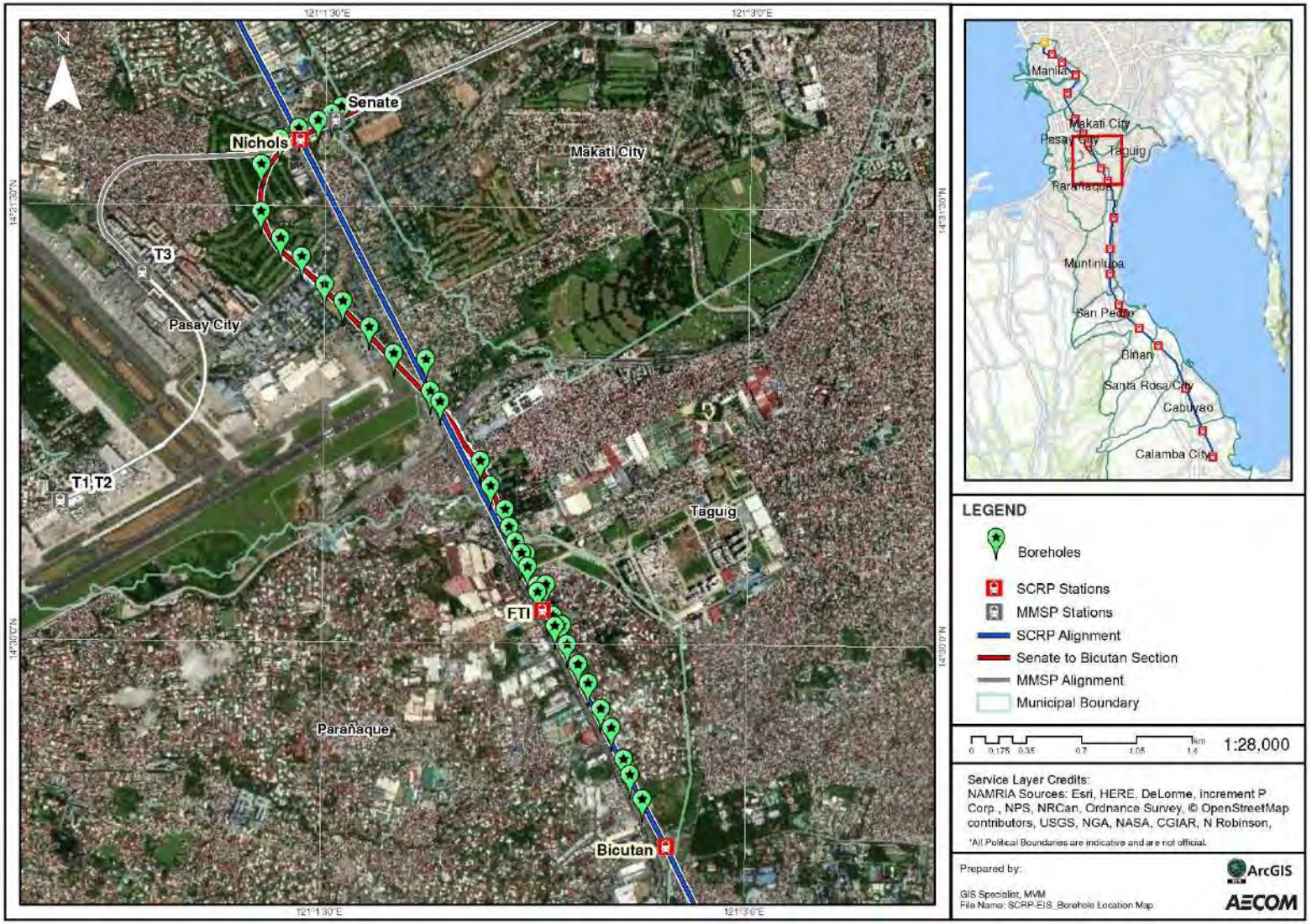


Figure 3.1.20 Borehole Locations along the SCRP interconnecting line

505. Based on the geotechnical investigation results, most of the areas traversed by the the SCRP interconnecting line at approximately 26 m depth are comprised of brown, grayish brown, light gray, or gray sandstone with RQD values from 0 to 71% and sands with SPT N-values ranging from 56 to 62.

506. Heterogeneous mixtures of sands, silts, and clay were observed up to 10 m depth.

507. Siltstone lenses of varying thickness and orientation have been noted in several logs along the whole length of the SCRP interconnecting line**. Figure 3.1.21** shows a soil profile showing the distribution of soil and rocks intersected by the boreholes. A more detailed study is recommended in order to identify the continuity of siltstone lenses in between the existing boreholes.

508. Borehole scanning of 14 holes was initially performed to get a better image of underlying structures. Downhole data was acquired using Acoustic Televiewer (ATV) and Optical Televiewer (OTV). Orientations of fractures and bedding planes were identified based on the data acquired. Interpretations are limited to a specific hole, as correlation cannot be done due to limited data. However, based on the initial data, it is likely that the bedrock is layered. Joints at approximately 26 m depth have also been observed (**Figure 3.1.22**).Scanning of other boreholes in the area will confirm the presence of bedding planes and fractures present and their continuity.

509. The lithology intersected by the Senate and FTI stations is the Diliman Tuff member of Guadalupe Formation.The residual soil mantle thickness ranges from 1 to 10 m.

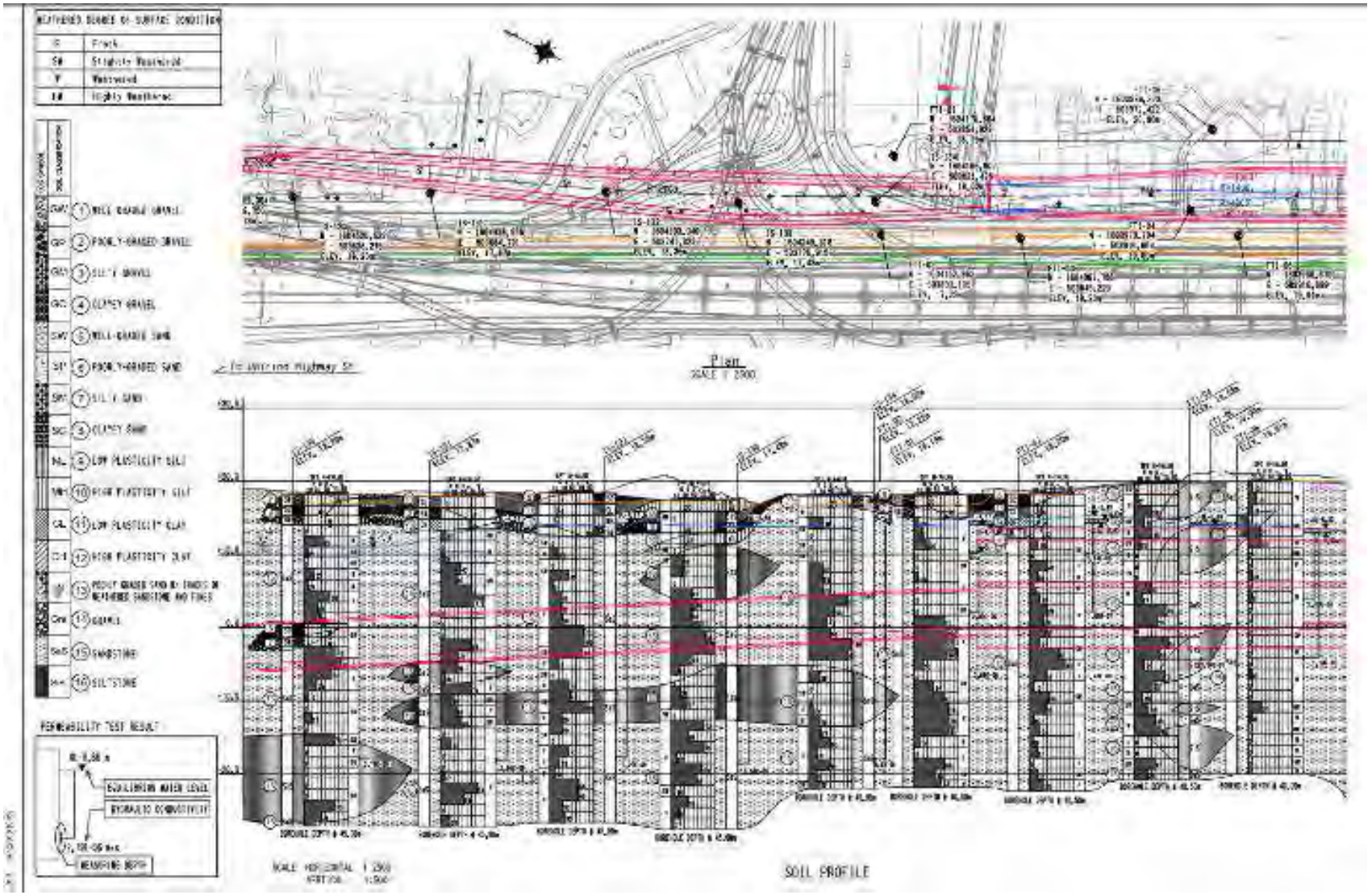


Figure 3.1.21 Soil Profile from IS-130 to FTI-06

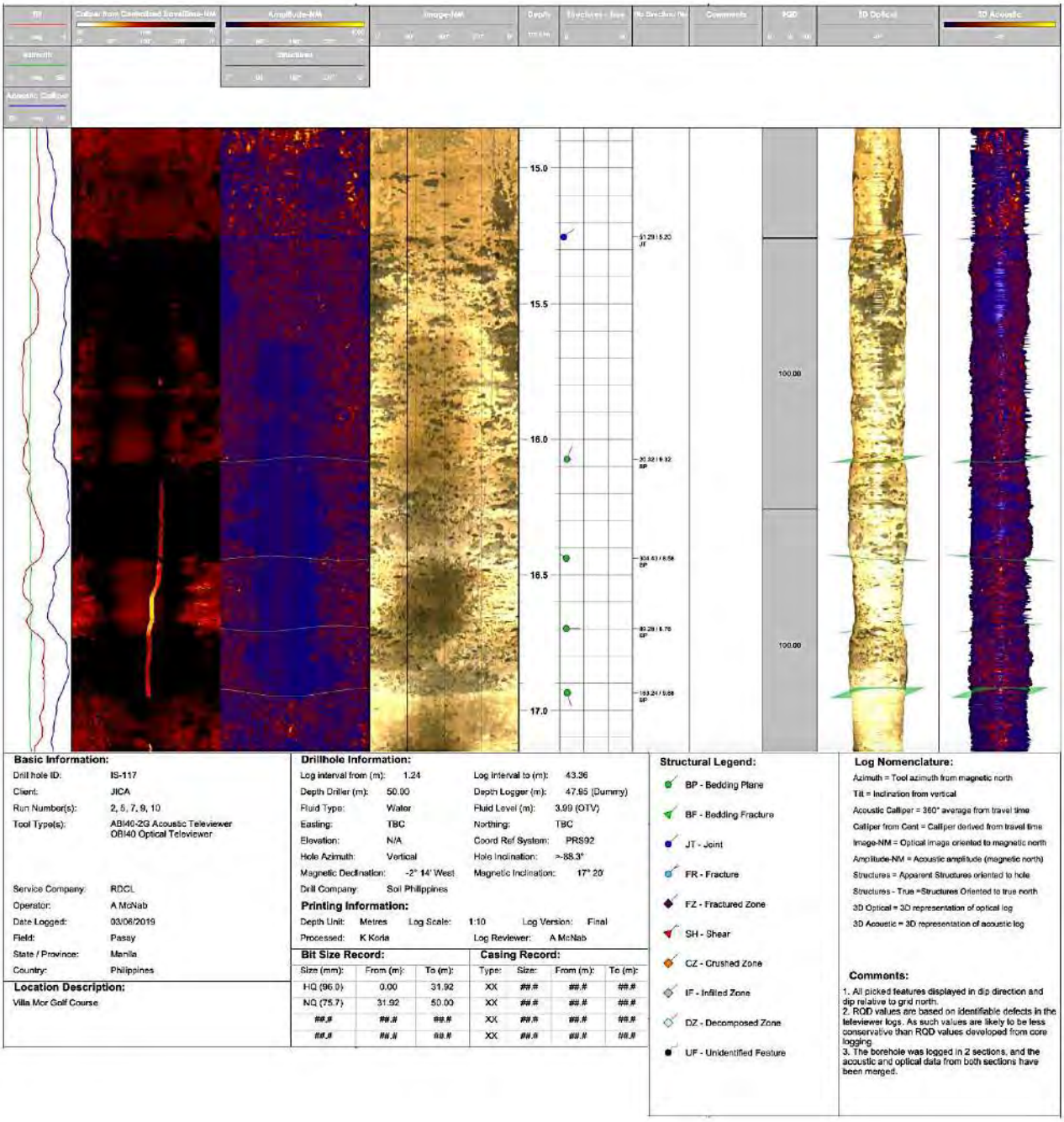


Figure 3.1.22 Borehole Scan of IS-112 (between Senate St and FTI St)

3.1.2.3. Geologic and Other Natural Hazards

510. The hazards which can potentially affect the Project include floods, landslides, and volcanic- and earthquake-related hazards. The seismic-related hazards include ground rupture, ground shaking, and liquefaction.

(1) Seismicity

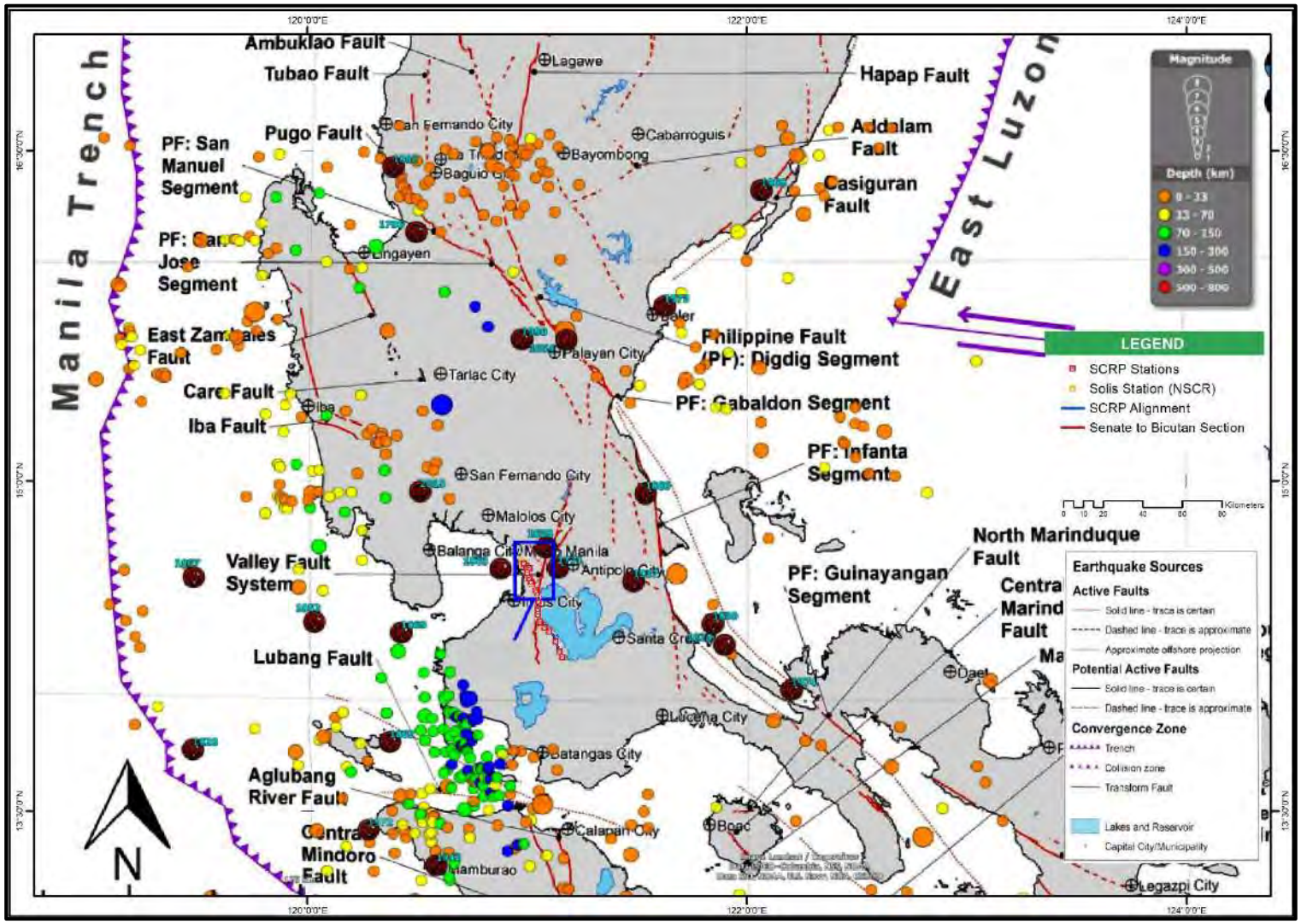
511. **Figure 3.1.23** shows the plot of historically destructive earthquakes with magnitudes greater than 5 around Southwest Luzon. The clusters of earthquakes are found to the northeast offshore of Baler, Quezon and southwest offshore between Mindoro and Batangas.

512. Earthquake epicenters cluster between Mindoro and Batangas, offshore west of Zambales, north of Bataan, and along the Philippine Fault Zone. Earthquakes in offshore Zambales and Mindoro-Batangas clusters may be attributed to the subduction along Manila Trench. Shallower events may have been triggered by movement along the Lubang-Verde Passage Fault, the Central Mindoro Fault, or the Aglubang River Fault. Earthquakes to the north of Bataan may correspond to volcanic earthquakes that preceded and succeeded the 1991 Mt. Pinatubo eruption. The linear trend of earthquakes along the PFZ is proof of its activity.

513. The Valley Fault system transects the eastern long axis of Metropolitan Manila. Records indicate the last movements of the VFS took place in August 19, 1658 for the West Valley Fault and February 1, 1771 for the East Valley Fault, which generated earthquakes of Ms 5.7 and 5.0, respectively.

514. **Table 3.1.10** lists the major seismic events (M ≥ 6.5) within 100 km from the centre of the project line from 1907 to 2013. The strongest recorded quake within 74 km southwest of the Banlic Depot corresponds to a Magnitude 7.1 event, which was recorded on November 14, 1994.

515. The SCRP interconnecting line has been aligned to prevent intersecting segments of the Valley Fault System.



USGS, 2019; JICA-MMDA-PHIVOLCS, 2004; Bautista & Oike, 2000

Figure 3.1.23 Historical and Instrumental Earthquakes >Ms 5.0 around Southwest Luzon

Table 3.1.10 Major Seismic Events within 100 km from the project alignment

Year	Month	Day	Hour	Min	Sec	North	East	Depth	Ml	Mb	Ms	Distance from nearest Project Segment	Direction from the Project
1994	11	14	19	15	27.8	13.50	121.09	7		6.1	7.1	74	Southwest
1940	3	28	15	48	50.0	14.20	120.60	160			6.8	58	West
1939	5	6	17	0	7.0	13.50	121.30	110			6.5	77	South
1937	8	20	11	59	16.0	14.50	121.50	15			7.5	46	East

Source: PHIVOLCS

(2) Ground Subsidence and Settlement

516. Settlement due to loading of the proposed engineering structures such as stations and equipment depot can potentially take place on sections of the project line which will traverse the area underlain by Recent Deposits. Potential settlement will depend on the design load and geotechnical properties of the foundation materials. Such properties can only be determined during the design stage when drilling, in-situ tests, and laboratory tests will be conducted.

517. Subsidence usually takes place in areas underlain by limestone and compressible materials like peat or clays. It can also take place when groundwater is excessively extracted from an area. Visually, the existing stations of the Project have not exhibited indications of subsidence. A more detailed geotechnical assessment of the project stations is needed to determine the stability of the structures.

518. For most areas covered by the Project, reports of subsidence due to excessive groundwater extraction are currently not available. Most of the production wells of the water providers and establishments which use groundwater are located farther west of the existing railway stations. Extraction of groundwater via shallow tube wells of the settlements along the line is deemed low to bring about settlement of the ground near or beneath the stations and railway.

519. The SCRP interconnecting line is not susceptible to ground subsidence.

(3) Liquefaction

520. Earthquake vibrations can cause liquefaction. Unconsolidated materials saturated with water which used to be stable soil turns into a mobile fluid that is not capable of supporting structures. Underground objects may float toward the surface and structures may collapse as a result (Tarbuck, Lutgens & Tasa, 2015).

521. The areas underlain by the Recent Deposits where groundwater is deemed shallow are potentially vulnerable to liquefaction in the occurrence of event of a major earthquake. The segments from Solis Station to Buendia Station and from Muntinlupa Station to Banlic Depot fall under such a classification (Figure 3.1.24).

522. This preliminary assessment needs to be validated by geotechnical investigation particularly at the locations of the train stations. The investigation should include drilling with Standard Penetration Tests (SPT), water level measurements, grain size analysis of recovered soil samples, and calculation of liquefaction potential.

523. The SCRP interconnecting line is found on soil that is generally not susceptible to liquefaction.

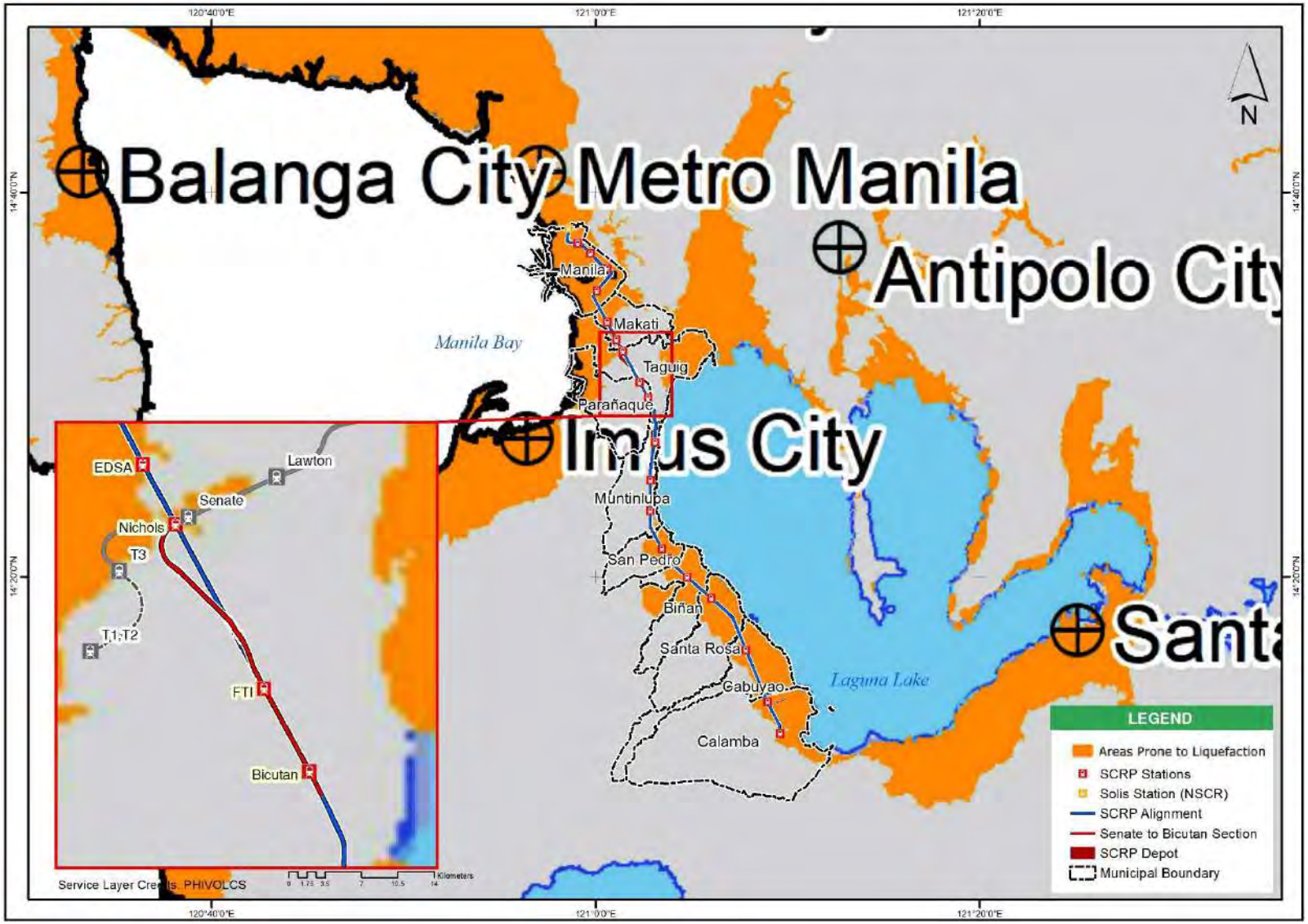


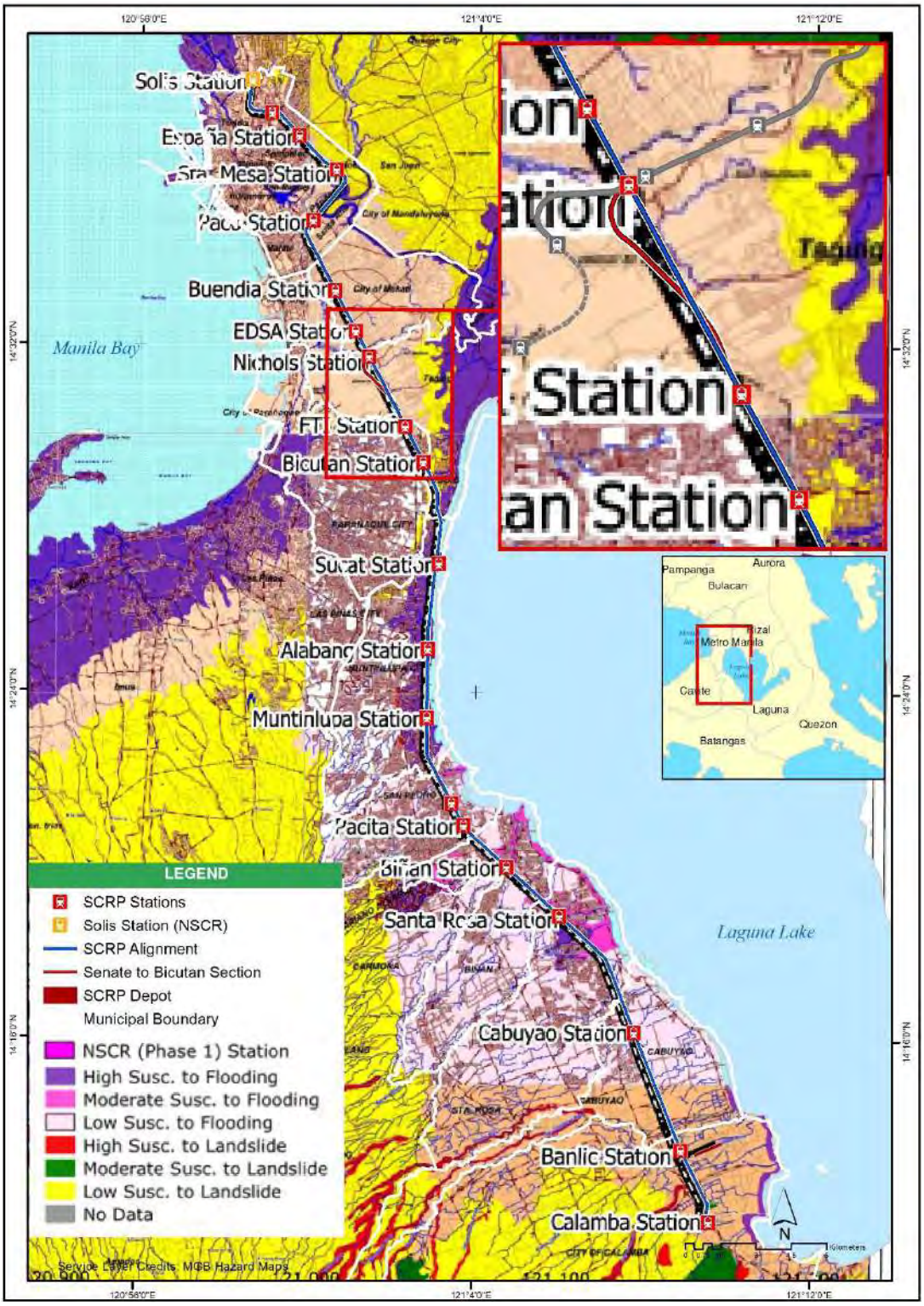
Figure 3.1.24 The Project Line Plotted on the Liquefaction Potential

(4) Landslides

524. Movement of rock, debris, or other materials occur down a slope when gravity exceeds the strength of Earth's materials. Landslides may cause destruction of structures, loss of property value, and disruption of transportation routes.

525. Due to its flat to gentle slope, the majority of the areas traversed by the Project Line has low susceptibility to landslides. **Figure 3.1.25** shows the flood and landslide hazard map of the project alignment.

526. Earthquake-induced landslide susceptible areas include Barangay West Rembo in Makati and McKinley Parkway in Taguig.



Source: Mines and Geosciences Bureau, 2010

Figure 3.1.25 Flood and Landslide Susceptibility of Southwest Luzon

(5) Ground Shaking

527. Slippage along faults and subduction along plate boundaries cause vibrations produced by the rapid release of energy. Earthquakes that can be generated by the major geological and tectonic structures in the region could bring about ground shaking which could affect the stability of railway line and its stations. A study conducted by Thenhaus, Hanson and Algermissen of the United States Geological Survey and the Philippine Institute of Volcanology and Seismology (1995) estimated peak ground horizontal accelerations that have a 10% probability of being exceeded in 50 years for rock conditions, medium soil, and soft soil conditions in the Philippines.

528. In the case of the project line, the segments from Pasay Road Station to Muntinlupa Station and the SCRP interconnecting line are underlain by weathered pyroclastic deposits which are deemed to fall under medium soil category (**Figure 3.1.26**). The segments from Solis Station to Buendia Station and from Muntinlupa Station to Banlic Depot are underlain by unconsolidated sediments which are deemed to fall under the soft soil category (**Figure 3.1.27**).

529. Accordingly, the peak ground accelerations correspond to 0.4 *g* and 0.7 *g*, respectively. These regional values though need to be validated through more detailed seismological studies as part of due diligence of the currently established stations.

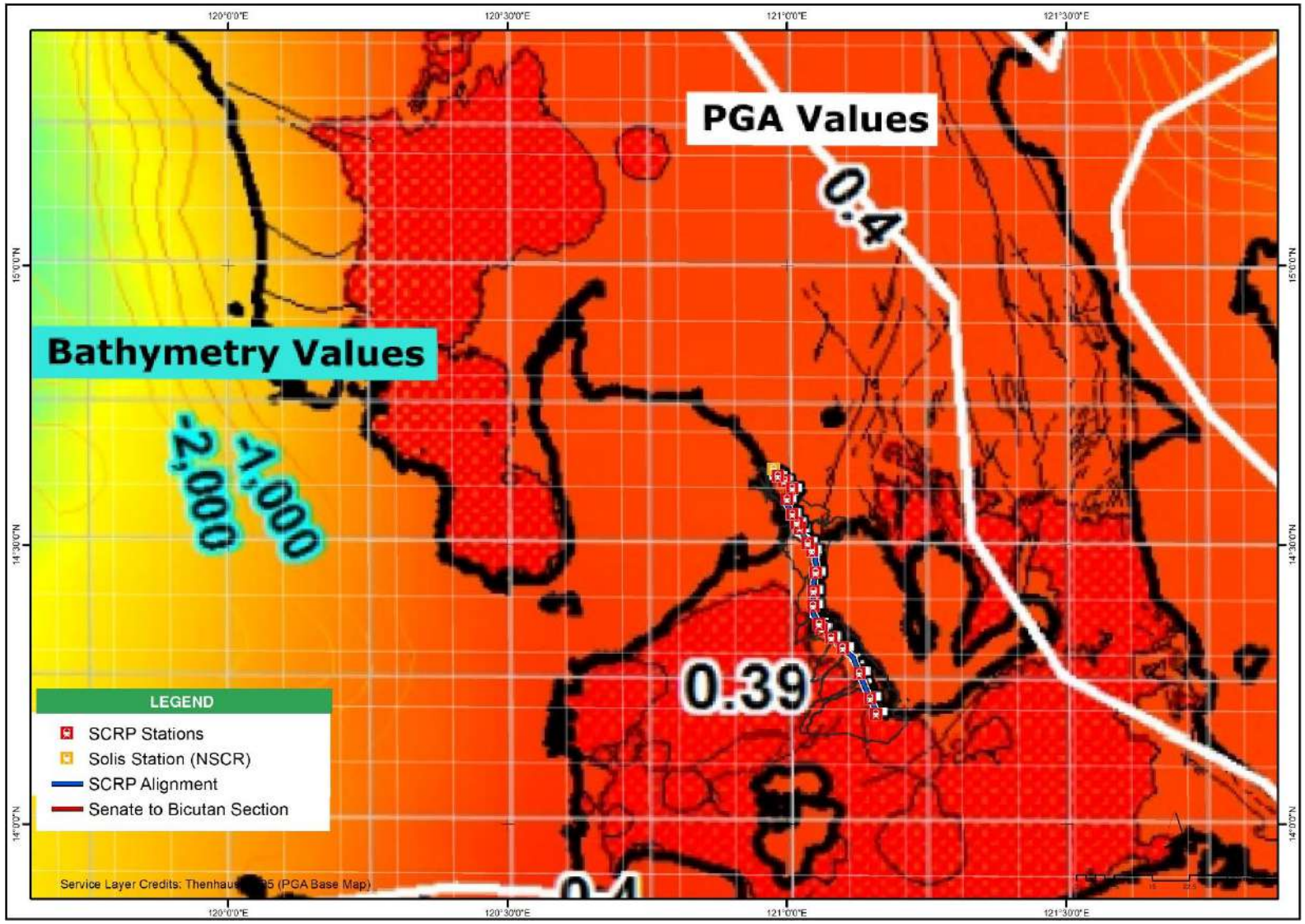


Figure 3.1.26 PGA for Medium Soils of the Project Line

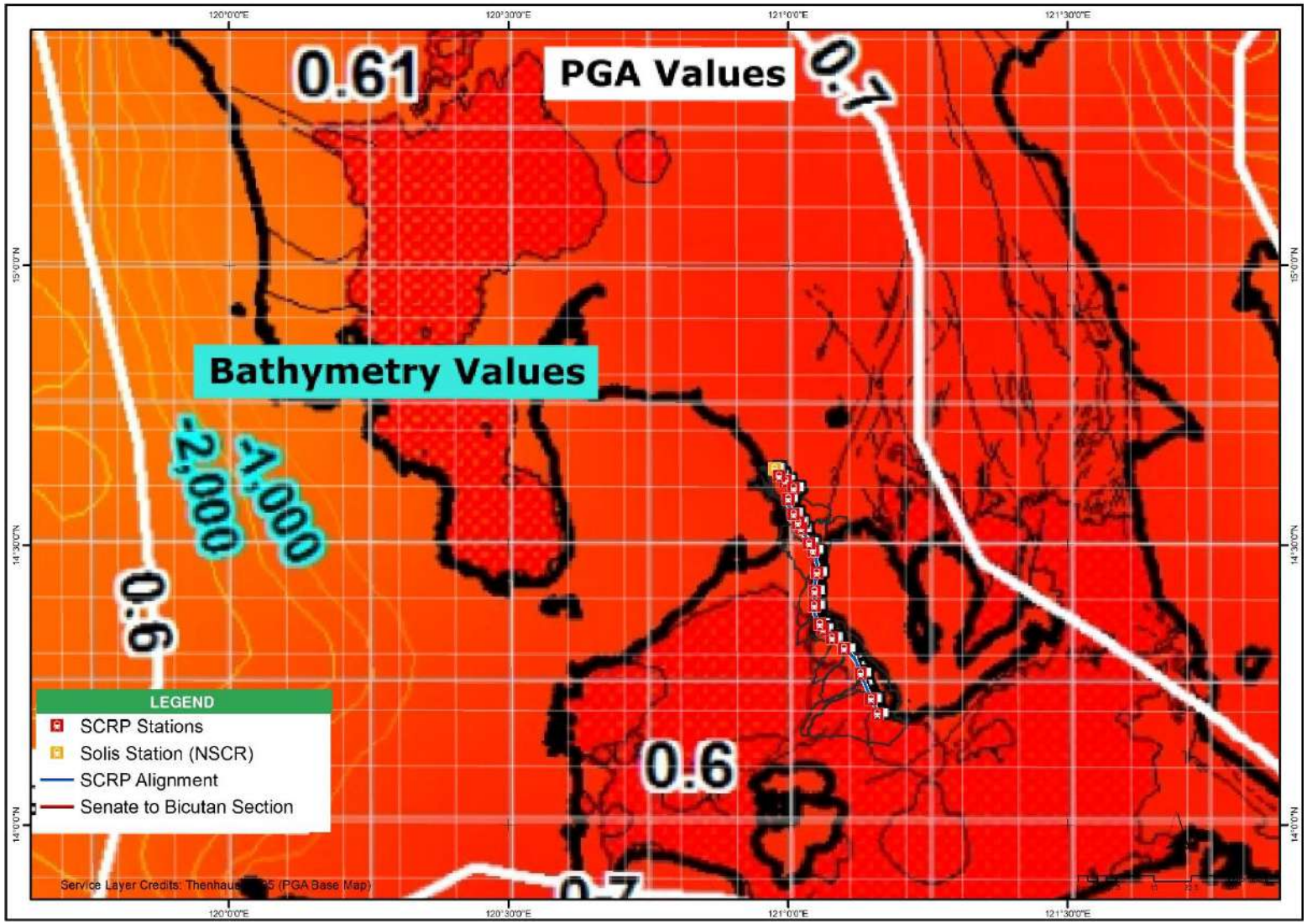


Figure 3.1.27 PGA Map for Soft Soils of the Project Line

(6) Ground Rupture

530. Ground rupture occurs when a new rupture is created or when renewed movement of old fractures takes place (Punongbayan, 1994). PHIVOLCS recommends a buffer zone of at least 5 m on both sides of a fault trace or from the edge of a deformation zone. The segment of the Project between the Bicutan and San Pedro Stations is vulnerable to ground rupture where it is intersected by the active West Valley Fault. The trace of the fault is shown in **Figure 3.1.28**.

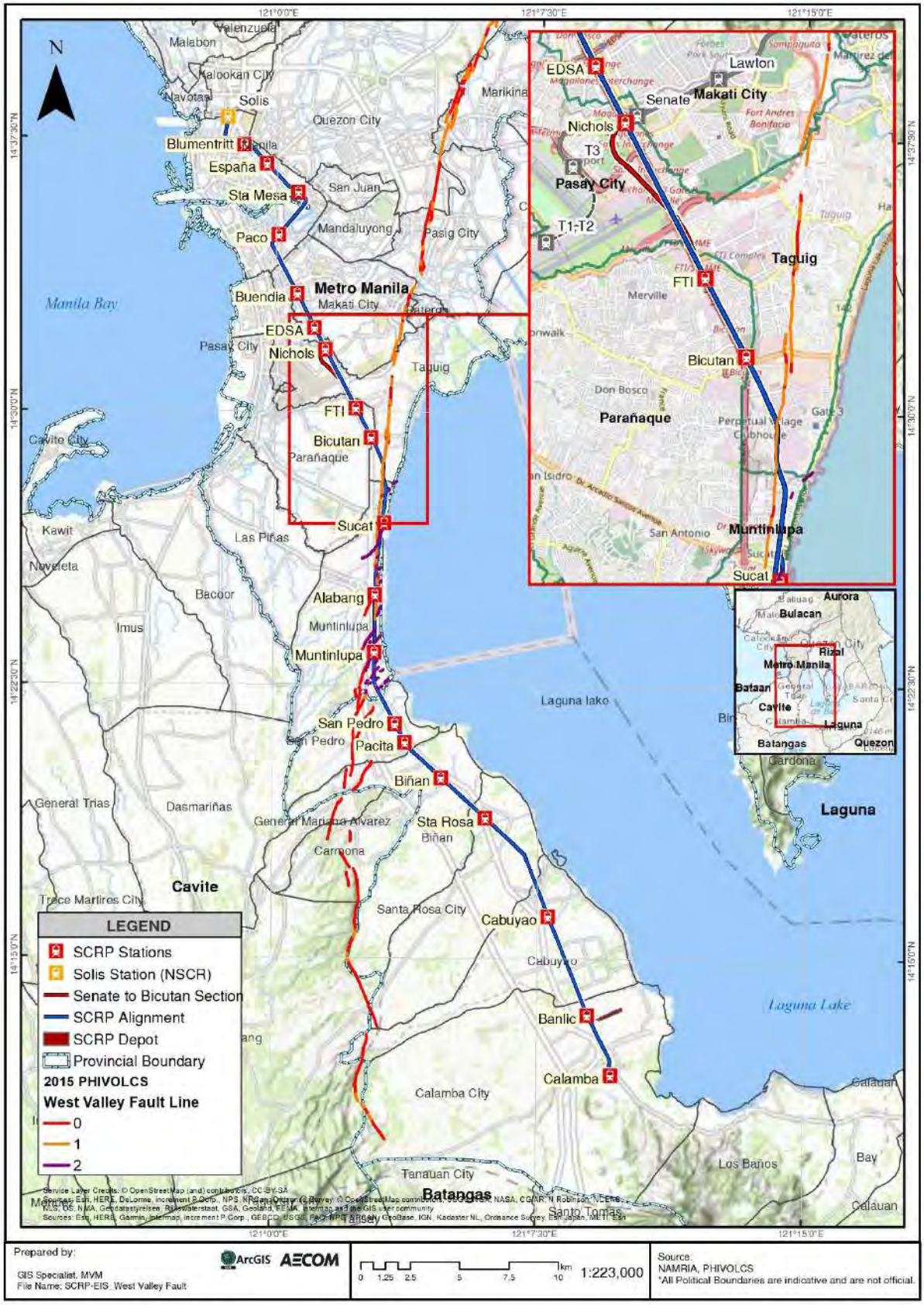


Figure 3.1.28 Intersection of the Project Alignment and the West Valley Fault System

(7) Volcanic Hazards

531. As shown in **Figure 3.1.29**, the nearest active volcano from the Project is Taal Volcano. The crater of this volcano is approximately 28 km southwest of the Calamba Station. Due to its low elevation compared to the Project route, the only hazards which can potentially affect the Project are ground shaking and ash fall. Mt. San Cristobal, located beside Mt. Banahaw has been deemed potentially active by PHIVOLCS. Eruption of this volcano will also bring about ground shaking and ash fall to the Project.

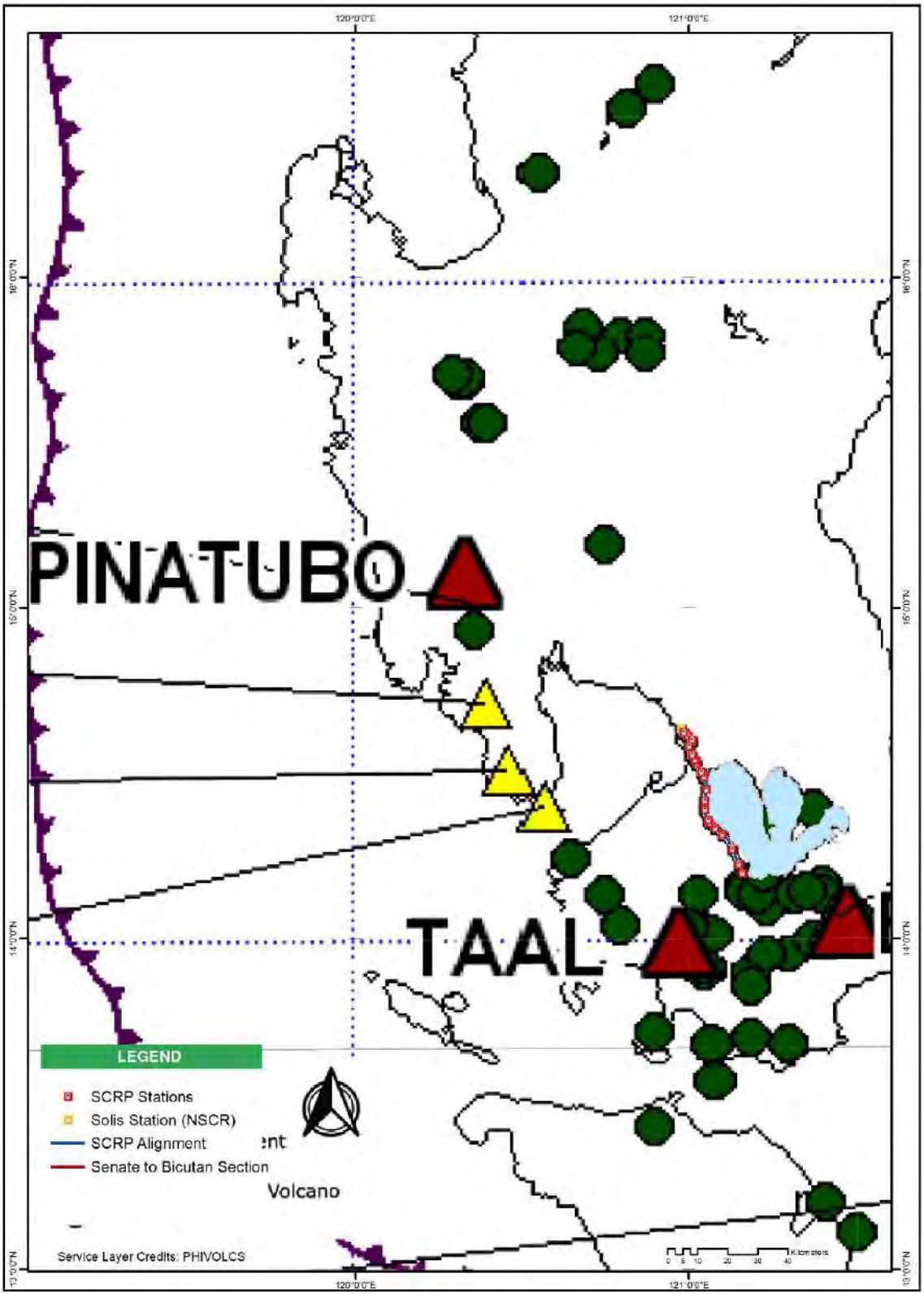


Figure 3.1.29 Distribution of Volcanoes in the Philippines

3.1.2.4. Impact Identification, Prediction and Assessment and Mitigation

(1) Pre-construction and Construction Phase

1) Change in Surface Landform/Geomorphology/Topography/Terrain/Slope

532. Pre-construction activities for the Project would not entail significant terrain alteration. These will only involve surveys, foundation/geotechnical exploration, and detailed engineering design, most of which will involve minimal land alteration, clearing, and removal of vegetation cover at the selected sections of the railway route and therefore will not result in any significant terrain alteration.

533. The Laguna Lakeshore corresponds to the gently sloping to flat area which serves as the immediate border of Laguna de Bay. The low elevation makes this area susceptible to flooding when the lake overflows. The segments from Sucat Station to Calamba Station and up to the location of the depot in Banlic, Calamba are located within this flood-prone terrain unit. The Cavite Manila Coastal Zone corresponds to the southernmost extension of the Central Plain of Luzon. It receives eroded sediments from the rivers draining the long Cavite slope and from Pasig River. The segment from Solis Station to Bicutan Station traverses this terrain unit.

534. Construction of embankment for the Project will change the present topographic condition. But this change will be minimal for the total length of the embankment is only 0.9 km as compared to the total length of 55.6 km.

2) Change in Sub-surface Geology/Underground Conditions

535. During the detailed design, geotechnical investigation has been conducted to provide a sufficient level of information on the underlying soils and rock to facilitate engineering design. The work involves field investigation, rotary drilling and laboratory testing in accordance with the American Society for Testing and Materials (ASTM) standards. The results show the varied soil conditions of the subsurface profile.

536. The Project construction will entail the excavation of overburden or weathered rocks to facilitate the placement of required engineering structures.

537. The project line will run nearby and/or cross the West Valley Fault (WVF) for approximinately 12 km between Bicutan station and San Pedro Station. During DD, a comprehensive study on West Valley Fault has been conducted through literature review, interviews, and site surveys. From the site survey, the displacement during the last 18 years is 7.0 cm. The same type of displacement is predicted to occur in the future. This displacement can cause damage to civil engineering structures such as track structures, collapse, and damage to the bridge.

538. Tunneling works for the SCRP interconnecting line will alter existing underground stress distributions. In addition, excavation and tunneling may accidentally hit buried facilities such as pipelines that could spill contaminants to the groundwater and soil.

539. Installation of buried facilities and introduction of new material types to the ground can react with the soil.

540. Solid wastes generated can be the cause of pollution that would impact the quality of surrounding soil or ground.

3) Inducement of Subsidence, Liquefaction, Landslides, Mud/Debris Flow, etc.

541. The hazards which can potentially affect the Project include flooding, landslides, ground subsidence, flooding, and earthquake related hazards. The seismic related hazards include ground rupture, ground shaking, and liquefaction. During the DED Phase, Geotechnical investigation, liquefaction assessment, 13 as well as comprehensive study on West Valley Fault has been conducted. In addition, PHIVOLCS assessed the project to the following earthquake and volcanic hazards: safe for ground rupture except for the portion of the alignment approximately 12 km between Bicutan Station and San Pedro Station which will run nearby and/or across the West Valley Fault; partially least to partly moderately susceptible to liquefaction; safe for earthquake-induced landslide; safe for tsunami; approximately 28.9 km northeast of Taal Volcano; and safe for pyroclastic flow/ base surge.

Liquefaction

542. The areas underlain by the Recent Deposits where groundwater is deemed shallow are potentially vulnerable to liquefaction in the event of a major earthquake occurrence. The segments from Solis Station to Nichols Station and from Muntinlupa Station to Banlic Depot fall under the area which are vulnerable to liquefaction in the event of a major earthquake occurrence.

Landslide

543. Due to its flat to gentle slope, the entire project line has low susceptibility to landslides. The project is also safe to earthquake-induced landslide based on the Earthquake Hazard Assessment of PHIVOLCS.

Ground Rupture

544. The segment the project between the Bicutan and San Pedro Stations is vulnerable to ground rupture where it is intersected by trace of the active West Valley Fault. Based on the comprehensive study for structure consideration against West Valley Fault, the soil condition along the project alignment near the fault is good and the base rock seems to appear up to 7.5 m in depth.

Ground Shaking

545. The nearest active volcano from the Project is Taal Volcano. The crater of this volcano is approximately 28 km southwest of the Calamba Station. Due to its low elevation compared to the Project route, the only hazards which can potentially affect the Project are ground shaking and ash fall.

Ground Subsidence

546. Tunneling works for SCRP interconnecting line will leave an underground void which will affect pore water pressure of overlying materials, leading to possible ground subsidence.

547. Leakage from pipes may saturate the ground, causing it to soften and subside.

Flooding

548. Excavation and tunneling sites may collect rainfall and groundwater, creating pools of water. Burst pipes can leak significant amounts of water to the surface.

2) Mitigation Measures

549. Based on the geotechnical investigation, liquefaction potential analysis and a comprehensive study on West Valley Fault were conducted during the DED Phase. The design

[13] Conforming the procedures described in DPWH LRFD Seismic Bridge Design Specification 2014

and construction of the civil structures, stations and foundation of the Project will reflect the results and recommendation of the assessment. The project will comply with the provisions of the National Building Code and the Structural Code of the Philippines, and international standards to eliminate/ minimize impacts of liquefaction, ground shaking, and ground rupture hazards.

550. Some engineering measures are:

- Sufficient protection measures such as soil improvements will be provided during excavation works;
- Coordination with PHIVOLCS during earthquake events in order to make adjustments including assessment of possible damages to the structures being constructed;
- Track structure will be designed from the viewpoint of restorability. Rail joints will be installed at both ends of section affected by the displacement of superstructure due to fault movement. Track structure will fit to the new compensated alignment. Cross section of viaduct will be widened to absorb the new compensated alignment after the displacement of structure due to fault movement;
- For the seismic design of the station building, ensuring the function of the station building and safety of its users, as well as considering the structural integrity of the track and viaduct.
- For the bored pile construction, the use of bentonite or polymer wast is highly recommended, to stabilize uncased borings in loose soils.
- The area where thick, soft clay (compressible) layers exist, deep ground improvement or deep foundation is recommended to reduce excessive consolidation settlement.

551. In case of an emergency, emergency escape routes and early warning system, emergency power supplies for the Project are also installed to stations, viaduct, and depot to ensure continued operation of vital services. Earthquake drills will also be conducted annually. Emergency Response Plan is also established and implemented.

552. It is also strongly advised that the site is regularly inspected for structures constructed and under construction to detect any defects to minimize potential accidents incurred by natural hazards. In addition, appropriate materials handling program or a site protection and rehabilitation program will be implemented.

(2) Operation Phase

1) Change in Surface Landform/Geomorphology/Topography/Terrain/Slope

553. The operation of the Project will not bring about changes in topography and geomorphology.

2) Change in Subsurface Geology/Underground Condition

554. Underground stress distributions may change due to tunneling.The installation of buried facilities introduces new material types to the ground which can react with soil.

555. Pollution due to solid wastes may impact the quality of surrounding ground. Water leaks underground may be caused by buried pipelines.

3) Inducement of Subsidence, Liquefaction, Landslide, Mud/Debris Flow, etc.

556. During operation phase, ground shaking can bring about liquefaction and settlement of the track and station foundation. Bridge crossings can also be damaged. Ground rupture can affect the segment between Bicutan and San Pedro Stations. Possible impacts include but are not limited to loss of soil strength, settlement of soil, lateral spreading, bearing failure, floatation of embedded structures, and damage to overlaying structures.

557. The basic mitigation measure for the hazards that can potentially affect the project line is to undertake the appropriate studies which will generate information that can be used to assess damages to the structures.

558. Impacts of ground shaking can be mitigated through appropriate foundation design based on combination of geotechnical and seismicity studies. Coordination with PHIVOLCS during earthquake events will be made in order to make operational adjustments. Earthquake resistance of the Project will rely on the constructed protective measures and its maintenance.

559. Proper and prompt maintenance checks are very important to every installed structure and facility. Upgrades or installation of new technological advances when available are also encouraged for the continued operation of the Project. Regular earthquake drills also advised to be put in place to prevent loss of life.

3.1.3. Pedology

3.1.3.1. Soil Types

560. The project alignment will be traversing at least seven (7) types of soil. These soils are the: (1) Novaliches Clay Loam Adobe, (2) Guadalupe Clay, (3) Guadalupe Clay Adobe, (4) Quingua Silt Loam, (5) Carmona Sandy Clay Loam, (6) Lipa Loam, and (7) Macolod Clay Loam.

(1) Novaliches Clay Loam Adobe

561. This soil type is part of the Novaliches Soil Series which can be found on moderately sloping to rolling volcanic foothills. The soil type contains Fe-Mn concretions with irregular gravels and partially weathered tuffaceous rock fragments. The water retention for this soil type is high and the permeability is moderate. This soil type is towards the development of a mature soil formed from other alluvial deposits.

(2) Guadalupe Clay

562. This soil type is defined to be coarse and granular when moisture is absent but plastic and sticky when moisture is present. This soil type is part of the Guadalupe soil series which came from the weathering of the tuff deposit found in the area. The first 30 cm of the series is defined to be moist clay loam and the next 28 cm is defined by the presence of soft weathered saprolytes.

(3) Guadalupe Clay Adobe

563. Compared to Guadalupe Clay, Guadalupe Clay Adobe is hard and compact, and difficult to cultivate. This makes this soil type unsuitable for cropping. This soil type is also part of the Guadalupe soil series which came from the weathering of the tuff deposit found in the area. The first 30 cm of the series is defined to be moist clay loam and the next 28 cm is defined with presence of soft weathered saprolytes.

(4) Quingua Silt Loam

564. This type of soil covers 208,500,000 m² in the province of Bulacan, and 215,690,000 m² of land cover in the province of Pampanga. The mineralogy of this type of soil is generally mixed. The parent materials are recent alluvium, and recent coastal deposits. Soil thickness is found to be ranging from 100-150 cm. Fertility ranges from moderate to very high fertility, making it a good soil for agriculture.

(5) Carmona Sandy Clay Loam

565. This soil type is part of the Carmona Series which is derived from the weathered product of volcanic tuff material. The Carmona Sandy Clay Loam is pale brown to grey sandy clay with abundant concretions as seen on the topmost layer of the soil. In subsoil, it is coloured pale brown to yellowish grey plastic when wet, with abundant dark brown and reddish-brown concretions. When moisture is absent, it is hard and compact. In the substratum, the weathered tuffaceous material can be seen.

(6) Lipa Loam

566. The Lipa Loam is part of the Lipa Series. These soils span deep as it gives moderately well to well drainage capabilities. The Lipa Series can be found on undulating to rolling terrains. Lipa Loam has a subsurface characteristic that is brown to dark-brown in appearance. Other characteristics signify it as a mallow, loose, and very friable fine granular loam. The subsoil is defined as dark brown clay of a friable fine granular tuffaceous material with concretions and an irregular and abrupt boundary. The substratum is made up of highly weathered tuff mixed with tuffaceous gravels and concretions.

(7) Macolod Clay Loam

567. This soil type is part of the Macolod Series. The Macolod Clay Loam is hard, fine and gravelly in texture on the surface. It is generally sticky when wet and granular when dry from 30-60 cm. Substratum is composed of highly weathered rock and sticky when moisture is abundant. The soils permeability is medium to poor.

568. The distribution of these soil types along the project alignment can be found in **Figure 3.1.30**.

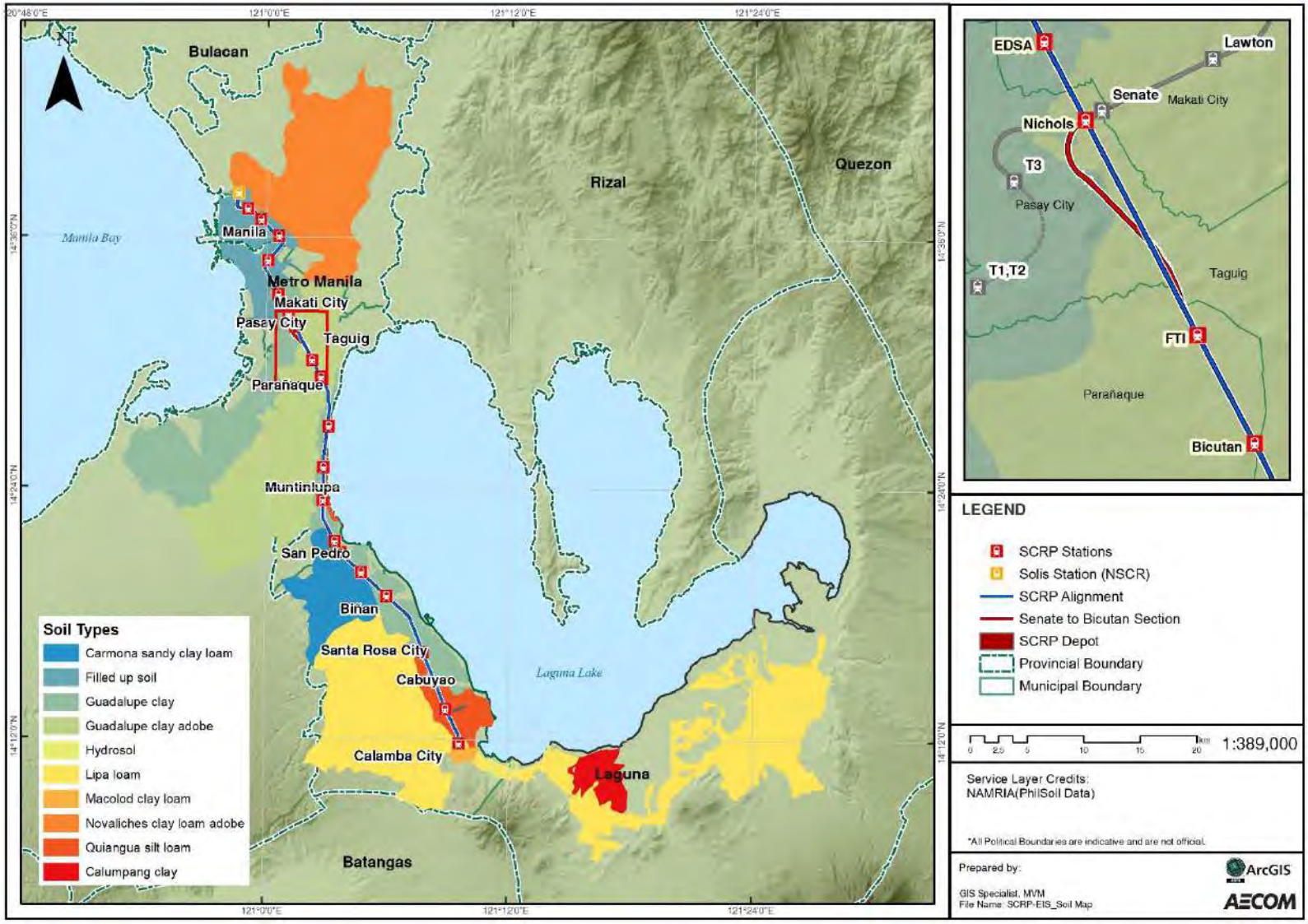


Figure 3.1.30 Soil Types found along the Project Alignment

3.1.3.2. Soil Erosion/Loss of Topsoil/Overburden

569. The baseline conditions for the erodibility of the soils along the project alignment is generally little to no erosion due to land cover and water content of the soil. The topography also plays a part on the erodibility of the soils in the area. Since the area is generally flat, the erodibility of the soils would also be lesser. The river bank stability for the soils along the alignment is generally stable because the soil types are mixed with clay particles. Clay particles add stability to the riverbanks through flocculation.

3.1.3.3. Soil Quality (Soil Fertility)

(1) Field Survey

570. Soil samples were collected at ten (10) established sampling stations along the proposed project alignment on January 23 – February 20, 2018 (**Table 3.1.11** and **Figure 3.1.31**) for physicochemical analyses such as such as pH, Nitrogen (N), Phosphorus (P), Potassium (K), micronutrients, and heavy metals. Soil samples were collected from two (2) horizons per sampling station. Surface/Disturbed soil samples were taken at 0-25 cm depth using soil auger and were analysed for pH, N, P, K, and micronutrients. The subsurface/undisturbed soil samples were taken at 25-50 cm and were analysed for heavy metals.

571. The limits used for assessment of trace metals are the Target and Intervention Values of Dutch Standards. USEPA 2010 Standard and Leeper, 1978 were used as reference for the assessment of parameters that are not found in the Dutch Standards. The Dutch Standards are environmental pollutant reference values used in environmental remediation, investigation, and clean-up.

Table 3.1.11 Sampling Stations for Soil Quality Testing

Sampling Stations		Coordinates	Date of Sampling
S01	PNR – Solis Station	14°37'41.65"N; 120°58'32.40"E	February 14, 2018
S02	Area near Pandacan Depot	14°35'36.65"N; 121° 0'41.87"E	February 15, 2018
S03	PNR - Sta. Mesa	14°35'54.27"N; 121° 0'46.14"E	February 13, 2018
S04	PNR – Buendia	14°33'17.27"N; 121° 0'33.81"E	February 14, 2018
S05	PNR – FTI	14°30'22.55"N; 121° 2'9.58"E	February 8, 2018
S06	PNR – Sucat	14°27'4.63"N; 121° 3'2.59"E	February 20, 2018
S07	PNR – Biñan	14°19'52.00"N; 121° 4'51.00"E	January 23, 2018
S08	PNR – Calamba	14°12'23.54"N; 121° 9'28.66"E	January 24, 2018
S09	Alligator Lake Area	14°10'47.90"N; 121°12'25.82"E	January 26, 2018
S10	Paciano Rizal Elementary School	14° 8'56.27"N; 121°16'4.30"E	January 25, 2018

Figure 3.1.31 Soil Quality Sampling Station

(2) Applied Standard

572. The adequate values for parameters such as pH, organic matter, primary nutrients (P, K), secondary nutrient: Magnesium (Mg), micronutrients: Iron (Fe), Copper (Cu), Manganese (Mn), and Zinc (Zn), as set in the General Guidelines for the Fertility Rating of Soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy, which were adopted by BSWM, were used to determine the fertility of the collected soil samples. Dutch Target and Intervention Values (2000) were adopted for trace metals such as Lead (Pb), Arsenic (As), Mercury (Hg), Cadmium (Cd), and Chromium Hexavalent (Cr^{+6}).

(3) Results and Analysis

573. **Table 3.1.12** shows the results of the surface soil quality analysis pertaining to soil fertility rating and trace metals.

574. The soil samples collected at Stations S01 (Solis), S02 (Pandacan), S03 (Sta. Mesa) and S09 (Alligator Lake) belongs to Hydrosol, Guadalupe Clay in Stations S04 (Buendia) and S06 (Sucat); Guadalupe Clay Adobe in Station S05 (FTI), Quingua Silt Loam in Stations S07 (Biñan) and S08 (Calamba); and Lipa Loam in Station S10 (Paciano Rizal Elementary School).

575. The results of the soil quality analysis in all stations showed that the pH level, organic matter, primary nutrients (P and K), Mg and macronutrients (available Fe, Cu, Mn and Zn) were adequate based on the general guideline values for the fertility rating of soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy except for the pH level at Station S05 (FTI) and organic matter at Station S10 (Paciano Rizal Elementary School) which exceeded the adequate values of 5.5-8.5 and 1-8 for pH and organic matter, respectively. The lowest nitrogen concentration level was in Station S06 (Sucat) at 250 mg/kg while the highest nitrogen concentration level was in Station S08 (Calamba) at 1,300 mg/kg. The lowest calcium concentration level was in Station S10 at 1.02 cmol/kg while the highest Ca concentration level was in Station 01 (Solis) at 171.21 cmol/kg.

576. The levels of Pb in stations S01 (Solis), S02 (Pandacan), S03 (Sta. Mesa), S05 (FTI) and S08 (Calamba) exceeded the Target Value of the Dutch Standard but were way below the intervention values. The levels of Hg, As, and Cr^{+6} in all sampling stations were well within the Target Values of the Dutch Standard. The levels of Hg in six (6) stations (S01, S02, S04, S05, S06, and S07) were below the detectable limits of the method of analysis. Levels of Cr^{+6} in stations S03, S04, S07, S08, S09, and S10 were also below the detectable limits of the analysis. Levels of Cd exceeded the Target Value of Dutch Standard but were below the Intervention Value.

1) Results by Sampling Stations

Station S01 (PNR Solis Station)

577. The soil sample collected at Station S01 (Solis) is a filled-up soil. The result of soil quality analysis shows that levels of pH, organic matter, primary nutrients (P and K), Mg and micronutrients (available Fe, Cu, Mn and Zn) at this site are adequate based on the General Guidelines for the Fertility Rating of Soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy. The level of N is 260 mg/kg while level of Ca is 171.21 cmol/kg. The levels of Hg, As, and Cr^{+6} are within the Dutch Target Values (2000). The levels of Pb and Cd do not conform to the Dutch Target Values but are within the Intervention Values.

Station S02 (Area near the Pandacan Depot)

578. The soil sample collected at Station S02 (Pandacan) is a filled-up soil. Levels of pH, organic matter, primary nutrients (P and K), Mg, and micronutrients (available Fe, Cu, Mn, and

Zn) at this site are adequate based on the General Guidelines for the Fertility Rating of Soils[14]. The levels of N and Ca are 280 mg/kg and 22.245 cmol/kg, respectively. The levels of Hg, As, and Cr^{+6} are within the Dutch Target Values (2000). The levels of Pb and Cd do not conform to the Dutch Target Values but are within the Intervention Values.

Station S03 (PNR Sta. Mesa)

579. The soil sample collected at Station S03 (Sta. Mesa) is also a filled-up soil. Levels of pH, organic matter, primary nutrients (P and K), Mg, and micronutrients (available Fe, Cu, Mn, and Zn) at this site are adequate. The levels of N and Ca are 1,300 mg/kg and 110.445 cmol/kg, respectively. The same with Station S01 (Solis) and Station S02 (Pandacan), the levels of Hg, As and Cr^{+6} are within the Dutch Target Values (2000). The levels of Pb and Cd do not conform to the Dutch Target Values but are within the Intervention Values.

Station S04 (PNR Buendia)

580. The soil sample collected at Station S04 (Buendia) is classified as Guadalupe clay. Levels of pH, organic matter, P, Mg, and micronutrients (available Fe, Cu, Mn, and Zn) at this site are adequate. Level of K recorded at 0.15 cmol/kg is inadequate. The level of N and Ca are 270 mg/kg and 10.315 cmol/kg, respectively. The levels of Pb, Hg, As, and Cr^{+6} are within the Dutch Target Values (2000). The level of cadmium does not conform to the Dutch Target Values but is within the Intervention Values.

Station S05 (PNR FTI)

581. The soil sample collected at Station S05 (FTI) is classified as Guadalupe clay adobe. Levels of organic matter, primary nutrients (P and K), Mg, and micronutrients (available Fe, Cu, Mn, and Zn) in this site are adequate. On the other hand, the pH level at this station is high. The levels of N and Ca are 1,300 mg/kg and 110.445 cmol/kg, respectively. The levels of Hg, As, and Cr^{+6} are within the Dutch Target Values (2000). The levels of Pb and Cd do not conform to the Dutch Target Values but is within the Intervention Values.

Station S06 (PNR Sucat)

582. The soil sample collected at Station S06 (Sucat) was classified as Guadalupe clay. Levels of pH, organic matter, P, Mg, and micronutrients (available Fe, Cu, Mn, and Zn) in this site are adequate. Level of K recorded at 0.14 cmol/kg is inadequate. The levels of N and Ca are 250 mg/kg and 35.59 cmol/kg, respectively. The levels of Pb, Hg, As, and Cr^{+6} are within the Dutch Target Values (2000). The level of cadmium does not conform to the Dutch Target Values but is within the Intervention Values.

Station S07 (PNR Biñan)

583. The soil sample collected at Station S07 (Biñan) was classified as Quingua Silt Loam. Levels of pH, organic matter, primary nutrients (P and K), magnesium, and micronutrients (available Fe, Cu, Mn, and Zn) in this site are adequate. The levels of N and Ca are 970 mg/kg and 19.18 cmol/kg, respectively. The levels of Pb, Hg, As, and Cr^{+6} are within the Dutch Target Values (2000). The level of Cd does not conform to the Dutch Target Values but is within the Intervention Values.

Station S08 (PNR Calamba)

584. The soil sample collected at Station S08 (Calamba) is classified as Quingua Silt Loam. Levels of pH, organic matter, primary nutrients (P and K), Mg, and micronutrients (available Fe,

[14] General Guidelines for the Fertility Rating of Soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy

Cu, Mn, and Zn) in this site are adequate[15]. Levels of N and Ca are 1,300 mg/kg and 5.11 cmol/kg, respectively. The levels of Hg, As, and Cr^{+6} are within the Dutch Target Values (2000). The levels of Pb and Cd do not conform to the Dutch Target Values but is within the Intervention Values.

Station S09 (Alligator Lake Area)

585. The soil sample collected at Station S09 (Alligator Lake) was classified as Hydrosol. Levels of pH, organic matter, primary nutrients (P and K), Mg, and micronutrients (available Fe, Cu, Mn, and Zn) in this site are adequate. The levels of N and Ca are 820 mg/kg and 14.6 cmol/kg, respectively. The levels of Pb, Hg, As, and Cr^{+6} are within the Dutch Target Values (2000). The level of cadmium does not conform to the Dutch Target Values but is within the Intervention Values.

Station S10 (Paciano Rizal Elementary School)

586. The soil sample collected at Station S09 (Alligator Lake) was classified as Hydrosol. Levels of pH, primary nutrients (P and K), Mg, and micronutrients (available Fe, Cu, Mn, and Zn) in this site are adequate. Level of organic matter measured at 0.75 is low. The levels of N and Ca are 800 mg/kg and 1.02 cmol/kg, respectively. The levels of Pb, Hg, As, and Cr^{+6} are within the Dutch Target Values (2000). The level of cadmium does not conform to the Dutch Target Values but is within the Intervention Values.

[15] Based on the General Guidelines for the Fertility Rating of Soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy

Table 3.1.12 Results of Surface Soil Analysis Pertaining to Soil Fertility Rating and Trace Metals

Parameters	Sampling Stations										Adequate Values[1]	
	S01	S02	S03	S04	S05	S06	S07	S08	S09	S10		
Surface Soil Analysis Pertaining to Soil Fertility Rating												
Soil Type	Filled-up Soil	Filled-up Soil	Filled-up Soil	Guadalupe Clay	Guadalupe Clay Adobe	Guadalupe Clay	Quiangua Silt Loam	Quiangua Silt Loam	Hydrosol	Lipa Loam	-	
pH	8.12	8.11	7.85	8.2	9.12	7.7	8.1	7.8	8.0	8.0	5.5-8.5	
Organic Matter, %	2.48	1.82	3.24	1.77	2.59	1.22	2.4	2.9	1.2	0.75	1-8; >3**	
Primary Nutrients												
Total Kjeldahl Nitrogen, mg/kg	260	280	1300	270	1300	250	970	1300	820	800	-	
Phosphorus, mg/kg	1135	4863	1913	6380	348	3873	2829	239	887	244	>10 >20**	
Potassium, cmol/kg	14.57	0.46	0.45	0.15	3.97	0.14	5.32	2.74	5.03	6.87	>0.25	
Secondary Nutrients												
Calcium, cmol/kg	171.21	22.245	110.445	10.315	110.445	35.59	19.18	5.11	14.6	1.02	-	
Magnesium, cmol/kg	154.47	12.01	79.15	2.44	79.15	4.54	59.69	66.76	227.05	52.80	>0.50	
Micronutrients												
Available Iron, mg/kg	42,608	20,393	42,429	31,941	18,933	202,214	76,432	396,112	25,694	64,802	>4.5	
Available Copper, mg/kg	459	63	104	971	65	399	189	168	90	126	>0.2	
Available Manganese, mg/kg	196	554	445	826	491	333	581	734	1,394	3,233	>1.0	
Available Zinc, mg/kg	391	239	1600	388	255	1062	434	369	130	82.6	>1.5; >1.0**	
Soil Analysis for Trace Metals											Dutch Standards2	
											Target Values	Intervention Values
Lead, mg/kg	142	85.8	201	31	123	45	54.2	208	15.4	19	85	530
Mercury, mg/kg	<0.05	<0.05	0.06	<0.05	<0.05	<0.05	<0.05	0.09	0.04	0.04	0.3	10
Cadmium, mg/kg	7.43	2.90	2.87	3.93	2.50	4.17	3.55	5.11	3.65	3.78	0.8	12
Arsenic, mg/kg	2.93	1.62	2.32	1.37	1.57	2.15	1.88	3.55	9.76	10.0	29	55
Chromium Hexavalent, mg/kg	5.4	0.74	<0.2	<0.2	10.0	0.78	<0.2	<0.2	<0.2	<0.2	100	380

Note: ** Limits applicable to dry land crops; Highlighted items do not conform with the standard
Target Values of Dutch Standard (2000) – indicates the level at which there is a sustainable soil quality
Intervention Values of Dutch Standard (2000) – representative of the level of contamination above which there is serious case of soil contamination

Sources:
1 Adequate Values are based on General Guidelines for the Fertility Rating of Soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy (adopted by BSWM)
2 Dutch Target and Intervention Values (2000)

2) Results by Parameters

587. Results of analysis for each parameter were graphed showing its relative concentration levels at the ten (10) sampling stations. Brief discussions were made comparing the results across the sampling stations and against relevant General Guidelines for the Fertility Rating of Soils and Dutch Target and Intervention Values.

pH Level

588. Extreme levels of alkalinity or acidity greatly impacts the absorption of certain nutrients by plants. Though there are nutrients that can be absorbed by plants through a broad spectrum of pH levels, there are some nutrients that are sensitive to pH levels. Measurement of pH also plays a great role in determining what type of plants will grow on a pH-specific type of soil.

589. **Figure 3.1.32** shows the graphical presentation of the levels of pH in ten (10) sampling stations. As shown, pH levels in all stations are adequate except for pH level in Station S05 (Sucat) which exceeded the maximum guideline value set in the General Guidelines for the Fertility Rating of Soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy. The lowest pH level was recorded in Station S06 (Sucat) at 7.7.

590. There are many factors that affect the levels of pH in soil. Usually the pH of the soil is controlled by the provenance of the sediments or the bedrock from the soil was derived. For stations 4 and 5, the alkalinity of the soil can be attributed to the bedrock where the soil came from. The bedrock for these stations is tuff. Weathering of silica produces a basic environment. For the other stations, the general acidity or alkalinity of the soil can be attributed to the amount of organic matter present in the area or the mineralogy of the soil. Decomposition of organic matter has been linked to a decrease in pH due to production of carbonic acid.

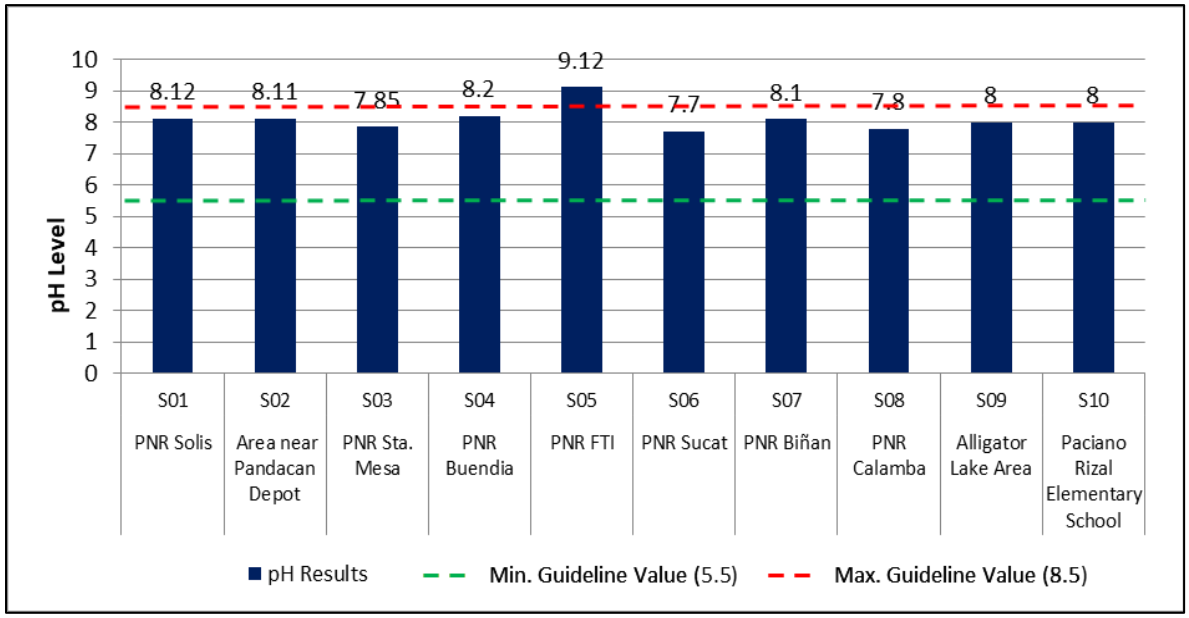


Figure 3.1.32 Result of pH Level Measurement of Soil Samples

Organic Matter

591. The amount of organic matter present in a given soil ecosystem is influenced by a variety of other soil properties such as soil texture, soil pH, soil temperature, moisture content, aeration, clay mineralogy and biological activities. It is important to take note that some of these soil properties, in turn, are being influenced by the amount of organic matter present in a given soil

ecosystem. Organic matter serves as a “revolving nutrient fund” for plants by facilititating nutrient availability for plants and as an agent.

592. **Figure 3.1.33** shows the graphical presentation of the levels of organic matter in ten (10) sampling stations. As shown, levels of organic matter in all stations are adequate except for the organic matter in Station S10 (Paciano Rizal Elementary School) which is below the minimum guideline value set in the General Guidelines for the Fertility Rating of Soils. The highest level of organic matter was recorded in Station S03 (Sta. Mesa) at 3.24%.

593. There are a lot of factors to consider for the attribution to soil organic matter content. The survey showed that the organic matter content of the stations surveyed were close to the minimum guideline value. The generally low amount of organic matter present in the soil samples can be attributed to the climate the Philippines is experiencing. Higher temperatures are attributed to higher decomposition rates, which is experienced normally by tropical countries like the Philippines.

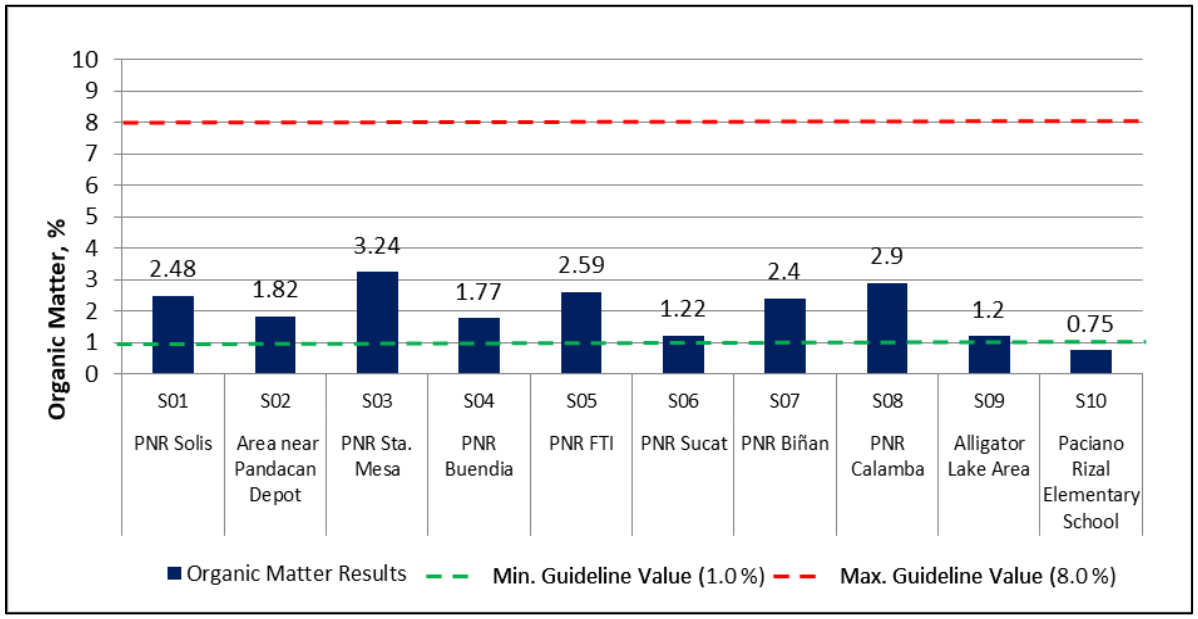


Figure 3.1.33 Result of Organic Matter Measurement of Soil Samples

Total Kjeldahl Nitrogen

594. Total Kjeldahl Nitrogen (TKN), unlike total Nitrogen, is the sum of all plant-bound nitrogen including ammonia. Nitrogen are building blocks of plants for growth. High Nitrogen content in soil would be beneficial for plants but Nitrogen in excess will result to low-yield for agricultural plants. There are also cases where the plants get deformations due to excess Nitrogen in soil. High concentration levels of Nitrogen can also affect the water quality and might be a signal for possible groundwater contamination.

595. **Figure 3.1.34** shows the graphical presentation of the levels of total Kjeldahl Nitrogen in ten (10) sampling stations. As shown, the highest level of total Kjeldahl Nitrogen was recorded in Stations S03 (Sta. Mesa), S05 (FTI) and S08 (Calamba) at 1,300 mg/kg while the lowest nitrogen level was recorded in Station S06 at 250 mg/kg.

596. There are six stations (stations 3,5,7,8,9, and 10) that yielded exceptionally high TKN content in soil. These can be attributed to high activity of nitrogen-fixing bacteria during the first phases of decomposition (ammonia production) or nitrogen residue from recent animal manure decomposition.

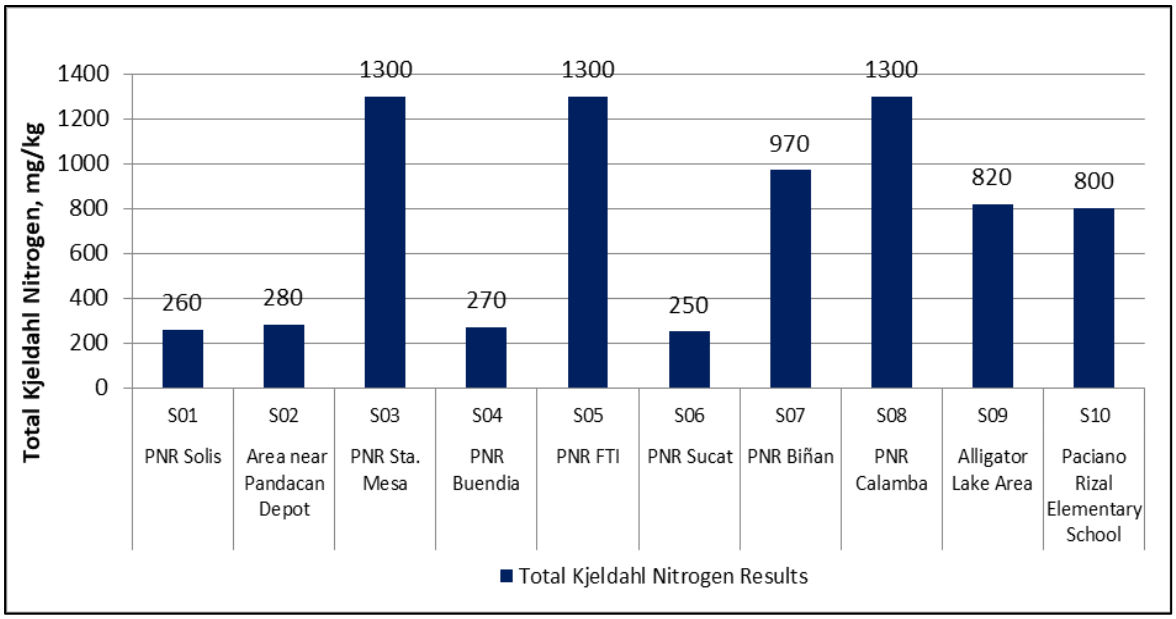


Figure 3.1.34 Result of Total Kjeldahl Nitrogen Measurement of Soil Samples

Phosphorus

597. Phosphorous in soils serve as an energy source for cellular reactions of plants. They can hasten the maturity of a plant or stimulate the stages of early development of a plant. Phosphorous is one of the three vital ingredients of commercial fertilizers together with Nitrogen and Potassium. Phosphorous in soils comes in two forms, the plant-ready inorganic Phosphorous and the organic Phosphorous. There is a natural fixation of these organic phosphorous that converts it into the inorganic type. There are several factors that increase the concentration of phosphorous in soils. They can be added through the use of fertilization, leaching from rocks, etc. Phosphorous in excess is harmful to water resources. They might cause unwanted eutrophication events since they hasten cellular activity.

598. **Figure 3.1.35** shows the graphical presentation of the levels of phosphorus in ten (10) sampling stations. As shown, levels of phosphorus in all stations are adequate (>10.0 mg/kg). The highest level of phosphorus was recorded in Stations S04 (Buendia) at 6,300 mg/kg while the lowest phosphorus level was recorded in Station S08 at 239 mg/kg.

599. Since phosphorous is a highly soluble substance, the high amounts of phosphorous in some stations can be attributed to residual phosphorous that has been carried through water runoffs. Elevated amounts of phosphorous can also be an indication of a possible groundwater pollution.

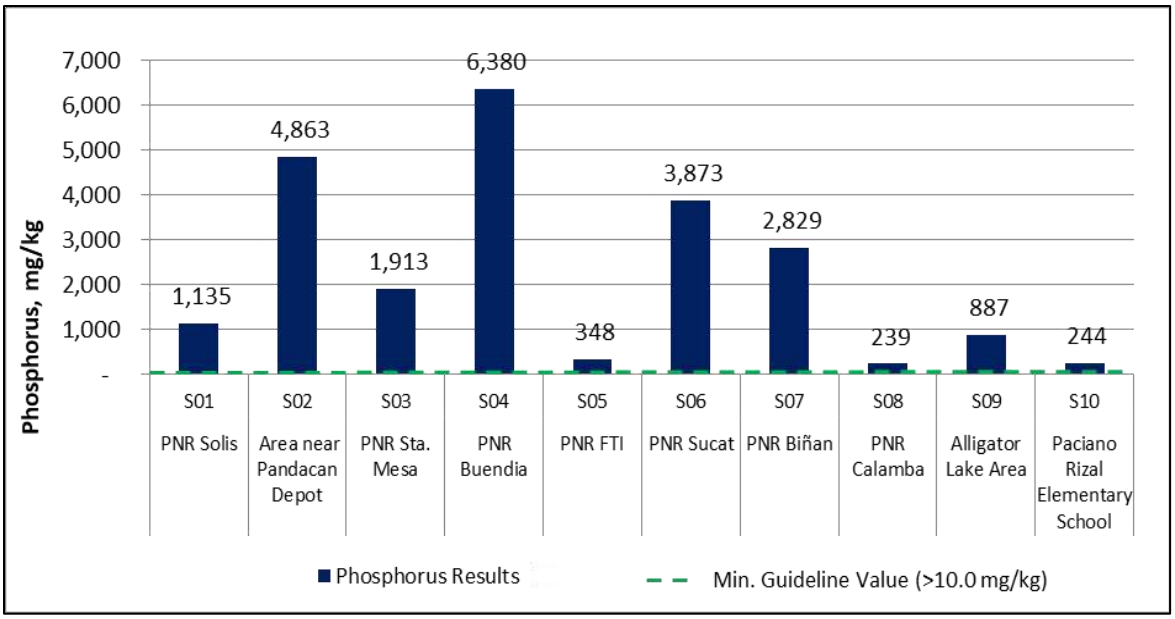


Figure 3.1.35 Result of Phosphorus Measurement of Soil Samples

Potassium

600. Potassium is responsible for the movement of water, nutrients, and carbohydrates through plants. It is also utilized by plants for manufacturing Adenosine Tri-Phosphate (ATP) which drives processes in the cells of plants. Potassium concentrations in soils are generally high (20,000 ppm). Plants usually develop specific symptoms if experiencing deficiency with potassium. They usually develop discoloration along the margins of the leaves and during maturation will continue the process of "necrosis". Problems arising from potassium deficiency can be addressed by the use of fertilizers.

601. **Figure 3.1.36** shows the graphical presentation of the levels of potassium in ten (10) sampling stations. As shown, levels of potassium in Stations S04 (Buendia) and S06 (Sucat) are inadequate while in other stations (i.e. S01, S02, S03, S05, S07, S08, S09 and S10), potassium levels are adequate. The highest level of potassium was recorded in Station S01 (Solis) at 14.57 cmol/kg while the lowest potassium level was recorded in Station S06 at 0.14 cmol/kg.

602. Potassium level is greatly affected by the moisture content of the soil and mineralogy. For station 1, it is difficult to pinpoint the factor that affected the elevated concentration of potassium in the soil because the soil in the area is transported and is not in situ.

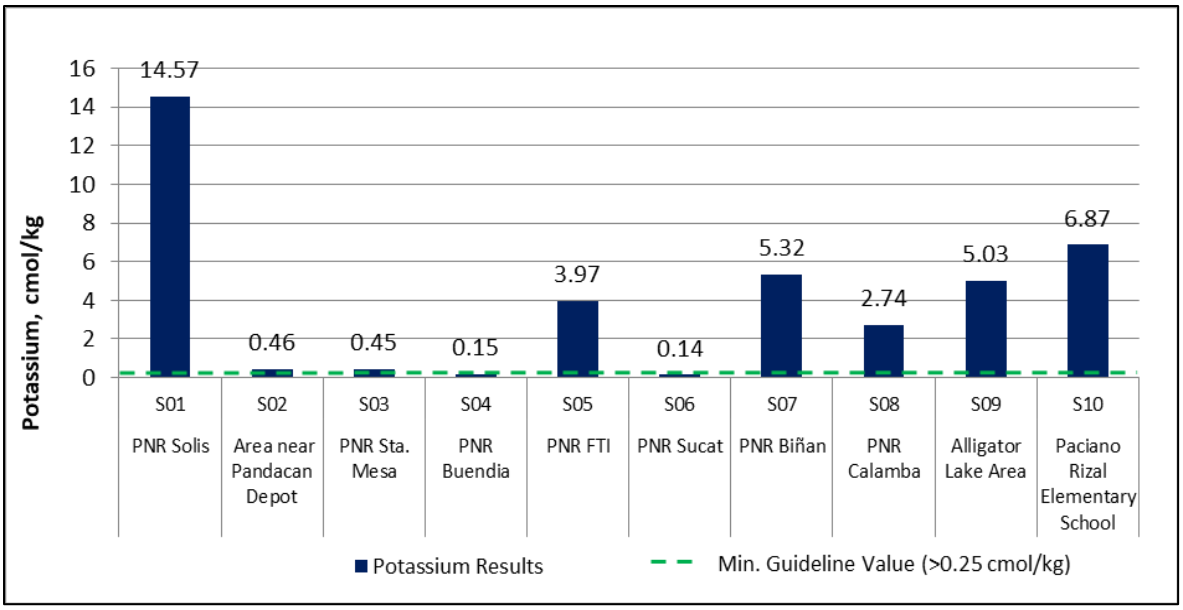


Figure 3.1.36 Result of Potassium Measurement of Soil Samples

Calcium

603. Presence of calcium in soil ensures proper soil porosity through flocculation of clay and organic matter. It is also important for proper tissue growth of plants. Calcium also helps in the metabolism of starch. It also has the ability to neutralize excess acid or alkalinity in soil.

604. **Figure 3.1.37** shows the graphical presentation of the levels of calcium in ten (10) sampling stations. As shown, the highest level of calcium was recorded in Station S01 (Solis) at 171.21 cmol/kg while the lowest potassium level was recorded in Station S06 (Sucat) at 1.02 cmol/kg.

605. Calcium is known to pose no toxicity for the plants but it is known that excess calcium reduces the uptake of nutrients of plants. Though it is known that calcium is known to neutralize the alkalinity or acidity of soil, it is still a common mistake to assume that when the soil pH is high it is correlated to elevated levels of calcium in soil.

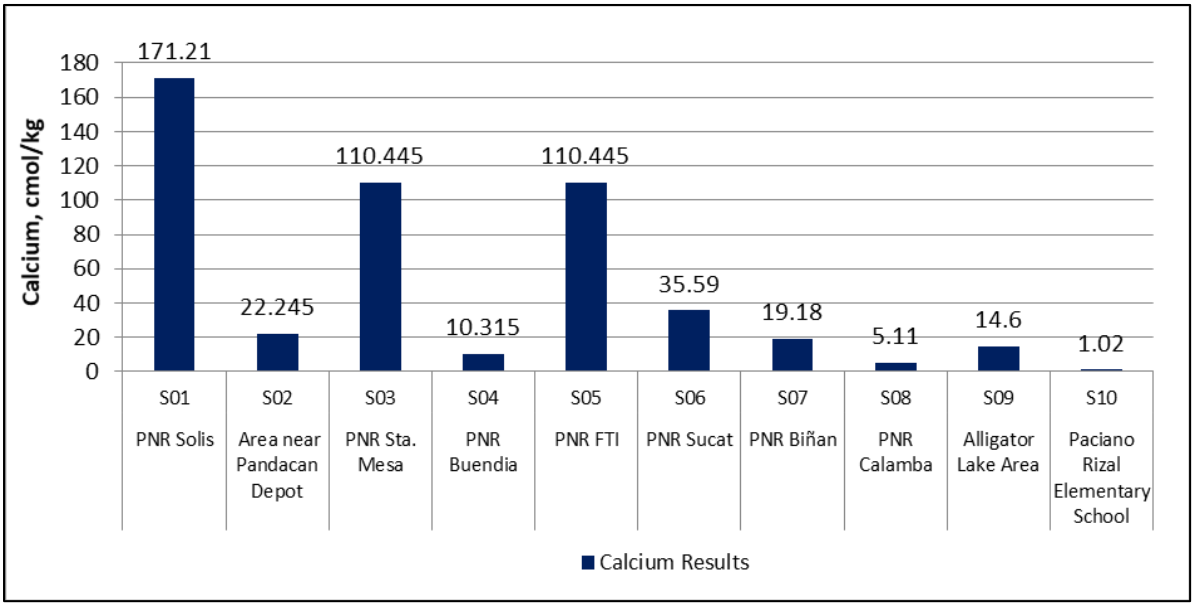


Figure 3.1.37 Results of Calcium Measurement of Soil Samples

Magnesium

606. Magnesium is an important component of chlorophyll in plant tissues. Insufficient amount of magnesium in soil will result to stunted growth of the plant. Magnesium also helps in activating specific enzyme systems. Enzymes are complex substances that affect heavily the metabolism of plants. Insufficient amount of magnesium in soil develops magnesium-deficient plants which in turn pose harm to the livestock that intakes these magnesium-deficient plants. The animals that consume these magnesium deficient plants suffer from grass tetany.

607. **Figure 3.1.38** shows the graphical presentation of the levels of magnesium in ten (10) sampling stations. As shown, levels of magnesium in all stations are adequate (>0.50 cmol/kg). The highest level of magnesium was recorded in Station S09 (Alligator Lake) at 227.05 cmol/kg while the lowest magnesium level was recorded in Station S04 (Buendia) at 2.44 cmol/kg.

608. The source of natural magnesium is very reliant on the mineralogy of the soil. It is therefore difficult to pinpoint the reason that attributed to the high or low soil concentration findings for the survey stations since the majority of the alignment is supposedly covered with Recent deposits.

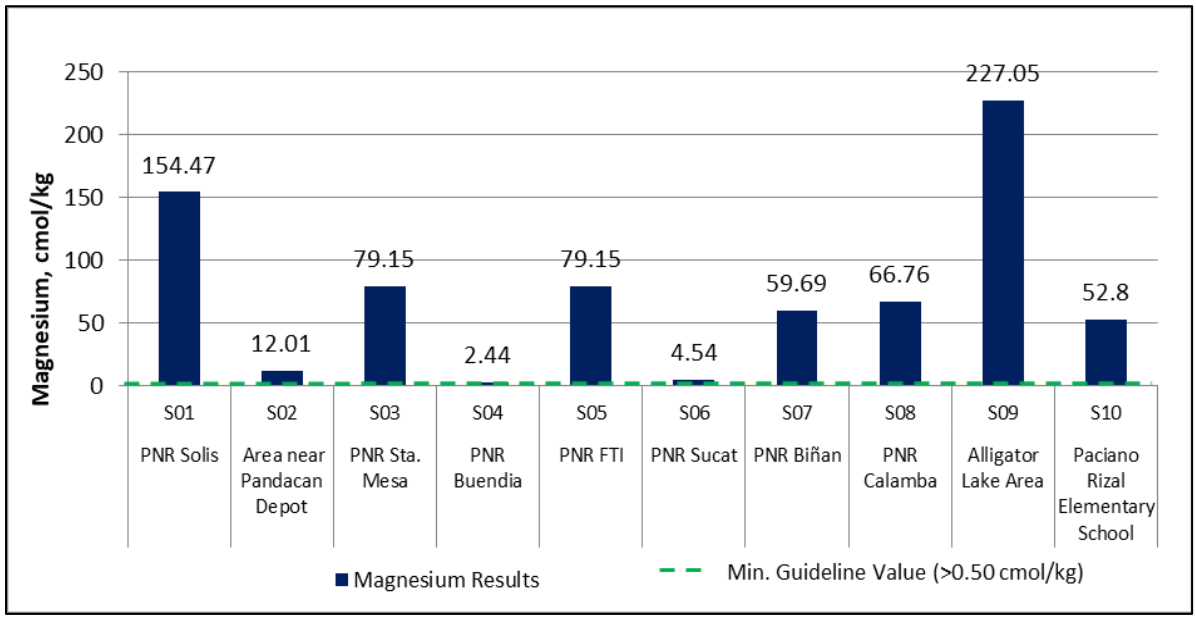


Figure 3.1.38 Results of Magnesium Measurement of Soil Samples

Available Iron

609. Iron is important for development and function of chlorophyll in plants. It is also important for respiration, nitrogen fixation, energy transfer, and metabolism. Excess concentration of iron in soil is commonly linked to problems with the uptake of other nutrients rather than producing toxicity impacts.

610. **Figure 3.1.39** shows the graphical presentation of the levels of available iron in ten (10) sampling stations. As shown, levels of available iron in all stations are adequate (>4.5 mg/kg). The highest level of available iron was recorded in Station S08 (Calamba) at 396,112 mg/kg while the lowest available iron was recorded in Station S05 (Sucat) at 18,933 mg/kg.

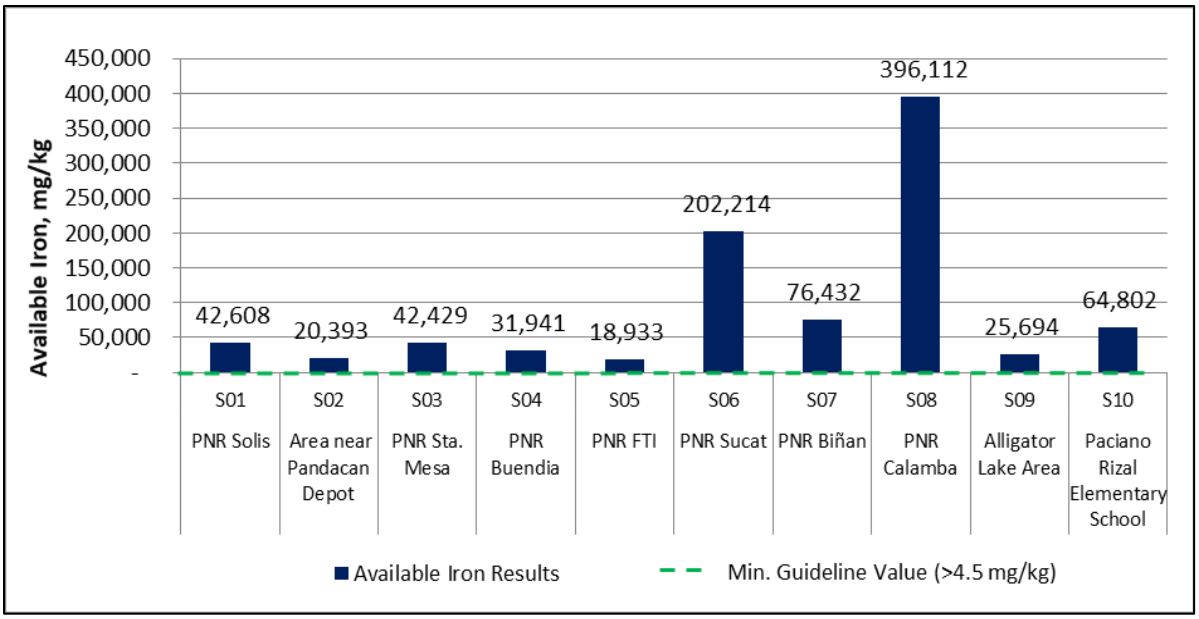


Figure 3.1.39 Results of Available Iron Measurement of Soil Samples

Available Copper

611. Copper, like iron facilitates respiration, and photosynthesis. It is also important for the metabolism of plants. Copper in plants also affects the flavor, sugar content and storage life of fruits. Increased concentration of copper is considered to pose no toxicity problems for the plant. Elevated concentrations just prevent other nutrients from being taken in by plants.

612. **Figure 3.1.40** shows the graphical presentation of the levels of available copper in ten (10) sampling stations. As shown, levels of available copper in all stations are adequate (>0.2 mg/kg). The highest level of available copper was recorded in Station S04 (Buendia) at 971 mg/kg while the lowest available copper was recorded in Station S02 (Pandacan) at 63 mg/kg.

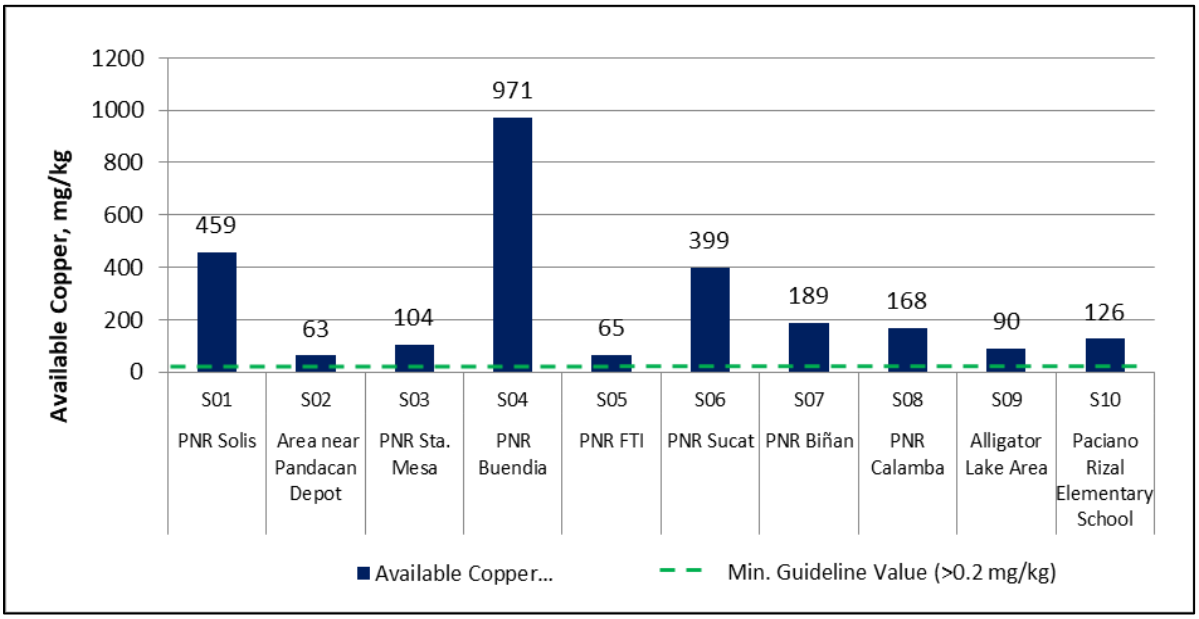


Figure 3.1.40 Results of Available Copper Measurement of Soil Samples

Available Manganese

613. Manganese is important for photosynthesis and production of chlorophyll and nitrogen. It is also responsible for the production of ascorbic acid, riboflavin, and carotene. A variety of factors affects the availability of manganese in soil, following are some: pH, Organic matter, Moisture, and other nutrients. There are no direct links to toxicity due to excessive manganese concentration. But like other nutrients, excess manganese is correlated to a decrease in uptake of other nutrients.

614. **Figure 3.1.41** shows the graphical presentation of the levels of available manganese in ten (10) sampling stations. As shown, levels of available manganese in all stations are adequate (>10 mg/kg). The highest level of available manganese was recorded in Station S10 (Paciano Rizal Elementary School) at 3,233 mg/kg while the lowest available manganese was recorded in Station S01 (Solis) at 196 mg/kg.

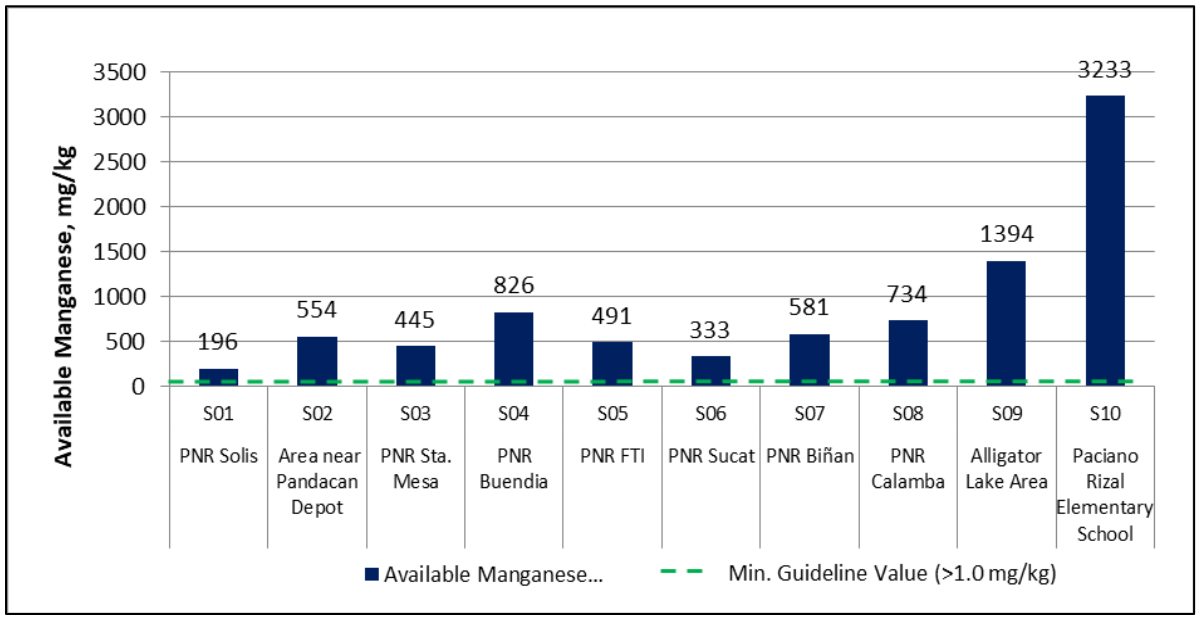


Figure 3.1.41 Results of Available Manganese Measurement of Soil Samples

Available Zinc

615. Zinc is responsible for the production of plant growth hormones and proteins. The development of roots, and as well as carbohydrates and chlorophyll production are also dependent on the intake of zinc. There are several factors that affect the availability of zinc in soil, following are some: pH, Organic Matter, Moisture, and other nutrients. Toxicity with zinc is difficult to detect because the normal symptoms are just darker than normal leaves.

616. **Figure 3.1.42** shows the graphical presentation of the levels of available zinc in ten (10) sampling stations. As shown, levels of available zinc in all stations are adequate (>1.5 mg/kg). The highest level of available zinc was recorded in Station S03 (Sta. Mesa) at 1,600 mg/kg while the lowest available zinc was recorded in Station S10 (Paciano Rizal Elementary School) at 83 mg/kg.

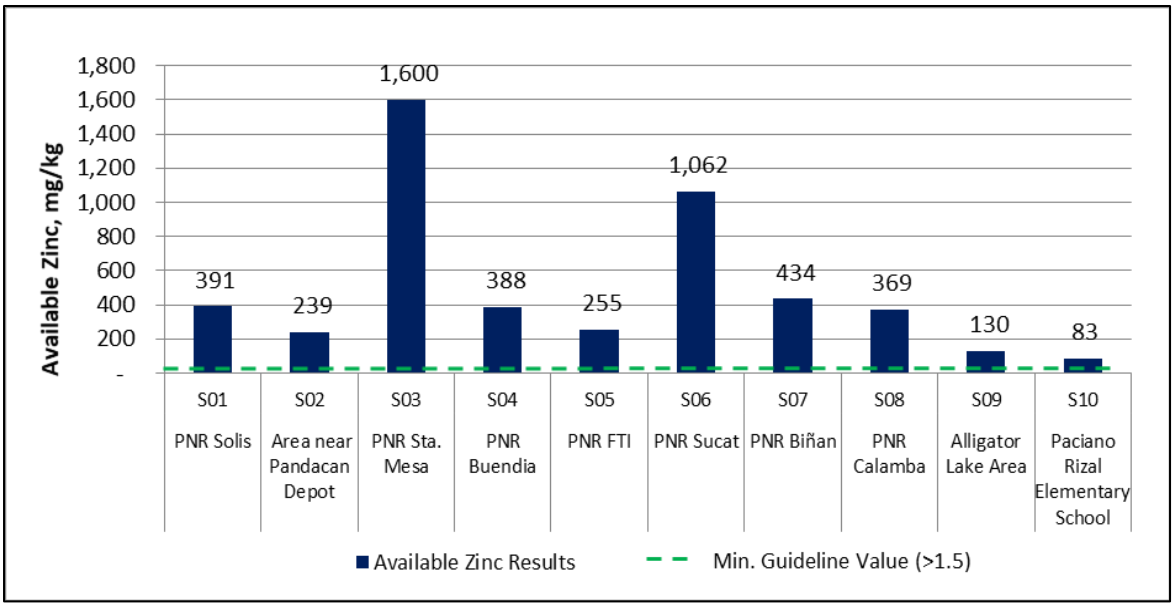


Figure 3.1.42 Results of Available Zinc Measurement of Soil Samples

Lead

617. Lead is a naturally occurring heavy metal. In high concentrations, it is considered toxic and is linked to a plethora of medical problems. Lead contamination is common in highly industrialized areas. The major 2 major sources of lead are old paints and auto emissions.

618. **Figure 3.1.43** shows the graphical presentation of the levels of lead in ten (10) sampling stations. As shown, levels of lead in Stations S04, S06, S07, S09, and S10 are within the Dutch target value while levels of lead in Stations S01, S02, S03, S05, and S08 do not conform to the Dutch target value but are within the intervention value. The highest level of lead was recorded in Station S08 (Calamba) at 208 mg/kg while the lowest lead was recorded in Station S09 (Alligator Lake) at 15.4 mg/kg.

619. Lead can be carried to other places by runoff but it is observed that soils sampled near old buildings yield high lead content.

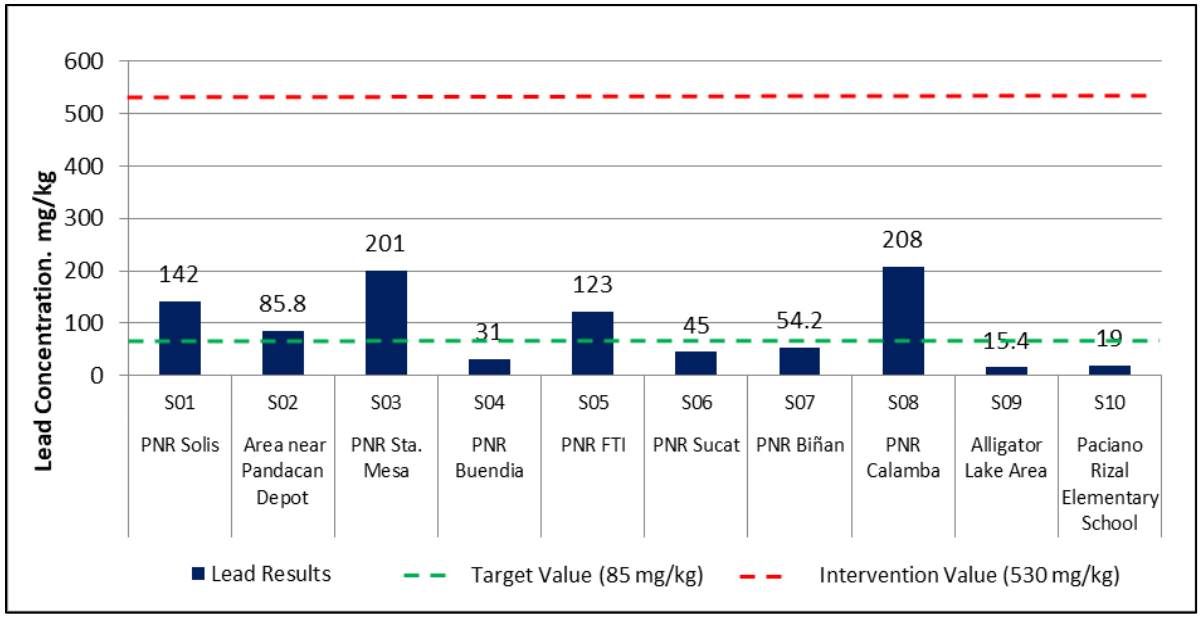


Figure 3.1.43 Results of Lead Measurement of Soil Samples

Mercury

620. Mercury is a toxic compound that is present naturally and can be introduced to the environment through anthropogenic activities. Mercury is able to bioaccumulate through the food chain, that is why soil and water contaminated with mercury has the highest potential to contaminate the whole food chain with mercury. Mercury has adverse effects on nearly all the systems of the human body. The top contributor of mercury to the environment are industrial activities (cement kiln, gold mining, coal power plants, etc.).

621. **Figure 3.1.44** shows the graphical presentation of the levels of mercury in ten (10) sampling stations. As shown, levels of mercury were not detected in stations S01, S02, S04, S05, S06, and S07. In Stations S03, S08, S09 and S10, levels of mercury were detected but are within Dutch target value. The highest level of mercury was recorded in Station S08 (Calamba) at 0.09 mg/kg.

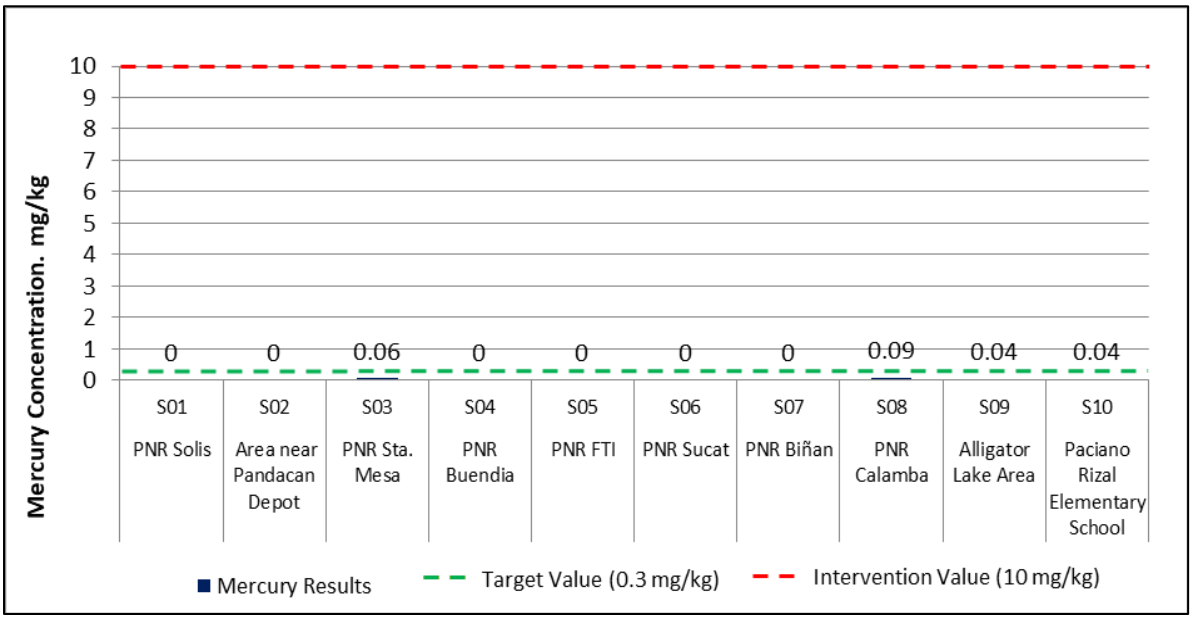


Figure 3.1.44 Results of Mercury Measurement of Soil Samples

Cadmium

622. Cadmium is a toxic element that is used in manufacturing of batteries, paints, and soil fertilizers. Just like lead, cadmium contamination is also linked to industrialization. Like lead, cadmium also poses a lot of medical problems due to cadmium ingestion or inhalation.

623. **Figure 3.1.45** shows the graphical presentation of the levels of cadmium in ten (10) sampling stations. As shown, levels of cadmium in all stations do not conform to the Dutch target value but are within the Intervention Value. The highest level of cadmium was recorded in Station S01 (Solis) at 7.43 mg/kg while the lowest cadmium level was recorded in Station S05 (FTI) at 2.5 mg/kg.

624. The high concentrations of cadmium observed in the survey stations might have been brought by industrial activities present in the area.

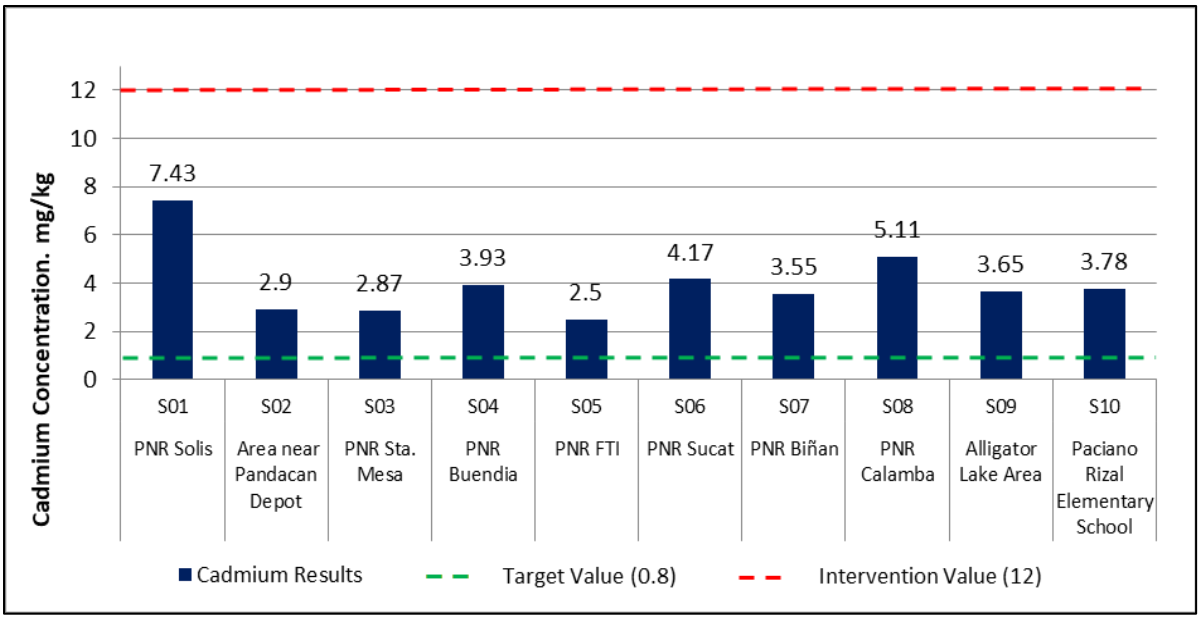


Figure 3.1.45 Results of Cadmium Measurement of Soil Samples

Arsenic

625. Arsenic is another type of toxic compound that is most toxic in its inorganic form. Long-term exposure to arsenic from drinking water has been proven to cause cancer and skin lesions. There are other diseases that have been proven to be caused by arsenic exposure, including cardiovascular diseases, and diabetes. The common sources of arsenic other than industrial activities are the following: Chromated Copper Arsenate (CCA) treated timber, termite control products and some herbicides.

626. **Figure 3.1.46** shows the graphical presentation of the levels of cadmium in ten (10) sampling stations. As shown, levels of arsenic in all stations conform to the Dutch target value. The highest level of arsenic was recorded in Station S10 (Paciano Rizal Elementary School) at 10.0 mg/kg while the lowest concentration was recorded in Station S04 at 1.37 mg/kg.

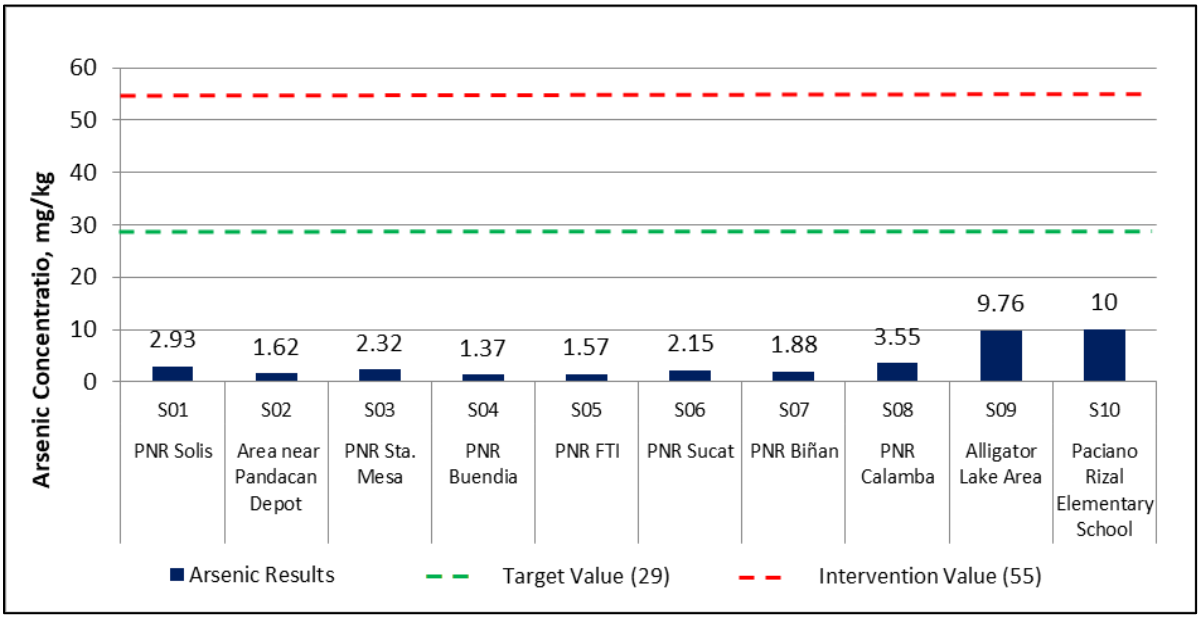


Figure 3.1.46 Results of Arsenic Measurement of Soil Samples

Chromium Hexavalent

627. Chromium can exist in different valencies including its ground state but it is the hexavalent chromium that is substantially more toxic. Chromium, once taken up by plants, affect the germination, plant growth, photosynthesis, and the uptake of a variety of nutrients. For humans, chromium is actually beneficial in small amounts. Ingestion of chromium in high amounts can cause organ damage, stomach ulcers, vomiting, and heart problems.

628. **Figure 3.1.47** shows the graphical presentation of the levels of chromium hexavalent in ten (10) sampling stations. As shown, levels of chromium hexavalent were not detected in stations S03, S04, S07, S09, and S10. In Stations S01, S02, S05, S06, levels of chromium hexavalent were detected and are within the Dutch target value. The highest level of chromium hexavalent was detected in Station S05 (Sucat) at 10 mg/kg.

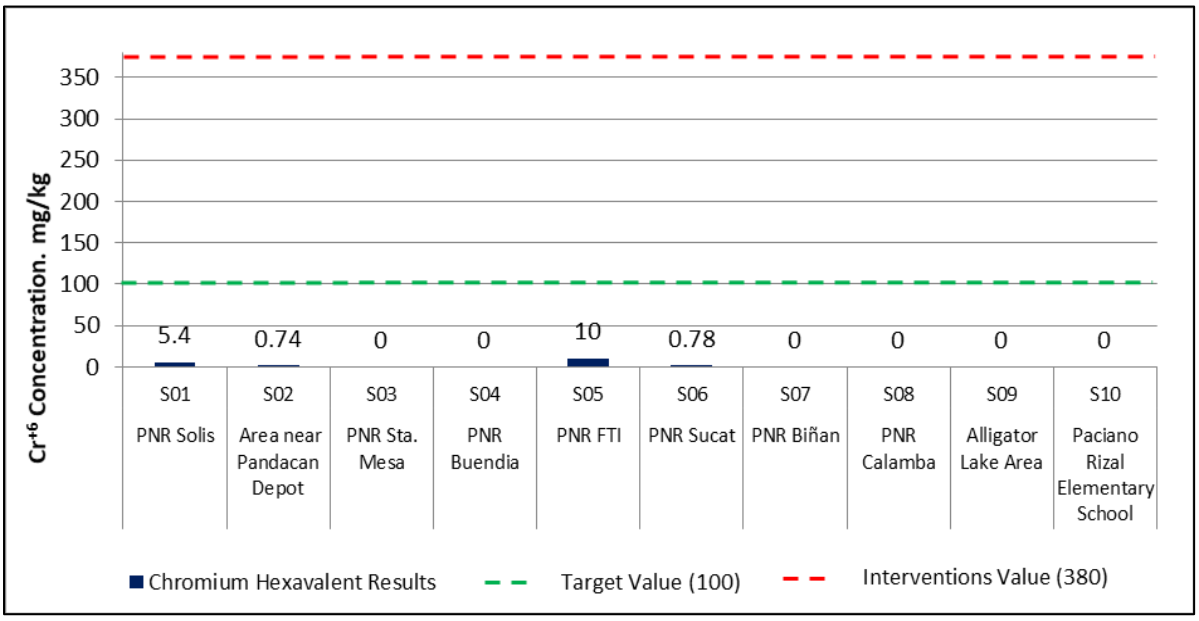


Figure 3.1.47 Results of Chromium Hexavalent Measurement of Soil Samples

3.1.3.4. Soil Quality (Soil Contamination)

629. Soil contamination or pollution is defined as the presence of toxic chemicals (pollutants or contaminants) in soil, in high enough concentrations to pose a risk to human health and/or the ecosystem. In the case of contaminants which occur naturally in soil, even when their levels are not high enough to pose a risk, soil pollution is still said to occur if the levels of contaminants in soil exceed the levels that should naturally be present.

630. Two (2) sites were identified for soil contamination assessment including Sucat Thermal Power Plant (STPP) area for the proposed Sucat Station/ Depot and the agricultural area in Banlic, Calamba City for the proposed Banlic Depot.

(1) Field Survey

631. Soil samples were collected on March 23, 2018 at one (1) station (SC01) at the proposed Banlic Depot and also one (1) station (SSR01) at the proposed Sucat Station/ Depot on August 20, 2018. The soil samples were submitted to Mach Union Laboratory, Inc. for analysis for levels of pH, Arsenic (As), Barium (Ba), Copper (Cu), Zinc (Zn), Iron (Fe), Cadmium (Cd), Chromium (Cr), Lead (Pb), Manganese (Mn), Mercury (Hg), Selenium (Se), Nickel (Ni), Oil and Grease (O&G), and Cyanide (CN).

632. Additional samples were collected at four (4) stations for the proposed Banlic Depot and eight (8) stations at the proposed Sucat Station/Depot which were established during the detailed design phase of the Project. Soil samples were collected on April 06 - 07, 2019 at the proposed Banlic Depot and on April 08 - 12, 2019 at the eight (8) for the proposed Sucat Station/Depot. The samples were submitted to Mach Union Laboratory, Inc. to be analyzed for levels of pH, Arsenic (As), Barium (Ba), Copper (Cu), Zinc (Zn), Iron (Fe), Cadmium (Cd), Chromium (Cr), Lead (Pb), Manganese (Mn), Mercury (Hg), Selenium (Se), Nickel (Ni), Oil and Grease (O&G), Cyanide (CN) and Polychlorinated Biphenyls (PCBs).

633. **Table 3.1.13** describes the location and date of soil sampling conducted for the Project as shown in **Figure 3.1.48**.

Table 3.1.13 Location and Date of Sampling for Soil Contamination Assessment

Sampling Stations		Date of Sampling
Location	**Coordinates**	
FS Study		
SC01	14°13'38.48"N, 121° 9'31.55"E	March 23, 2018
SSR01	14°27’04.32” N, 121°03’08.28” E	August 20, 2018
Detailed Design Phase		
Banlic DD SS1	14°13’23” N, 121°09’19” E	April 7, 2019
Banlic DD SS2	14°13’26” N, 121°09’29” E	April 6-7, 2019
Banlic DD SS3	14°13’30” N, 121°09’37” E	April 6, 2019
Banlic DD SS4	14°13’35” N, 121°09’48” E	April 6, 2019
STPP DD SS1	14°26’53.05” N, 121°03’04.45” E	April 12, 2019
STPP DD SS2	14°26’52.79” N, 121°03’05.65” E	April 8, 2019
STPP DD SS3	14°26’58.86” N, 121°03’06.22” E	April 11, 2019
STPP DD SS4	14°27’01.48” N, 121°03’07.02” E	April 10, 2019
STPP DD SS5	14°27’3.32” N, 121°03’07.23” E	April 12, 2019
STPP DD SS6	14°27’5.43” N, 121°03’07.41” E	April 10-11, 2019
STPP DD SS7	14°27’7.38” N, 121°03’07.32” E	April 10, 2019
STPP DD SS8	14°27’7.41” N, 121°03’08.04” E	April 8, 2019

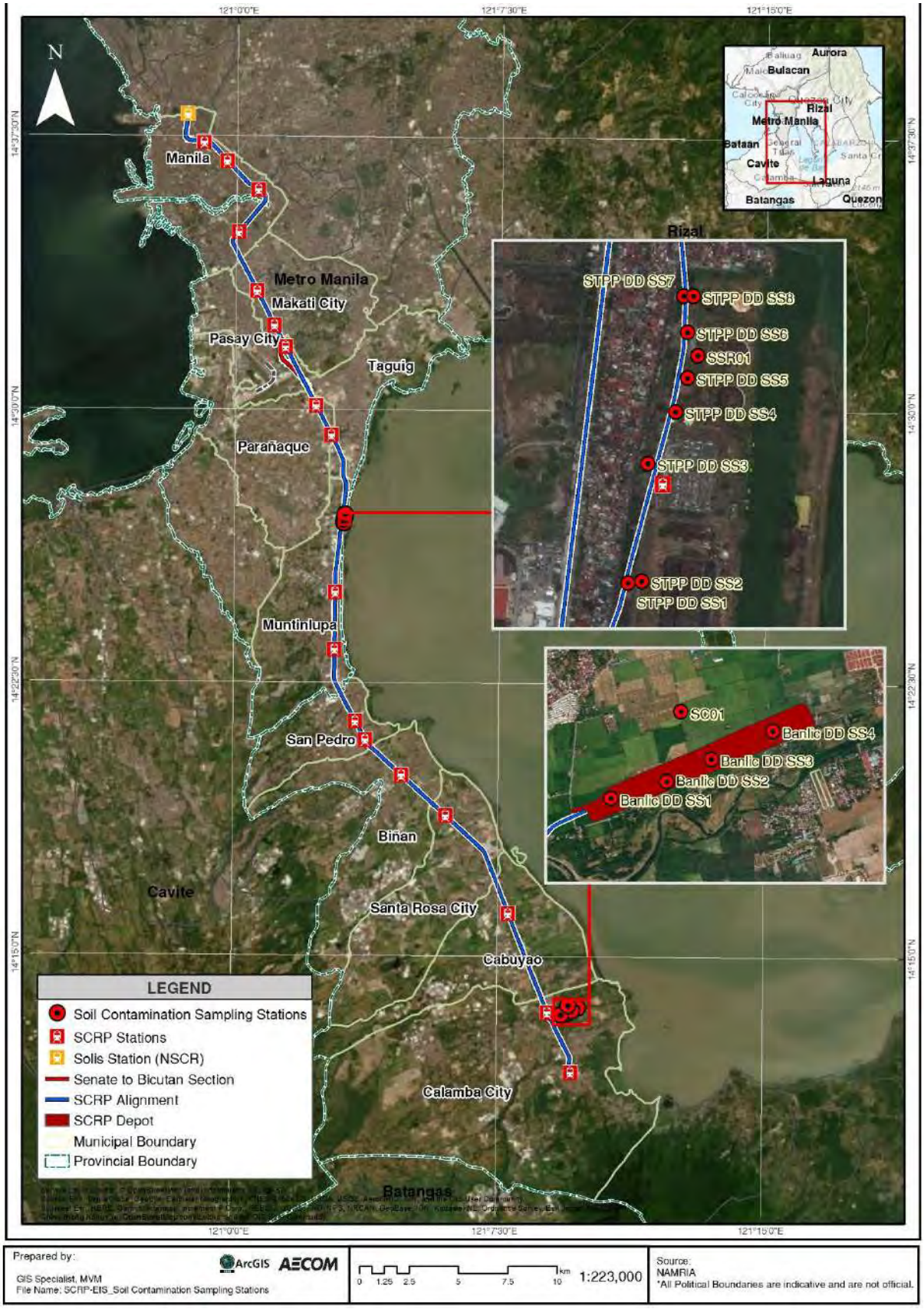


Figure 3.1.48 Soil Contamination Sampling Stations

(2) Applied Standard

634. The Dutch Target and Intervention Values, 2000 (the New Dutch List) was adopted for soil contamination assessment.

(3) Results and Analysis

635. **Table 3.1.14** shows the results of analysis of soil samples collected at eight (8) sampling stations at the proposed Sucat Station and four (4) sampling stations at the proposed Banlic Depot.

Table 3.1.14 Results of Soil Contamination Sampling in the Proposed Sucat Station and Proposed Banlic Depot

Parameter	STPP DD SS1	STPP DD SS2	STPP DD SS3	STPP DD SS4	STPP DD SS5	STPP DD SS6	STPP DD SS7	STPP DD SS8	Banlic DD SS1	Banlic DD SS2	Banlic DD SS3	Banlic DD SS4	TV (in mg/kg)	IV (in mg/kg)	Standard[2] (in mg/kg)
	Sampling Stations												New Dutch List		
pH	8.42	7.77	8.69	8.08	8.67	8.43	8.25	8.11	7.53	7.78	7.7	7.23	-	-	-
Arsenic (As), mg/kg	3.55	3.53	2.23	2.74	4.90	5.53	6.19	6.72	2.11	2.39	2.89	2.10	29	55	-
Barium (Ba), mg/kg	132	152	123	141	155	201	229	202	140	153	151	157	160	625	-
Copper (Cu), mg/kg	48.5	63.1	29.7	52.9	36.6	52.8	44.1	42.4	58.2	63.2	76.3	64.2	36	190	-
Zinc (Zn), mg/kg	738	233	236	190	227	560	316	149	142	156	178	146	140	720	-
Cadmium (Cd), mg/kg	1.23	1.13	0.743	1.13	1.38	1.92	1.44	1.46	0.567	0.685	0.678	0.856	0.8	12	-
Chromium (Cr), mg/kg	17.3	23.9	9.70	18.5	16.7	17.7	12.7	19.8	5.11	4.79	5.06	5.46	100	380	-
Lead (Pb), mg/kg	11.9	13.7	4.49	7.56	87.4	82	10.8	1.95	5.69	3.83	4.59	<0	85	530	-
Mercury (Hg), mg/kg	0.1705	0.1789	0.0573	0.0907	0.1975	0.0808	0.1128	0.1121	0.1054	0.139	0.2196	0.1004	0.3	10	-
Selenium (Se), mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.7	100[1]	-
Nickel (Ni), mg/kg	46.2	76.1	14.1	10.4	11.9	10.5	7.93	3.23	0.667	0.532	0.911	0.412	35	210	-
Cyanide (Cn)- Free, µg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1	20	-
Oil and Grease (O&G), mg/L	1.04	0.954	0.479	0.598	1.86	1.22	1.26	2.44	0.656	0.654	0.738	1.06	-	-	-
Iron (Fe), mg/kg	20,598	23,109	15,710	23,138	27,266	31,777	30,539	29,414	13,637	16,186	15,423	19,183	-	-	3,000-100,000
Manganese (Mn), mg/kg	508	875	596	826	1,420	1,603	1,503	1,711	821	762	949	859	-	-	30-5,000
Polychlorinated Biphenyls (PCBs)															
Aroclor 1016, µg/L	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	-	-	-
Aroclor 1221, µg/L	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	-	-	-
Aroclor 1232, µg/L	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	-	-	-
Aroclor 1242, µg/L	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	-	-	-
Aroclor 1248, µg/L	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	-	-	-
Aroclor 1254, µg/L	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	-	-	-
Aroclor 1260, µg/L	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	-	-	-
Aroclor 1262, µg/L	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	-	-	-
Aroclor 1268, µg/L	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	-	-	-

1) Results by Parameter

pH

636. The pH levels in the soil samples collected at eight (8) sampling stations in the proposed Sucat Station range from 7.77 to 8.69 (**Figure 3.1.49**). The lowest level was measured in STPP DD SS2 while the highest level was measured in STPP DD SS3.

637. The pH levels in the soil samples collected at four (4) sampling stations in the proposed Banlic Depot range from 7.23 to 7.78. The lowest level was measured in Banlic DD SS4 while the highest concentration was measured in Banlic DD SS2.

638. The New Dutch List has no standard value for pH in soils.

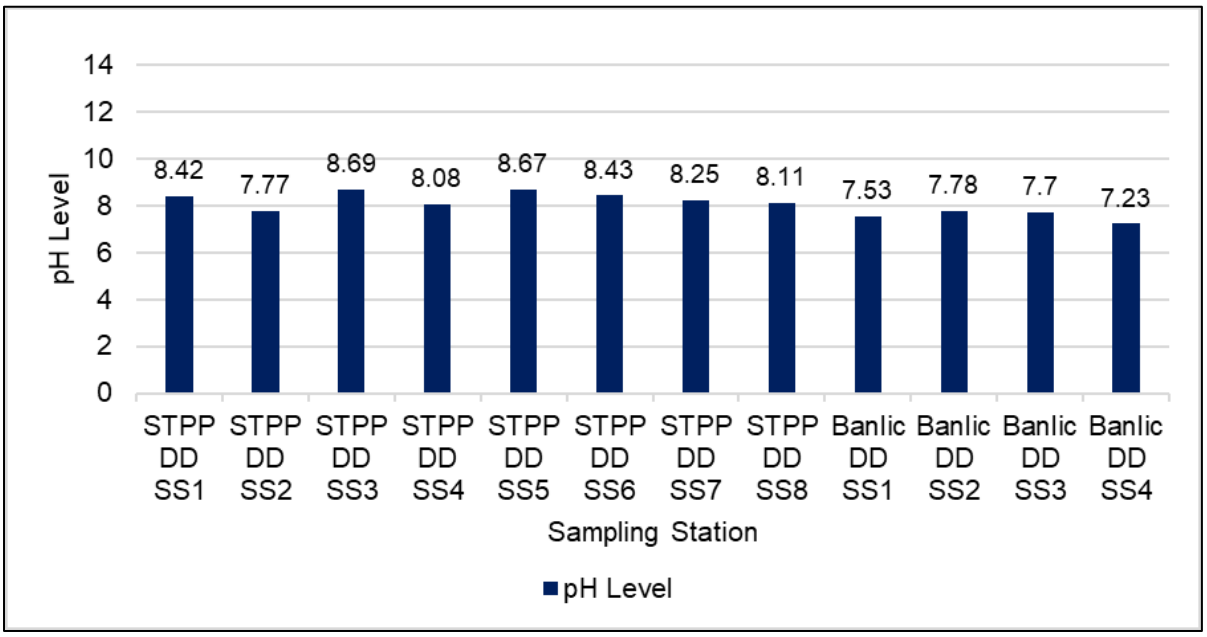


Figure 3.1.49 Results of pH Measurement of Soil Samples

Arsenic

639. Arsenic concentrations in the soil samples collected at eight (8) sampling stations in the proposed Sucat Station range from 2.23 mg/kg to 6.72 mg/kg, which levels did not exceed the Dutch intervention value of 55 mg/kg (**Figure 3.1.50**). The lowest concentration was measured in STPP DD SS3 while the highest concentration was measured in STPP DD SS8.

640. Arsenic concentrations in the soil samples collected at four (4) sampling stations in the proposed Banlic Depot range from 2.1 mg/kg to 2.89 mg/kg, which levels did not exceed the Dutch intervention value of 55 mg/kg. The lowest concentration was measured in Banlic DD SS4 while the highest concentration was measured in Banlic DD SS3.

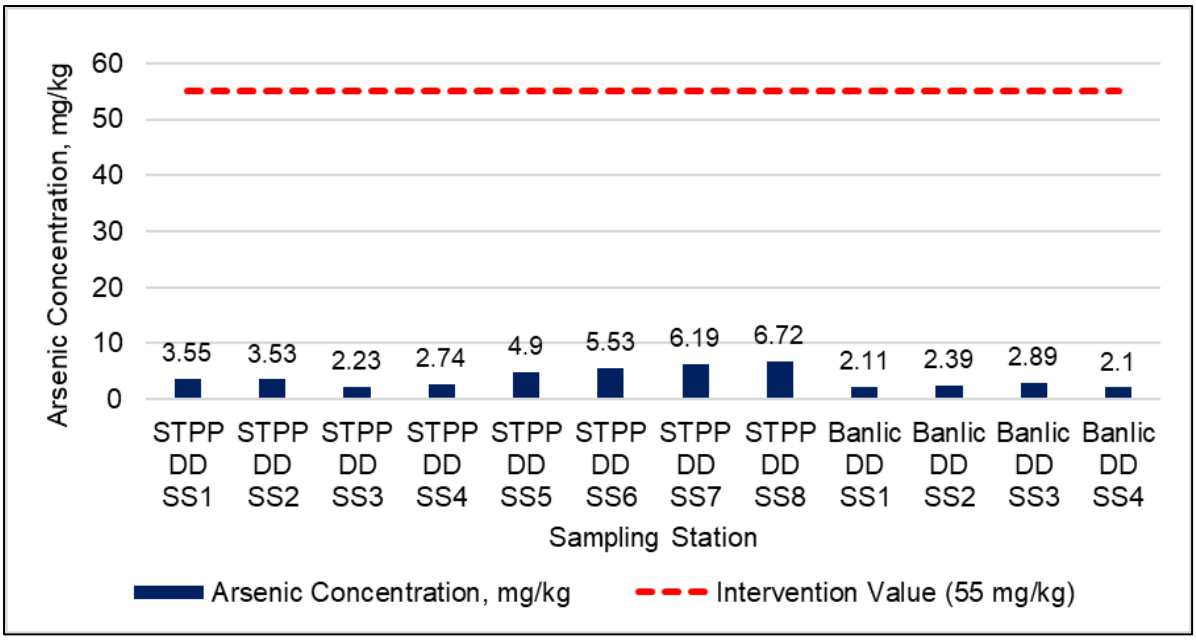


Figure 3.1.50 Results of Arsenic Measurement of Soil Samples

Barium

641. Barium concentrations in the soil samples collected at eight (8) sampling stations in the proposed Sucat Station range from 123 mg/kg to 229 mg/kg, which levels did not exceed the Dutch intervention value of 625 mg/kg (**Figure 3.1.51**). The lowest concentration was measured in STPP DD SS3 while the highest concentration was measured in STPP DD SS7.

642. Barium concentrations in the soil samples collected at the proposed Banlic Depot range from 140 mg/kg to 157 mg/kg, which levels did not exceed the Dutch intervention value of 625 mg/kg. The lowest concentration was measured in Banlic DD SS1 while the highest concentration was measured in Banlic DD SS4.

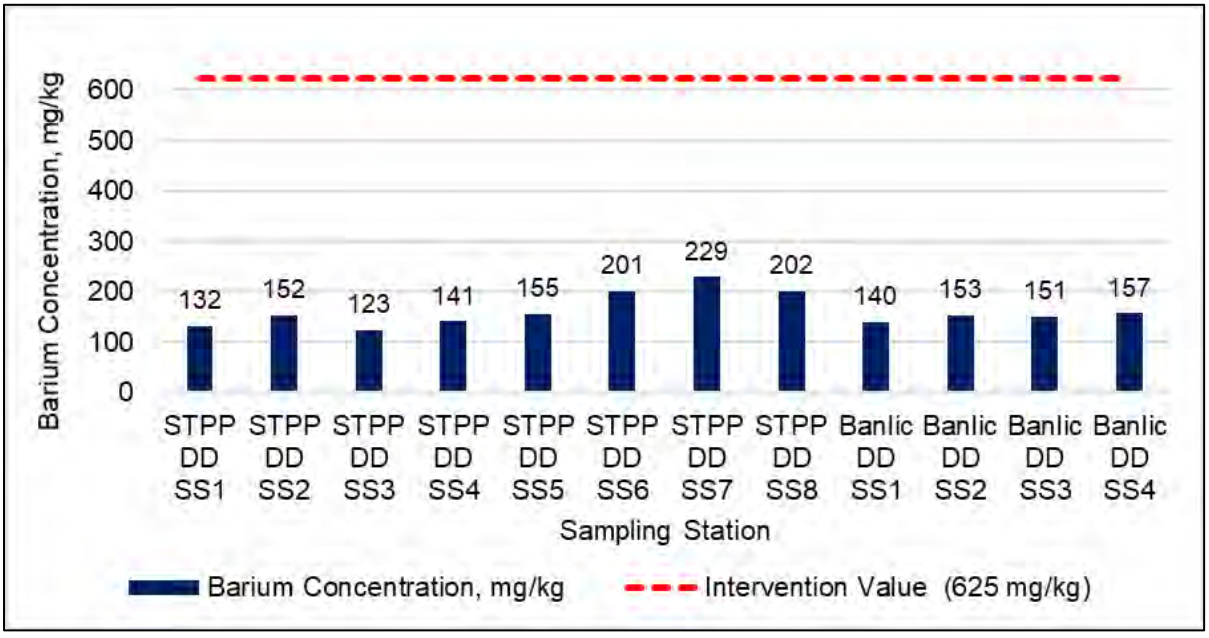


Figure 3.1.51 Results of Barium Measurement of Soil Samples

Copper

643. Copper concentrations in the soil samples collected at eight (8) sampling stations in the proposed Sucat Station range from 29.7 mg/kg to 63.1 mg/kg, which levels did not exceed the Dutch intervention value of 190 mg/kg (**Figure 3.1.52**). The lowest concentration was measured in STPP DD SS3 while the highest concentration was measured in STPP DD SS2.

644. Copper concentrations in the soil samples collected at the proposed Banlic Depot range from 58.2 mg/kg to 76.3 mg/kg, which levels did not exceed the Dutch intervention value of 190 mg/kg. The lowest concentration was measured in Banlic DD SS1 while the highest concentration was measured in Banlic DD SS3.

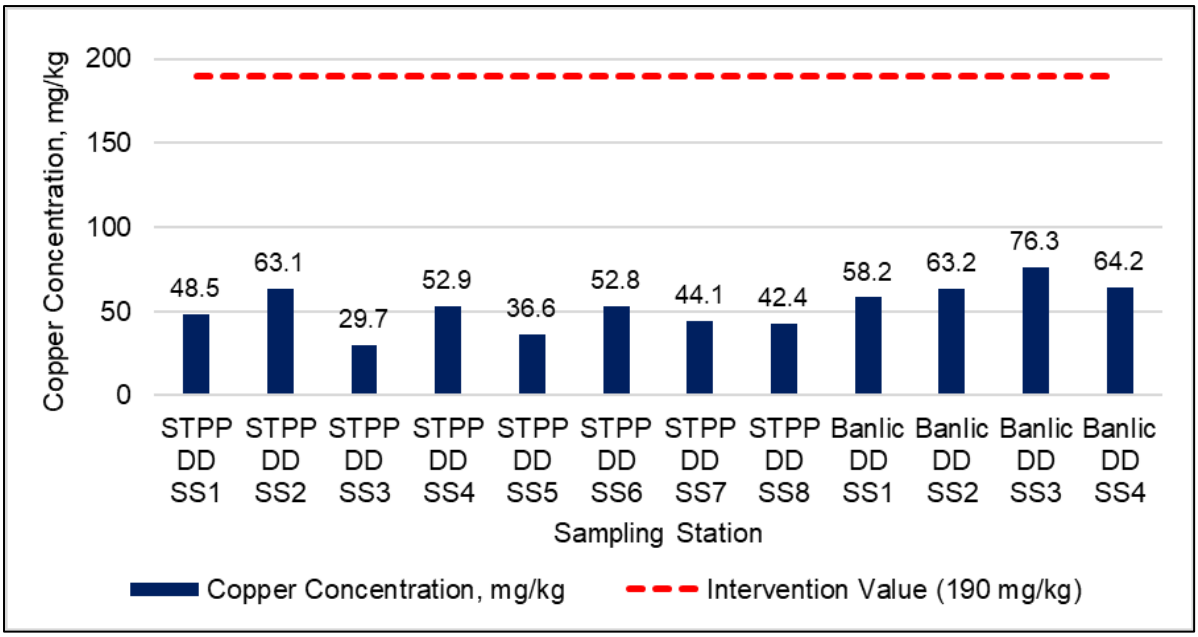


Figure 3.1.52 Results of Copper Measurement of Soil Samples

Zinc

645. Zinc concentrations in the soil samples collected at eight (8) sampling stations in the proposed Sucat Station range from 149 mg/kg to 738 mg/kg, which levels are slightly higher than the Dutch target value of 140 mg/kg but did not exceed the Dutch intervention value of 720 mg/kg except in STPP DD SS1 (**Figure 3.1.53**). The lowest concentration was measured in STPP DD SS8 while the highest concentration was measured in STPP DD SS1.

646. Zinc concentrations in the soil samples collected at the proposed Banlic Depot range from 142 mg/kg to 178 mg/kg, which levels are slightly higher than the Dutch target value of 140 mg/kg but did not exceed the Dutch intervention value of 720 mg/kg. The lowest concentration was measured in Banlic DD SS1 while the highest concentration was measured in Banlic DD SS3.

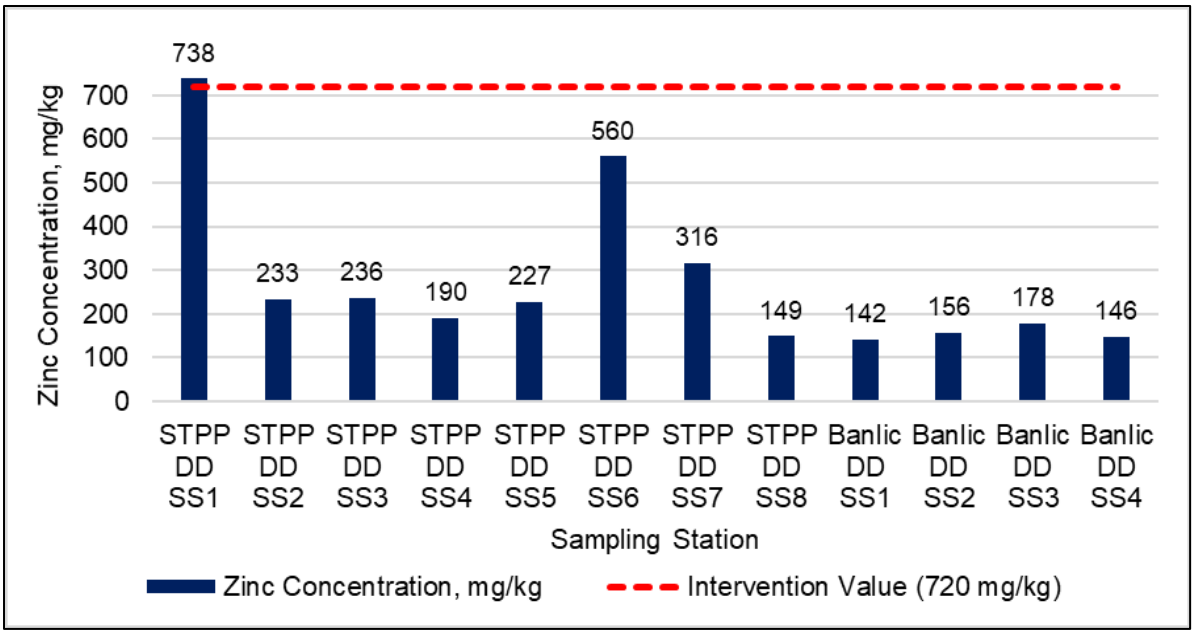


Figure 3.1.53 Results of Zinc Measurement of Soil Samples

Cadmium

647. Cadmium concentrations in the soil samples collected at eight (8) sampling stations in the proposed Sucat Station range from 0.743 mg/kg to 1.92 mg/kg, which levels did not exceed the Dutch intervention value of 12 mg/kg (**Figure 3.1.54**). The lowest concentration was measured in STPP DD SS3, while the highest concentration was measured in STPP DD SS6.

648. Cadmium concentrations in the soil samples collected at the proposed Banlic Depot range from 0.567 mg/kg to 0.856 mg/kg, which levels did not exceed the Dutch intervention value of 12 mg/kg. The lowest concentration was measured in Banlic DD SS1 while the highest concentration was measured in Banlic DD SS4.

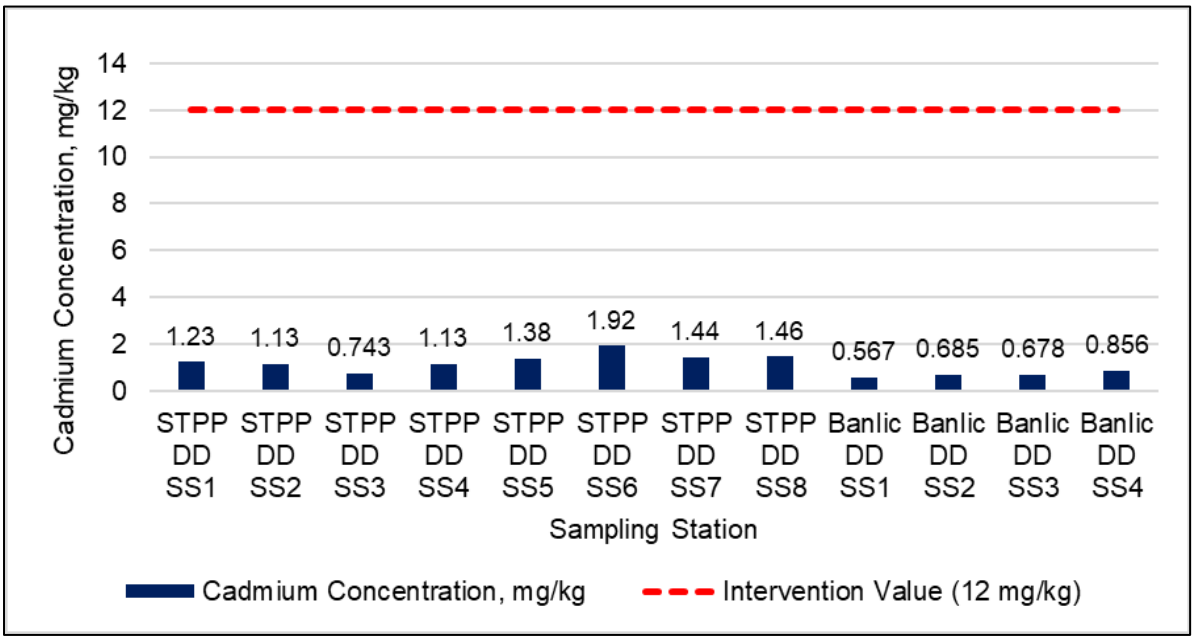


Figure 3.1.54 Results of Cadmium Measurement of Soil Samples

Chromium

649. Chromium concentrations in the soil samples collected at eight (8) sampling stations in the proposed Sucat Station range from 9.70 mg/kg to 23.9 mg/kg, which levels did not exceed the Dutch intervention value of 380 mg/kg (**Figure 3.1.55**). The lowest concentration was measured in STPP DD SS3 while the highest concentration was measured in STPP DD SS2.

650. Chromium concentrations in the soil samples collected at the proposed Banlic Depot range from 4.79 mg/kg to 5.46 mg/kg, which levels did not exceed the Dutch intervention value of 380 mg/kg. The lowest concentration was measured in Banlic DD SS2 while the highest concentration was measured in Banlic DD SS4.

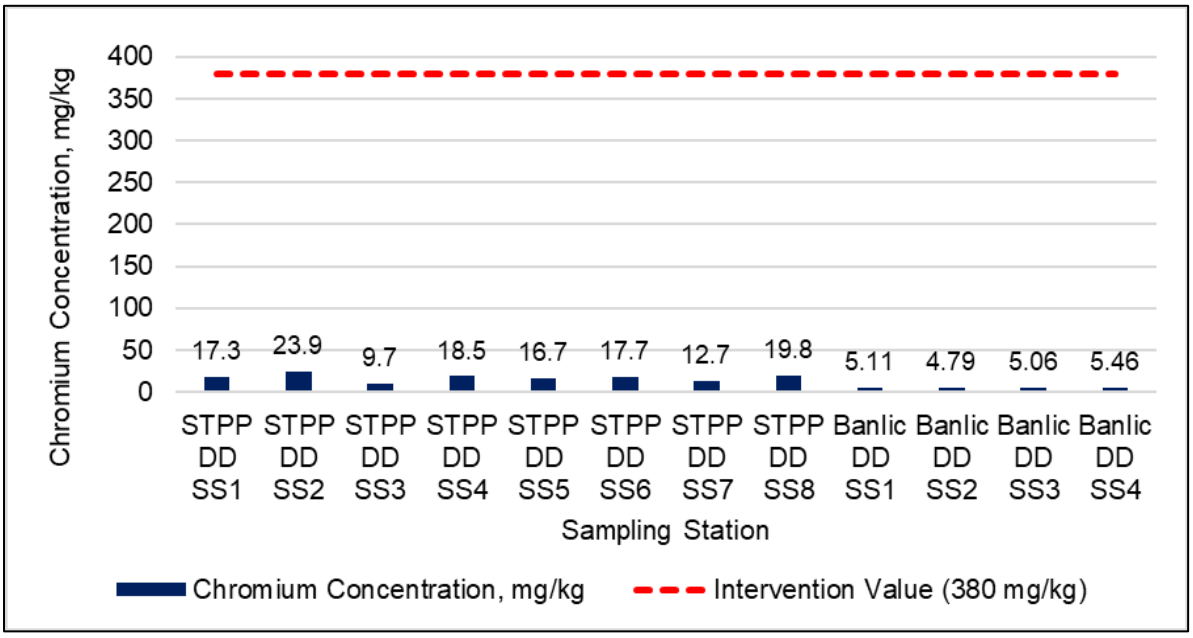


Figure 3.1.55 Results of Chromium Measurement of Soil Samples

Lead

651. Lead concentrations in the soil samples collected at eight (8) sampling stations in the proposed Sucat Station range from 1.95 mg/kg to 87.4 mg/kg, which levels did not exceed the Dutch intervention value of 530 mg/kg (**Figure 3.1.56**). The lowest concentration was measured in STPP DD SS8 while the highest concentration was measured in STPP DD SS5.

652. Lead concentrations in the soil samples collected at the proposed Banlic Depot range from 0 mg/kg to 5.69 mg/kg, which levels did not exceed the Dutch intervention value of 530 mg/kg. The lowest concentration was measured in Banlic DD SS4 while the highest concentration was measured in Banlic DD SS1.

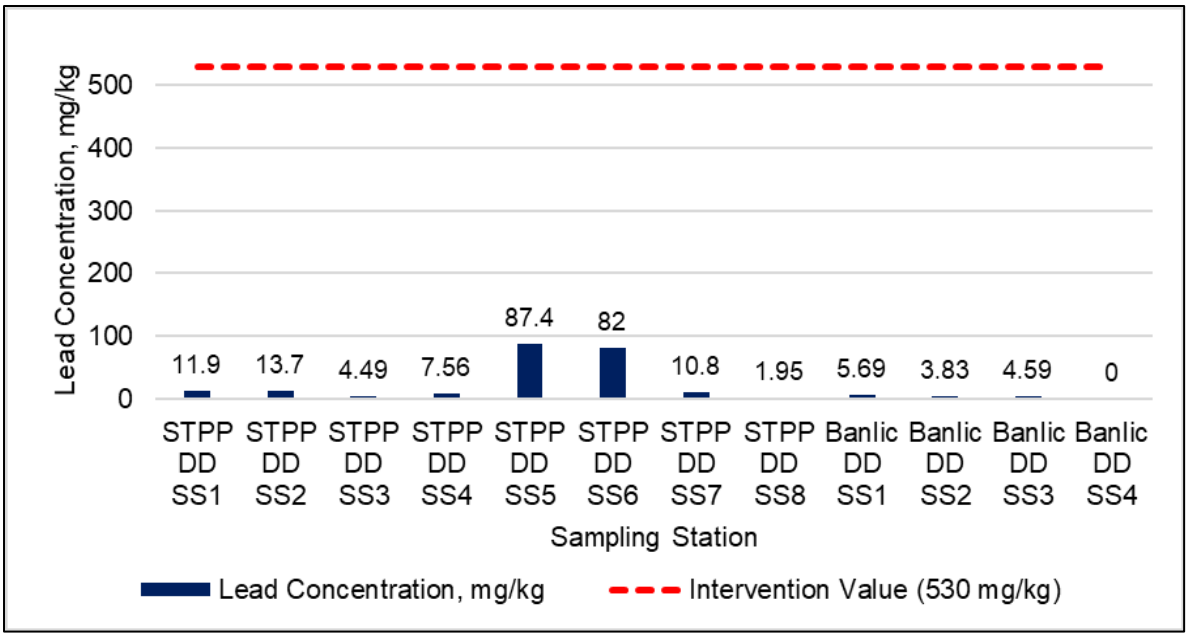


Figure 3.1.56 Results of Lead Measurement of Soil Samples

Mercury

653. Mercury concentrations in the soil samples collected at eight (8) sampling stations in the proposed Sucat Station range from 0.0573 mg/kg to 0.1975 mg/kg, which levels did not exceed the Dutch intervention value of 10 mg/kg (**Figure 3.1.57**). The lowest concentration was measured in STPP DD SS3 while the highest concentration was measured in STPP DD SS5.

654. Mercury concentrations in the soil samples collected at the proposed Banlic Depot range from 0.1004 mg/kg to 0.2196 mg/kg, which did levels not exceed the Dutch intervention value of 10 mg/kg. The lowest concentration was measured in Banlic DD SS4 while the highest concentration was measured in Banlic DD SS3.

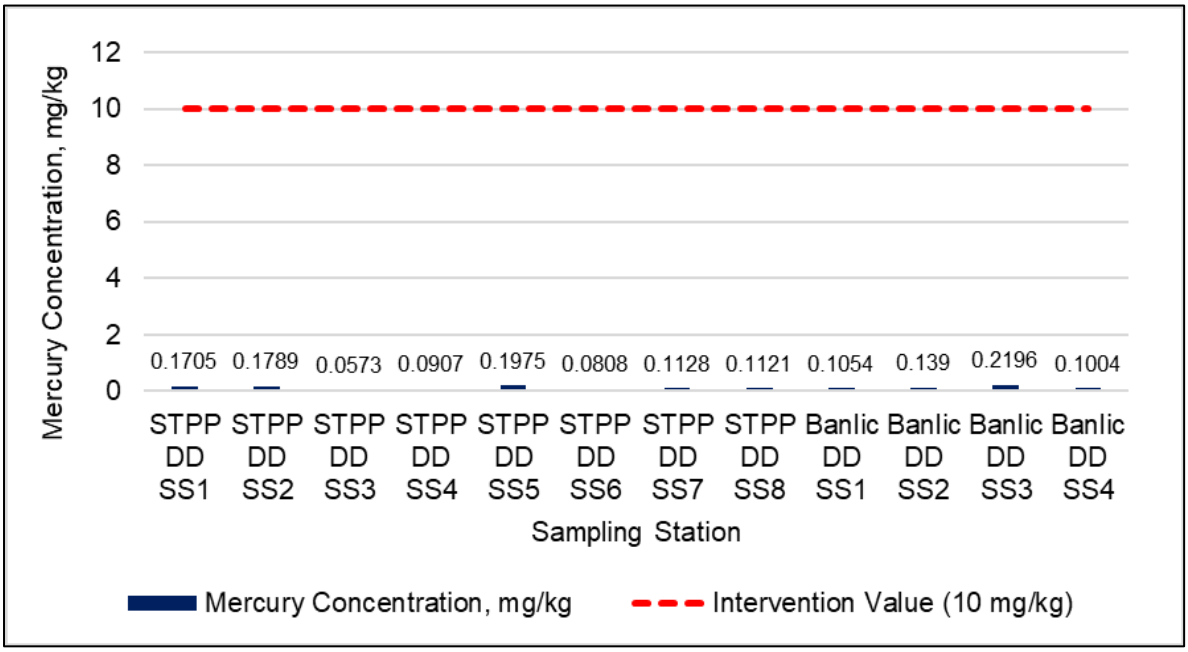


Figure 3.1.57 Results of Mercury Measurement of Soil Samples

Selenium

655. Selenium concentrations in the soil samples collected in all eight (8) sampling stations at the proposed Sucat Station and four (4) stations at the proposed Banlic Depot are <0.4 mg/kg, which levels did not exceed the Dutch intervention value of 100 mg/kg (**Figure 3.1.58**).

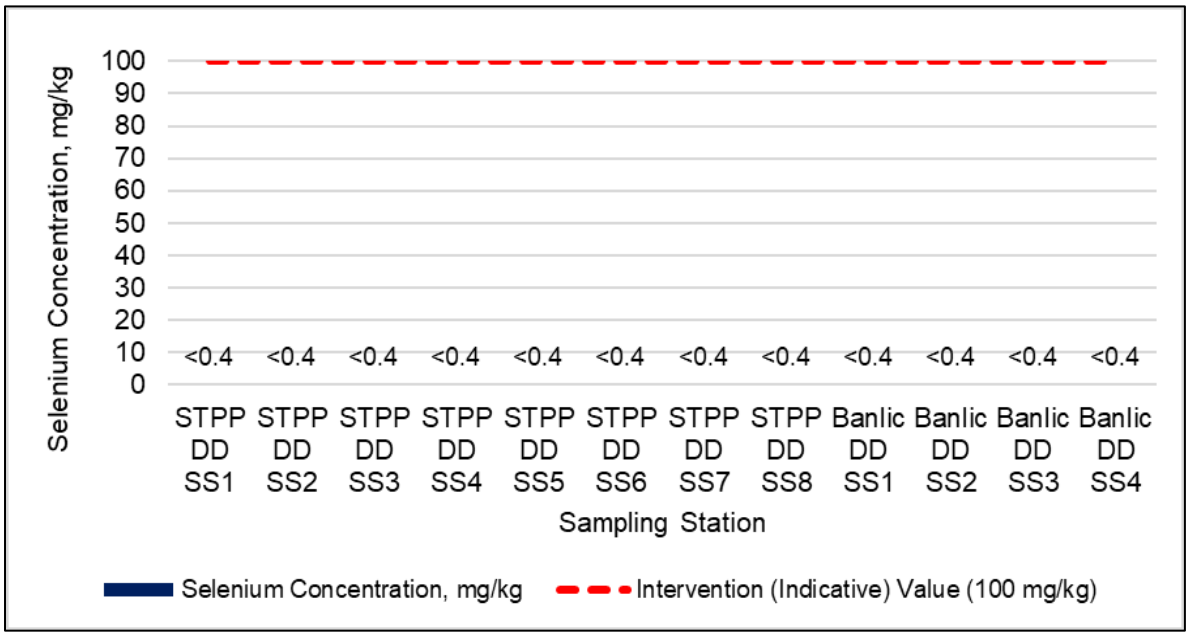


Figure 3.1.58 Results of Selenium Measurement of Soil Samples

Nickel

656. Nickel concentrations in the soil samples collected at eight (8) sampling stations in the proposed Sucat Station range from 3.23 mg/kg to 76.1 mg/kg, which levels did not exceed the New Dutch List's intervention value of 210 mg/kg (**Figure 3.1.59**). The lowest concentration was measured in STPP DD SS8 while the highest concentration was measured in STPP DD SS2.

657. Nickel concentrations in the soil samples collected at the proposed Banlic Depot range from 0.412 mg/kg to 0.911 mg/kg, which levels did not exceed the Dutch intervention value of 210 mg/kg. The lowest concentration was measured in Banlic DD SS4 while the highest concentration was measured in Banlic DD SS3.

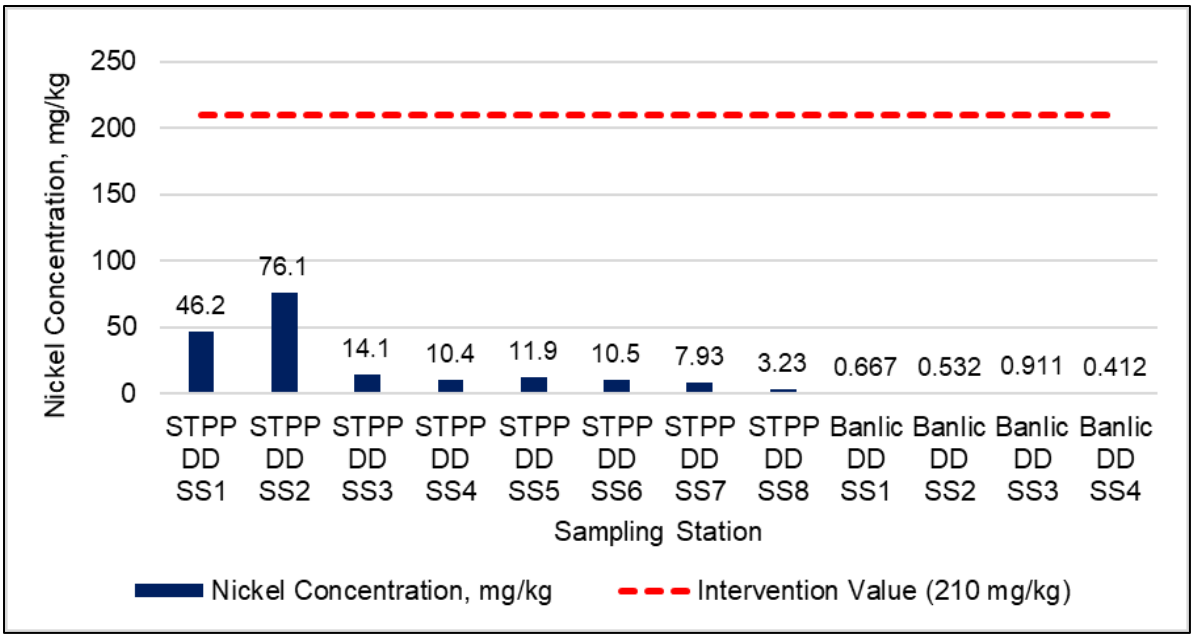


Figure 3.1.59 Results of Nickel Measurement of Soil Samples

Cyanide-Free

658. Cyanide-free concentrations in the soil samples collected in all eight (8) stations at the proposed Sucat Station and four (4) stations in the proposed Banlic Depot are <0.01 µg/kg, which levels did not exceed the Dutch intervention value of 20,000 µg/kg (**Figure 3.1.60)**.

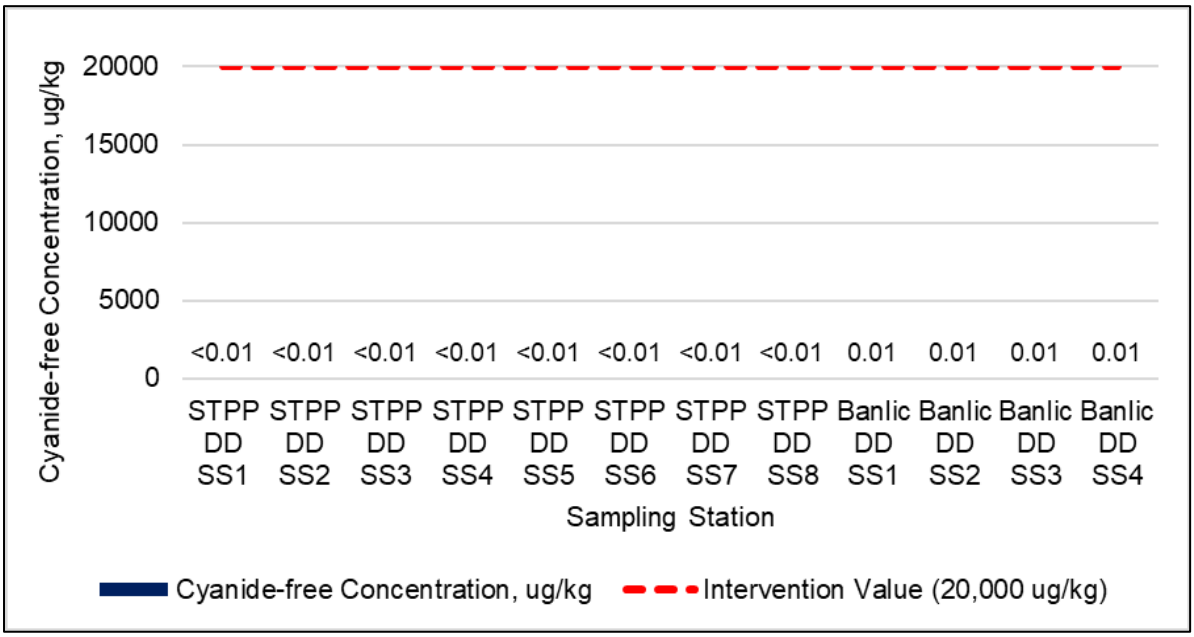


Figure 3.1.60 Results of Nickel Measurement of Soil Samples

Iron

659. Iron concentrations in the soil samples collected at eight (8) sampling stations in the proposed Sucat Station range from 15,710 mg/kg to 31,777 mg/kg, which levels are within the Leeper standard range of 3,000-100,000 mg/kg (**Figure 3.1.61**). The lowest

concentration was measured in STPP DD SS3 while the highest concentration was measured in STPP DD SS6.

660. Iron concentrations in the soil samples collected at the proposed Banlic Depot range from 13,637 mg/kg to 19,183 mg/kg, which levels are within the Leeper standard range of 3,000-100,000 mg/kg. The lowest concentration was measured in Banlic DD SS1 while the highest concentration was measured in Banlic DD SS4.

661. The New Dutch List has no standard value for Iron.

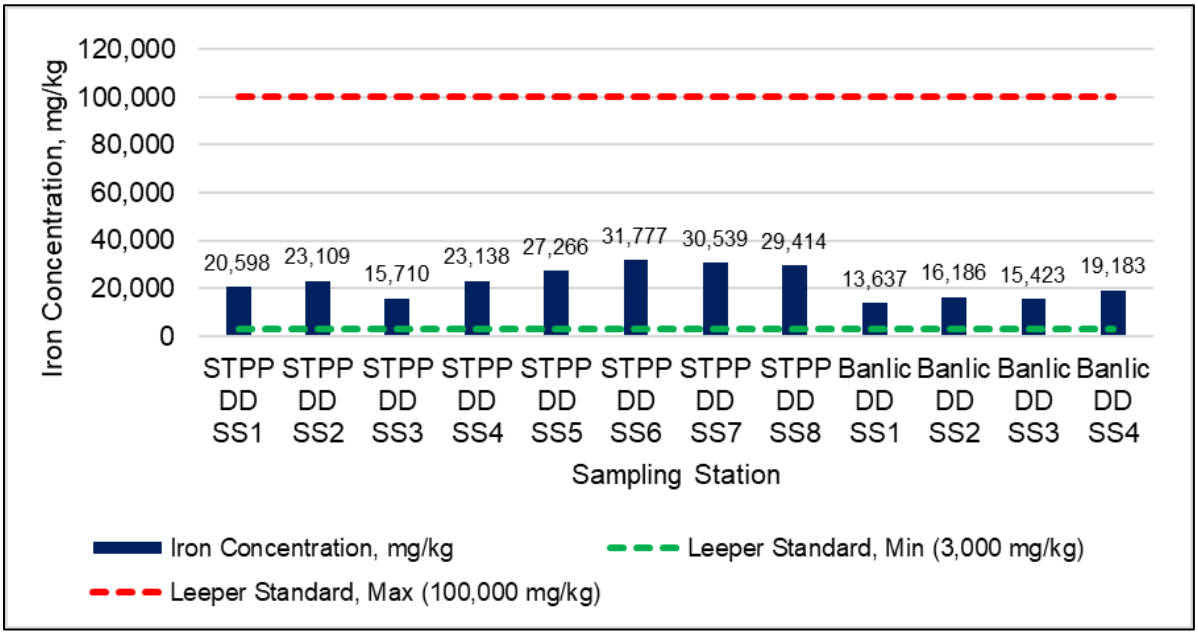


Figure 3.1.61 Results of Iron Measurement of Soil Samples

Manganese

662. Manganese concentrations in the soil samples collected at eight (8) sampling stations in the proposed Sucat Station range from 508 mg/kg to 1,711 mg/kg, which levels did not exceed the Leeper standard range of 30-5,000 mg/kg (**Figure 3.1.62**). The lowest concentration was measured in STPP DD SS1 while the highest concentration was measured in STPP DD SS8.

663. Manganese concentrations in the soil samples collected at the proposed Banlic Depot range from 762 mg/kg to 949 mg/kg, which levels did not exceed the Leeper standard of 30-5,000 mg/kg. The lowest concentration was measured in Banlic DD SS2 while the highest concentration was measured in Banlic DD SS3.

664. The New Dutch List has no standard value for Manganese.

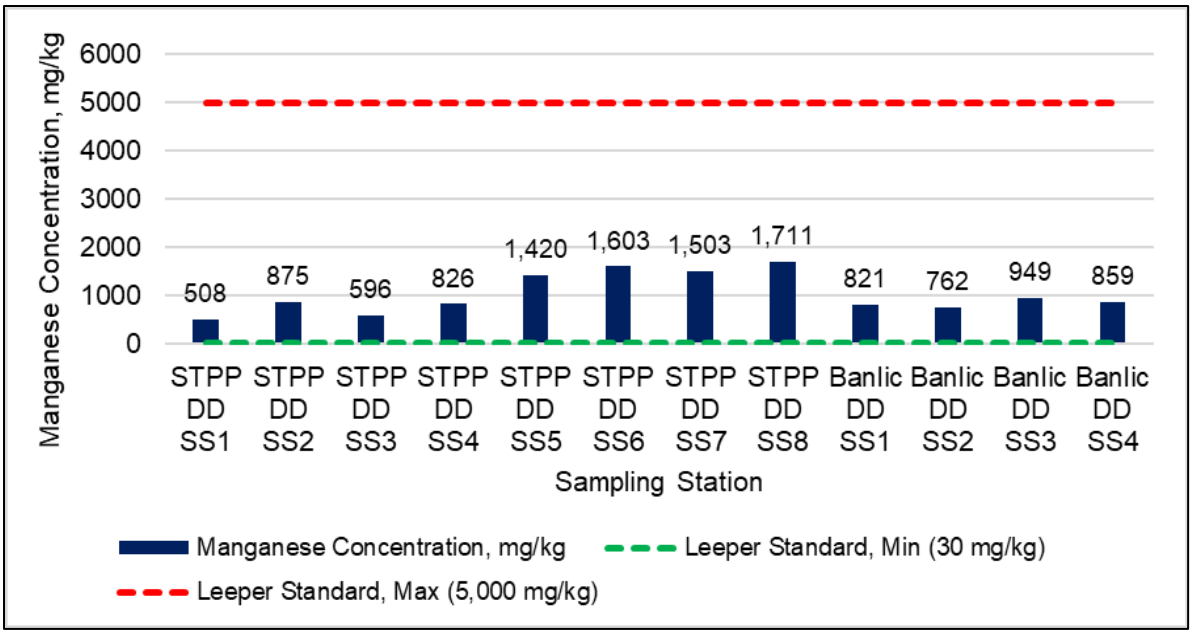


Figure 3.1.62 Results of Manganese Measurement of Soil Samples

Oil and Grease

665. Oil and Grease levels in the soil samples collected at the proposed Sucat Station range from 0.479 to 2.44 mg/L, with the lowest concentration measured in STPP DD SS2 while the highest concentration was measured in STPP DD SS8 (**Figure 3.1.63**).

666. Oil and Grease levels in the soil samples collected at the proposed Banlic Depot range from 0.654 to 1.06 mg/L, with the lowest concentration measured in Banlic DD SS2 while the highest concentration was measured in Banlic DD SS4.

667. The New Dutch List has no standard for Oil and Grease.

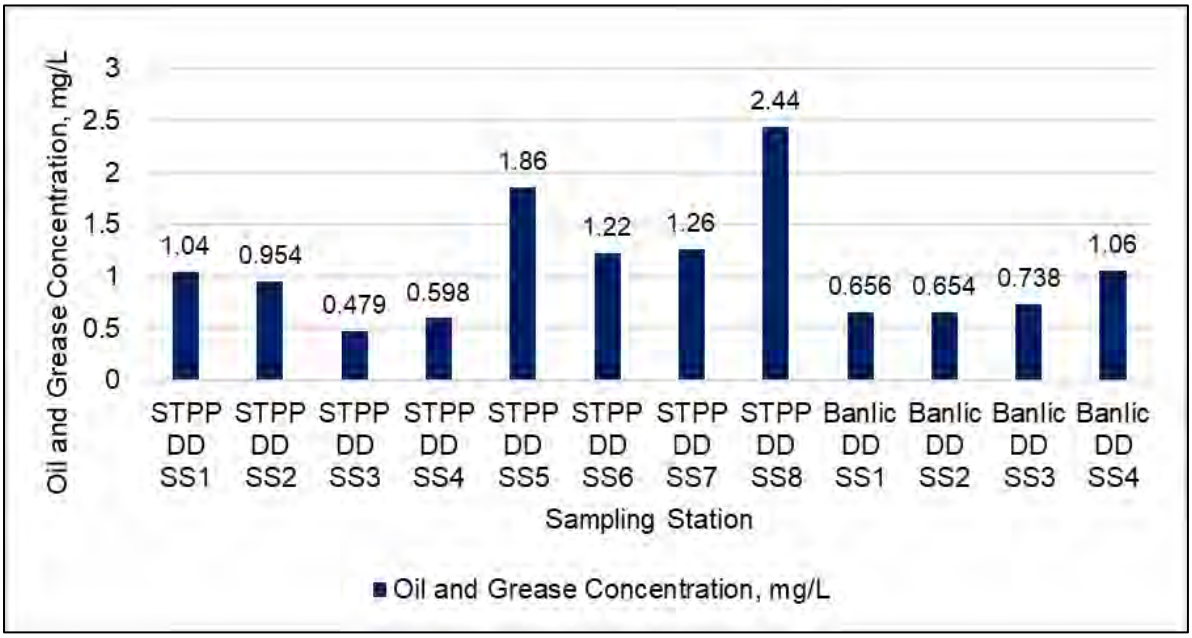


Figure 3.1.63 Results of Oil and Grease Measurement of Soil Samples

Polychlorinated Biphenyls

668. The concentrations of PCBs (as Aroclors) which are commercial mixtures containing different amounts of PCBs, in the soil samples collected in all stations at the proposed Sucat Station and proposed Banlic Depot are <0.04 µg/L.

669. The New Dutch List has no standard value for PCBs (as Aroclors).

2) Potential Soil Contamination Along the SCRP Interconnection

670. Fuel, oil, and grease that may spill from vehicles, machinery and heavy equipment during the construction of the project. Accidental leaks of chemical substances may contaminate the surrounding soil. Domestic and industrial wastes, if not managed properly, are also a potential source of soil contamination.

671. A walkthrough survey was conducted from February – March 2020 to identify potential contamination sources within a 500-m radius from the proposed alignment of the SCRP interconnecting line. The survey mainly focused on gasoline stations, auto repair shops, and factories. Sixty two (62) of such sources were identified, shown in **Figure 3.1.64.**

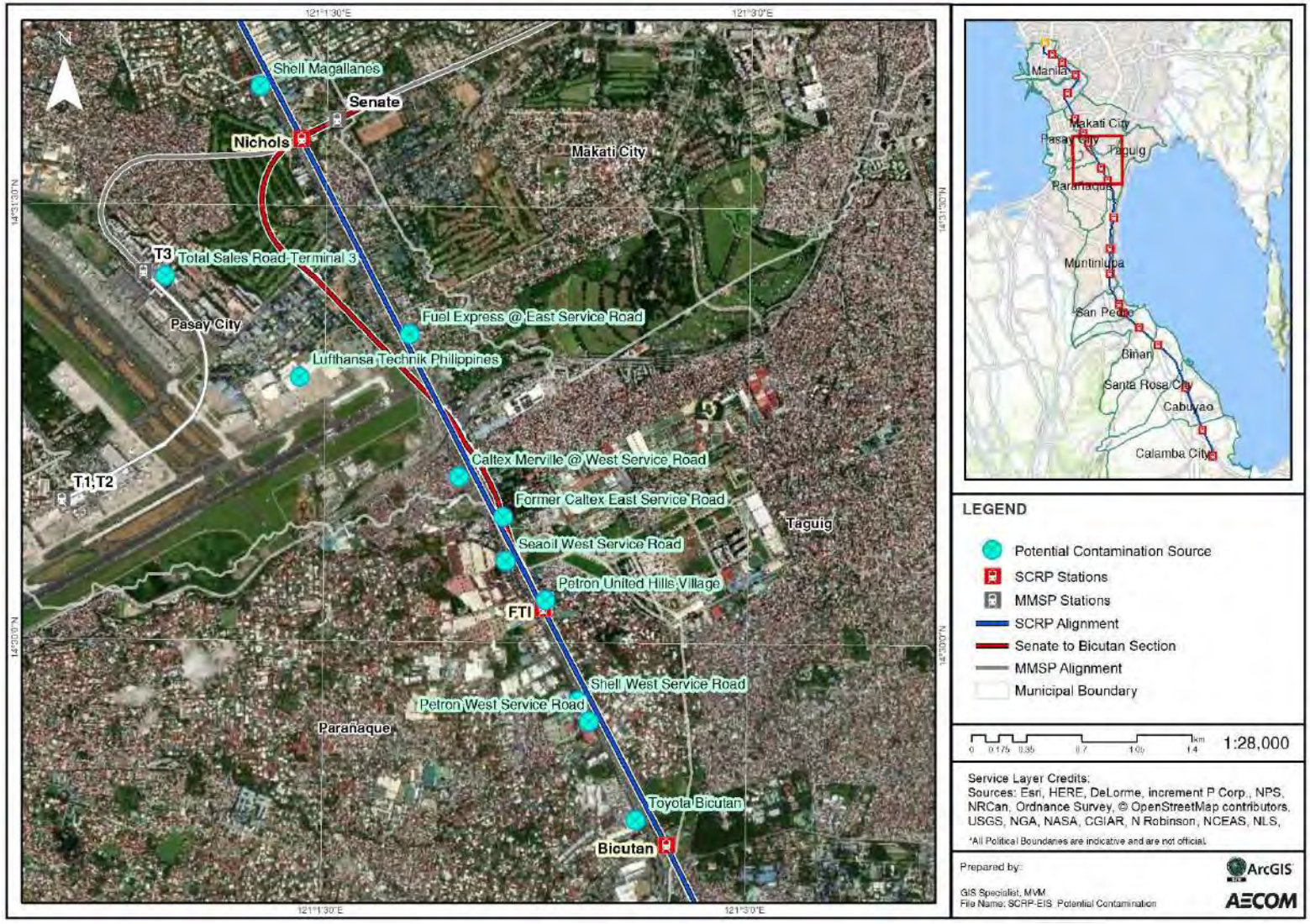


Figure 3.1.64 Potential Sources of Contamination within 500 m from the SCRP Interconnecting Line

3.1.3.5. Impact Identification, Prediction and Assessment and Mitigation

(1) Pre-construction and Construction Phase

1) Soil Erosion/Loss of Topsoil/Overburden

Soil Erosion and Sedimentation

672. During construction, earthmoving activities will be carried out along the alignment, stations and depot. These areas will be subjected to clearing and removal of vegetation, stripping of soil cover, excavation of underlying rock, grading or construction of embankments. Especially for the construction of the embankment, a large amount of soil will be required and it will be necessary to secure a temporary storage area near the site and transport in advance and place it temporarily. These activities will generate temporary placement of stockpiles of excavated materials within the Project area. The stockpiles of excavated materials if not properly managed could be exposed to erosion especially during rains and will contribute to the siltation of nearby drainage systems or natural waterways. The area of temporary placement will requires measures such as compaction, drainage, surface protection, etc. so that the material will not erode due to rain. Drainage system, temporary siltation ponds and drainage with silt traps will be also provided within the work areas so as not to contaminate the the waterways in the area. Also, care must be observed in the operation of heavy equipment for transporting and handling excavated materials from one area to another so as to avoid spills into drainage systems or nearby waterways. Drainage and canals around the work area will be regulary cleaned to de-clog.

673. During the DED Phase, erosion analysis of river bed and river banks in the vicinity of bridge piers and bridge abutment will be carried out. Based on the results and recommendations of the necessary river bed and bank scour protection, bridge abutments and bridge pier foundation will be provided as necessary such as installing gabion mattress, sheet pile depends on the site conditions. During construction, once heavy rainfall occurs, the amount of water increases rapidly and might erode the bank. Measures are required to evacuate the construction machines to a safe place at any time.

674. Soft ground exists along the project alignment based on geological investigations. On soft ground, there is a concern about the stability of soil. Countermeasures such as casing shall be used as protection for soil. Collapse of soil may occur during extraction of casing, but this could be prevented by using permanent casing.

675. The time scale for the erosion of exposed surfaces and materials stockpiles is deemed short-term as this process would likely take place only during the rainy season of the construction period. The construction contractor will be required to submit and implement appropriate materials handling program or a site protection and rehabilitation program that will be monitored regularly by DOTr. Erosion and Sediment Control Plan is also prepared with designed measures to minimize, if not prevent slope failure during construction.

2) Change in Soil Quality

Degradation of Soil Fertility

676. The soil quality survey conducted at selected sampling sites shows that lead and cadmium does not conform to the international standards. DOTr will collect soil samples prior to start of construction activities to validate the baseline levels preferably during the wet season.

677. Pre-construction activities that will result in solid waste generation include the demolition of existing structures and clearing and securing of ROW. During the DED Phase, an initial waste management program has been prepared. DOTr through the contractor will develop a comprehensive Waste Management Program to cover solid, liquid and hazardous wastes

management and submit to EMB prior to the start of construction. Recycling of wastes will be implemented, as much as possible, through sorting, stockpiling, and containing recyclable wastes. If appropriate, leftover concrete and metals will be used for suitable alternative projects. If waste is inevitable, it will be sorted in the designated temporary storage area prior to disposal. Temporary storage area will be designated by the contractor. Non-recyclable wastes will be disposed of by an accredited contractor to a designated landfill.

678. During construction works, soils may become contaminated in the event leaks and accidental spills of fuels and lubricants from construction vehicles and machineries, as well as other hazardous chemicals like paints and solvents. These may result in relatively insignificant number of contaminants in the soil. Hazardous Waste Management Plan will be strictly enforced and soil quality will be continuously monitored to maintain the quality and early detection contamination. Oil spills could be prevented, requiring the Contractors to undertake the following:

- Conduct proper inspection and maintenance of machines and equipment;
- Store bulk hazardous chemicals in impermeable areas and with appropriate secondary containment;
- Comply with environmental permitting requirements for the storage, transport, treatment and handling of hazardous substances and wastes in accordance with RA 6969;
- Implementation of manual for workers to prevent oil and chemical spills and provide regular training to workers on environment management and working environments; and
- Implement an Emergency Response Plan and a Health and Safety Management Plan in case of spills.

679. The construction workforce, will likewise, generate solid wastes such as industrial waste packaging materials from construction materials and general wastes from workers such as food scraps, putrescible wastes, toiletries, and recyclable and non-recyclable packaging materials. If such wastes will not be handled properly, these would cause land and potential surface water contamination and negative impacts to aesthetics. Mitigation measures to address solid waste impacts include:

- Submission and implementation of Solid Waste Management Plan as part of contractors' engagement in accordance to RA 9003;
- Placement of waste bins to avoid dispersal of litter and regular site maintenance duties; and
- Regular collection, transportation, and disposal of wastes to minimize the attraction of vermin, insects, and pests.

Excavated Soil Disposal

680. During construction phase, excess soil from earthwork activities such as tunneling, excavation, backfilling, and embankment will be generated. Based on the construction plan, at least about 2,368,288 m^3 of soil will be for disposal as a result of soil excavation and backfilling operations for tunneling works, the construction of stations, elevated structures, earthworks for construction workability, and drainage and box culvert at the Depot. Especially earthwork accounts for a large portion of constructing a tunnel and a depot. If not managed properly, soil wastes may be discharged to water bodies through run-off and could cause increased sedimentation in nearby rivers.

681. Excess soil during the construction phase may be contaminated. The walkthrough survey identified multiple potential contamination sources in the vicinity of the Project alignment (**Figure 3.1.64**). If the excavated soil is suspected to be contaminated, samples will be collected and sent for analysis. Assessment of the extent of soil contamination will also be conducted.

682. As a measure, DOTr will prepare Spoil Management and Disposal program via contractor prior to construction and strictly implement. As much as possible, the excavated soil will be recycled and reused for utilization in the Project or other project/s. For the handling of excavated soil, placement of excavated materials in appropriate disposal sites or spoils area and with adequate containment. In addition, implementation of construction plan and soil management plan will be strictly enforced. Proper disposal of solid waste by the contractor in accordance to RA 9003 will also be at hand including waste minimization and segregation.

683. If there are portions in the Project alignment that will require treatment/remediation, the DOTr, its general contractor, and subcontractor will follow DENR-EMB Memorandum Circular 2017-004 Guidelines for Site Remediation, including all statutory requirements under DAO 29 Series of 1992 IRR of RA 6969 and related issuances.

(2) Operation Phase

1) Soil Erosion/Loss of Topsoil/Overburden

684. Since the railway is located in a relatively flat terrain, soil erosion during operation of the Project is not likely to occur.

2) Change in Soil Quality

685. The potential impact on soil quality degradation during operation phase of the Project will be significant at the Depot where train maintenance activities will take place in particular. If handling of chemicals, fuel oil, lubricants, wastes, and used oils is not properly implemented. Improper management of chemicals, solid wastes, and wastewater may result in land contamination as well as aesthetic impacts.

686. Management measures will include proper chemical storage and handling; segregation of wastes; provision of waste bins that will allow proper waste segregation; use of sealable waste bins to avoid attraction of vermin, insects, and pests, regular collection and transportation of wastes for recycling or disposal at licensed facilities; and formulation and implementation of policies on solid waste minimization and solid waste management for patrons and staff.

687. Hazardous solid wastes to be generated, as part of general maintenance works, such as lead acid batteries, air filters, busted fluorescent, used oil, etc. will be disposed of in accordance with the provisions of R.A. 6969 "*The Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990* as well as R.A. 9003, *The Ecological Solid Waste Management Act*. Wastes of these kinds will be properly inventoried, labelled, and stored prior to proper disposal through DENR-accredited transporters and treaters.

688. Some other measures include as follows;

- Provide proper inspection and maintenance of machines and equipment;
- Implementation of manual for workers to prevent oil and chemical spills and provide regular training to workers on environment management and working environments;
- Implement an Emergency Response Plan and a Health and Safety Management Plan in case of spills; and
- Continuous monitoring of toxic level to ensure that contaminant will not pose a hazard. In case traces of trace contaminants are detected, consult with the DENR – EMB and develop a soil management plan.

3.1.4. Terrestrial Ecology

689. The Philippines is one of the mega-diverse countries due to its diverse habitats and high rates of endemism. However, it is also one of the world's hotspots, with a wide range of threatened terrestrial ecoregion.

690. The proposed alignment of the Project will traverse the high density residential and commercial areas in Metropolitan Manila and Province of Laguna. The most notable ecological area near the proposed project alignment is the Mount Makiling Forest Reserve (MMFR) which is approximately 4 km away, the Laguna de Bay and the Tadlac Lake (also known as Alligator Lake).

691. MMFR is a 4,244-hectare nature reserve 65 km southeast of Metro Manila. Mt. Makiling contains diverse flora from a large number of endemic families, genera and species that include many interesting forms. There are also some species introduced from several parts of the world, some of which are already naturalized after long years of existence in the area. There are also threatened species based on International Union for Conservation of Nature (IUCN) and Department of Environment and Natural Resources Administrative Order 2007-01 found inside the reserve. *Aphanamixis polystachya*, *Artocarpus rubrovenius*, *Balakata luzonica*, *Cinnamomum mercadoi*, *Dillenia reifferscheidia*, and *Myristica philippinensis* are among the species listed as vulnerable in both the DENR's Department Administrative Order (DAO 2007-1) and the IUCN Red List.

692. Laguna de Bay is the largest lake in the Philippines located east of Metro Manila between the provinces of Laguna to the south and Rizal to the north. Its dominant use at present is for fishery, both open water fishing and aquaculture. It is also part of the flyway of migratory birds for shelter and food.

693. Tadlac Lake is also included in the area of study to check the biodiversity in its surrounding. The lake is located in Barangay Tadlac, Los Baños near the border of Calamba City in the province of Laguna. The lake is contained in a piece of land jutting out to the Laguna de Bay that was known as Malilimbas Point and is directly situated below the northeastern slope of Mount Makiling, the highest mountain in the Laguna Volcanic Field. Because of its origin, the lake has no outlet and is replenished only by rainfall. Tadlac Lake is also notable for its history of annual Lake overturns, locally called *langal.* This phenomenon, rare elsewhere but usually occurring in Tadlac lake during the cold months of December to February, is the result of trapped carbon dioxide (CO2) erupting from the deep layers of the lake towards the surface, leading to fish kills due to low levels of dissolved oxygen[16]. This phenomenon was greatly heightened by the introduction of aquaculture to the lake in the mid-1980s, eventually leading to a massive and costly fishkill in 1999, which in turn led to the cessation of aquaculture activities on the lake.

3.1.4.1. Terrestrial Flora

694. Some of the most marked temporal fluctuations in species abundances are linked to the seasons. In theory, multispecies assemblages can persist if species use shared resources at different times, thereby minimizing interspecific competition. The Philippines have only two (2) seasons: the dry and wet seasons. The dry season starts in late November and ends in May while wet or rainy season starts in June and lasts until October.

695. The project alignment encompasses large amounts of developed, disturbed and maintained areas. It is surrounded by heavy industrial facilities, residential areas and infrastructures. Hence, no actual or significant difference is expected in terms of data gathering during the dry or wet season. Also, species composition from plant diversity assessment does not

[16]Santos-Borja, Adelina C. (2008). "Multi-Stakeholders" Efforts for the Sustainable Management of Tadlac Lake, the Philippines". Research Center for Sustainability and Environment, Shiga University.

solely rely on physical factors, specifically climate or weather data, or does not arrest the fact that there are more diverse species during the wet season only.

696. For this study, the terrestrial flora surveys were conducted during the dry and wet seasons.

(1) Field Survey

697. The terrestrial flora survey for dry season was conducted on 5 to 11 February 2018 while the wet season was conducted on 25 to 27 June 2018 at six (6) established sampling stations as described in **Table 3.1.15**. Individual trees with a diameter at breast height (dbh) of 10 cm or more, were geo-tagged and measured through their biometrics. One (1) additional terrestrial flora transect was surveyed on 18 to 20 June 2019 as described in **Table 3.1.16**, located in proximity to the FTI Station and Bicutan Station. A copy of the inventory of terrestrial flora during field surveys can be found in **Annex 3-1**.

698. During the terrestrial flora survey, modified belt transect method wherein nine (9) quadrats (20 m x 20 m) were laid out along a 2-km transect at every 250 m interval. Nested quadrat sampling technique was used to assess and characterize the structure and species composition of the different plant communities. For large woody plants whose diameter is equal or greater than 10 cm, measurements of diameter at breast-height (dBH), merchantable height (MH), and total height (TH) were done inside the 20 m x 20 m quadrat. Frequency of shrubs, poles, and saplings inside the 5 m x 5 m quadrat was counted to account for the intermediate species, while percentage cover of understorey species (grasses and other plants below 1 m in height) inside the 1 m x 1 m quadrat was determined.

699. Information gathered in the field were tabulated and analysed to characterize floral composition within the study area. The relative density, relative dominance, and relative frequency values for each tree species were determined to obtain their Importance Value (IV), which is the standard measurement in forest ecology to determine the rank relationships of species. Also, the relative frequency, relative density, and relative dominance indicate different aspects of the species importance in a community. Importance values were determined using the following formula:

$$\text{Density} = \frac{\text{number of individuals}}{\text{area sampled}}$$

$$\text{Relative Density} = \frac{\text{density for a species}}{\text{total density for all species}} \times 100$$

$$\text{Frequency} = \frac{\text{number of plots in which species occur}}{\text{total number of plots sampled}}$$

$$\text{Relative Frequency} = \frac{\text{frequency value for a species}}{\text{total frequency for all species}} \times 100$$

$$\text{Dominance} = \frac{\text{basal area or volume for a species}}{\text{area sampled}}$$

$$\text{Relative Dominance} = \frac{\text{dominance for a species}}{\text{total dominance for all species}} \times 100$$

$$\text{Importance Value} = \text{Relative Density} + \text{Relative Frequency} + \text{Relative Dominance}$$

700. Diversity indices (Shannon, Simpson's and Evenness) for each sampling quadrats were generated using Paleontological Statistical software package for education and data analysis

(PAST version 3.12). Moreover, endemism and ecological status of the different species were assessed to determine the ecological importance of the vegetation in the area. Plant classification followed the latest Angiosperm Phylogeny Group classification (APG IV, 2016) while the common names adopted that of Rojo (1998).

Table 3.1.15 Terrestrial Ecology Sampling Stations

Sampling Station	GPS Coordinates	Profile/Dominant Species**	Vegetation Type	Human Activity
Transect 1 – 204 (Dagupan Ext.), Tondo, Manila	N 14°37'37.15" E120°58'32.10"	• Shrub species: *Chromolaena odorata, Stachytarpeta jamaicensis, Senna alata, Lantana camara, etc.* • *Tree species: Ficus septica, Ficus umifolia, Premna odorata, Sweitenia macrophylla, Pterocarpus indicus, Artocarpus heterophyllus, Tamarindus indica, Psidium guajava, Muntigia calabura, Syzigium cuminii, Chrysophyllum cainito, Ficus balete, Ficus religiosa*, etc. • Herbaceous species: *Alternanthera sessilis, Xanthosoma violaceum, Synedrella nodiflora, Vernonia sp., Paspalum conjugatum, Mikania cordata, Heliotropium indicum*, etc.	Heavy built-up area, dense residential area along existing PNR RoW from Solis to Blumentritt-Monumento. Vegetation includes grasses, shrubs and few individual trees mostly horticultural and pioneer species found in a very disturbed environment.	Human settlements on the sides of the old railroad
Transect 2 - East Service Road, Taguig	N 14°31'39.53" E121°01'26.72"	• Herbaceous layer: *Ipomoea triloba, Tridax procumbens, Mikania cordata* (Burm. f.) B.L. Rob., etc. • Shrub species: *Lantana camara* L., *Chromolaena odorata, Bridelia stipularis, Sida acuta and Sida rhomboidifolia,* etc. • Tree species: *Artocarpus altilis, Leucaena leucocephala, Trema orientalis* (L.) Blume*, Macaranga tanarius* (L.) Muell.-Arg.*, Ficus ulmifolia, Ficus septica* Burm. f. *Melanolepis multiglandulosa, Gmelina arborea*, etc.	Built-up area and heavy residential areas along FTI-Nichols existing railway. The alignment is adjacent to SLEX. Vegetation includes weeds, shrubs and few individual trees mostly horticultural species and pioneer trees found in a very disturbed environment	Mostly concrete business establishments; skyway, SLEX
Transect 3 – Niugan and Banay-Banay, Cabuyao, Laguna	N 14°16'46.32" E121°07'48.95"	• Shrub species: *Lantana camara* L., *Chromolaena odorata, Solanum ferox, Ficus spp., Hedyotis sp., Borreira ocymoides*, etc. • Tree species: *Artocarpus ovatus, Ficus psuedopalma, Leucaena leucocephala, Garuga floribunda, Trema orientalis* (L.) Blume*, Macaranga tanarius* (L.) Muell.-Arg.*, Ficus septica Burm.*	Open and bare areas with spares tree vegetation near to residential areas and industrial zones.	Human settlement, Near Cabuyao Sanitary dump site

Sampling Station	GPS Coordinates	Profile/Dominant Species**	Vegetation Type	Human Activity
		f., M. multiglandulosa, Munitigia calabura, Artocarpus blancoi, etc. • Herbaceous layer: *Mimosa pudica* L., Replace "Stachytarpeta jamaicensis" with "Stachytarpheta Jamaicensis" • , *Mikania cordata* (Burm. f.) B.L. Rob., *Caesalpinia latisiliquum, Tridax procumbens*, etc.		
Transect 4 – Tadlac, Los Banos, Laguna	N 14°10'52.28" E121°12'15.09"	• Shrub species: *Chromolaena odorata, Lantana camara* L., *Triumfetta rhomboidea*, etc. • Tree species: *Leucaena leucocephala, Trema orientalis* (L.) Blume, *Terminalia cattapa, Mangifera indica, Muntigia calabura*, etc. • Herbaceous layer: *Tridax procumbens Rolfe, Centrocema pubescens, Stachytarpeta jamaicensis, Mikania cordata* (Burm. f.) B.L. Rob., *Mimosa pudica,* etc.	Dense vegetation of sparse tree individuals near Laguna de bay and residential areas, includes open spaces with dense grasses and weeds. "Cut" hill with dense tree vegetation.	Human settlement; resorts
Transect 5 – Baybayin and Timugan, Los Banos, Laguna	N 14°10'47.06" E121°13'10.04"	• Tree species: *Leucaena leucocephala, Samanea saman, Pithecelobium dulce, Trema orientalis (*L.) Blume, *Macaranga tanarius* (L.) Muell.-Arg., *Ficus septica* Burm. f., *Gmelina arborea,* etc. • Herbaceous layer: *Zehneria indica* (Lour.) *Keraudren Centrosema pubescens, Ipomoea triloba, Mikania cordata (*Burm. f.) B.L. Rob., *Passiflora foetida, Tridax procumbens*, etc. • Grass species: *Thysanolaena latifolia, Sorghum halepense, Saccharum spontaenum,* etc.	Dense vegetation of sparse tree individuals includes diverse floral species of ground, shrub and herbaceous layer. Sparse tree vegetation includes those located at trails and open spaces. Agroforestry farms and small vegetation near buffer zone of Maria Makiling Forest Reserve (MMFR)	Human settlement
Transect 6 – Sto. Nino Los Banos, Laguna	N 14°10'32.08" E121°14'54.76"	• *Shrub species: Solanum torvum, Sida acuta, Chromolaena odorata,* etc. • Tree species: *Gmelina arborea, Trema orientalis (*L.) Blume, *Macaranga tanarius* (L.) Muell.-Arg. *Morinda citrifolia L., Ficus septica Burm. f. Melanolepis multiglandulosa,* etc.	Disturbed vegetation from the project alignment going to IRRI-RoW with sparse tree vegetation that include those located near residential houses;	Close proximity to human habituation

Sampling Station	GPS Coordinates	Profile/Dominant Species**	Vegetation Type	Human Activity
		• Herbaceous layer: *Coccinea grandis* (L.) Voigt*, Centrosema pubescens, Passiflora foetida, Mikania cordata* (Burm. f.) B.L. Rob*., Caesalpinia latisiliquum, Tridax procumbens,* etc. • Grass species: *Imperata cylindrica, Thysanolaena latifolia, Sorghum halepense, Saccharum spontaenum,* etc.	encompassing Molawin creek with dense pioneer tree species; open and bare sections at IRRI-IPB section.	

Table 3.1.16 Terrestrial Flora Transects for the Underground Interconnecting Stations

Sampling Station	Length (km)	GPS Coordinates	Vegetation Type
Underground Segment T1	1.73	Start: 14° 29' 22.629" N; 121° 2' 40.818" E End: 14° 30' 12.515" N; 121° 2' 14.156" E	This transect is located between FTI station and Bicutan Station. It is parallel to the train station and primarily composed of a mixture of mature and sapling or pole-sized trees. Patches of grasses between trees can also be observed within the transect. The transect is dominated by *Swietenia macrophylla* (Big leafed mahogany), *Pterocarpus indicus* (Narra) and *Mangifera indica* (Mangga) planted along each side of the road (**Figure 3.1.65**)

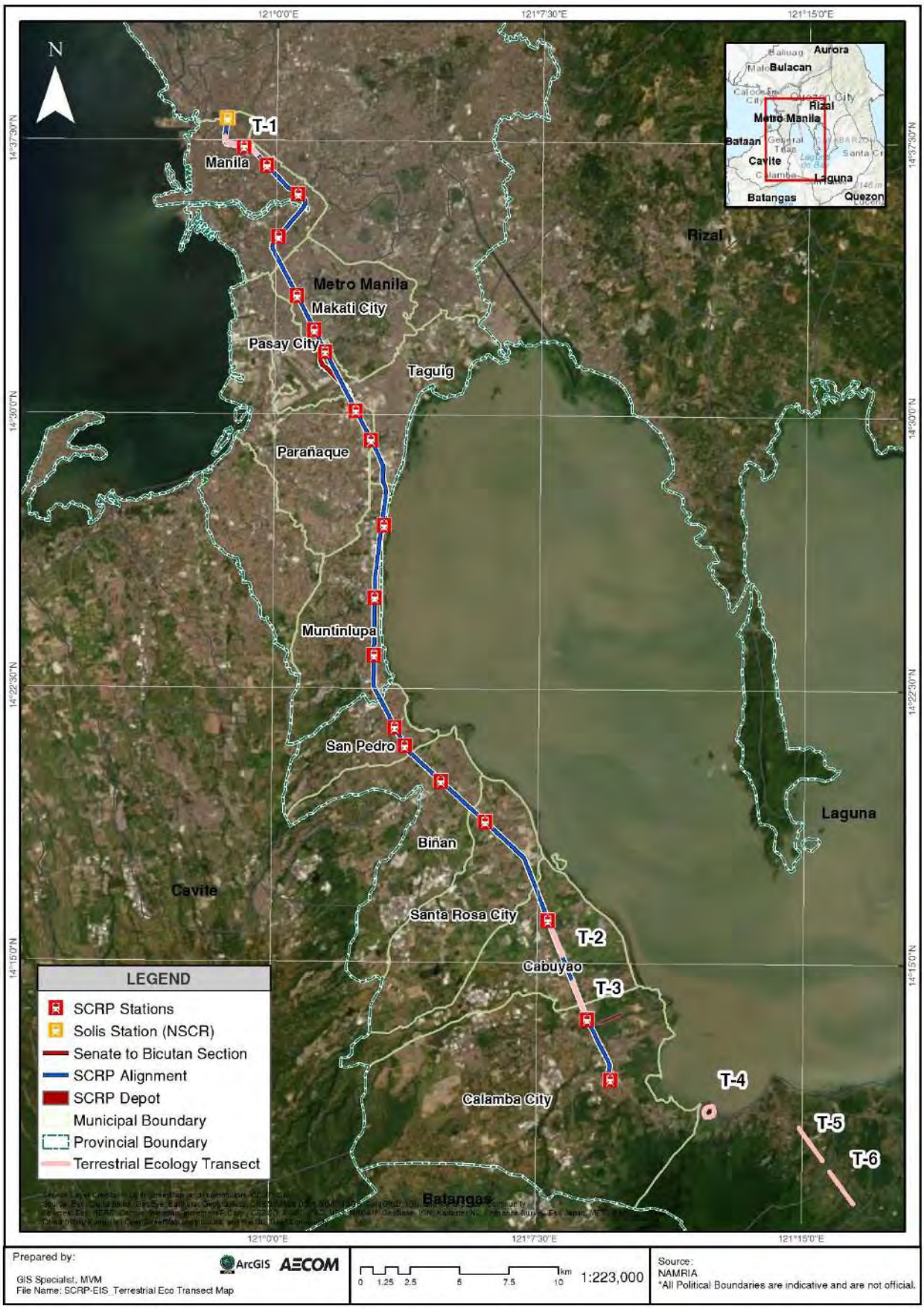


Figure 3.1.65 Location of Transect Plot for Terrestrial Ecology

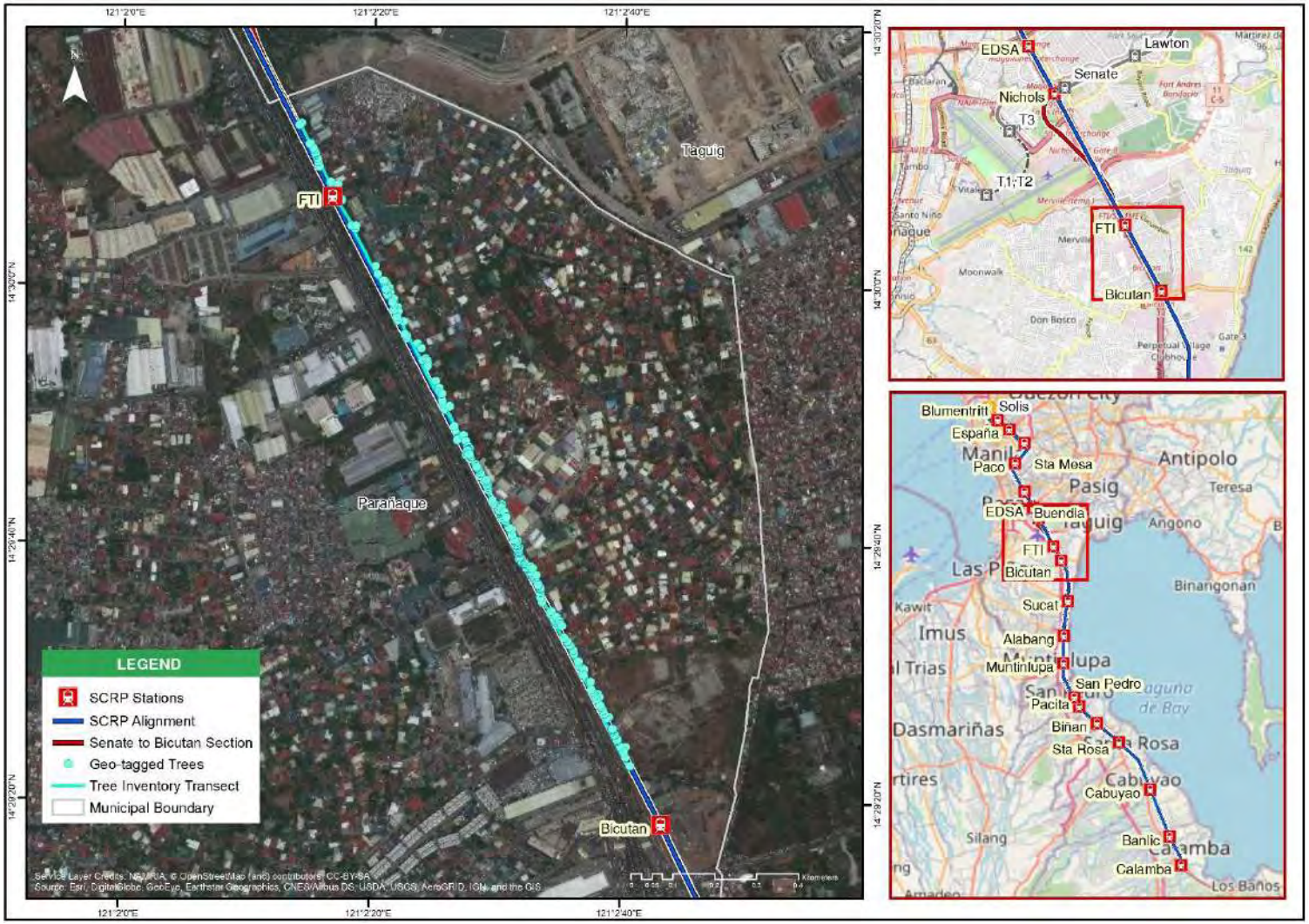


Figure 3.1.66 Site map showing Underground Segment T1 (between FTI Station and Bicutan Stations)

(2) Results and Analysis

701. The Project will not pass through any protected area, reserved forest area, or natural forest area. The most notable ecological area near the project alignment is the MMFR which is approximately 4 km away. The project alignment encompasses large amounts of developed, disturbed, and maintained areas. It is surrounded by heavy industrial facilities, residential areas, and infrastructures.

702. Majority of plants recorded at the Project site during the dry season survey are weeds species common to disturbed and degraded areas. Few numbers of both endemic tree species were encountered in the transect plots. There are no threatened species recorded to all transect plots. Dominant families include Cannabaceae, Fabaceae, Verbenaceae, Anacardiaceae, Lamiaceae, Asteraceae and Moraceae. Recorded plant species during the wet season survey are predominantly grasses, shrubs and followed by few species of sparse trees. Floristic composition was mainly confined to shrubs and ground cover species. These are mostly weed species triggered by abundant moisture as brought about by continued monsoon rains. Also, due to the wet season effects, there is a large increase in the number of vascular flora and abundance of ground cover species as compared to that of dry season survey. Few numbers of both endemic and threatened tree species were encountered in the transect plots. Dominant plant families observed in the area include Poaceea, Rubiaceae, Malvaceae, Cannabaceae, Fabaceae, Verbenaceae, Anacardiaceae, Lamiaceae, Asteraceae and Moraceae.

1) Associated Vegetation/Significant Landscapes

Internal Environment

703. Associated vegetation or landscapes are important in assessing terrestrial ecology assessment since these areas can serve as either viable alternative shelter or entrance site for new plant or animal species recruits from the main ecosystems or an area affected by any development or disturbance. Based on the site surveys, there is no observed associated vegetation in the Project area as it was already surrounded by heavy industrial facilities, residential areas and infrastructures except for areas located in Los Baños, Laguna. Additionally, areas within the existing PNR alignment from Manila to Calamba are smothered with weeds and other invasive species. Sparse tree vegetation is notable within houses and squatter areas that build temporary houses within the PNR rails.

704. A small creek (Molawin creek) was observed near the alignment that joins other minor creek lines that run parallel to the International Rice Research Institute (IRRI). The creek hosts a number of tree species and patches of vegetation such as bamboo, pioneer tree species, and herbaceous plants. On the other hand, Brgy. Tadlak and Alligator Lake host tree species of pioneer and common planted trees. The area provides good quality habitat for endemic flora species, including Is-Is (*Ficus ulmifolia*) and Niog-Niogan (*Ficus psuedopalma*). Consequently, these small units of ecological area will provide the best habitat in the proposed alignment for fauna such as birds and bat species that do not rely on hollows.

External Environment

705. External environment focuses on other significant landscapes that are outside or not located within the Project area but relatively adjacent to it. This includes protected areas designated by the Philippine's laws or international treaties and conventions in the vicinity of the Project sites and determine the distance between protected area and the railway track. Additionally, other proclaimed/declared biodiversity, wetlands, and protected areas that are near to the identified sampling station where there are notable ecosystems were accounted. Associated vegetation or landscapes located externally are important in assessing terrestrial ecology assessment since these areas can serve as final sanctuary or viable alternative shelter

or entrance site for new plant or animal species recruits from the main ecosystems or an area that has been totally disturbed and affected by any development or disturbance.

706. Notable ecological area near the project alignment and depot site is the Mount Makiling Forest Reserve (MMFR) located at Los Baños, Laguna. A number of significant endangered and endemic wildlife species, especially floral species are present in MMFR.

2) General Vegetation

707. The project alignment from Solis, Manila to Calamba, Laguna encompasses mostly developed, disturbed, and maintained areas. Almost 60% of the surrounding area of the proposed project alignment comprised of dense residential areas and urbanized zones, consequently, small existing vegetation present in the study area is generally disturbed. Tree vegetation is generally sparse. Two (2) classification of vegetation were defined for the project alignment, representing few structural and floristic compositions of general plant form such as trees, shrubs, grasses, and herbaceous species. These are mainly comprised of:

708. Small to medium sized individuals of sparse trees of Is-Is (*Ficus ulmifolia*), Anabiong (*Trema orientalis*), Datiles (*Muntigia calabura*), Gmelina (*Gmelina arborea*) and Acacia (*Samanea saman*) forming patches of understorey species Hagonoy (*Chromolaena odorata*) and herbaceous layer of weeds and grasses within built-up and disturbed areas and across PNR properties;

709. Variable vegetation on remnants of fruit tree orchards from residential areas with genus Mangifera, Artocarpus, Nephelium. Pioneer tree species along alignment include genus of Acacia, Leucaena, Trema and Muntigia tree species.

710. The vegetation types of high conservation significance within the project alignment include those areas with the presence of noteworthy, endemic, threatened or endangered plant and tree species. The vegetation in the identified transect plots considered to be of the highest conservation significance within the project alignment is Transect 4 (Tadlac lake/ Alligator lake), portion of Transect 3 (Cabuyao) and Transect 5 (near MMFR Buffer zone). Tadlac Lake, also colloquially known as Alligator Lake, is a freshwater crater lake located in Barangay Tadlac, Municipality of Los Banos. The vegetation within the lake near to the “cut” hill has the characteristics of young secondary growth such that the vegetation in the area contains more native trees species such as *Ficus nota, Semecarpus cuneiformis, Ficus psuedopalma, Ficus ulmifolia* and *Litsea glutinosa*, among others. Dense bamboo species are also prominent at the top of the hill which promotes more growth of understorey layer with the abundant moisture from monsoon rains. The vegetation communities in other sections of the transect plot are generally remnants of previous land uses with the presence of residential houses and privately-owned resorts (T4). Transect 3 features bare and open area and with patches of vegetation within the transect plot. One (1) species of endemic tree, listed as VU in the Philippine Red List (DENR-DAO 2007-1 (11)), was recorded. Transect 5 include flora along the buffer zone of MMFR.

3) Transect Plot Profiles

711. The transects were identified and selected based on the presence of vegetation units across the proposed alignment, including the presence of major landscape features such as small ecological units (e.g. creeks, rivers, etc.). Additionally, the presence of high value species such as those endemic, threatened plant and tree species located either on a patch of forest or aggregate within the proposed alignment also served as a basis for selecting sampling sites. The selected transect or sampling sites are the areas with remaining forest or vegetation formation based on present satellite imagery and ground reconnaissance survey. The vegetation was described per transect with nine (9) quadrats each at an interval of 250 m, with the flora at each of these quadrats recorded in detail. The flora records provided the names for use in the vegetation descriptions, and contributed to the flora species lists and frequency of occurrence

data. Several parameters relating to the individual quadrats were used to assist in both the description of vegetation types and the determination of flora distribution (particularly in terms of defining associated habitats). The following transects are described in detail in terms of vegetation profile, location and other aspects of biological information.

Transect 1 (Solis Station)

712. Transect 1 is located at Tondo, Manila encompassing a high built-up area (Figure 3.1.67).

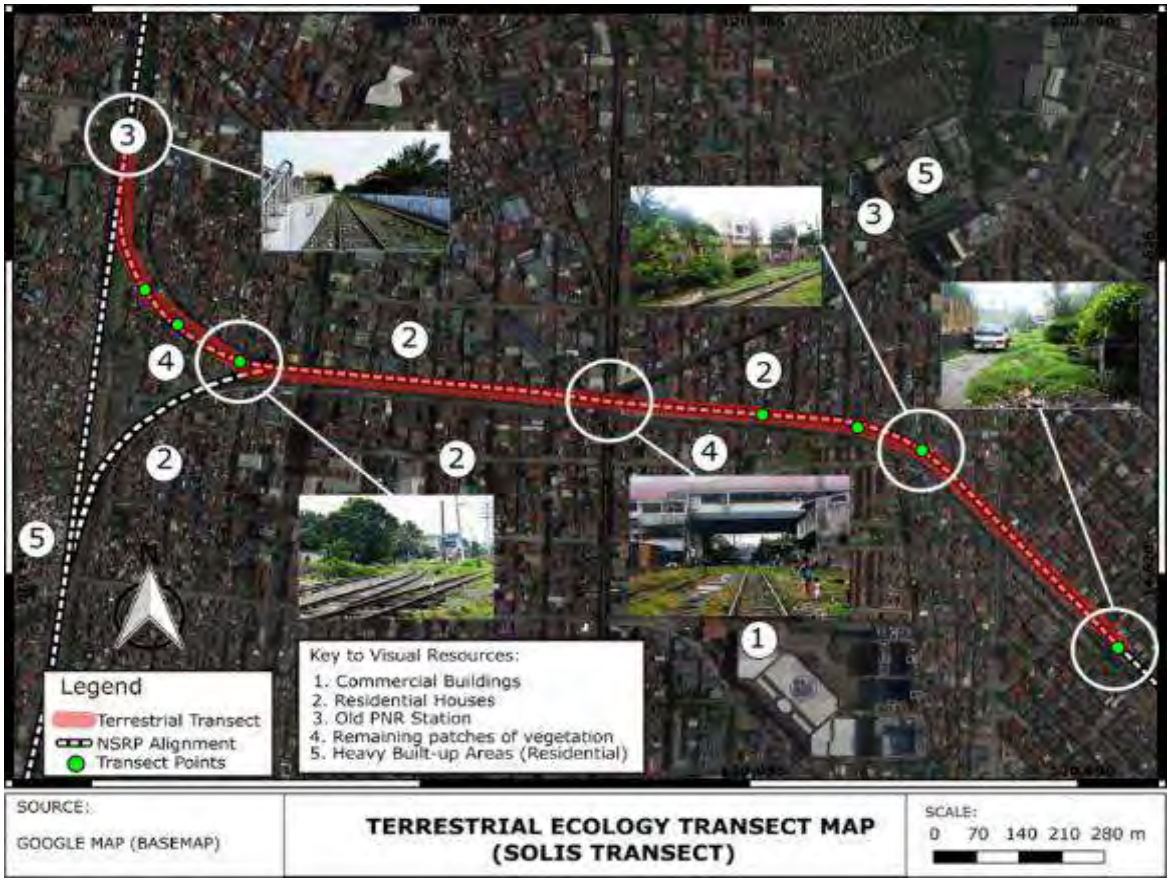


Figure 3.1.67 Map Showing Transect 1 established at Solis Station, Tondo, Manila

713. During dry season survey, the area is almost devoid of vegetation and only patches of disturbed grasses and weeds growing along the alignment can be observed along with few trees. This vegetation occurred in low density near smothered places and residential areas. In terms of understorey and ground cover, shrubs are represented by Hagonoi (*Chromolaena odorata*), *Cleome rutidosperma*, *Blumea lacera*, *Urena lobata* and *Stachytarpeta jamaicensis.* The most dominant ground cover is Bunga-Bunga (*Alternathera sessilis*) and Tuhod manok (*Synedrella nodiflora*) which are common species of open and disturbed area. The area is already disturbed and no notable plant species of ecological significance are found in the plot. In terms of other tree species present in the plot, pioneers are represented by few individuals of forest trees such as Hauili (*Ficus septica*), Narra (*Pterocarpus* indicus), Anabiong (*Trema orientalis*) and an endemic species of Is-Is (*Ficus ulmifolia*). On the other hand, other exotic trees and horticultural species are represented by *Muntigia calabura*, *Samanea saman*, *Sweitenia macrophylla*, *Artocarpus heterophyllus*, *Psidium guajava*, *Syzigium cuminii* and *Chrysophyllum cainito.* Fig trees are also prominent in the area.

Transect 1 during dry season showing patches of vegetation and sparse tree individuals. Growth of grasses and weeds makes up aggregate cover such as *S. halepense, E. atoto, A. sessilis* and *C. odorata.*

Plate 3.1-1 Photographs of the Transect 1 During Dry Season Survey

714. During wet season survey, the area is revived with dense patches of vegetation such as grasses and weeds growing along the alignment which is the only major vegetation that can be observed in the area. This vegetation occurred in a high density and abundance due to continued rain showers. Trees were limited to horticultural species such as Mangga (*Mangifera indica*), Nangka (*Artocarpus heterophyllus*) and Sampaloc (*Tamarindus indicus*). In terms of understorey, shrubs are represented by dense Hagonoi (*Chromolaena odorata*), *Cassia alata, Blumea lacera, Urena lobata* and Cogon (*I. cylindrica*). The most dominant ground cover *is Alternathera sessilis* and *C. pubescens* which are common species of open and disturbed environments. Additionally, there are no significant landscapes. In terms of other tree species present in the plot, pioneers are represented by few individuals such as Hauili (*Ficus septica*), Anabiong (*Trema orientalis*) and an endemic species of Is-Is (*Ficus ulmifolia*). On the other hand, other exotic trees and horticultural species are represented by *Muntigia calabura, Samanea saman, Sweitenia macrophylla, Artocarpus heterophyllus, Psidium guajava, Syzigium cuminii* and *Chrysophyllum cainito*.

Transect 1 during wet season showing dense vegetation of grasses and ground cover layer. Growth of grasses and weeds makes up aggregate cover such as *S. halepense, I. cylindrica, A. sessilis* and *C. pubescens.*

Plate 3.1-2 Photographs of the Transect 1 during Wet Season Survey

Transect 2 (FTI-Nichols)

715. Transect 2 (FTI-Nichols) is located at Taguig-Bicutan area. The transect plot is characterized with heavy built-up environments and surrounded by skyway roads and residential areas (**Figure 3.1.68**).

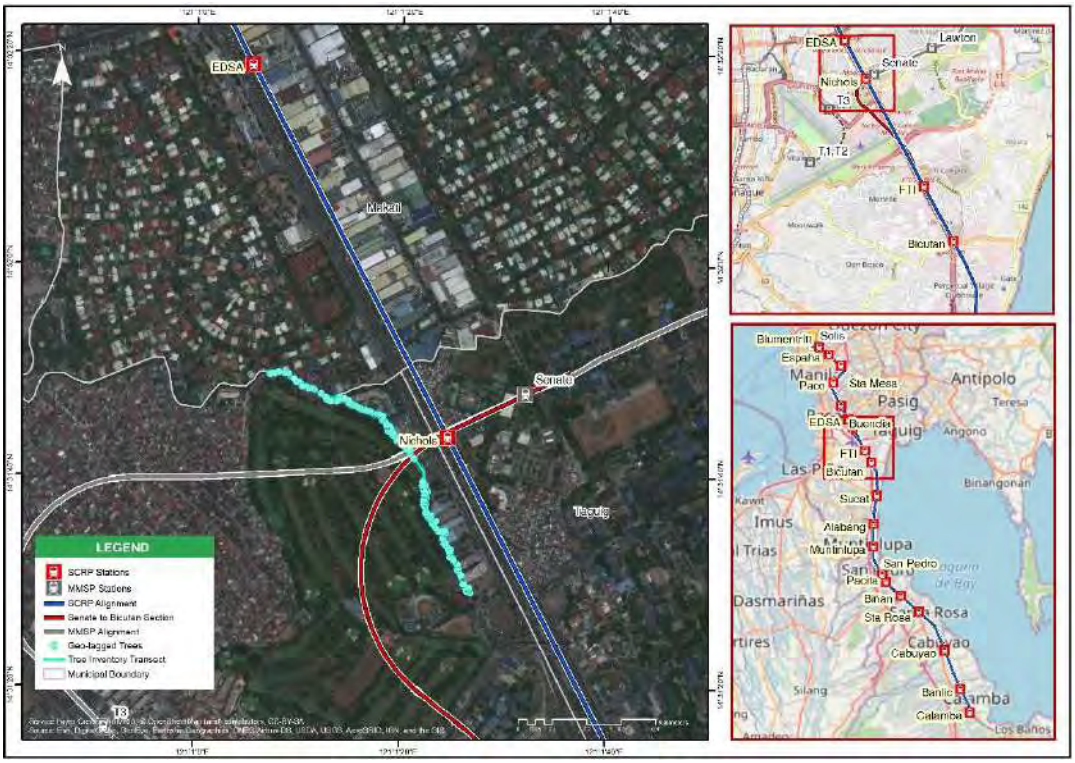


Figure 3.1.68 Map showing Transect 2 Established at FTI-Nichols Station

716. During dry season survey, the vegetation in this area is very minimal similar to T1 plot in terms of trees but more on ground and shrub layer. On the mid-point section, sparse tree individuals of Anabiong (*T. orientalis*) can be observed along with Datiles (*M. calabura*), Mahogany (*S. macrophylla*), and Rain tree (*S. saman*). Other sparse tree species include Mangga (*Mangifera indica*) and Sampaloc (*Tamarindus indicus*) covered by creeping vines within the alignment. Sparse tree vegetation and bare areas with the presence of very scattered shrubs and trees are notable in sections approaching the main station. These areas are well maintained and growth of plant species is regulated. Understorey shrubs species are represented by Hagonoi (*Chromolaena odorata*), *Cleome rutidosperma*, *Blumea lacera*, *Urena lobata* and *Stachytarpeta jamaicensis.* Grasses are represented by *S. halepense, I. cylindrica and S. spontaenum*. Ground cover species include Bunga-Bunga (*Alternathera sessilis*), Gatas-gatas (*Euphorbia hirta*), Botonesan (*Borreira ocymoides*), Tuhod manok (*Synedrella nodiflora*) and Alikbangon lalaki (*Commelina diffusa*).

Transect 2 during dry season showing sparse tree and grass vegetation well maintained. The railway is active and operational during the survey. Small crop yard was also observed at the sides of the rail tracks.

Plate 3.1-3 Photographs of the Transect 2 during Dry Season Survey

717. Wet season survey documented high emergence of moisture trigger species in idle sections represented by ground and shrub layer. On the mid-point section, sparse tree individuals of Anabiong (*T. orientalis*) can be observed along with Datiles (*M. calabura*), Mahogany (*S. macrophylla*), and Rain tree (*S. saman*) on waterlogged or flooded sections. Walking through the transect plot are small crop yards that residents along the railway tracks established. According to some residents interviewed, they were allowed to plant some crops and other plants to cover the railway as long as it doesn't affect railway operation. These small crop yards contribute to the vegetation cover along the railway tracks such as cassava, banana, kamoteng baging, etc. Although these small farms are within the PNR properties, no significant impact is seen by removing these shanties farms. Other sparse tree species include Mangga (*Mangifera indica*) and Ipil-Ipil (*Leuceana leucocephala*). Sparse tree vegetation and bare areas with the presence of very scattered shrubs and trees are notable in sections approaching the main station. These areas unmaintained due to rainy season and growth of plant species are well developed. Understorey shrubs species are represented by Hagonoi (*Chromolaena odorata*), *Cleome rutidosperma*, *Blumea lacera*, *Urena lobata* and *Stachytarpeta jamaicensis.* Grasses are represented by *S. halepense, I. cylindrica and S. spontaenum*. Ground cover species include Bunga-Bunga (*Alternathera sessilis*), Gatas-gatas (*Euphorbia hirta*), Botonesan (*Borreira ocymoides*), Alikbangon (*Commelina benghalensis*) and Alikbangon lalaki (*Commelina diffusa*) which were very dense in idle sections. Other trees that naturalized in the area and became part of the railway landscapes are by few individuals of forest tree species such as small diameter sized *Alstonia scholaris*, *Leucaena leucocephala, Trema orientalis*, *Macaranga tanarius*, *Ficus ulmifolia*, *Ficus septica* and *Muntingia calabura.*

Transect 2 during wet season showing sparse tree and dense grass vegetation. The railway is active and operational during the survey. Some sections of the transect are in waterlogged or flooded condition due to monsoon rains.

Plate 3.1-4 Photographs of the Transect 2 during Wet Season Survey

Transect 3 (Cabuyao)

718. Transect 3 (Cabuyao) is located at Brgy. Banay-Banay and Niugan at the municipality of Cabuyao. The transect plot is surrounded by agricultural farms (**Figure 3.1.69**).

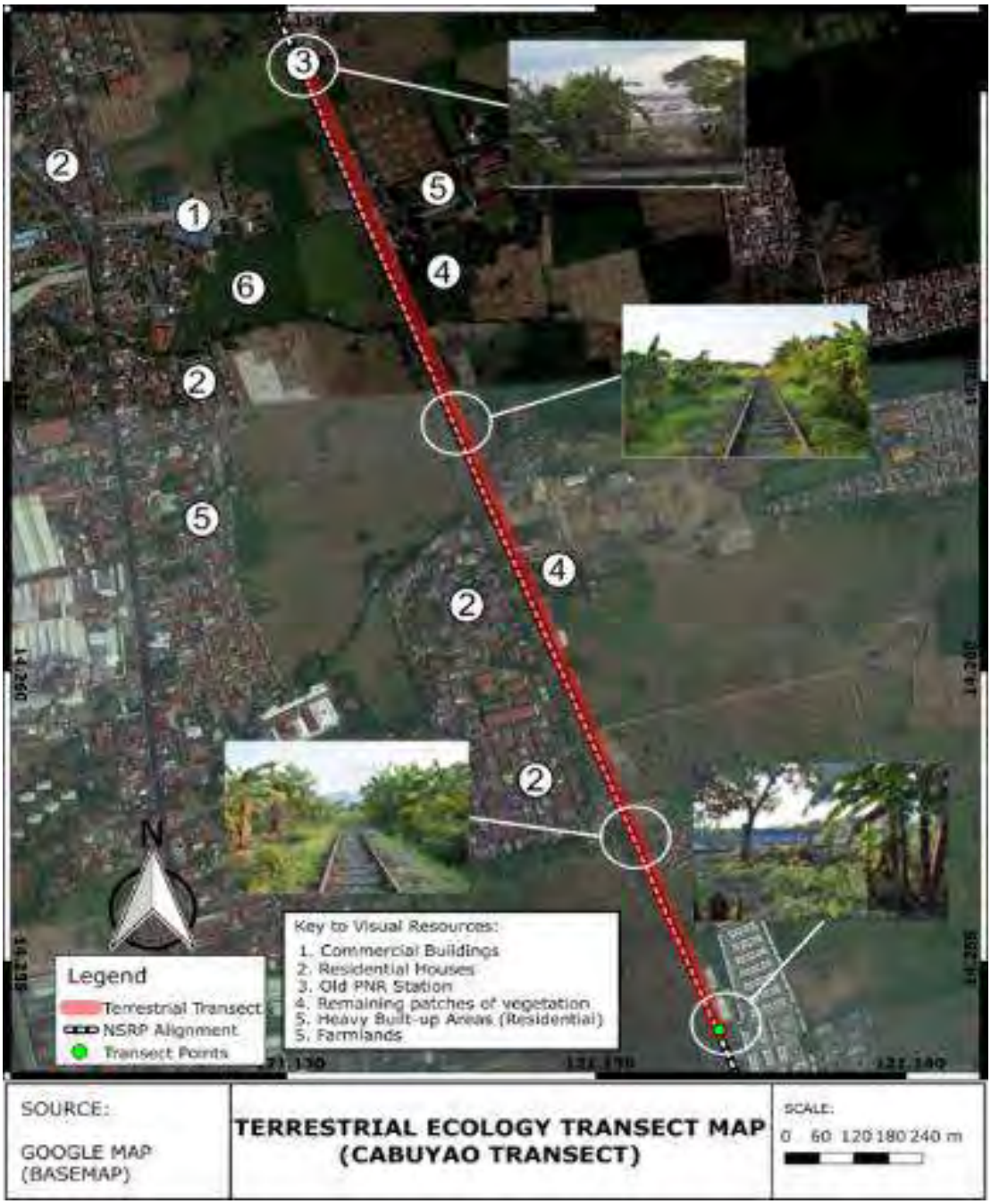


Figure 3.1.69 Map showing Transect 3 established at Brgy. Banay-Banay and Niugan

719. During dry season survey, the vegetation in this area is moderately thicker than T1 and T2 in terms of trees, ground cover, grasses and shrub layer. On the mid-point section, sparse tree individuals of Rain tree (*Samanea saman*) and Gmelina (*Gmelina arborea*) can be observed along with native tree species of Rimas (*Artocarpus altilis*), Is-Is (*Ficus ulmifolia*) and Niog-Niogan (*Ficus psuedopalma*), Alagau (*Premna odorata*), Datiles (*Muntigia calabura*) and Anabiong (*Trema orientalis*). In terms of understorey and intermediate species layer, several individuals of Ligas (*Semecarpus cuneiformis*), Binunga (*Macaranga tanarius*), Sablot (*Litsea glutinosa*) and Mahogany (*S. macrophylla*) were observed. Ground cover species typically include dense vegetation of grass species such as Talahib (*Sacharrum spontaenum*), Cogon (*Imperata cylindrica*) and *Penissetum sp.* Other invasive or exotic ground cover species include legume Dilang butiki (*Centrocema pubescens*), Bunga-Bunga (*Alternanthera sessilis*) and Dagad (*Tridax procumbens*). Medium sized diameter trees were represented by Rimas (*A. altilis*), Anubing (*A.*

ovatus) and Acacia (*S. saman*). Two (2) tree species of Antipolo (*Artocarpus blancoi*) which is endemic to the country and listed in IUCN and DENR Redlist is present in the area. Other sections of the transect plot are dominated by bamboo species Kawayan tinik (*Bambusa blumea*) near minor creek lines. Ipil-Ipil (*Leucaena leucocephala*) and Mahogany (*Sweitenia macrophylla*) can also be observed in shaded areas as sparse trees along with banana plantation.

Transect 3 during dry season showing open and bare sections of the plot dominated by grasses and weeds. On the other sections, dense stand of mixed agroforestry trees was observed along with large diameter Antipolo (*Artocarpus blancoi*), an endemic tree to the Philippines. Understorey layer in the whole plot are dominated by common weeds which are light tolerant and are common exotics.

Plate 3.1-5 Photographs of the Transect 3 During Dry Season Survey

720. During wet season survey, the vegetation became dense in terms of ground cover and understorey similar to other transect plots. Dense clumps of *I. cylindrica* and *C. pubescens* dominate almost all portions. On the mid-point section, sparse tree individuals of Rain tree (*Samanea saman*) and Gmelina (*Gmelina arborea*) can be observed waterlogged or flooded brought about by monsoon rains. Many of Mangga trees were also observed debarked. Other tree species were Antipolo (*Artocarpus altilis*), Is-Is (*Ficus ulmifolia*) and Niog-Niogan (*Ficus psuedopalma*), Alagau (*Premna odorata*), Datiles (*Muntigia calabura*) and Anabiong (*Trema orientalis*). In terms of understorey and intermediate species layer, dense individuals of Ipil-Ipil (*Leucaena leucocephala*), Binunga (*Macaranga tanarius*), Sablot (*Litsea glutinosa*) and Anonang (*Cordia dichotoma*) were observed. Ground cover species were expected to increase in abundance. The transect covers dense vegetation of grass species such as Talahib (*Sacharrum spontaenum*), Cogon (*Imperata cylindrica*) and *Penissetum sp.* Other invasive or exotic ground cover species include legume Dilang butiki (*Centrocema pubescens*), Bunga-Bunga (*Alternanthera sessilis*) and Dagad (*Tridax procumbens*). Medium sized diameter trees were represented by Rimas (*A. altilis*) and Acacia (*S. saman*). Previously documented tree species of conservation status were still present in the area. Though there are notable clearings made by residents to clean the area, idle sections were still covered by dense grasses. Other sections of the transect plot are dominated by bamboo species Kawayan tinik (*Bambusa blumea*) near minor creek lines. Ipil-Ipil (*Leucaena leucocephala*) and Mahogany (*Sweitenia macrophylla*) can also be observed in shaded areas as sparse trees along with a banana plantation. Shanties along railway sections were observed to increase more light-build huts and houses on sides of the railway. Flooded sections are observed 60% of the area. Bananas along railway tracks are maintained by local residents as these trees also serve as a barrier or cover to their temporary houses.

Transect 3 during wet season showing open and bare sections were densely dominated by grasses and ephemeral ground cover species. In other sections, vegetation is extremely flooded or in waterlogged condition. The previously recorded large diameter Antipolo (*Artocarpus blanco*i), is still present in the area.

Note: (Left) Dense stand of Cogon (*I. cylindrica*), Talahib (*S. spontaenum*) and Elephant grass (*Pennisetum purpureum)* and some tree individuals of Anabiong (*T. orientalis*); (Right) Open and bare areas with Antipolo (*A. blanco*i) (VU).

Plate 3.1-6 Photographs of the Transect 3 during Wet Season Survey

Transect 4 (Tadlac Lake)

721. Transect 4 (Tadlac Lake) is located at Brgy. Tadlac, Los Baños, Laguna. Transect 4 is characterized by a crater lake surrounded by dense residential houses (**Figure 3.1.70**). The project alignment is approximately 1-km from the lake that runs parallel to the area. The lake is characterized by freshwater Crater Lake filled with maar (e.g. Broad, low-relief volcanic crater caused by a phreatomagmatic eruption) (MGB, 2008). Bamboos and dense grasses dominate portions surrounding the lake. These include grasses, weeds and some individual trees near trails and within the “cut” hill which faces north of the lake.

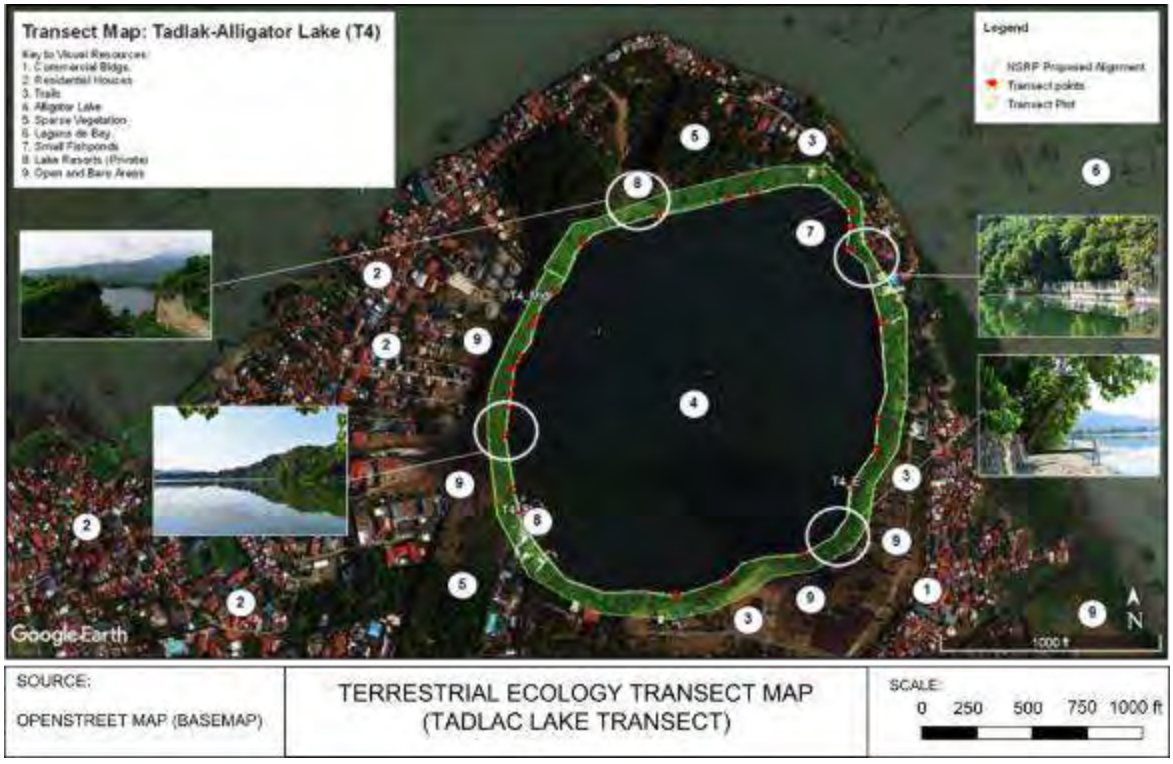


Figure 3.1.70 Map showing Transect 4 established at Brgy. Tadlac, Los Baños, Laguna

722. During dry season survey, there are no endangered plant or tree species in the area. Only common tree species were recorded near the lake and the hilly slopes within the periphery of the area. Tree species include big diameter Rain tree (*Samanea saman*), Smooth Narra (*Pterocarpus indicus*), Gmelina (*Gmelina arborea*), Kamachile (*Pithecelobium dulce*) and Ipil-Ipil (*Leucaena leucocephala*) are present within the periphery of the lake and on top of the hill. Rimas (*Artocarpus altilis*), Anabiong (*Trema orientalis*), Talisai (*Terminalia cattapa*), Ipil-Ipil (*Leucaena leucocephala*) and Datiles (*Muntingia calabura*) were documented at the sides encircling the outline of the lake. In terms of understorey and intermediate species layer, several individuals of Ligas (*Semecarpus cuneiformis*), Binunga (*Macaranga tanarius*), Sablot (*Litsea glutinosa*) and some bamboo species such as Kawayan killing (*Bambusa vulgaris*) were observed. In terms of ground cover, several species were abundant and recorded in the “cut” hill. Hagonoi (*Chromolaena odorata*) and Cogon (*Imperata cylindrica*) occupy ridges and trails near open spaces.

Transect 4 during dry season featuring the vegetation along the alligator lake dominated by grasses (e.g. Talahib (S. spontaenum) and sparse tree individuals (e.g. Kamachile (Pithecelobium dulce). The “cut” hill on the northern portion of the lake facing Laguna de Bay is characterized by pioneer tree, shrubs and grasses. The hill resembles a rock formation with dense vegetation cover.

Plate 3.1-7 Photographs of the Transect 4 during Dry Season Survey

723. During wet season survey, there are no endangered plant or tree species in the area, hence, dominated only by native species and some exotic trees. Only common tree species were recorded near the lake and the hilly slopes within the periphery of the area. Tree species include big diameter Rain tree (*Samanea saman*), Smooth Narra (*Pterocarpus indicus*), Gmelina (*Gmelina arborea*), Kamachile (*Pithecelobium dulce*) and Ipil-Ipil (*Leucaena leucocephala*) are present within the periphery of the lake and on top of the hill. Rimas (*Artocarpus altilis*), Anabiong (*Trema orientalis*), Talisai (*Terminalia cattapa*), Ipil-Ipil (*Leucaena leucocephala*) and Datiles (*Muntingia calabura*) were documented at the sides encircling the outline of the lake. In terms of understorey and intermediate species layer, several individuals of Ligas (*Semecarpus cuneiformis*), Binunga (*Macaranga tanarius*), Sablot (*Litsea glutinosa*) and some bamboo species such as Kawayan killing (*Bambusa vulgaris*) were observed. The lake serves as a significant ecological area for other wildlife species such as birds and aquatic plants. Some *Nelumbo sp*. plants were observed flowering in the lake. In terms of ground cover, several species were abundant such as *M. cordata, C. pubescens, P. purpureum* and *P. foetida* that are mostly moisture trigger species. However, plant invasion influenced the diversity of ground cover and understorey species. Monsoon rains favored growth of weed species which include Dilang butiki (*Centrocema pubescens*), *Amaranthus spinosus*, Dagad (*Tridax procumbens*) and Bunga-Bunga (*Alternanthera sessilis).* Hagonoi (*Chromolaena odorata*) and Cogon (*Imperata cylindrica*) occupy ridges and trails near open spaces. These open spaces provide opportunities for many ground cover species especially grasses and weeds to grow and develop. The diversity of plants in the area presumably came from seeds that are dispersed by wind or birds, although not documented, it is the most effective mechanism by which these plant species were dispersed in the area.

Transect 4 during wet season showing the vegetation along the alligator lake dominated by dense grasses (e.g. Talahib (*S. spontaenum*) and bamboos. The dense vegetation covers the rock formation in the lake.

Plate 3.1-8 Photographs of the Transect 4 during Wet Season Survey

Transect 5 (Timugan)

724. Transect 5 is located at two (2) barangays in Los Baños, consisting of Brgy. Timugan and Brgy. Baybayin which covers the starting point near Laguna de Bay to the MMFR buffer zone (**Figure 3.1.71**). The landscape resources within the forest reserve are surrounded by a buffer zone delineated by law for the purpose of providing protection to the reserve and the resources therein.

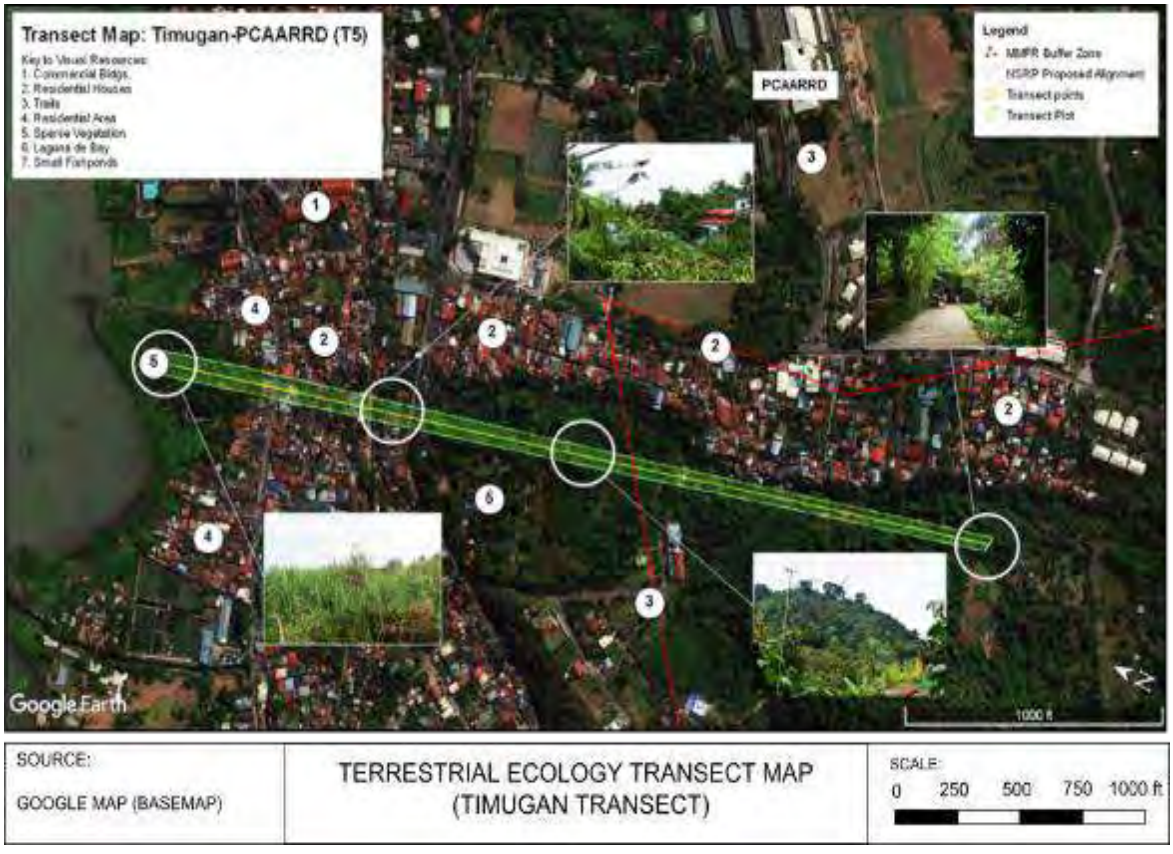


Figure 3.1.71 Map showing Transect 5 established at Brgy. Timugan (Incl. Baybayin), Los Baños, Laguna

725. During dry season survey, there are established agroforestry farms within the transect plot and include mature trees of Mangga, Santol and Lanzones. On the mid-point section, sparse tree individuals of Ipil-Ipil (*Leucaena leucocephala*), Datiles (*Muntigia calabura*), Rain tree (*Samanea saman*) and Kamachile (*Pithecelobium dulce*) can be observed within the private area. In terms of understorey and intermediate species layer, the same species were observed. Further inland, some remnants of planted bananas (*Musa sp.*) were abandoned because the existing condition of the area, according to the officials present during the survey. Ground cover species include thick vegetation of grass species such as Talahib (*Sacharrum spontaenum*), Cogon (*Imperata cylindrica*) and *Penissetum sp*. There is no significant vegetation nor endangered species of plants and trees recorded within the survey plot even though it is located within the buffer zone.

Transect 5 during dry season showing dense cover of grasses Talahib in the first section of the plot and dense tree vegetation going to the MMFR buffer zone. Tree species of *A. altilis, M. calabura*, and *T. cattapa* located within residential areas and thick bamboo vegetation.

Plate 3.1-9 Photographs of the Transect 5 during Dry Season Survey

726. During wet season survey, the small hill is actually covered by manga trees and other horticultural trees. However, dense grass vegetation emerges from wet season rains and dominated portions going to Laguna de bay which is the starting point of the plot. The starting point was also claimed privately owned. (**Plate 3.1-10** Photographs of the Transect 5 during Wet Season Survey). On the mid-point section, the sparse tree individuals previously documented from dry season survey were still present such as Ipil-Ipil (*Leucaena leucocephala*), Datiles (*Muntigia calabura*), Rain tree (*Samanea saman*) and Kamachile (*Pithecelobium dulce*) can be observed within the private area. In terms of understorey and intermediate species layer, the same species were observed. Some of the portions near residential areas are well maintained by residents occupying the buffer zone. There are few individuals of *B. papyrifera* that emerged from root stocks in the area due to abundant soil moisture in the area. Further inland, some planted bananas (*Musa sp.*) which were abandoned because of the existing condition of the area were still observed, according to some local guides during the survey. Ground cover species include thick vegetation of grass species such as Talahib (*Sacharrum spontaenum*), Cogon (*Imperata cylindrica*) and *Penissetum sp.* There is no significant vegetation nor endangered species of plants and trees recorded within the survey plot even though it is located within the buffer zone. As the area is dominated by residential areas and agroforestry farm, significant flora is actually located in greater watersheds of MMFR. These areas are not used for any other land uses including agroforestry and was proclaimed as national park with many distinct flora and fauna at the designated forest reserves and critical areas.

Transect 5 during wet season dominated by dense ground cover layer and moisture triggered species. Tree species of A*. altilis, M. calabura*, and *T. cattapa* located within residential areas and thick bamboo vegetation.

Plate 3.1-10 Photographs of the Transect 5 during Wet Season Survey

Transect 6 (San Antonio - IRRI-IPB Section)

727. Transect 6 is located at Brgy. Sto. Nino, Los Baños, Laguna. Shanties' residential areas are the first to be seen along railway tracks from the starting point located at the center of the barangay (**Figure 3.1.72**).

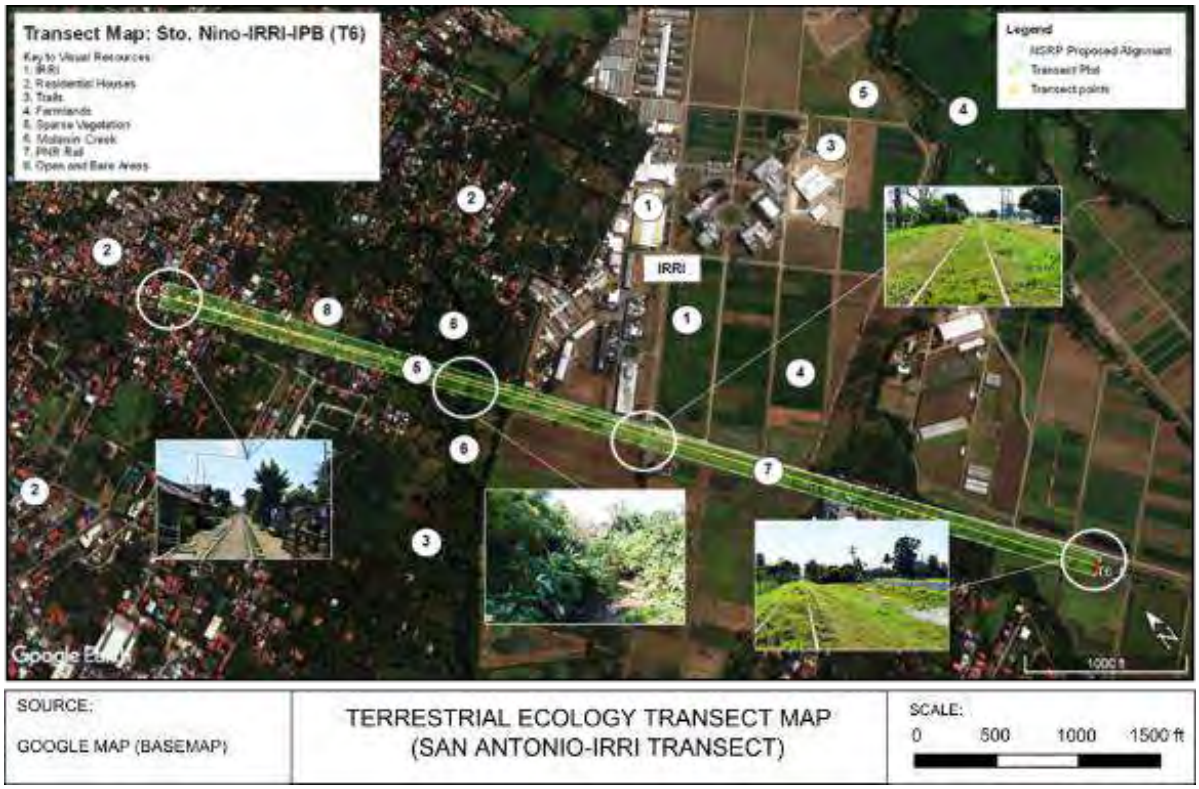


Figure 3.1.72 Map showing Transect 6 Established at Brgy. Sto. Niño (IRRI-IPB section) Los Baños, Laguna

728. During dry season survey, the transect plot is characterized by abandoned fishponds and vast areas of wetlands or inundated area smothered by different plant species. The vegetation in the transect plot is very disturbed. Walking through the plots are residential houses inside vegetated areas, some of which are planted and domesticated tree species of Santol (*S. koetjape*), Lanzones (*L. domesticum*) and some small backyard garden. Near the mid-plot is a

small creek called Molawin creek. The creek actually hosts diverse species of trees and dense cover of bamboo poles. These species include Tangisang bayawak (*F. variegata*), Tibig (*Ficus nota*) and an endemic species of Moraceae, Antipolo (*Artocarpus blancoi*). On the mid-point section, the area is already devoid of canopy trees which are actually open and bared areas passing through the front gate of IRRI. Weeds and some small shrubs and herbaceous vines dominate the railway tracks such as Bunga-bunga (*Alternathera sessilis*), Kuliot (*Sida rombhoidifolia*), Melon daga (*Zherenia indica*) and Dilang butiki (*Centrocema pubescens*).

729. Other ground cover species include Talahib (*Sacharrum spontaenum*), Cogon (*Imperata cylindrica*), Dagad (*Tridax procumbens*). Sparse trees can be observed at the end of the plot dominated by an exotic and invasive species of Paper Mulberry (*Broussonetia papyrifera* (L.) Vent.).

Transect 6 during dry season showing residential areas near the rail tracks. Tree species are actually planted mahogany trees, including fruit trees such as Mangga (*Mangifera indica*), Santol (*Sandoricum koetjape*) and ornamental palms. Open fields near IRRI and UPLB comprise the later section of the plot with planted trees along roadsides.

Plate 3.1-11 Photographs of the Transect 6 during Dry Season Survey

730. During wet season survey, plants along rails and residential houses contributed to the overall richness and abundance of the area. Rainy season augmented energy to develop vegetation in the area since the transect plot runs parallel with the existing railway tracks which encompasses variable vegetation from orchards and riparian flora. Based on the wet season survey, the vegetation in the transect plot is very disturbed, hence, weeds and grass vegetation dominated the rail with dense number. Walking through the plots are residential houses inside vegetated areas, some of which are planted and domesticated tree species of Santol (*S. koetjape*), Lanzones (*L. domesticum*) and some small backyard garden. Near the mid-plot is a small creek called Molawin creek that flows stream water from MMFR. The creek actually hosts diverse species of trees and dense cover of bamboo, sedges and grasses. These species include Tangisang bayawak (*F. variegata*), Tibig (*Ficus nota*) and an endemic species of Moraceae, Antipolo (*Artocarpus blancoi*). On the mid-point section, the area is already devoid of canopy trees which are actually open and bared areas passing through the front gate of IRRI. Weeds and some small shrubs and herbaceous vines dominate the railway tracks such as Bunga-bunga (*Alternathera sessilis*), Kuliot (*Sida rombhoidifolia*), Melon daga (*Zherenia indica*) and Dilang butiki (*Centrocema pubescens*).

731. Other ground cover species include Talahib (*Sacharrum spontaenum*), Cogon (*Imperata cylindrica*), Dagad (*Tridax procumbens*). Sparse trees can be observed at the end of the plot dominated by an exotic and invasive species of Paper Mulberry (*Broussonetia papyrifera* (L.) Vent.) (**Plate 3.1-12**). Some individuals of Is-Is (*F. ulmifolia*) are mixed with some banana plants and smothered with *C. pubescens* as dominant ground cover species in the area. It should be noted that the ground cover vegetation is extremely exposed to heat and direct sunlight which only opportunistic and light demanding species grow within the area.

Transect 6 during wet season showing dense vegetation of *B. papyrifera* with rootstocks and dense grass of *S. halopense, C. pubescens* and *M. cordata*. All sections were dominated by dense grass and herbaceous vines species. Tree species include mahogany trees, including fruit trees such as Mangga (*Mangifera indica*), Santol (*Sandoricum koetjape*) as part of gardens and orchards by residents. Open fields near IRRI and UPLB comprise the later section of the plot with planted trees along roadsides.

Plate 3.1-12 Photographs of the Transect 6 During Wet Season Survey

4) Species Diversity

732. During the dry season survey, 107 morpho-species, 99 genera belonging to 42 families were documented in the six transect plots established within the project alignment. Dominant families in the said transect plots were Fabacae, Moraceae, Anacardiaceae, Lamiaceae, Euphorbiaceae, Annonaceae, Malvaceae, Poaceae, Convulvolaceae and Asteraceae. The most frequently occurring tree species were *Trema orientalis*, *Artocarpus altilis* (Park.) Fosb, *Ficus ulmifolia* Lamk, *Muntigia calabura* L., *Premna odorata* Blanco, *Leucaena leucocephala* (Lam.) de Wit, *Gmelina arborea* Roxb., and *Macaranga tanarius* (L.) Muell.-Arg. The aforementioned species were present in all transects except for *Artocarpus blancoi* (Elmer) Merr., which were recorded in Transect 3 only with 2 individual trees.

733. Apart from the species recorded from the quadrat sampling, additional 5 species (not present in the quadrats) were recorded from the opportunistic survey. Hence, a total of 112 morpho-species of plants were encountered in the whole Project Railway alignment.

734. During wet season survey, 109 morpho-species, 102 genera belonging to 42 families were documented in the six (6) transect plots established within the project alignment. Dominant families in the said transect plots were Fabacae, Moraceae, Anacardiaceae, Lamiaceae, Euphorbiaceae, Annonaceae, Malvaceae, Poaceae, Convulvolaceae and Asteraceae. The most frequently occurring tree species were *Trema orientalis*, *Artocarpus altilis* (Park.) *Fosb, Ficus ulmifolia* Lamk*, Muntigia calabura* L.*, Premna odorata* Blanco*, Leucaena leucocephala* (Lam.) de Wit*, Gmelina arborea* Roxb.*,* and *Macaranga tanarius* (L.) Muell.-Arg. The aforementioned species were present in all transects except for *Artocarpus blancoi* (Elmer) Merr., which was recorded in Transect 3 only with two (2) individual trees.

735. Apart from the species recorded from the quadrat sampling, additional five (5) species (not present in the quadrats) were recorded from the opportunistic survey. Hence, a total of 114 morpho-species of plants were encountered in the whole project alignment. The large number of vascular flora recorded reflects a number of factors:

- The long, linear nature of the Project area, meaning that it intersected a wide variety of plant communities and therefore vegetation types;
- The relatively large number of intensively sampled quadrats across the railway alignment; and

- The timing of the field surveys following substantial wet season species that were available for recording; approximately 50% of the species recorded were annual or weekly perennial flora and ephemeral species.

736. As for the findings from the flora survey near the underground Interconnecting Stations, a total of 857 tree individuals belonging to 73 morpho-species, 61 genera and 28 families were recorded inside the four (4) transects. Dominant families were Fabaceae (13 species), Moraceae (10 species), Arecaceae (6 species), and Myrtaceae (5 species). The most frequently occurring species were *Pterocarpus indicus* (Narra; 272 individuals), *Swietenia macrophylla* (Big leafed mahogany; 97 individuals), *Terminalia catappa* (Talisai; 77 individuals), *Albizia saman* (Akasya; 66 individuals), and *Delonix regia* (Fire tree; 35 individuals). **Table 3.1.17** shows the ten (10) most frequently occurring species as well as the transect number where they were recorded. From the top 10 most dominant species, only three (3) species such as *Pterocarpus indicus* (Narra), *Terminalia catappa* (Talisai), and *Lagerstroemia speciosa* (Banaba) are categorized as native or indigenous to the country while all others are exotics or introduced from other countries. This only shows that majority of the trees being used for urban planting nowadays are mostly exotics.

Table 3.1.17 Top 10 Most Frequently Occurring Species in the SCRP Interconnecting Line Flora Transects

Number	Species	Common Name	Count	Transect Number
01	*Pterocarpus indicus*	Narra	272	T1,T2,T3,T4
02	*Swietenia macrophylla*	Big Leafed Mahogany	97	T1,T3,T4
03	*Terminalia catappa*	Talisai	77	T1,T2,T3,T4
04	*Albizia saman*	Acacia	66	T1,T2,T3,T4
05	*Delonix regia*	Fire Tree	35	T1,T2,T3
06	*Mangifera indica*	Mangga	34	T1,T3,T4
07	*Lagerstroemia speciosa*	Banaba	17	T1,T3
08	*Moringa oleifera*	Malunggay	17	T1
09	*Leucaena leucocephala*	*Ipil-ipil*	16	T1,T2
10	*Spathodea campanulata*	African Tulip	14	T1,T2,T3

Tree Flora

737. During the dry season survey, a total of 42 morpho-species with 40 genera belonging to 18 families were recorded in the whole proposed project alignment. The average number of trees per quadrat (20m x 20m) is about one (1) individual or an average density of 0.0025 tree/m^2 (1 tree for every 100 m^2). This is understandable since the area is very disturbed and generally dominated by invasive shrubs and grasses which compete with relatively few individual trees as "weeds". Additionally, since the transect plots are located in a very disturbed environment and built-up areas, it is expected that tree or plant cover would be very minimal as these areas are very well maintained, hence, the lower tree density of the transect plots can be attributed to the general land use and condition of the area.

738. On the other hand, sparse tree vegetation is characterized by the dominance of small-sized pioneer trees similar in abandoned (e.g. inactive) or idle areas of PNR. The trees with the largest diameter include both fruit and forest trees which are represented by Rimas (*Artocarpus altilis*), Anabiong (*Trema orientalis*), Duhat (*Syzigium cuminii*), Mangga (*Mangifera indica*), Kamachile (*Pithecelobium dulce*), Rain tree (*Samanea saman*), Alagau (*Premna odorata*), Santol (*Sandoricum koetjape*) and Antipolo (*Artocarpus blancoi*). These tree species are present in all transect plots except for the species of *A. blancoi* which is only documented in Brgy. Banay-Banay (T3) near the PNR railway track mixed with abandoned banana stands.

739. Similar to dry season survey, a total of 42 morpho-species with 40 genera belonging to 18 families were recorded in the whole project alignment during wet season survey. There were also no changes in the composition of tree species in the area during the wet season as cutting and/or removal, or any other factors leading to the decrease of vegetation in the area is prohibited. The average number of trees per quadrat (20m x 20m) is about 1 individual or an average density of 0.0025 tree/m^2 (1 tree for every 100 m^2). This is understandable since the area is very disturbed and generally dominated by invasive shrubs and grasses which compete with relatively few individual trees as "weeds". Disturbed areas are dominated by weed species, particularly grasses, and native disturbance response species. Disturbed areas include: access tracks, residential areas, roadsides, and cleared open areas. Additionally, since the transect plots are located in a very disturbed environment and built-up areas, it is expected that tree or plant cover would be very minimal as these areas are very well maintained, hence, the lower tree density of the transect plots can be attributed to the general land use and condition of the area. The existing observable land use of the area are agricultural in the south stations (alignment), and heavy built-up residential areas in Solis, FTI and Cabuyao area. Moreover, most areas surveyed are almost bare in vegetation especially in stations actively operating or areas where shanties are present with the exception that some vegetation has been beneficial to these shanties to hide their temporary houses within PNR railway tracks. On the other hand, sparse tree vegetation is characterized by the dominance of small-sized pioneer trees similar in abandoned (e.g. inactive) or idle areas of PNR. The trees with the largest diameter include both fruit and forest trees which are represented by Rimas (*Artocarpus altilis*), Anabiong (*Trema orientalis*), Duhat (*Syzigium cuminii*), Mangga (*Mangifera indica*), Kamachile (*Pithecelobium dulce*), Rain tree (*Samanea saman*), Alagau (*Premna odorata*), Santol (*Sandoricum koetjape*) and Antipolo (*Artocarpus blancoi*). These tree species are present in all transect plots except for the species of *A. blancoi* which is only documented in Brgy. Banay-Banay (T3) near the PNR railway track mixed with abandoned banana stands.

740. The relative density, relative dominance and relative frequency values for each tree species in all the transect plots were determined to obtain their Importance Value (IV), a standard measure in ecology that determines the rank relationships of species. High Importance values of species indicate a composite score for high relative species dominance, density and frequency. Based on the computed IV (**Table 3.1.18**), the three (3) most important species (with the highest IV) are Acacia (22.88), Narra (14.88), and Dita (14.56). Most of the tree species documented in the project alignment are agroforestry species planted in the remaining patches of vegetation in the area. This implies low conservation value of the area, particularly in areas that are highly disturbed. However, the variation of IV among the canopy species, except for Acacia, Narra and Dita, is significant. This, therefore, suggests an imbalance distribution (imbalance co-existence) among the native plants (e.g. trees) and ground cover layer.

Table 3.1.18 Top 10 Species with the Highest Importance Value (IV)

Scientific Name	Common name	Family Name	Importance Value (IV)	
			Dry Season	Wet Season
Samanea saman (Jacq.) Merr.	Acacia	FABACEAE	-	22.88
Pterocarpus indicus	Narra	FABACEAE	-	14.88
Alstonia scholaris (L.) R. Br.	Dita	APOCYNACEAE	-	14.56
**Mangifera indica* L.	Mangga	ANACARDIACEAE	12.73	14.00
Artocarpus blancoi (Elmer) Merr.	Antipolo	MORACEAE	-	13.29
Artocarpus heterophyllus Lam.	Nangka	MORACEAE	19.24	11.50
Broussonetia papyrifera (L.) Vent.	Paper mulberry	MORACEAE	12.81	8.65
Sandoricum koetjape (Burm. f.) Merr	Santol	MELIACEAE	17.83	7.66
**Pithecellobium dulce (Roxb) Benth.*	Kamachile	FABACEAE	6.03	7.71
Premna odorata Blanco	Alagau	LAMIACEAE	6.73	6.24
Leucaena leucocephala (Lam.) de Wit	Ipil-Ipil	FABACEAE	18.52	-
Ficus ulmifolia Lamk	Is-Is	MORACEAE	12.05	-
**Muntigia calabura* L.	Datiles	MUNTIGIACEAE	8.30	-

Note: IV –Importance Value

Intermediate and Understorey

741. During the dry season survey, a total of 13 morpho-species with unique 13 genera belonging to 8 families were recorded for understorey layer. The average density is slightly higher than that of trees, at 0.12 individual/m^2 or equivalent to 12 individuals for every 100m^2. The two most abundant understorey species are Hagonoy (*Chromolaena odorata*) and Coronitas (*Lantana camara*) with 23 and 17, respectively. The most dominant families at the understorey are Asteraceae with 23 individuals and Verbenaceae with 17 individuals. The representative species of family Asteraceae are predominantly shrubs (9 species), while those representing family Malvaceae are herbaceous plants (4 species). A total of 93 individual species were recorded in the area.

742. During wet season survey, there were no changes in the richness of intermediate and understorey layer. Similar to any disturbed forests, lower plant forms or the understories are significantly more diverse than larger trees. A total of 13 morpho-species with unique 13 genera belonging to 8 families were recorded for understorey layer. The average density is extremely higher than that of trees and the dry season conditions, at 0.36 individual/m^2 or equivalent to 36 individuals for every 100 m^2. These suggest high influence of abundant moisture from the surrounding environment due to monsoon rains. The representative species of family Asteraceae are predominantly shrubs (9 species), while those representing family Malvaceae are herbaceous plants (4 species). A total of 93 individual species were recorded in the area.

743. The list of all the understorey plant species recorded in the whole proposed project alignment are presented in **Table 3.1.19**.

Table 3.1.19 Top 10 Most Abundant Understorey Species

Scientific Name	Common name	Family Name	Total Count	
			Dry Season	Wet Season
Chromolaena odorata (L.) R.M. King & H. Rob.	Hagonoy	ASTERACEAE	23	32
Lantana camara L.	Coronitas	VERBENACEAE	17	27
**Urena lobata* L.	Kulot-Kulotan	MALVACEAE	13	21
Penissetum purpureum	Pandakaki	POACEAE	9	18
Stachytarpheta jamaicensis (L.) Vahl	Kandikandilaan	VERBENACEAE	9	17
**Sida acuta* Burm. f.	Walis-walisan	MALVACEAE	8	13
**Sida javensis* Cav.	Igat-Igat	MALVACEAE	6	9
Cassia alata Linn.	Akapulko	FABACEAE	5	8
**Sida rhombifolia* L.	Takling baka	MALVACEAE	4	5
Ficus ulmifolia Lamk.	Is-Is	MORACEAE	4	5

Note: * Invasive species

Ground Cover

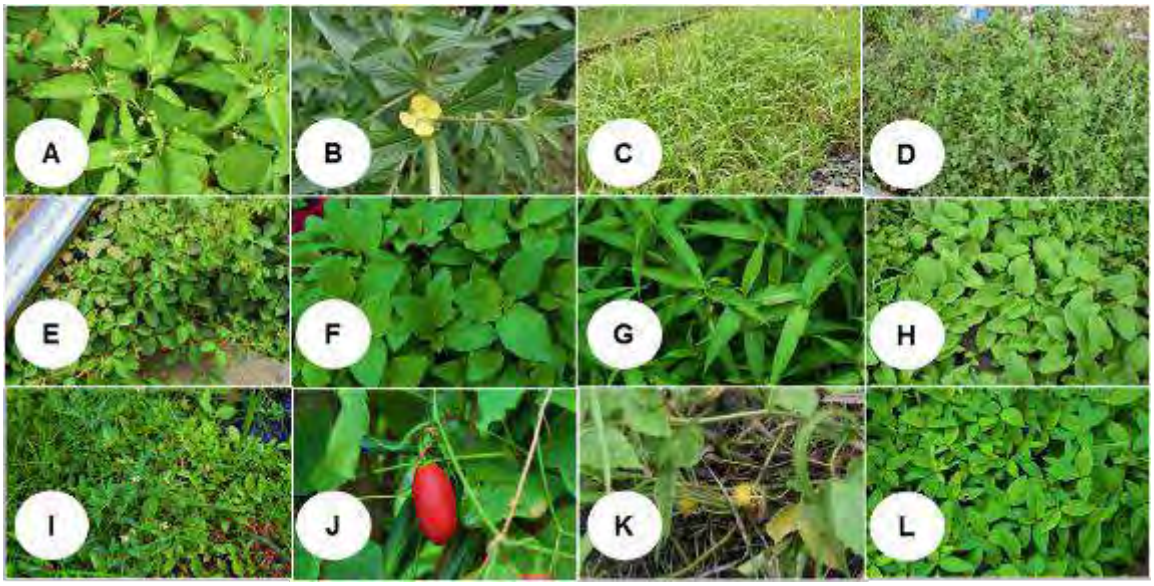
744. Ground cover species are all species (crawling or erect) inside the 1m x 1m quadrat with height of less than 1m. Hence, seedlings of different tree species are included as a ground cover.

745. During dry season survey, there are 51 ground cover species recorded from the all transect plots. It must be noted that the ground cover species referred to in this survey are all species (crawling or erect) inside the 1m x 1m quadrat with height of less than 1 meter. Hence, seedlings of different tree species are included as a ground cover. Based on the survey, ground cover occupies more than 80% of the ground layer leaving less growing spaces for the other recruits of seedlings of other tree species, hence, low species diversity. Based on site survey and measurements, the most dominant species that occupy the highest relative cover are Bunga-Bunga (28.11%), Uuko (16.21%), and a species of runner weed, Dagad (14.86%). **Plate 3.1-13** shows some of the documented ground cover species in the project alignment.

Note: (a) Dadayem (*Bidens alba* (L.) DC.), ASTERACEAE; (b) Aurorang gubat (*Ipomea triloba* L.); (c) Bagan-Bagan (*Lycianthes biflora* (Lour.) Bitter), SOLANACEAE; (d) Bunga-Bunga (*Alternanthera sessilis* (L.) R.Br. ex DC., AMARANTHACEAE; (e) Makahiya (**Mimosa pudica L.*), FABACEAE; (f) *Asystasia gangetica,* ACANTHACEAE; (g) Dagad (*Tridax procumbens* Linn.), ASTERACEAE; (h) Alangingi (*Cayratia trifolia* (L.) Quis.), VITACEAE; (i) Igat-Igat (**Sida javensis* Cav.), MALVACEAE; (j) Melon daga (*Zehneria indica* (Lour.) Keraudren), CUCURBITACEAE; (k) Aurora (*Ipomea sp.*), CONVULVOLACEAE; (l) Tamling (*Coccinea grandis* (L.) Voigt), CUCURBITACEAE.

Plate 3.1-13 Photographed and Recorded Dominant Ground Cover Species at Different Transect Plots during Dry Season Survey

746. During wet season survey, ground cover occupies more than 80% of the ground layer leaving less growing spaces for the other recruits of seedlings of other tree species, hence, low species diversity. Similar to the results of dry season survey, there were 51 ground cover species recorded from the all transect plots during the wet season flora survey. It must be noted that sufficient rainfall to promote plant growth in ground cover layer increased species abundance and composition. In terms of relative cover, the majority of the species are represented by the family of Asteraceae such as *Tridax procumbens*, *Mikania cordata*, *Ageratum conyzoides*, *Synedrella odorata*, *Chromolaena odorata* and some individuals of *Bidens pilosa.* Ground cover is dense in open areas, especially in areas where idle and abandoned farms are present. Smothering weeds such as Dilang butiki (*Centrocema pubescens*) were dominating disturbed vegetation covering most sections of railway tracks (**Plate 3.1-14**).



Note: (A) Silihan (*Physalis angulata* L.), SOLANACEAE; (B) Malapako (*Ludwigia octovalvis* (Jacq.) P.H. Raven); (C) Hakati (*Paspalum conjugatum*), POACEAE; (D) Spindletop (*Cleome rutidosperma* DC., AMARANTHACEAE; (E) Alangingi (*Cayratia trifolia* (L.) Quis.), VITACEAE;; (F) *Commelina benghalenis* L., COMMELINACEAE; (G) *Alikbangon lalaki* (*Murdania nudiflora* (L.) Brenan), COMMELINACEAE; (H) *Ipomea sp.*, CONVULVOLACEAE; (I) Dagad (*Tridax procumbens*), ASTERACEAE; (J) Melon daga (*Zehneria indica* (Lour.) Keraudren), CUCURBITACEAE; (K) Karunggut (*Passiflora foetida* L.), CONVULVOLACEAE; (L) Pintado (*Euphorbia heterophylla* L.), EUPHORBIACEAE.

Plate 3.1-14 Photographed and Recorded Dominant Ground Cover Species at Different Transect Plots during Wet Season Survey

Table 3.1.20 Top 10 Most Dominant Ground Cover Species During Dry and Wet Season Surveys

Scientific Name	Common Name	Family Name	Relative % Cover	
			Dry Season	Wet Season
Alternanthera sessilis (L.) R.Br. ex DC.	Bunga-Bunga	AMARANTHACEAE	28.11	26.71
Mikania cordata (Burm. f.) B.L. Rob.	Kulitis	ASTERACEAE	16.21	25.11
**Tridax procumbens* Linn.	Dagad	ASTERACEAE	17.86	21.42
**Centrosema pubescens* Benth.	Dilang Butiki	FABACEAE	10.56	12.66
Synedrella nodiflora	Tuhod manok	ASTERACEAE	8.15	8.23
Coccinea grandis (L.) Voigt	Tamling	CUCURBITACEAE	7.15	8.14
Zehneria indica (Lour.) Keraudren	Melon Daga	CUCURBITACEAE	4.25	8.25
**Sida rhombifolia* L.	Takling baka	MALVACEAE	3.45	6.22
**Urena lobata* L.	Kulot-Kulotan	MALVACEAE	2.34	3.65
Sorghum halepense (L.) Pers.	Johnson grass	POACEAE	2.73	3.43

Species Diversity Indices

747. During the dry season, the diversity index of the project area ranged from low to moderately low, while evenness indices varied from very low to low (**Table 3.1.20** and **Figure 3.1.73**). Diversity indices were highest in the understorey and herbaceous layer. The vegetation in some of the transect plots (e.g. T1, T2, T3) is considered as disturbed vegetation, though sparse and very minimal, these areas where trees are not that dominant can be regarded as vegetation patches or formations.

748. Most of the sampling plots have low diversity. Transect plots 1, 2, 3 and 4 are considered to be low in diversity primarily because the condition of the plots is extremely disturbed. Transect plot 5 obtained the highest value (2.559) while Transect 1 (*H'*=2.163) got the lowest Shannon index (2.163). The number of species present in each transect plot was primarily the reason for

very low/low value of the Shannon index, which is also influenced by the number of individuals which concentrated much on the ground cover species.

749. Transect 1 obtained the highest value of Simpson index (0.971) while Transect 3 had the lowest value of Simpson index (0.950). In terms of Evenness index, plot 4 had the highest value of close to 1.0 understandably because it contains a relatively more species primarily ground cover species.

750. During wet season survey, the diversity index of the area ranged from moderate to very high, while evenness indices are very high (**Table 3.1.21** and **Figure 3.1.74**). Diversity indices were highest in the understorey and herbaceous layer. The vegetation in all of the transect plots are considered as disturbed vegetation, though sparse and very minimal, these areas where trees are not that dominant can be regarded as vegetation patches or formations. Evenness index was very low in the tree layer.

751. The species diversity per transect suggests introduction, disturbance, and invasion. Consequently, the number of species per transect recorded in the survey coincide with the general trend that the disturbed areas are dominated with more understorey and ground cover species which are mostly opportunistic and light tolerant species.

Table 3.1.21 Diversity Indices and Number of Species and Individuals per Transect

Transect Plot No.	No. of species		No. of Individuals		Diversity Indices					
	Dry	Wet	Dry	Wet	Dry Season			Wet Season		
					H'	D'	J'	H'	D'	J'
1	56	56	284	1196	2.163	0.971	0.934	3.709	0.966	0.914
2	32	32	244	483	2.186	0.954	0.919	3.227	0.949	0.928
3	33	33	226	596	2.170	0.950	0.906	2.838	0.948	0.922
4	41	41	312	609	2.349	0.963	0.958	3.398	0.957	0.916
5	52	52	806	862	2.559	0.965	0.901	3.559	0.964	0.923
6	47	47	307	644	2.467	0.958	0.906	3.361	1.000	0.905

Note: H' – Shannon index; D = Simpson's index; J' – Evenness index
Diversity Index: vh – very high (3.50 above), h – high (3.00 – 3.49), m – moderate (2.50 – 2.99), l – low (2.00 – 2.49), vl – very low (1.99 – below); Evenness Index: vh – very high (0.75 – 1.00), h – high (0.50 – 0.74), m – moderate (0.25 – 0.49), l – low (0.15 – 0.24), vl – very low (0.05 – 0.14).

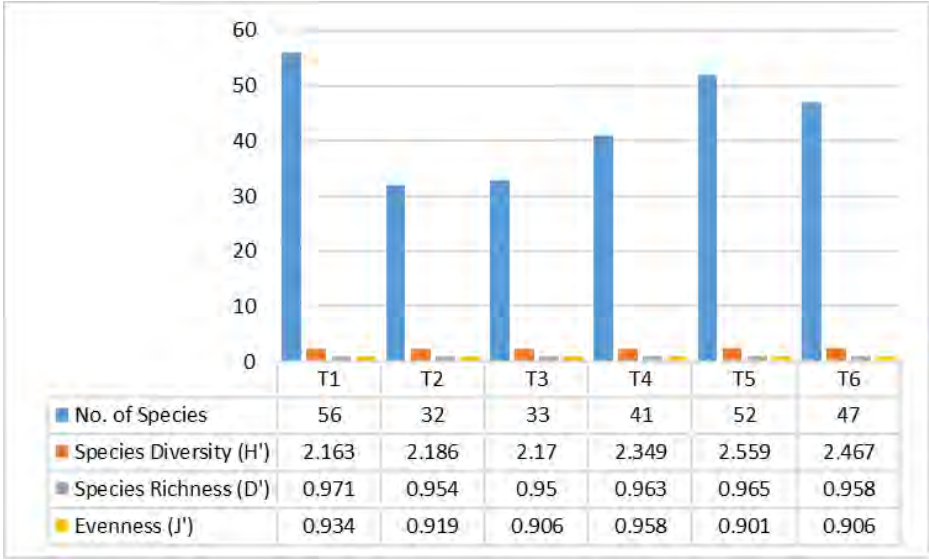


Figure 3.1.73 Diversity Indices and Number of Species for Each Plot during Dry Season Survey

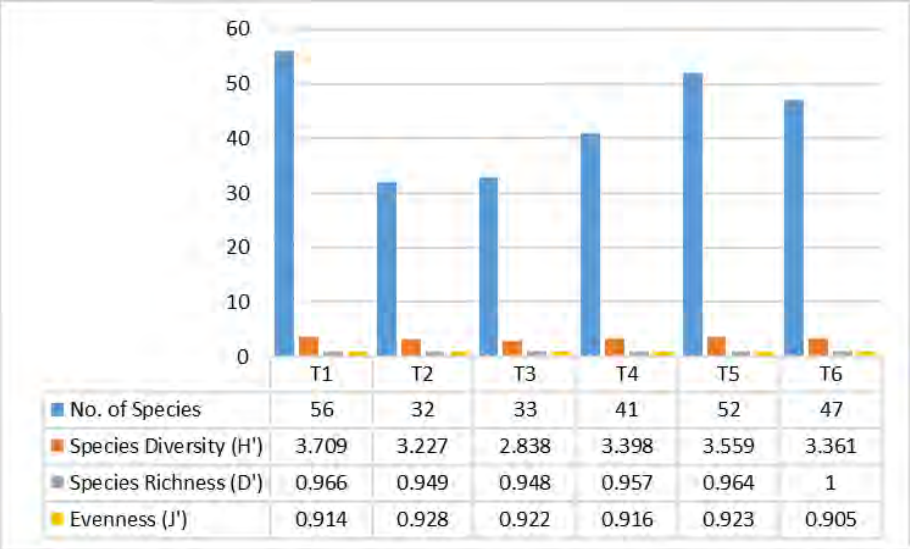


Figure 3.1.74 Diversity Indices and Number of Species for Each Plot during Wet Season Survey

752. In terms of the findings for the SCRP interconnecting line, calculated diversity index values are summarized in **Table 3.1.22**. Here, the computed overall diversity and evenness index scores of the surveyed four (4) additional transects were 2.74 and 0.41, respectively; which fall under the "moderate" condition rating. Comparing the resulting index values per additional transect, Underground Segment T1 (*H* = 3.35; *J* = 0.62) had the highest *H* and *J* scores, followed by Underground Segment T4 (*H* = 2.17; *J* = 0.18), Underground Segment T3 (*H* = 1.93; *J* = 0.41), and Underground Segment T1 (*H* = 0.97; *J* = 0.17). A possible contributing factor for the observed lower score for Underground Segment T2 and Underground Segment T3 could be associated with the dominance of *Pterocarpus indicus* (Narra) and *Swietenia macrophylla* (Big leaved mahogany) among these sites, which may have overpowered the percent contribution of other arborescent species.

Table 3.1.22 Summary of Diversity Indices for the SCRP Interconnecting Line

Site	Diversity Index (H)	Evenness Index (J)	Dominance Index ()
U-Segment T1	3.35	0.62	272
U-Segment T2	0.97	0.17	97
U-Segment T3	1.93	0.41	77
U-Segment T4	2.17	0.42	66
Overall	2.74	0.41	35

Diversity index threshold values: > 3.50 (**very high**); 3.00 – 3.49 (**high**); 2.50 – 2.99 (**moderate**); 2.00 – 2.49 (**low**); < 1.99 (**very low**)

Evenness index threshold values: 0.75 – 1.00 (**very high**); 0.50 – 0.74 (**high**); 0.25 – 0.49 (**moderate**); 0.15 – 0.24 (**low**); 0.05 – 0.14 (**very low**)

5) Biodiversity Value

a. Ecologically Important Species

753. The ecological or biodiversity value of an area is always measured in terms of species richness and in the number of endemic and threatened species present. Species that are of botanical importance (endemic, threatened, and new record) are listed below.

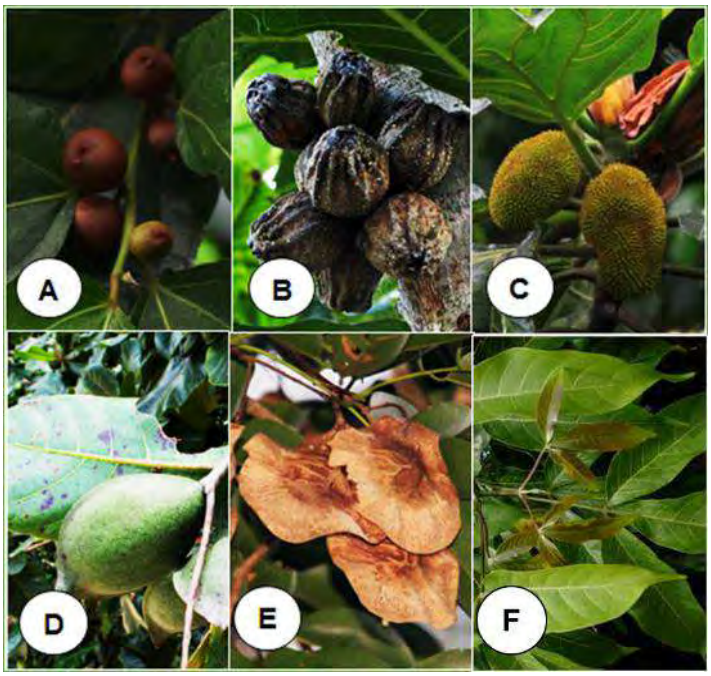
Endemic and Indigenous Species

754. The geographical distribution of plant species has been very useful for assessing biodiversity values of regions, countries, and islands. Species confined to a particular site should be given particular conservation management strategies, as they are more vulnerable to disturbance due to their narrow range.

755. During dry season survey, of the total 107 taxa identified to species level, five (5) species (5%) were found to be Philippine endemics or have natural habitat confined only in the country (**Table 3.1.23**).

756. During wet season survey, five (5) species (4% of the total taxa identified) were found to be Philippine endemics or have natural habitat confined only in the country (**Table 3.1.23**).

757. Noteworthy among the list are those species that are also included in either the Philippine red list or in the International Union for Conservation of Nature (IUCN). These include Antipolo, Piling liitan, Niog-Niogan, and Anubing. These trees should be prioritized for species conservation (**Plate 3.1-15**). Eighty four percent (84%) of the total number of species recorded in the area are indigenous to the Philippines and exhibits different economic and ecological importance. These species are represented by different general plant forms such as trees, vines, herb and shrub.



Note: (A) Is-Is (*Ficus ulmifolia* Lamk.), MORACEAE; (B) Niog-Niogan (*Ficus pseudopalma* Blanco), MORACEAE; (C) Antipolo (*Artocarpus blancoi* (Elmer) Merr., MORACEAE; (D) Talisai (*Terminalia catappa* L., COMBRETACEAE; (E) Smooth Narra (*Pterocarpus indicus* Willd. forma *indicus*, FABACEAE; (F) Molave/Molawin (*Vitex parviflora* Juss., LAMIACEAE).

Plate 3.1-15 Photographs of the Endemic Tree Species Recorded at Different Transect Plots Established within the Project

Table 3.1.23 List of Philippine Endemic Species Recorded at the Established Transects During Dry and Wet Season Surveys

Species	Common Name	Family Name	Endemism	Presence	
				Dry Season	Wet Season
Artocarpus blancoi (Elmer) Merr.	Antipolo	MORACEAE	PE	✔	✔
Ficus pseudopalma Blanco	Niog-Niogan	MORACEAE	PE	✔	✔
Ficus ulmifolia Lamk	Is-Is	MORACEAE	PE	✔	✔
Ficus nota (Blanco) Merr	Tibig	MORACEAE	PE	✔	✔
Canarium luzonicum	Piling liitan	BURSERACEAE	PE	✔	✔

Note: **PE: Philippine Endemic Species; It should be emphasized that categorizing species as endemic is very much dependent on availability of published biodiversity data, recent taxonomic revisions, nomenclatural changes, and new evidence from various disciplines used in systematics among others. Thus, estimates of endemism should be interpreted within the context of the methodologies and limitations imposed by contributing factors aforementioned.

758. Based on the results of the flora survey for the SCRP interconnecting line, a total of four (4) species were found to be endemic to the Philippines. These include three (3) species of *Ficus* sp. such as *Ficus balete* (Balete), *Ficus pseudopalma* (Niog-niogan) and *Ficus ulmifolia* (Is-is). The other endemic species is a Batanes-endemic gymnosperm called *Podocarpus costallis* (Arius). In determining the endemism of species, it should be noted that categorizing species as endemic is very much dependent on availability of published biodiversity data, recent taxonomic revisions, nomenclatural changes, and new evidences from various disciplines used in plant systematics. Thus, estimates of endemism should be interpreted within the context of methodologies and limitations imposed by contributing factors.

Threatened Species

759. The conservation status of species is based on the most recent recommendations of the Philippine Plant Conservation Committee (PPCC) of the Protected Areas and Wildlife Bureau (PAWB) now the BMB, officially issued as DENR Administrative Order No. 2007-01 better known as ‘‘The National List of Threatened Philippine Plants and their Categories’. The listing of threatened species of the IUCN red list was also used as reference.

760. Five (5) species recorded from project alignment are listed under either the Philippine Red List (DAO 2007-01) or the IUCN Red List of Threatened Species (2016.3) (**Table 3.1.24**). Noteworthy among the list are critically endangered (CR) Smooth Narra (*Pterocarpus indicus*) (IUCN) and premium tree species which are specifically used in railroad ties namely, Molave (*Vitex parviflora*). The transect plots where the threatened species occurred were included to guide the PAMB in their species conservation efforts. Even if Narra is widely seen in the whole country, its basis of its conservation status is its low population in the wild. Further, Narra is one of the notable tree species in the alignment, hence, appropriate management and monitoring strategies to ensure the continued survival of its population (as well as other threatened species) will be developed.

761. For the flora survey on SCRP interconnecting line, eight (8) species recorded in the area were found to be threatened under the updated national list of threatened Philippine plants and their categories (DAO 2017-11) and/or the IUCN Red list of threatened species (2019-1). Species categorized in these lists should be given appropriate conservation actions. Noteworthy among the list are *Podocarpus costalis* (Arius)*, Pterocarpus indicus* (Narra), and *Ficus ulmifolia* (Is-is). *Podocarpus costalis* (Arius), an endemic species from Batanes is categorized as endangered under DAO 2017-11 and IUCN 2019-1. *Pterocarpus indicus* (Narra) is categorized as endangered in IUCN 2019-1 and vulnerable in DAO 2017-11. Lastly, *Ficus ulmiforlia* (Is-is), an endemic species recorded during opportunistic survey is categorized as vulnerable under IUCN 2019-1.

The complete list of threatened species with corresponding threat status is presented in **Table 3.1.25** present the list of threatened flora species recorded at near the SCRP interconnecting line.

Table 3.1.24 List of Threatened Species Recorded at the Established Transects

Species	Common name	Family	IUCN 2016 ver.3	DAO 2007-01	Presence	
					Dry Season	Wet Season
Artocarpus blancoi	Antipolo	MORACEAE	VU		✔	✔
Ficus ulmifolia	Is-is	MORACEAE	VU		✔	✔
Pterocarpus indicus	Narra	FABACEAE	VU	CR	✔	✔
Vitex parviflora	Molave	LAMIACEAE	VU	EN	✔	✔
Sweitenia macrophylla	Mahogany	MELIACEAE	VU		✔	✔
Canarium luzonicum	Piling liitan	BURSERACEAE	VU		✔	

Note: **DAO 2007-11 updated checklist (2011) pursuant to "Wildlife Resources Conservation and Protection Act 9147" defines the different threatened categories as follows:

Table 3.1.25 List of Threatened Flora Species Recorded Near the SCRP Interconnecting Line

Species	Common name	Family	IUCN 2019	DAO 2017-11
Araucaria heterophylla	Norfolk Island Pine	ARAUCARIACEAE	VU	NA
Adonidia merrillii	Manila Palm	ARECACEAE	NA	VU
Diospyros discolor	Kamagong	EBENACEAE	NA	VU
Pterocarpus indicus	Narra	FABACEAE	EN	VU
Vitex parviflora	Molave	LAMIACEAE	VU	EN
Swietenia macrophylla	Big-Leaf Mahogany	MELIACEAE	VU	NA
Ficus ulmifolia	Is-is	MORACEAE	VU	NA
Podocarpus costalis	Arius	PODOCARPACEAE	EN	EN
Araucaria heterophylla	Norfolk Island Pine	ARAUCARIACEAE	VU	NA
Adonidia merrillii	Manila Palm	ARECACEAE	NA	VU
Diospyros discolor	Kamagong	EBENACEAE	NA	VU
Pterocarpus indicus	Narra	FABACEAE	EN	VU

Critically Endangered Species (CE) - refers to a species or subspecies facing extremely high risk of extinction in the wild in the immediate future. This shall include varieties, formae or other infraspecific categories.
Endangered Species (EN) - refers to a species or subspecies that is not critically endangered but whose survival in the wild is unlikely if the causal factors continue operating. This shall include varieties, formae or other infraspecific categories.

Vulnerable Species (VU) - refers to a species or subspecies that is not critically endangered nor endangered but is under threat from adverse factors throughout its range and is likely to move into the endangered category in the future. This shall include varieties, formae or other infraspecific categories.**Other Threatened Species (OTS)** - refers to a species or subspecies that is not critically endangered, endangered or vulnerable but is under threat from adverse factors, such as over collection, throughout its range and is likely to move to the vulnerable category in the near future. This shall include varieties, formae or other infraspecific categories.

Other Wildlife species (OWS) - refers to non-threatened species of plants that have the tendency to become threatened due to destruction of habitat or other similar causes as may be listed by the Secretary upon the recommendation of the National Wildlife Management Committee. This shall include varieties, formae or other infraspecific categories.

IUCN defines the different threatened categories as follows:

Critically Endangered (CR) - A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the criteria (A to E) as described below.

Endangered (EN) - A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the criteria (A to E) as described below.

Vulnerable (VU) - A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the criteria (A to E) as described below.

Invasive Species

762. Most of the transect plots are covered with invasive species that smother less amount of native vegetation along the alignment. Alien or exotic invasive species (IAS) as defined during the Convention on Biological Diversity (CBD) include any "*alien or exotic species that are intentionally or unintentionally introduced by humans in native habitats and these take space and spread at the expense of native species*".

763. Because of the imminent threat posed by these exotic species over native species, Article 8 of the CBD states the need to: "Prevent the introduction of alien invasive species which threaten ecosystems, habitats, and species and control or eradicate them upon the event of bioinvasion". Such alien plant species that smother and predominate natural habitats are collectively termed as bio invasive species. The increasing rate of damage and effects of biological invasion (bioinvasion) are realized in most countries that have been engaging themselves to the use of exotic tree species either for massive production (plantation) or for reforestation efforts towards regaining local forest vegetation. Following the definition of the CBD, the project has few invasive plant species recorded based from the plant assessment surveys. **Table 3.1.26** shows the list of bio-invasive species recorded during the dry and wet season surveys.

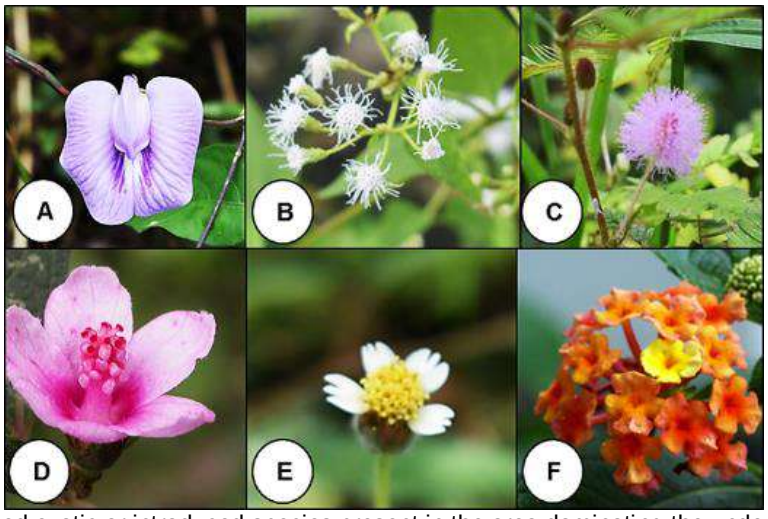
Table 3.1.26 List of Invasive Alien Species (IAS) Documented in the Study Area during Dry and Wet Season Surveys

Common Name	Scientific Name	Family Name	Eco Class**
Gonoi/ Hagonoy	*Chromolaena odorata* (L.) R King & H. Robinson	ASTERACEAE	Exotic/Invasive
Sapinit/ Coronitas	*Lantana camara* L.	VERBENACEAE	Exotic/Invasive
Kulot-Kulot	*Urena lobata* L.	MALVACEAE	Exotic/Invasive
Dilang butiki	*Centrosema pubescens* Benth.	FABACEAE	Exotic
Makahiya	*Mimosa pudica* L.	FABACEAE	Exotic/Invasive

Note: ** Based from the IAS Assessment Protocol of Florece and Baguinon (2008)

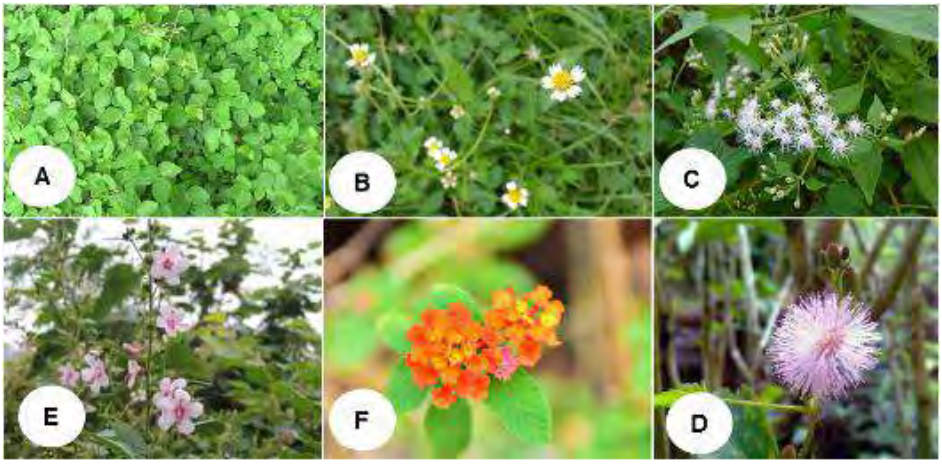
764. The recorded plant species has negative effects in terms of maintaining local biodiversity in the area. These plants can grow individually in clumps or as dense thickets, crowding out more desirable species. In disturbed areas in the Project site, it is part of the general vegetation as the dominant understorey species, disrupting succession and decreasing biodiversity. Some of the recorded species have direct impacts to existing vegetation or replanting area. For example, the recorded plant species of Coronitas (*L. camara*) and Gonoi (*C. odorata*) have allelopathic qualities that can reduce vigor of nearby plant species and reduce their productivity (GISD, 2006). *Lantana camara* has been the focus of biological control attempts for a century, yet still poses major problems in many regions.

765. Other effects are characterized by provision of poisonous food for native or resident animal species (*e.g*. fruits, berries and seeds) that are not part of their actual diet. Another plant species is the Hagonoi/Gonoi (*Chromolaena odorata*) that forms dense stands preventing establishment of other species, both due to competition and allelopathic effects.



Some of the documented exotic or introduced species present in the area dominating the understorey and ground cover of Project railway alignment. (a) Dilang butiki (*Centrosema pubescens* Benth); (b) Hagonoy (*Chromolaena odorata* (L.) R.M. King & H. Rob.); (c) Makahiya (*Mimosa pudica* L.); (d) Kulot-Kulot (*Urena lobata* L.); (e) *Tridax procumbens*; (f) Coronitas (*Lantana camara* L.)

Plate 3.1-16 Exotic or Introduced Plant Species Documented within the Project during Dry Season Survey



Note: (A) Dilang butiki (*Centrosema pubescens* Benth); (B) Hagonoy (*Chromolaena odorata* (L.) R.M. King & H. Rob.); (C) Makahiya (*Mimosa pudica* L.); (D) Kulot-Kulot (*Urena lobata* L.); (E) *Tridax procumbens*; (F) Coronitas (*Lantana camara* L.)

Plate 3.1-17 Exotic or Introduced Plant Species Documented within the Project during Wet Season Survey

b. Economic Use

766. In terms of economic uses and importance, some plants and trees recorded in the project ite during dry and wet season surveys have potential for medicinal, ornamental, field, fodder and timber purposes (**Table 3.1.27** and **Table 3.1.28**). Most of the floral species recorded are tree species with known economic and human use values (tangible products) such as source of timber, fruits, medicines, ornamentals and fuel wood. These include members of the families of Anacardiaceae, Meliaceae, Moraceae, Lamiaceae, Fabaceae and Euphorbiaceae.

767. Other economic uses such as raw materials (e.g. fiber, timber, fuel wood, fodder, fertilizer) can be obtained from the following tree species known for timber such as Narra (*Pterocarpus inidicus*), Molave (*Vitex parviflora*), Anubing (*Artocarpus ovatus*), Banato (*Mallotus philippinensis*) and Rimas (*Artocarpus altilis*). Fodder and fuel wood uses can be derived from tree species such as Ipil-Ipil (*Leucaena leucocephala*) and Kakawate (*Gliricidia sepium*). However, cutting and

utilizing some threatened tree species are banned by the DENR because of its current status in the wild or its present conservation status. Consequently, there are also species recorded that actually belong to “lesser known or used species”. A great number of these tree species are potentially valuable timber and other uses such as Rimas (*Artocarpus altilis*), Bangkal (*Nauclea orientalis*), Kamachile (*Pithecelobium dulce*), Alim (*Melanolepis multiglandulosa*) and African Tulip (*Spathodea campanulata*).

768. Food sources (e.g. oils, fruits, seeds, juices/extracts) can also be obtained from tree species recorded in the project sites such as *Psidium guajava*, *Mangifera indica*, *Passiflora foetida*, *Terminalia catappa*, including palm species*, Calamus sp*. and *Cocos nucifera*. Medicinal and other known herbal uses from plants are also noted to some species recorded in the site such as Uuko (*Mikania cordata*), *Cassia alata*, seeds of Mahogany (*Swietenia macrophylla*), among others. Other tree species include Philippine Endemic tree species such as Is-Is (*Ficus ulmifolia*), Piling liitan (*Canarium luzonicum*), and Antipolo (*Artocarpus blancoi*).

Table 3.1.27 List of Some Economic Uses and Importance of Significant Flora Recorded at the Established Transects along the Project during Dry Season Survey

Species	Family Name	Economic Uses and Importance
Canarium luzonicum	BURSERACEAE	The resin is primarily from volatile turpentines; Fruits are edible; Seeds are sources of oils.
Mallotus philippinensis	EUPHORBIACEAE	Tree is used to produce red dye and herbal remedies. It produces rottlerin, a potent large conductance potassium channel opener.
Pterocarpus indicus	FABACEAE	Timber; Wood is used for furniture; Reforestation species.
Vitex parviflora	LAMIACEAE	Timber; Wood are used in railroad ties. Fruits are medicinal.
Artocarpus blancoi	MORACEAE	Timber; paper production and being a shade provider are its primary uses, although its seeds and fruits are edible.
Ficus ulmifolia	MORACEAE	The fruits are edible, but have little flavor; sometimes eaten with sugar and cream. The hard and rough leaves are used to clean household materials.
Ficus nota Burm. f	MORACEAE	Fruits are medicinal. Wood used as source of timber.
Ficus balete	MORACEAE	Timber; The wood is used for furniture, house building, turnery, light carpentry, interior joinery and panelling, boxes and crates, boats.

Table 3.1.28 List of Some Economic Uses and Importance of Significant Flora Recorded at the Established Transects along the Project during Wet Season Survey

Species	Family Name	Economic Uses and Importance
Vitex parviflora	LAMIACEAE	Timber; Wood is used for furniture and railroad ties; Reforestation species.
Mallotus philippinensis	EUPHORBIACEAE	Tree is used to produce red dye and herbal remedies. It produces rottlerin, a potent large conductance potassium channel opener.
Pterocarpus indicus	FABACEAE	Timber; Wood is used for furniture; Reforestation species.
Vitex parviflora	LAMIACEAE	Timber; Wood are used in railroad ties. Fruits are medicinal.
Artocarpus blancoi	MORACEAE	Timber; paper production and being a shade provider are its primary uses, although its seeds and fruits are edible.
Ficus ulmifolia	MORACEAE	The fruits are edible, but have little flavor; sometimes eaten with sugar and cream. The hard and rough leaves are used to clean household materials.
Ficus nota Burm. f	MORACEAE	Fruits are medicinal. Wood used as source of timber.
Ficus balete	MORACEAE	Timber; The wood is used for furniture, house building, turnery, light carpentry, interior joinery and panelling, boxes and crates, boats.

3.1.4.2. Terrestrial Fauna

(1) Field Survey

769. Birds are good indicators as they respond fast to threats and changing environmental conditions. Species composition and diversity of birds may differ between seasons and between sampling sites.

770. A survey to determine the presence of terrestrial vertebrates along the Project was conducted on February 9-12 and 24, 2018 for dry season and July 14-18, 2018 for wet season at the same six (6) transects for terrestrial flora survey, namely: Solis, FTI Taguig, Cabuyao, Tadlac, Timugan and San Antonio-IRRI (**Table 3.1.27**).

771. A rapid site assessment (employing point observation for birds) was carried-out on June 20, 29 to 30 and July 06 to 07, 2019 to establish site-based baseline data for birds nearby the SCRP interconnecting line.12 observation points were established within greenspaces (i.e. American Cemetery, Bonifacio Heights Condominium, Villamor Air Base Golf Course, and vegetated portion along East Service Road between Bicutan and FTI Stations) that are along and/or within the immediate vicinity of the SCRP interconnecting line.

772. The terrestrial fauna survey was focused on the terrestrial vertebrate groups of Philippine wildlife; birds, mammals, amphibians and reptiles (herpetofauna). Standard field methods and procedures were used for each taxa during the survey. Direct and indirect transect identification such as tracks, signs and auditory cues, trapping and mist-netting were used. Microhabitat searches were also done in the immediate vicinity of the transect line, 10 meters to the left and 10 meters to the right, to ascertain the presence of small and/or cryptic species of wildlife.

1) Birds

773. Direct observations of birds were done wherein observers walked along existing trails and streams and occasionally in a perpendicular or parallel direction several meters from existing paths. The pace of walking was varied in order to detect different species. Standardized 2km transect was used in each site. Where possible, observer walked across different habitat types and spent time searching in habitat breaks. Searches were conducted from 5:30-9:00 in the morning, and in the afternoon at 3:30-6:00 or before sunset. Observers were equipped with binoculars. Birds flying and perching over the area were counted individually.

774. Mist netting was employed to confirm species occurrence and distribution as well as identification of cryptic species of birds. Mist nets were hoisted along possible flight paths of birds, e.g., in between trees, just above the ground with a clearance of at least 15 cm to 1 m. Net locations were recorded using a handheld GPS unit. The nets were set in the afternoon and checked in the morning of the next day. For each site, three sets of nets with two nets each were set serially along the transect line. These nets were also used to catch Volant mammals during the night. Nets were checked before noon and at 5:00 pm or an hour before dusk.

2) Mammals

775. Mist nets used for birds were also employed for catching bats. Mist netting were done in most of the study areas except in FTI-Taguig where there was no site where the nets can be set. Mist nets were set and positioned in strategic points of the sampling sites (e.g., flyways, across established trails near a river or stream, forest edges, openings and forest interior) but away from human habitations. Since the sites are in close proximity to human settlements adjustments were made. The nets were set and opened at 6:00 pm and removed the following morning at 6:00 am in the Los Baños sites (Tadlac, Timugan and San Antonio-IRRI) while in Solis and Cabuyao, it was set at 5:30-9:00pm because of security reasons. Net watching for insectivores was done at 6:00-9:00pm. Numbers of individuals caught were counted. Photographs of captured species

were taken; these were set free after photo documentation. Net watching was not done in the FTI-Taguig site because there was no area along the site where the nets could be set.

776. Live trapping was conducted from 1800H-0600H to catch small non-volant mammals. Twenty live traps were set in each site. Roasted coconut meat mixed with peanut butter, bread, and fried dried fish were used as baits for live traps. The traps were placed along possible runways, near holes or among root tangles and fallen logs, where small non-volant mammals might be present. Checking of traps was performed early in the morning of the next day. Introduced/invasive species of rodents are killed through drowning while other species are set free after photo documentation. Live trapping was not done in FTI-Taguig and Cabuyao because there was no area where we can set the traps along SLEx and in Cabuyao, there was a problem with the security.

777. Identification, nomenclature, classification and conservation status were determined based on Heaney et al. (1998), Fieldiana (Peterson et al., 2008), published taxonomic keys, and IUCN.

3) Reptiles and Amphibians (Herpetofauna)

778. Reptiles and amphibians (herps) surveys were conducted using the Visual Encounter Survey and hand-grabbing technique (Heyer et al., 1994; Matsui, 2006) while doing the transect walks. The Visual Encounter Survey was used in the sampling to conduct searches in high potential areas throughout the sampling sites. These methods were supplemented with acoustic searching for frogs, turning of rocks and logs, peeling bark, digging through leaf litter, and excavating burrows and termite mounds.

779. Purposive time-constrained herpetofaunal survey was conducted at 6:00-9:00 at the morning and 19:00-21:00 hours at the evening. Any amphibian or reptile seen and captured were identified, recorded, and released in the same habitat after being measured and photographed.

780. Identification, nomenclature, classification and conservation status were determined based on Brown and Alcala (1978, 1980), published taxonomic keys, IUCN, AmphibiaWeb, Frost et al. (2006), Frost (2007), and other available field guides. Paleontological STatistics (PaST), ver. 1.42 by Hammer, Harper and Ryan (2016) was used to compute diversity indices.

4) Use of Urban Greenspaces to Determine Wildlife Assemblage in the SCRP including Interconnecting Line

781. The National Capital Region (NCR) is the Philippines' seat of power and development. It comprises 17 contiguous cities and a municipality with an overall land area of approximately 638 km^{-2} (i.e. 0.20% of the national land area). It is geographically situated in the lowlands of southwestern Luzon Island. Located on the eastern coast of Manila Bay and the western side of Laguna Lake, it serves as an important fly-path for many water birds.

782. A large portion of the SCRP alignment straddle along seven (7) major cities in the NCR. To date, these cities are highly urbanized, and the original vegetation cover therein which serve as important wildlife habitats have long been removed and converted into development areas. As it is now (without the project), remaining biodiversity along major portions of the entire project length is already depauperate. Some of the major disturbances in these urban environments are growing human population, pollution, and conversion of natural habitats to built-up areas hence, they are simply with low conservation significance (Vallejo *et al*., 2009). However, within this sea of urban development, are few islands of greenspaces which serve as sanctuary for NCR's remaining wildlife. These greenspaces are usually characterized by woodland patches (mostly comprised of exotic species), shrubland interspersed with small trees, well-maintained or manicured lawns with uncut grassy portions, some are with artificial lagoons, some are traversed

by a water body, and most are with built-up portions (e.g. office buildings, drainage or stormwater canal, memorial stones, fences, concrete pathways, and monuments).

783. In terms of terrestrial wildlife assessment for the Senate, FTI, and Bicutan Stations of the interconnection section, emphasis was given to these greenspaces and other vegetation patches adjacent or directly on top of the proposed alignment. There are 27 major greenspaces identified in various locations along the alignment. **Table 3.1.29** presents the 27 major greenspaces in the NCR. They range in distance from 0.1 to 9.0 km perpendicular from the proposed alignment. **Figure 3.1.75** shows the locations of the 27 major greenspaces in the NCR relative to the underground interconnection section (Senate, FTI, and Bicutan Stations).

Table 3.1.29 List of Major Green Spaces Adjacent to Underground Interconnection Section (Senate, FTI, and Bicutan Stations)

Name of Greenspace	Approximate Area (ha)	Approximate Distance (km)
Filinvest City	195.8	9.231
LPPCHEA	169.7	4.949
Libingan ng mga Bayani	140.0	1.348
Heritage Park	140.0	1.815
Philippine Navy Golf Course	37.1	0.971
Villamor Air Base Golf Course	56.2	0.126
Philippine Army Golf Course and Stadium	18.9	0.509
American Memorial Cemetery	58.4	0.301
Manila Polo Club	22.8	0.756
Manila Golf & Country Club	43.8	0.971
Manila South Cemetery	26.9	3.839
Wack Wack Golf and Country Club	114.0	1.584
Camp Aguinaldo Grounds	20.0	1.137
Camp Aguinaldo Golf Course	2.0	1.384
Marikina River Banks	3.9	1.915
Manila North Cemetery	142.5	5.338
Ateneo de Manila University	38.3	2.608
UP Hardin ng Rosas	14.0	1.476
Open Space corner EDSA and Quezon Ave.	7.0	1.707
Philam Village	3.2	3.182
Ninoy Aquino Parks and Wildlife Center	20.6	0.909
Quezon Memorial Circle	27.8	1.380
UP Diliman	63.8	2.302
Veterans Memorial Medical Center	54.8	0.383
UP Arboretum	18.2	1.660
Bagbag Cemetery	4.9	0.684
Holy Cross Memorial Park	46.2	0.923

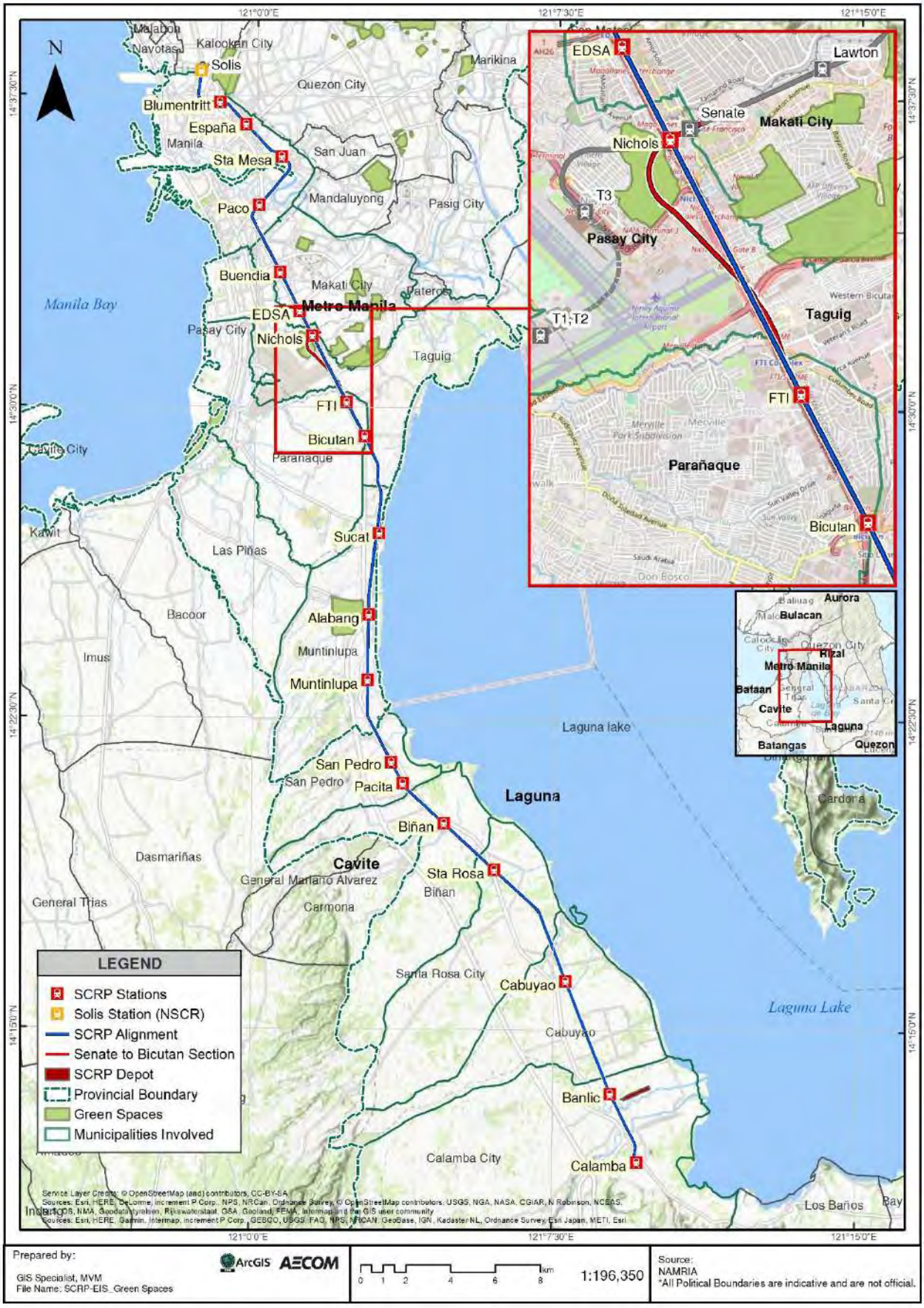


Figure 3.1.75 Distribution of the Major Green Spaces near the Project

5) Use of Secondary Data

784. Secondary data (both published and unpublished) which conducted field studies at various greenspaces in the NCR were integrated into this assessment to establish a robust baseline for terrestrial wildlife. **Table 3.1.30** presents the list of secondary data sources used in the terrestrial wildlife assessment of the Senate, FTI, and Bicutan Stations.

Table 3.1.30 Sources of secondary information for terrestrial wildlife

Information / Data / Document Description or Title	Author and Date Published / Generated
https://avibase.bsc-eoc.org/checklist.jsp?region=PH	Avibase – Bird Checklist of the World Philippines 2020
AECOM. 2018 Rapid Site Assessment of Filinvest City as Part of LEED Accreditation Process.	AECOM Philippines Inc. (2018)
Bajarias, A. (2016). A Field Guide to Flight: Identifying Birds on Three School Grounds (pp. 1-142). Quezon City: Ateneo de Manila University Press.	Ateneo de Manila University Press. (2016)
Birds of the Philippines - Ayala Alabang Birds. Retrieved 25 July 2019, from https://www.tonjiandsylviasbirdlist.com/Birds-By-Location/Ayala-Alabang-Birds/	https://www.tonjiandsylviasbirdlist.com/Birds-By-Location/Ayala-Alabang-Birds/ (2019)
Cuyegkeng, A., Favis, A., Gotangco, K., & Tan, M. (2014). Ateneo de Manila University Sustainability Report - July 2014.	Ateneo de Manila University (2014)
de Guia, M. 2018 (unpublished). Bird Watching Observations near the northern perimeter fence of Forbes Park	Michael de Guia (2018)
Vallejo, B., Aloya, A., Ong, P., Tamino, A., & Villasper, J. (2008). Spatial Patterns of Bird Diversity and Abundance in an Urban Tropical Landscape: The University of the Philippines (UP) Diliman Campus. Science Diliman, 20(1), 1-10.	Science Diliman (2008)

(2) Results

1) General Fauna

785. Adopted in this assessment are secondary data conducted at various times of the year which represent not just dry and wet seasons but migratory and non-migratory seasons as well in the NCR including the SCRP interconnecting line. Integrated data based on rapid site assessments and secondary sources provide baseline information and conclusions relating to species richness (grouped into amphibians, reptiles, birds and mammals), distribution range (including endemicity), and conservation status (including threatened and near threatened species).

786. Table 3.1.31 provides the key findings and conclusions of the terrestrial wildlife assessment.

Table 3.1.31 Key Findings and conclusions for terrestrial wildlife

Baseline Information	Key Findings and Conclusions
Wildlife species inventory	• A total of 221 species comprised of eight (8) amphibians, 12 reptiles, 188 birds, and 13 mammals was recorded along the SCRP interconnecting line, and nearby major greenspaces. • Recorded birds (188 species) represent approximately 36% of the known total for Luzon mainland (515 species as per https://avibase.bsc-eoc.org/checklist.jsp?region=PH).

Baseline Information	Key Findings and Conclusions
Summary of range distribution	• Range distributions were dominated by native but non-endemics (NBNE)/ resident breeding non-endemics (RBNE) with 95 species or 43% of the total. • Other range distributions noted were: migratory birds with 67 species or 30% of the total, endemics with 33 species or 15% of the total, introductions with 20 species or 9% of the total, and migrants with resident breeding populations with six species or 3% of the total. • High species richness for migratory birds were noted (67 species or 30% of the total). • Endemics were relatively high (33 species or 15% of the total) despite the depauperate habitat.
Conservation Status (Threatened, Near Threatened, and Least Concern)	• Majority of recorded wildlife are Least Concern or non-threatened with 190 species or 86% of the total based on IUCN 2020 and/or CITES 2020 in conjunction with RA 9147 and DAO 2019-09. • At least 28 species or 13% of the total (composed of four reptiles and 24 birds) are included in various conservation listings based on IUCN 2020 and/or CITES 2020 in conjunction with RA 9147 and DAO 2019-09. • Five (5) of these threatened species are introduced or not originally from the Philippines. • Three (3) species are Near Threatened based on IUCN 2020.
Hindrance to wildlife access, historical occurrences of pest infestation, forest/grass fire, and/or similar incidences	• The SCRP interconnecting line, and surrounding areas are highly urbanized, and the original vegetation therein have long been removed and converted into development areas. • Wildlife access across the entire SCRP interconnecting line are heavily fragmented or disjunct due to the absence of original vegetation and various development. Remaining wildlife habitats are limited mainly within the 27 major greenspaces. • Major disturbances are growing human population, pollution, and conversion of natural habitats and remaining greenspaces to built-up areas.
Vulnerability to Climate Change	• As the NCR area is extra vulnerable to the effects of climate change due to high pollution levels, absence of good vegetation cover, and increased flooding incidents, these may add-up to the projected sporadic increases in terms of ambient temperatures and extreme weather conditions. Said conditions may potentially impact the already limited wildlife populations in the NCR and overall health of the few remaining greenspaces.

787. The combined total from all the field studies and various published and unpublished report conducted in NCR's major greenspaces) is 221 species comprised of eight (8) amphibians, 12 reptiles, 188 birds, and 13 mammals. **Annex 3-2** presents the integrated wildlife list recorded in the NCR including the SCRP interconnecting line.

788. The range distributions of wildlife species noted were: 96 (43% of the total) native but non-endemics (applicable to amphibians, reptiles and mammals) or resident breeding non-endemics (applicable to birds), 67 (30% of the total) migratory birds, 33 (15% of the total) are endemics, 20 (9% of the total) introductions, and six (3% of the total) migratory species with resident breeding populations. Native but non-endemics (NBNE) or resident breeding non-endemics (RBNE) are species that naturally occurred in the Philippines, but their distribution is not limited/exclusive to the country. Endemic species are those restricted in distribution to the Philippines or found nowhere else in the world. There were five (5) Luzon endemics and 27 Philippine endemics noted in the area. These documented endemics remain relatively high despite the available greenspaces being limited in area, fragmented and discontinuous, and with poor vegetation quality (mostly exotics). It is likely that recorded endemics are part of the main-stay species (local wildlife assemblage) which means that they have adjusted to this kind of habitat despite its quality and the presence of various disturbances hence, their consistent occurrence in the area. Migrant species come to the country to escape the winter season in their place of origin. They usually stay from October to March, although some species may over-winter or stay longer. Recorded migrants in the NCR were high (at least 67 species or 30% of the total). Note that most migratory birds are also water birds and NCR being sandwiched by Manila Bay and Laguna Lake serves as an excellent fly-path for these birds hence, their increased number in the area. Migrants with resident breeding populations are mainly present from October to March but some populations

stay/breed in the Philippines. Introduced species are not originally from the Philippines but are assumed to stay and breed the entire time in the country since their introduction.

789. Majority (190 species or 86% of the total) of the documented wildlife in NCR's greenspaces are non-threatened or Least Concern based on IUCN 2020 and/or CITES 2020 in conjunction with RA 9147and DAO 2019-09. However, at least 28 species (13%) composed of four (4) reptiles and 24 birds are included in various conservation listings. **Table 3.1.32** provides a list of documented threatened species in NCR's greenspaces. It should be noted that five (5) of these threatened species are introduced or not originally from the Philippines. These are: *Cuora amboinensis* or south Asian box turtle, *Pelodiscus sinensis* or Chinese softshell turtle, *Cacatua alba* or umbrella cockatoo, *Cacatua sulphurea* or sulphur-crested cockatoo, and *Padda oryzivora* or Java sparrow. The other recorded threatened species are with various range distributions, namely: endemics (with 10 species), resident breeding but non-endemics (with four species), migratory (with eight species), and migratory with resident breeding populations (with one species). There are species not included in the IUCN 2020 listing but are classified as either Appendix I or II species based on CITES 2020 hence, are automatically categorized as Critically Endangered and Endangered, respectively. This is based on RA 9147 (Wildlife Act of 2001) and DAO 2019-09 (Updated National List of Threatened Philippine Fauna and their Categories).

Table 3.1.32 List of Threatened species recorded in NCR's greenspaces

Scientific Name	Common Name	Range Distribution (Kennedy et al., 2000 and IUCN 2020)	Conservation Status (IUCN 2020 and/or CITES 2020/ RA9147 and DAO 2019-09)
Reptiles			
Varanus marmoratus	Marbled Water Monitor	PE	Appendix II
Naja philippinensis	Northern Philippine Cobra	PE	Appendix II
Cuora amboinensis	South Asian Box Turtle	Introduced	Vulnerable
Pelodiscus sinensis	Chinese Softshell Turtle	Introduced	Vulnerable
Birds			
Accipiter gularis	Japanese Sparrowhawk	Migratory	Appendix II
Accipiter soloensis	Chinese Goshawk	Migratory	Appendix II
Accipiter virgatus	Besra	RBNE	Appendix II
Anas luzonica	Phillipine Duck	PE	Vulnerable
Bolbopsittacus lunulatus	Guaiabero	PE	Appendix II
Bubo philippensis	Philippine Eagle Owl	PE	Vulnerable
Butastur indicus	Grey-faced Buzzard	Migratory	Appendix II
Buteo buteo	Common Buzzard	Migratory	Appendix II
Cacatua alba	Umbrella Cockatoo	Introduced	Endangered
Cacatua sulphurea	Sulphur-crested Cockatoo	Introduced	Critically Endangered
Ducula carola	Spotted Imperial Pigeon	PE	Vulnerable
Egretta eulophotes	Chinese Egret	Migratory	Vulnerable
Falco peregrinus	Peregrine Falcon	Migratory/Resident	Appendix I
Falco tinnunculus	Common Kestrel	Migratory	Appendix II
Geokichla cinerea	Ashy Thrush	LE	Vulnerable
Haliastur indus	Brahminy Kite	RBNE	Appendix II
Loriculus philippensis	Philippine Hanging-Parakeet	PE	Appendix II
Otus megalotis	Philippine Scops Owl	LE	Appendix II
Padda oryzivora	Java Sparrow	Introduced	Endangered
Pandion haliaetus	Osprey	Migratory	Appendix II
Phylloscopus ijimae	Ijima's Leaf-warbler	Migratory	Vulnerable
Prioniturus luconensis	Green Raquet-tail	LE	Endangered
Spilornis holosphilus	Philippine Serpent Eagle	RBNE	Appendix II
Tyto longimembris	Grass Owl	RBNE	Appendix II

790. We highlight the presence of introduced species in NCR's greenspaces. At least 19 species (two turtles, one toad, one frog, nine birds, one shrew, four rats, and one squirrel) were documented by various studies. While most were accidentally introduced during the late 1800s, some were intentionally released (by the government) mainly for aesthetic purposes. However, noteworthy are recent introductions (either accidental or intentional) of parrots, cockatoos and a squirrel mostly in the affluent areas of NCR. It is likely that they were pets that escaped captivity or pets that were intentionally released by the owner. Recorded and confirmed present during rapid biodiversity assessment (conducted during 10 to 14 April 2018) inside Filinvest City was a small population of *Pelodiscus sinensis* or Chinese softshell turtle in Alabang Creek. Also, there were several individuals of *Cacatua sulphurea* or sulphur-crested cockatoo, *Psittacula krameri* or rose-ringed parakeet, and *Callosciurus finlaysonii* or variable squirrel observed and recorded near the American Memorial Cemetery, Villamor Air Base Golf Course, and Manila Golf & Country Club. Currently, there is no field research which establishes the potential impacts of these introductions but potentially they may cause concerns on resource competition and spread of diseases.

791. Seasonal wildlife assemblage surveys were also conducted. Dry season survey recorded a total of 64 species of terrestrial vertebrate wildlife were observed and recorded during the survey conducted in 6 sites from Solis to Los Baños. These are 55 species of birds, 6 species of mammals (5 volant and 1 non-volant), and 3 species of amphibians and reptiles (2 species of frog and 1 species of lizards).

792. Wet season survey documented a total of 51 fauna wildife species from the same sites (Solis to Los Banos). It is composed of 44 species of birds, 4 species of mammals and 3 species of amphibians and reptiles.

2) Transect Profiles

793. The transects are very close to human habitation and located mostly along the existing PNR railroad from wherein it is largely distinct from the surrounding environment. Two of the transect lines, T1 (Solis) and T2 (FTI-Taguig), are located in Metro Manila while four (4) transect lines, T3 (Cabuyao), T4 (Tadlac Lake), T5 (Timugan) and T6 (San Antonio-IRRI), are located in Laguna (**Table 3.1.33**). Transects T1 and T2 are located primarily in built up areas and are very near to human habitations. The two sites are highly disturbed by varied human activities. Transect T3 was located along the railroad adjacent to the rice fields, vegetable gardens and walled properties in Cabuyao City. Transect T4 is surrounded by houses and resorts and with barely trees or natural vegetation. Transect T5 is located near human settlements and resorts at the edge of Laguna Lake to a human settlement in Timugan wherein a number of fruit trees and ornamental trees are present. Transect T6 is located on the railway, more than a hundred meters from the national highway in San Antonio. There are houses on both sides of the existing railroad. Portion of the railroad near the International Rice Research Institute (IRRI) was cleared of vegetation.

794. **Table 3.1.33** presents the habitat type and human activities at each survey site.

Table 3.1.33 Terrestrial Fauna Sampling Stations

Station ID	Description	Start	End	Habitat Type
T1	Solis	E120.97551 N14.62707	E120.62253 N14.62253	Typical "Home along the Riles" site Undergrowth vegetation (weeds, and grass), cultivated leafy vegetables
T2	FTI Taguig	E121.02402 N14.52773	E121.2485 N14.17535	No vegetation National Road/Highway
T3	Cabuyao	E121.13026 N14.2706	E121.13701 N14.25377	Rice field, Less vegetation, more of roads, resorts, privately owned land,

Station ID	Description	Start	End	Habitat Type
				ipil-ipil, banana, ricefields, vegetable gardens
T4	Tadlac	E121.20363 N14.17944	E121.20565 N14.18486	Surrounded by houses and resorts, barely trees or natural vegetation
T5	Timugan	E121.21944 N14.17976	E121.22236 N14.16560	Agro-forest, secondary growth forest, Cultivated land
T6	San Antonio-IRRI	E121.2485 N14.17599	E121.2592 N14.16084	Rice fields, Undergrowth vegetation (sedges, weeds, grasses), cultivated areas

3) Species Diversity

Birds

795. During the dry season survey, 55 species of birds belonging to 26 families were recorded of terrestrial vertebrates. The highest number of species was recorded in T4 (Tadlac) with 35, followed by T6 (30), T5 (17), T3 (15), T1 (7) and T2 with only six (6) species. Only two (2) species are common to all the sites, the Eurasian Tree Sparrow *Passer montanus* and the Yellow-vented Bulbul *Pycnonotus goiaver.* The list of bird species documented from each site and the number of individuals counted are shown in **Table 3.1.34**.

796. The higher number of species recorded in T4 (Tadlac) may be due to the proximity of the site to bodies of water, i.e. the Laguna de Bay and the Tadlac Lake (Crocodile/ Alligator Lake). Before the area was besieged by the construction of resorts and houses, the part nearest Laguna de Bay was a habitat of hundreds of bee eaters (*Merops sp.)*

797. **Table 3.1.34** shows that T6 (San Antonio-IRRI) has the highest number of individuals recorded at 33.22% (379) of the total number of individuals of birds from all sampled sites. It is followed by T4 (Tadlac) with 25.24% (288), 15.6% (178) for T3 (Cabuyao), 9.29% (106) for T5 (Timugan), 8.9% (102) for T1 (Solis) and the least from T2 (FTI-Taguig) with 7.7 % (88).

798. The very few species of birds and individuals documented in transect T1 and T2 may accounted be to disturbed state of the sites. The area adjacent to the railroad tracks in Solis is occupied by informal settlers and there is very little vegetation where birds or any wildlife can thrive. It also teems with garbage and waste materials including human excreta. Transect T2 is mostly concrete walls which protect buildings from dust and noise pollution brought about by the constant flow of traffic along the South Luzon Expressway (SLEx). Few trees were found near Gate 3 of Fort Bonifacio within the PNR ROW which may not be enough to sustain or be a habitat for birds and volant mammals.

799. During wet season survey, 42 species of birds belonging to 26 families were observed and recorded. Data shows that the highest number of species is recorded in the Transect 6 (San Antonio-IRRI) area with 27, followed by Transect 3 (Cabuyao) and Transect 4 (Tadlac) with 20 each, 15 species in Transect 5 (Timugan), 10 in Transect 1 (Solis), and only 5 at Transect 2 (FTI). There were fewer species of birds documented during the wet season monitoring compared to the dry season survey which had 55. The result of the bird survey is presented in **Table 3.1.35**.

800. Species common to all sites during the wet season are; *Collocalia esculenta*, *Hirundo tahitica*, *Pycnonotus goiaver* and *Passer montanus*. The aforementioned species are generalists and are observed to inhabit open country and grassland, disturbed urban areas and forest edges

Table 3.1.34 List of Bird Species Documented from Six (6) Transect Line during Dry Season Survey

Family	Scientific Name	Common Name	Conservation Status	Distribution/ Endemicity	Feeding Guilds	Monitoring Sites (Transects)					
						1	2	3	4	5	6
Alcedinidae	Alcedo atthis	Common Kingfisher	Least Concern	Resident	Piscivore-Insectivore				3		
Alcedinidae	Todiramphus chloris	White-collared Kingfisher	Least Concern	Resident	Carnivore			5	3		1
Alcedinidae	Halcyon smyrnensis	White-throated Kingfiher	Least Concern	Endemic	Piscivore-Insectivore					2	1
Apodidae	Collocalia esculenta	Glossy Swiftlet	Least Concern	Resident	Insectivore		19	3	14		13
Apodidae	Collocalia troglodytes	Pygmy swiftlet	Least Concern	Endemic	Carnivore-Insectivore				7		4
Ardeidae	Egretta garzetta	Little Egret	Least Concern	Migratory	Carnivore	2		10	11	2	13
Ardeidae	Butorides striata	Little Heron	Least Concern	Migratory	Piscivore-Insectivore				4		
Ardeidae	Egretta intermedia	Intermediate Egret	Least Concern	Migratory	Carnivore				8	3	
Ardeidae	Bubulcus coromandus	Cattle Egret	Least Concern	Resident	Carnivore-Insectivore				10		31
Ardeidae	Ixobrychus sinensis	Yellow Bittern	Least Concern	Migratory	Carnivore-Insectivore				5		
Ardeidae	Bubulcus ibis	Cattle Egret	Least Concern	Resident	Carnivore-Insectivore					2	
Ardeidae	Nycticorax	Black-crowned Night Heron	Least Concern	Migratory	Carnivore				33		
Artamidae	Artamus leucorynchus	White-breasted Wood-swallow	Least Concern	Resident	Insectivore				4		7
Cisticolidae	Orthotomus derbianus	Grey-backed Tailorbird	Least Concern	Endemic	Insectivore				1		
Cisticolidae	Cisticola juncidis	Zitting Cisticola	Least Concern	Resident	Insectivore			3			2
Columbibae	Phapitreron leucotis	White-eared Brown Dove	Least Concern	Resident	Frugivore				2		
Columbibae	Spilopelia chinensis	Spotted Dove	Least Concern	Endemic	Piscivore-Insectivore						6
Columbibae	Geopelia striata	Zebra Dove	Least Concern	Resident	Granivore	1	1	4		5	13
Columbibae	Streptopelia tranquebarica	Red-turtle Dove	Least Concern	Resident	Granivore						7

Family	Scientific Name	Common Name	Conservation Status	Distribution/ Endemicity	Feeding Guilds	Monitoring Sites (Transects)					
						1	2	3	4	5	6
Corvidae	Corvus macrorhynchos	Large-billed Crow	Least Concern	Resident	Omnivore				4		5
Corvidae	Corvus enca	Slender-billed Crow	Least Concern	Resident	Carnivore					6	
Cuculidae	Centropus viridis	Philippine Coucal	Least Concern	Endemic	Insectivore				2		
Dicaeidae	Dicaem austral	Red-keeled Flowerpecker	Least Concern	Endemic	Frugivore				2	6	
Dicaeidae	Dicaeum trigonostigma	Orange-bellied Flowerpecker	Least Concern	Resident	Frugivore					6	
Estrildidae	Lonchura atricapilla	Chestnut Munia	Least Concern	Resident	Granivore			17			28
Estrildidae	Lonchura punctulata	Scaly-breasted Munia	Least Concern	Resident	Granivore						38
Hirundinidae	Hirundo tahitica	Pacific Swallow	Least Concern	Resident	Insectivore	9	2		16		2
Hirundinidae	Hirundo rustica	Barn Swallow	Least Concern	Resident	Insectivore			22	14	12	8
Laniidae	Lanius cristatus	Brown Shrike	Least Concern	Resident	Carnivore-Insectivore	1		5	7		19
Laniidae	Lanius schach	Long-tailed Shrike	Least Concern	Resident	Carnivore-Insectivore				1		2
Laridae	Childonias hybrid	Whiskered Tern	Least Concern	Migratory	Carnivore-Insectivore			45	24	8	11
Laridae	Sterna hirundo	Common Tern	Least Concern	Migratory	Carnivore			6	2		0
Locustellidae	Megalurus palustris	Striated Grassbird	Least Concern	Resident	Insectivore			8	3		16
Locustellidae	Megalurus timoriensis	Tawny Grassbird	Least Concern	Resident	Insectivore			4			13
Megalaimidae	Megalaima haemacephala	Coppersmith Barbet	Least Concern	Resident	Frugivore-Insectivore			0	1		
Megalaimidae	Megalaima haemacephala	Coppersmith Barbet	Least Concern	Resident	Frugivore-Insectivore					3	
Meropidae	Merops philippinus	Blue-tailed Bee-eater	Least Concern	Resident	Insectivore						3
Motacillidae	Anthus richardi	Richard's Pipit	Least Concern	Resident	Insectivore						4
Nectriniidae	Cinnyris jugularis	Olive-backed Sunbird	Least Concern	Resident	Frugivore-Insectivore				7	8	4
Passeridae	Passer montanus	Eurasian Tree sparrow	Least Concern	Resident	Granivore - Insectivore	80	54	27	47	15	60
Podicipedidae	Tachybaptus ruficollis	Little Grebe	Least Concern	Resident	Insectivore				12		

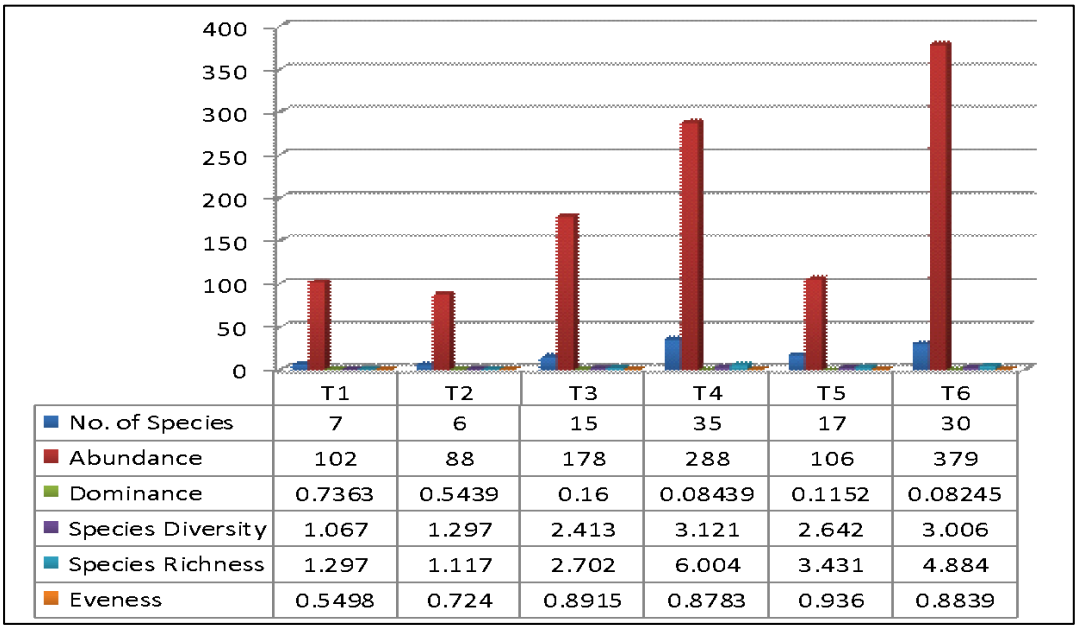
Family	Scientific Name	Common Name	Conservation Status	Distribution/ Endemicity	Feeding Guilds	Monitoring Sites (Transects)					
						1	2	3	4	5	6
Pycnonotidae	Pycnonotus goiavier	Yellow-vented Bulbul	Least Concern	Resident	Frugivore-Insectivore	6	4	15	16	15	12
Pycnonotidae	Ixos philippinus	Philippine Bulbul	Least Concern	Resident	Carnivore-Insectivore					10	
Rallidae	Gallirallus torquatus	Barred Rail	Least Concern	Resident	Omnivore				2		2
Rallidae	Amaurornis phoenicurus	White-breasted Waterhen	Least Concern	Resident	Omnivore				2		
Rallidae	Porzana cinerea	White-browed Crake	Least Concern	Native/Resident	Omnivore				11		
Rallidae	Gallinula chloropus	Common Moorhen	Least Concern	Resident	Omnivore				4		
Rallidae	Amaurornis olivacea	Plain Bush-hen	Least Concern	Endemic	Omnivore				3		
Rallidae	Gallirallus philippensis	Buff-banded Rail	Least Concern	Resident	Omnivore						2
Rhipiduridae	Rhipidura nigritorquis	Pied Fantail	Least Concern	Endemic	Insectivore				2		
Scolopacidae	Tringa nebularia	Common Greenshank	Least Concern	Resident	Carnivore-Insectivore						35
Strigidae	Otus megalotis	Philippine Scops Owl	Least Concern	Endemic	Carnivore					1	
Sturnidae	Acridotheres cristatellus	Crested Myna	Least Concern	Resident	Insectivore		8		1		17
Sturnidae	Aplonis panayensis	Asian Glossy Starling	Least Concern	Resident	Frugivore	3		4			
Sturnidae	Rhabdornis mystacalis	Stripe-headed Rhabdornis	Least Concern	Endemic	Frugivore-Insectivore					2	
Total						**102**	**88**	**178**	**288**	**106**	**379**
						1,141					

Table 3.1.35 List of Bird Species Documented from Six (6) Transect Line during Wet Season Survey

Family	Scientific Name	Common Name	Conservation Status	Distribution/ Endemicity	Feeding Guilds	Monitoring Sites (Transects)					
						1	2	3	4	5	6
Alcedinidae	Halcyon smyrnensis	White-throated Kingfisher	Least Concern	Native/Resident	Carnivore				1		2
Alcedinidae	Todiramphus chloris	White-collared Kingfisher	Least Concern	Native/Resident	Carnivore			5	1	1	1
Apodidae	Collocalia esculenta	Glossy Swiftlet	Least Concern	Native/Resident	Insectivore	3	19	3	29	18	7
Apodidae	Collocalia troglodytes	Pygmy swiftlet	Least Concern	Endemic	Insectivore	5			12		9
Ardeidae	Bubulcus coromandus	Cattle Egret	Least Concern	Resident-Migrant	Omnivore				1		
Ardeidae	Egretta garzetta	Little Egret	Least Concern	Resident-Migrant	Carnivore			4		2	
Ardeidae	Ixobrychus cinnamomeus	Cinnamon Bittern	Least Concern	Native/Resident	Carnivore				1		2
Ardeidae	Nycticorax	Black Crowned Night Heron	Least Concern	Native/Resident	Carnivore	1		2	3	3	1
Artamidae	Artamus leucorynchus	White-breasted Wood-swallow	Least Concern	Native/Resident	Insectivore						3
Caprimugidae	Caprimulgus affinis	Savana Nightjar	Least Concern	Native/Resident	Insectivore						1
Charadriidae	Charadrius dubius	Little ringed plover	Least Concern	Resident-Migrant	Insectivore			2			
Cisticolidae	Cisticola juncidis	Zitting Cisticola	Least Concern	Native/Resident	Insectivore			9			
Columbibae	Spilopelia chinensis	Spotted Dove	Least Concern	Native/Resident	Frugivore						1
Columbibae	Chalcophaps indica	Common Emerald Dove	Least Concern	Native/Resident	Frugivore					1	1
Columbibae	Geopelia striata	Zebra Dove	Least Concern	Native/Resident	Omnivore	6		5	4		14
Columbibae	Phapitreron leucotis	White-eared Brown Dove	Least Concern	Endemic	Frugivore					4	1
Corvidae	Corvus enca	Slender-billed Crow	Least Concern	Native/Resident	Omnivore						2
Corvidae	Corvus macrorhynchos	Large-billed Crow	Least Concern	Native/Resident	Omnivore					2	2
Cuculidae	Centropus viridis	Philippine Coucal	Least Concern	Endemic	Insectivore			1	2	1	2
Estrildidae	Lonchura atricapilla	Chestnut Munia	Least Concern	Native/Resident	Granivore	4		10			38
Estrildidae	Lonchura oryzivora	Java Sparrow	Least Concern	Introduced	Granivore				2		
Estrildidae	Lonchura punctulata	Scaly-breasted Munia	Least Concern	Native/Resident	Granivore			8			31

Family	Scientific Name	Common Name	Conservation Status	Distribution/ Endemicity	Feeding Guilds	Monitoring Sites (Transects)					
						1	2	3	4	5	6
Hirundinidae	Hirundo rustica	Barn Swallow	Least Concern	Resident-Migrant	Insectivore			2	3		8
Hirundinidae	Hirundo tahitica	Pacific Swallow	Least Concern	Resident-Migrant	Insectivore	4	9	5	6	7	6
Laniidae	Lanius schach	Long-tailed Shrike	Least Concern	Native/Resident	Carnivore			1			
Locustellidae	Megalurus palustris	Striated Grassbird	Least Concern	Native/Resident	Insectivore			6		2	
Megalaimidae	Psilopogon haemacephala	Coppersmith Barbet	Least Concern	Native/Resident	Frugivore						1
Meropidae	Merops philippinus	Blue-tailed Bee-eater	Least Concern	Native/Resident	Insectivore				32		6
Nectariniidae	Cinnyris jugularis	Olive-backed Sunbird	Least Concern	Native/Resident	Omnivore				2	7	3
Oriolidae	Oriolus chinensis	Black-naped Oriole	Least Concern	Native/Resident	Omnivore				1		
Passeridae	Passer montanus	Eurasian Tree sparrow	Least Concern	Native/Resident	Omnivore	74	30	48	51	17	54
Picidae	Picoides maculatus	Philippine pygmy woodpecker	Least Concern	Endemic	Insectivore					1	
Pycnonotidae	Hypsipetes philippinus	Philippine bulbul	Least Concern	Endemic	Insectivore					6	
Pycnonotidae	Pycnonotus goiavier	Yellow-vented Bulbul	Least Concern	Native/Resident	Omnivore	4	5	20	5	8	7
Pycnonotidae	Pycnonotus urostictus	Yellow-wattled Bulbul	Least Concern	Endemic	Omnivore						3
Rallidae	Gallinula chloropus	Common Moorhen	Least Concern	Resident-Migrant	Omnivore				2		
Rallidae	Gallirallus torquatus	Barred rail	Least Concern	Native/Resident	Omnivore			1			
Rhipiduridae	Rhipidura nigritorquis	Pied Fantail	Least Concern	Endemic	Carnivore	1		2	2		
Sturnidae	Acridotheres cristatellus	Crested Myna	Least Concern	Native/Resident	Omnivore		3				11
Sturnidae	Aplonis panayensis	Asian Glossy Starling	Least Concern	Native/Resident	Omnivore	8		5			
Turnicidae	Turnix suscitator	Barred buttonquail	Least Concern	Native/Resident	Omnivore			2			
Zosteropidae	Zosterops meyeni	Lowland White-eye	Least Concern	Endemic	Omnivore				2		2
Total						**110**	**66**	**141**	**162**	**80**	**219**
						778					

801. During the dry season, based on the number of species the T4 (Tadlac) site has the highest number with 35 species. It is followed by T6 (San Antonio-IRRI) with 30, T5 (Timugan) with 17, T3 (Cabuyao) with 15, T1 (Solis) with 7, and the least T2 (FTI-Taguig) with only six species recorded.



	T1	T2	T3	T4	T5	T6
No. of Species	7	6	15	35	17	30
Abundance	102	88	178	288	106	379
Dominance	0.7363	0.5439	0.16	0.08439	0.1152	0.08245
Species Diversity	1.067	1.297	2.413	3.121	2.642	3.006
Species Richness	1.297	1.117	2.702	6.004	3.431	4.884
Eveness	0.5498	0.724	0.8915	0.8783	0.936	0.8839

Figure 3.1.76 Diversity Indices of Bird Species during Dry Season Survey

802. Transect T6 (San Antonio-IRRI) has the highest number of individuals counted with 379 which is 33.22% of the total number of individuals (1141) observed and recorded. Birds are abundant in T6 because of the presence of rice fields which are good feeding grounds for insectivores. Next is T4 (Tadlac) with 288 individuals or 25.24%, followed by T3 (Cabuyao) with 178 (15.6%), T5 (Timugan) with 106 (9.29%), T1 (Solis) with 102 (8.95), and the barangay with the least counted individuals of birds is T2 (FTI-Taguig) with only 88 (7.71%)

803. Dominance of a species could be associated to the highest number of individuals recorded in each site. Transect T1 has the highest dominance value (0.6278) compared to T2 (0.4341), T3 (0.1284), T5 (0.08811), T4 (0.0679), and T6 has the least dominance value of 0.0708. The high dominance value of T1 and T2 may possibly be the effect of the presence of built up areas and close proximity of the area to human habitation that causes high disturbance. Since the area is near human habitation and highly exposed to urbanization, the development that took place and will take place in the area can cause rapid changes to the environment. With continuous development, the environment becomes homogeneous which causes high species dominance. High homogeneity in the environment will cause high competition of existing natural resources which will later result to the fittest individual ruling the environment. Hence, as the environment undergoes changes, species composition might dwindle allowing one species to become dominant. **Figure 3.1.76** shows that with high dominance value, there is less diversity and evenness as observed in T1 (Solis).

804. Transect T4 is the most diverse in terms of species composition compared to other sampling sites. It has a species diversity index value of 3.121. This was followed by T6 with 3.006. The high species diversity value does not necessarily mean that the equality of the distribution of species in a certain area are normally distributed. It is shown in **Figure 3.1.76** that despite high species diversity index value in T4, the evenness of species is highest in T5 (0.936). This was followed by T3 (0.0.8915) and T6 (0.6312), and T4 with an evenness value 0.8783.

805. A tool to determine the degree of disturbance of a certain habitat or site, is the determination of the percentage of species belonging to different feeding guilds. The increase/decrease in the number of species of a certain feeding guild will determine the effects of disturbance, natural or anthropogenic. Table 3.1.26 shows the species of birds with the respective habitats, feeding guilds, residency, and distribution, and IUCN conservation status of each species.

806. During dry season, there are nine types of feeding guilds observed and recorded for all bird species identified in six selected sites (**Figure 3.1.77**). Insectivory is the dominant feeding guild and comprises 24% (14) of the total number of species. This is followed by mixed feeders such as carnivores-insectivores with 21%, carnivores-omnivores (12%), granivores (9%), frugivores-insectivores (8%), frugivores (7%), piscivores- insectivores (5%), and the least number of species were granivores-insectivores has the lowest value of 2%.

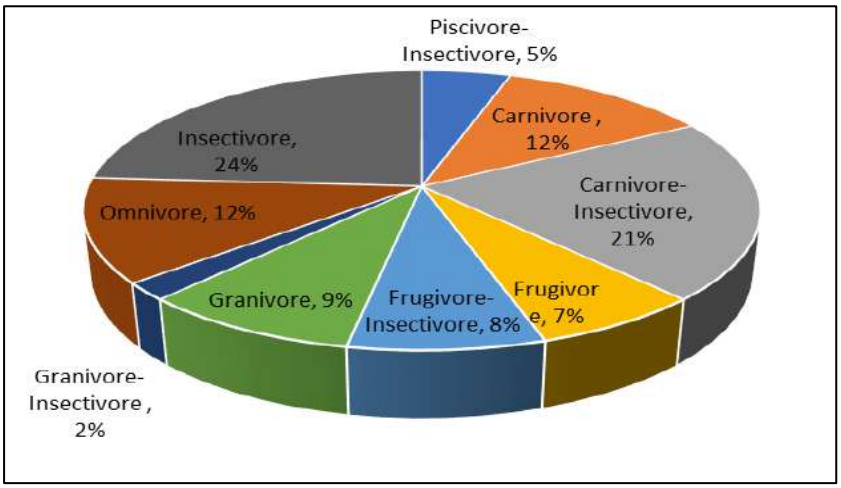


Figure 3.1.77 Percentage of Species Belonging to Different Feeding Guilds during Dry Season Survey

807. Percentage distribution patterns of bird's species based on residency status showed that most of the species of birds present in the six established transects during the 2018 terrestrial vertebrate survey are residents (69%), sixteen percent (16%) are endemic, and 15% are migrants (**Figure 3.1.78**).

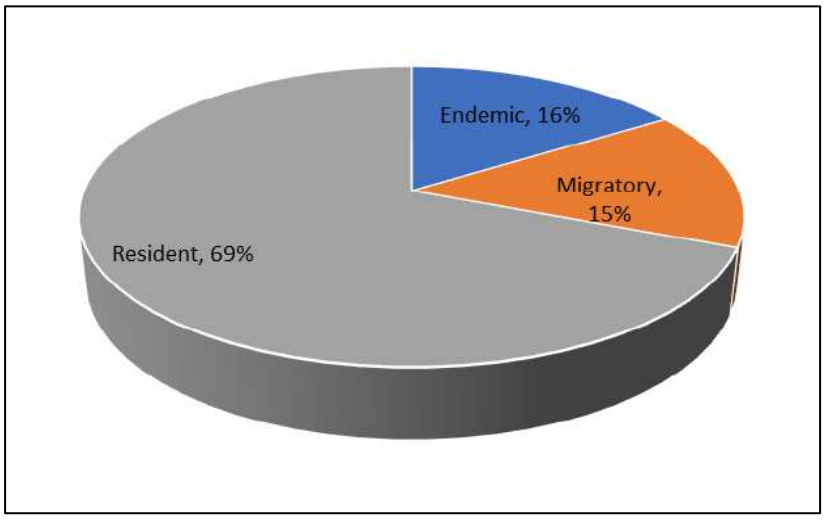
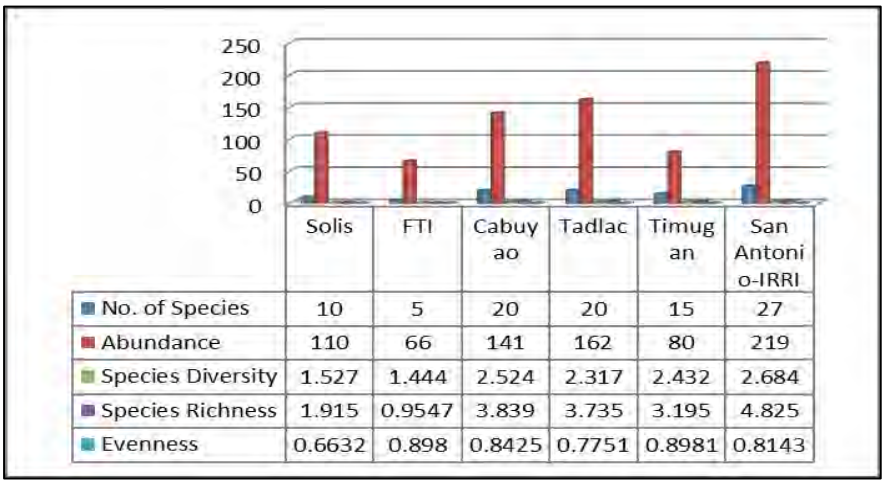


Figure 3.1.78 Percentage Distribution Patterns of Bird Species during Dry Season Survey

808. During wet season, abundance is highest in the San Antonio-IRRI area because of the abundance of food supply present in the rice fields and grassland as well as the presence of fruit trees along the sides of the old railroad. Species diversity is moderate in 2 of the monitored areas, San Antonio-IRRI site and Cabuyao, low in Timugan and Tadalc while it is very low in Solis and FTI. The reason for the very low species diversity in the first two sites is the lack of trees for roosting, perching and feeding, and pollution (noise, dust, air). Although there is an abundance of trees in Tadlac and Timugan, most of these sites are congested with people and cars. The moderate diversity in the San Antonio-IRRI site is because of the presence of rice fields, grassland and fruit trees like mangoes, aratiles, rambutan, etc. along the transect line. Species richness is moderate in 4 of the sites (Cabuyao, Timugan, Tadlac and San Antonio-IRRI) while very low in Solis and FTI. Evenness is high in Solis and Tadlac while it is very high in all the other sites (**Figure 3.1.79**).



	Solis	FTI	Cabuyao	Tadlac	Timugan	San Antonio-IRRI
No. of Species	10	5	20	20	15	27
Abundance	110	66	141	162	80	219
Species Diversity	1.527	1.444	2.524	2.317	2.432	2.684
Species Richness	1.915	0.9547	3.839	3.735	3.195	4.825
Evenness	0.6632	0.898	0.8425	0.7751	0.8981	0.8143

Figure 3.1.79 Diversity Indices of Bird Species During Wet Season Survey

809. During wet season, 53% of the species of birds are omnivores which means that most of the birds eat anything available for them, e.g., plants, insects and/or other vertebrates. Insectivores comprise 29%, granivores at 12%, while a few are carnivores (5%) and one species is a frugivore (1%). The general feeding guilds of avifauna during the wet season are presented in **Figure 3.1.80**. This is unlike in the dry season, where insectivores dominated and comprised 24% of the total number of species, while omnivores only comprised 12%.

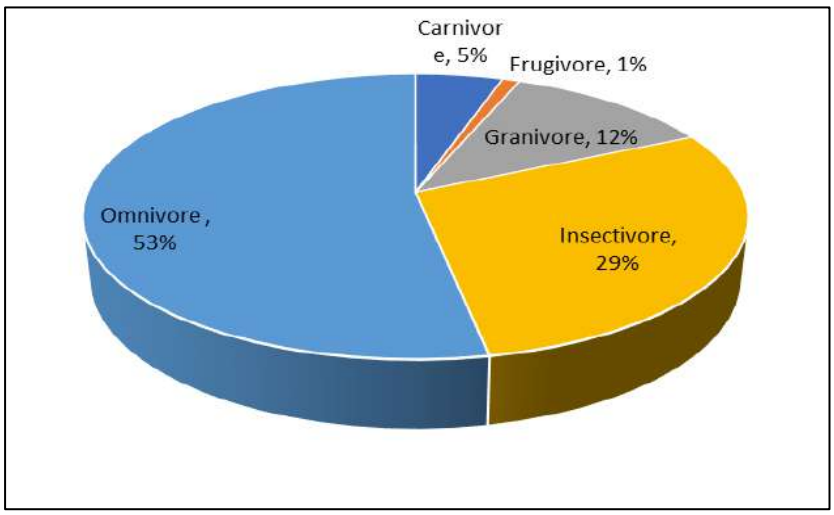


Figure 3.1.80 Percentage of Species Belonging to Different Feeding Guilds during Wet Season Survey

810. Most of the species of birds in the monitoring sites are native or resident comprising about 66% (**Figure 3.1.81**). Eighteen percent are endemic to the country, 14% are resident-migrant and 2% is introduced. The species distribution shows that the birds have adapted to their present habitat which in this case are mostly residential with few trees and is disturbed in most areas.

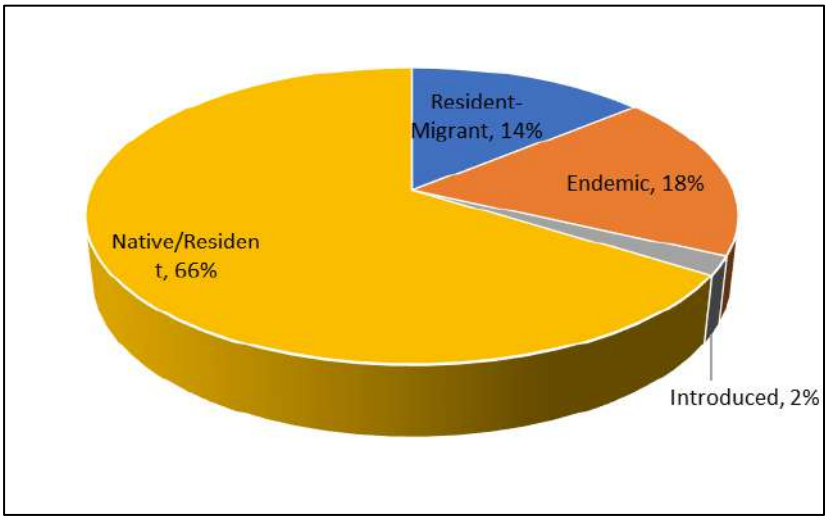


Figure 3.1.81 Percentage Distribution Patterns of Bird Species during Wet Season Survey

811. The comparison of the number of species during the dry and wet seasons is presented in **Table 3.1.36**. Overall, the number of species decreased from 55 recorded during the dry season to only 44 in the wet season. Except for Solis and Cabuyao where the number of species slightly increased, the number of species decreased in most of the sites with Tadlac registering the highest decrease (15 species). This may be because the migratory birds which pass through Crocodile/Alligator Lake and Laguna de Bay during the migration period early in the year are no longer present. The weather and climate may have affected the presence of the birds inasmuch as the rains were intermittently falling during the time the transect walks were conducted (early morning and late afternoon).

Table 3.1.36 Comparison of Number of Bird Species Documented during Dry and Wet Seasons

Sites	No. of Species per Monitoring Period	
	Dry Season	Wet Season
Overall	55	42
Solis	7	10
FTI	6	5
Cabuyao	15	20
Tadlac	35	20
Timugan	17	15
San Antonio-IRRI	30	27

812. Of the forty-two species documented during wet season survey, nine (9) were not recorded during dry season survey. These are *Caprimulgus affinis*, Chalcophaps *indica*, *Charadrius dubius*, *Hypsipetes philippinus*, *Ixobrychus cinnamomeus*, *Picoidus maculatus*, *Psilopogon haemacephala*, *Turnix suscitator* and *Zosterops meyeni* (**Table 3.1.37**)

Table 3.1.37 Comparison of Avifauna Species Documented During Wet and Dry Seasons

Species	Monitoring Seasons		Species	Monitoring Seasons	
	Wet	Dry		Wet	Dry
Acridotheres cristatellus	X	X	*Ixobrychus cinnamomeus*	X	
Alcedo atthis		X	*Ixobrychus sinensis*		X
Amaurornis olivacea		X	*Ixos philippinus*		X
Amaurornis phoenicurus		X	*Lanius cristatus*		X
Anthus richardi		X	*Lanius schach*	X	X
Aplonis panayensis	X	X	*Lonchura atricapilla*	X	X
Artamus leucorynchus	X	X	*Lonchura oryzivora*	X	
Bubulcus coromandus	X	X	*Lonchura punctulata*	X	X
Bubulcus ibis		X	*Megalaima haemacephala*		X
Butorides striata		X	*Megalurus palustris*	X	X
Caprimulgus affinis	X		*Megalurus timoriensis*		X
Centropus viridis	X	X	*Merops philippinus*	X	X
Chalcophaps indica	X		*Nycticorax*	X	X
Charadrius dubius	X		*Oriolus chinensis*	X	
Childonias hybrid		X	*Orthotomus derbianus*		X
Cinnyris jugularis	X	X	*Otus megalotis*		X
Cisticola juncidis	X	X	*Passer montanus*	X	X
Collocalia esculenta	X	X	*Phapitreron leucotis*	X	X
Collocalia troglodytes	X	X	*Picoides maculatus*	X	
Corvus enca	X	X	*Psilopogon haemacephala*	X	
Corvus macrorhynchos	X	X	*Pycnonotus goiavier*	X	X
Dicaem austral		X	*Pycnonotus urostictus*	X	
Dicaeum trigonostigma		X	*Rhabdornis mystacalis*		X
Egretta garzetta	X	X	*Rhipidura nigritorquis*	X	X
Egretta intermedia		X	*Spilopelia chinensis*	X	X
Gallinula chloropus	X	X	*Sterna hirundo*		X
Gallirallus philippensis		X	*Streptopelia tranquebarica*		X
Gallirallus torquatus	X	X	*Tachybaptus ruficollis*		X
Geopelia striata	X	X	*Todiramphus chloris*	X	X
Halcyon smyrnensis	X	X	*Tringa nebularia*		X
Hirundo rustica	X	X	*Turnix suscitator*	X	
Hirundo tahitica	X	X	*Zosterops meyeni*	X	
Hypsipetes philippinus	X				
Total Number of Species	**Dry Season**				**42**
	Wet Season				**53**

Mammals

813. During dry season survey, a total of five (5) species belonging to three (3) families were recorded from the six (6) established survey sites for mammals (**Table 3.1.39**). The species of mammals documented from the six (6) transects are composed of five (5) volant - four (4) fruit bats (*Cynopterus brachyotis, Ptenochirus jagori, Rousettus amplexicaudatus, and Macroglossus minimus)* and one (1) species of insect bat belonging to family Vespertilionidae, *Scotophilus kuhlii* and one (1) non-volant species which is an introduced species belonging to Family Soricidae, *Suncus murinus.*

814. The highest number of species was observed from the T6 where four of the volant species were captured and recorded, followed by T5 with 3, T1 and T3 with 2 species each. Non-volant species was only documented in T1 and not in any other site. There were no captured and recorded individuals from T2 since no nocturnal survey was done. This was due to the very close proximity to the national highway and there was no possible area to set-up the nets. No bats or rodents were caught in the nets and traps in TadlacInventory of Mammals Recorded at Six (6) Transects during Dry Season.

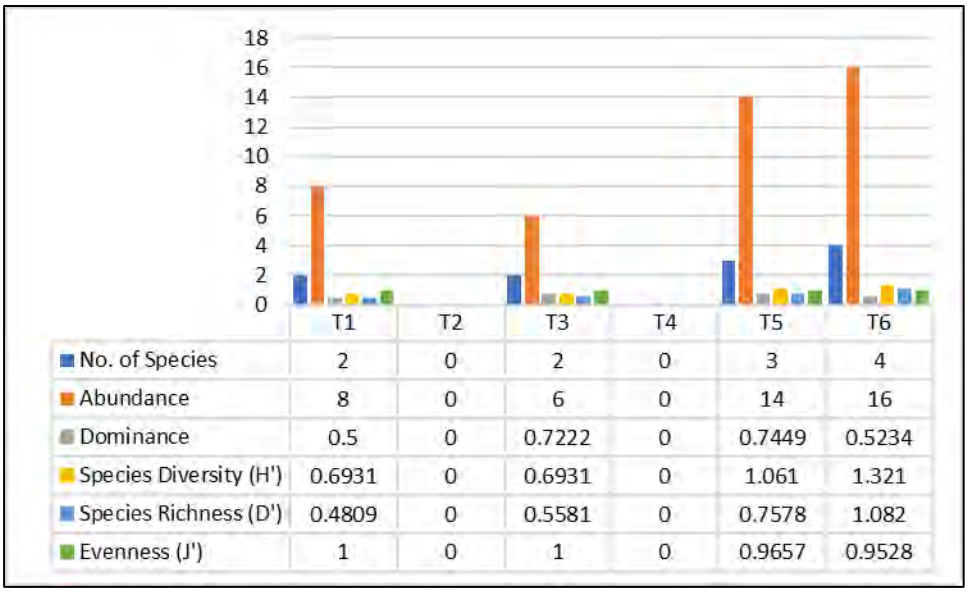
Table 3.1.38 Comparison of Number of Mammalian Species During Wet and Dry Seasons

Family	Scientific Name	Common Name	Conservation Status	Distribution	Feeding Guild	Monitoring Sites (Transects)					
						1	2	3	4	5	6
Pteropididae	*Cynopterus brachyotis*	Lesser Dog-faced Fruit Bat	Least Concern	Native	Frugivore			3		1	7
Pteropididae	*Ptenochirus jagori*	Greater Musky Fruit Bat	Least Concern	Endemic	Frugivore					4	6
Pteropididae	*Macroglossus minimus*	Dagger-toothed Long-nosed Fruit Bat	Least Concern	Native							1
Pteropodidae	*Rousettus amplexicaudatus*	Geoffroy's Rousette	Least Concern	Native						9	2
Vespertilionidae	*Scotophilus kuhlii*	Asiatic Lesser Yellow House Bat	Least Concern	Native	Insectivore	5		3			
Soricidae	*Suncus murinus*	Asian House Shrew	Least Concern	Introduced	Carnivore	3					
Total						**8**		**6**		**14**	**16**

815. Forty-four (44) individuals of combined Volant and non-volant mammals were recorded in all sites. Abundance is highest in the T6 site wherein a total of 16 individuals were caught in the nets. Fourteen (14) individuals were also caught in T5 while there were 8 caught in T1 and 6 in T3. More individuals were caught in nets set up in the T6 and T5 since fruit trees, coconuts and other trees are present along the railroad and in the community near the site. These trees may be utilized as roosting or feeding sites by the birds.

816. Another reason for the high and low abundance in the different sites may be because of the varied composition of habitats that can be found or cannot be found in each site.

817. There is not much difference in species dominance among the sites wherein the higher value is observed to be similar in T3 and T5 (0.7222 and 0.7449, respectively) and lower in T1 and T6 (both rounded off at 0.5).



	T1	T2	T3	T4	T5	T6
No. of Species	2	0	2	0	3	4
Abundance	8	0	6	0	14	16
Dominance	0.5	0	0.7222	0	0.7449	0.5234
Species Diversity (H')	0.6931	0	0.6931	0	1.061	1.321
Species Richness (D')	0.4809	0	0.5581	0	0.7578	1.082
Evenness (J')	1	0	1	0	0.9657	0.9528

Note:
H' – Shannon index; D = Simpson's index; J – Evenness index
Diversity Index: vh – very high (3.50 above), h – high (3.00 – 3.49), m – moderate (2.50 – 2.99), l – low (2.00 – 2.49), vl – very low (1.99 – below); Evenness Index: vh – very high (0.75 – 1.00), h – high (0.50 – 0.74), m – moderate (0.25 – 0.49), l – low (0.15 – 0.24), vl – very low (0.05 – 0.14).

Figure 3.1.82 Comparison of Mammal Diversity Indices between Monitoring Sites during Dry Season

818. The habitat, population status, distribution and conservation status of mammals observed during the survey of terrestrial vertebrates are presented in **Table 3.1.39**. The documented species of volant and non-volant mammal are highly adaptable species that are commonly found in and around villages or human settlements and agricultural areas. And no direct conservation measures are needed for these common and adaptable species. Based on data gathered, out of the six (6) sites, it showed tha*t Suncus murinus* is the only species of non-volant mammals sampled. It is an introduced species that can highly adapt to vast range and type of habitat. All of these are highly adapted to disturbed areas, especially areas near human settlements. Some of the species recorded are forest dwellers and depend on the forest for survival except *Macroglossus minimus, Rousettus amplexicaudatus*, and *Suncus murinus* which thrive in all habitats. There is not much variation in species observed in all survey sites. Among the captured and recorded species, 67% are native species, 16% endemic and 17% introduced species (**Figure 3.1.83**).

Table 3.1.39 Habitats, Population and Conservation Status and Distribution of Mammals

Species	Habitat	Population Status	Residency Status	Conservation Status
BATS				
Cynopterus brachyotis	Lower montane forests, dipterocarp forests, gardens, mangrove and strand vegetation	Abundant and widespread; populations stable and increasing	Native	Least Concern
Ptenochirus jagori	Primary and secondary forest; agricultural areas	Population are large and generally stable	Endemic	Least Concern
Macroglossus minimus	Found in disturbed and agricultural areas	Abundant and widespread; populations stable and increasing	Native	Least Concern

Species	Habitat	Population Status	Residency Status	Conservation Status
Rousettus amplexicaudatus	Roosts in caves, crevices; found in a variety of habitat	Abundant and widespread	Native	Least Concern
Scotophilus kuhlii	Roosts in caves, crevices, ceiling of the house	Abundant and widespread; populations stable and increasing	Native	Least Concern
RODENTS				
Suncus murinus	Abundant in all habitats	Non-native pest; abundant	Introduced	Least Concern

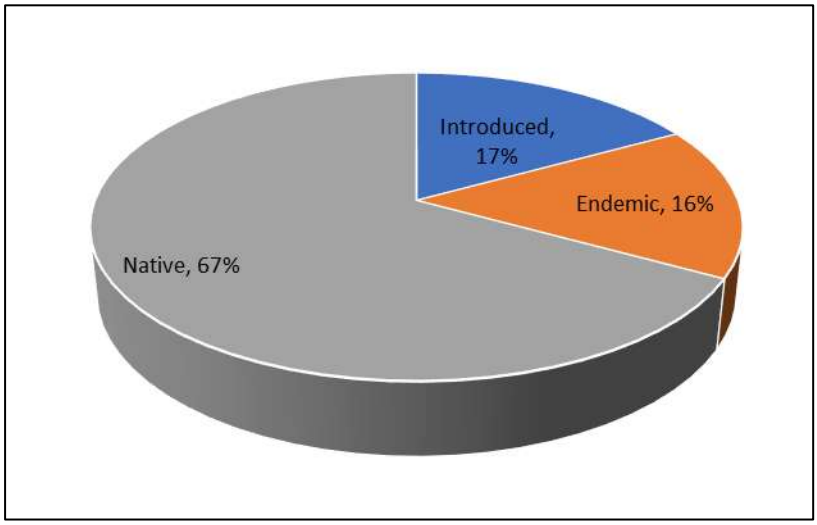


Figure 3.1.83 Percentage Distribution Patterns of Mammal Species during Dry Season

819. During wet season survey, only five (5) species of mammals were documented in the Project. This is composed of 3 volant and 2 non-volant species. Only one species was recorded in Solis while the five other sites had two species each. One species, *Cynopterus brachyotis* is common to most of the sites (5), except for Solis (**Table 3.1.40**).

820. Most of the volant species are common in different habitats except for *Ptenochirus jagori* which is a forest dependent species. All the two non-volant species are introduced. Sometimes the Asian House Shrew, *Suncus murinus* is considered beneficial because it preys on insect pests but it also preys on lizards which is detrimental to wildlife. The Oriental House Rat is considered agricultural and household pest.

821. More individuals were caught in nets set up in the T6 since fruit trees, coconuts and other trees are present along the railroad and in the community near the site. These trees may be utilized as roosting or feeding sites by the birds. Another reason for the high and low abundance in the different sites may be because of the varied composition of habitats that can be found or cannot be found in each site.

822. The number of species in each transect range from one (1) in Transect 1 in Solis to two (2) in other transects. The paucity of species of mammals in all transects may indicate that the areas are not able to sustain such species because of the lack of forests and fruiting trees where Volant mammals can roost or feed on, especially in Transect 1 in Solis and Transect 2 in FTI.

Table 3.1.40 Inventory of Mammals Recorded at Six (6) Transects

Family	Scientific Name	Common Name	Conservation Status	Distribution	Feeding Guild	Monitoring Sites (Transects)					
						1	2	3	4	5	6
Pteropodidae	*Cynopterus brachyotis*	Short-nosed Fruit Bat	Least Concern	Native/ Resident	Frugivore	0	-	1	5	6	1
Vespertolionidae	*Scotophilus kuhlii*	Lesser Asiatic yellow bat	Least Concern	Native/ Resident	Insectivore	0	-	1	0	0	0
Pteropodidae	*Ptenochirus jagori*	Greater musky fruitbat	Least Concern	Endemic	Frugivore	0	-	0	0	1	1
Soricidae	*Suncus murinus*	Asian House Shrew	Least Concern	Native/ Resident	Carnivore	1	-	0	0	0	0
Muridae	*Rattus tanezumi*	Oriental House Rat	Least Concern	Introduced	Omnivore	0	-	0	3	0	0
Total						**1**	**-**	**2**	**8**	**7**	**2**

823. All of the mammal species observed in all survey sites are of Least Concern and are not threatened in their habitats and ranges (**Table 3.1.40**). All of these are highly adapted to disturbed areas, especially areas near human settlements. There is not much variation in species observed in all survey sites. Among the captured and recorded species, 75% are native species and 17% endemic and 8% introduced species.

824. Species diversity of mammals in all monitoring sites is very low. The highest species diversity was recorded in Transects 3 and 6 at H' = 0.6931. Meanwhile, evenness in Transects 3 and 6 is very high (1). **Figure 3.1.84** shows the comparison of mammal diversity indices between monitoring sites during wet season survey.

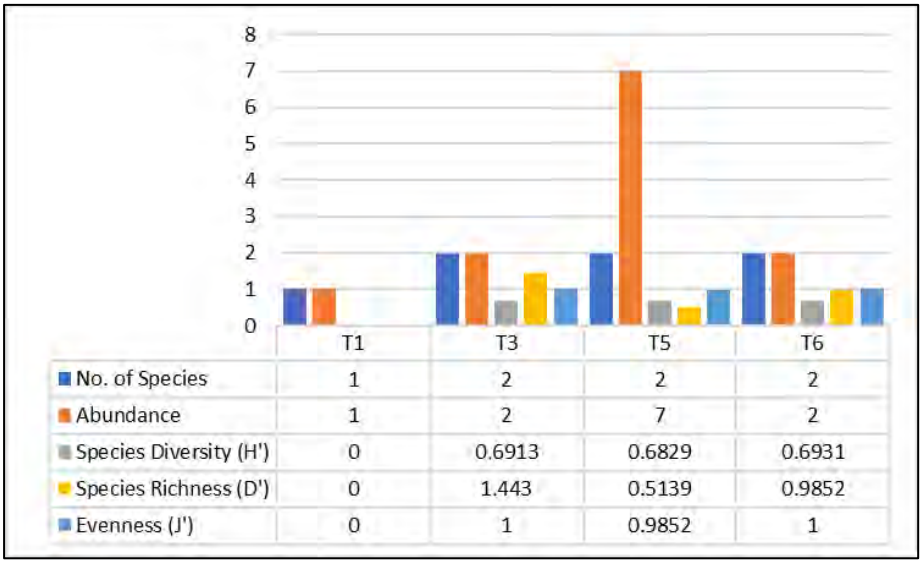


Figure 3.1.84 Comparison of Mammal Diversity Indices between Monitoring Sites during Wet Season

825. Forty percent (40%) of the mammalian species are frugivores particularly the bats (2 species). Insectivores, carnivores and omnivores comprise 20% each of the total species. **Figure 3.1.85** shows that Sixty percent of the species of mammals are native/residents while introduced and endemic species are 20% each.

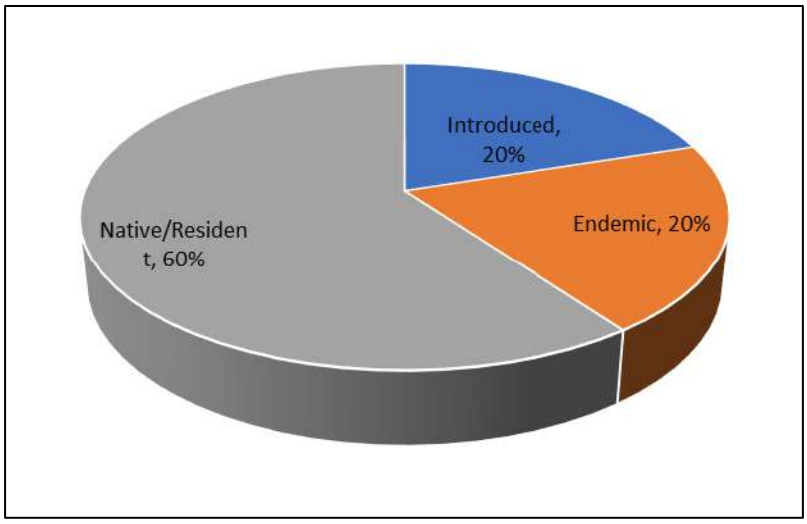


Figure 3.1.85 Percentage Distribution Patterns of Mammal Species during Wet Season

Table 3.1.41 Comparison of Number of Mammalian Species during Wet and Dry Seasons Monitoring

Sites	No. of Species Per Monitoring Period	
	Dry Season	Wet Season
Overall	6	5
Solis	2	1
FTI	-	-
Cabuyao	2	2
Tadlac	-	2
Timugan	3	2
San Antonio-IRRI	4	2

826. A total of seven species of mammals has been documented during the dry and wet seasons. Two species recorded during the dry season were not seen during the wet season, *Macroglossus minimus* and *Rousettus amplexicaudatus*. The Oriental house rat which is a very common species was caught during the wet season only. This may be because the live traps may have been set away from houses and/or gardens and farms.

Table 3.1.42 Comparison of Mammal Species between the Wet and Dry Seasons

Species	Monitoring Season	
	Dry Season	Wet Season
Cynopterus brachyotis	X	X
Scotophilus kuhlii	X	X
Ptenochirus jagori	X	X
Suncus murinus	-	X
Rattus tanezumi	-	X
Macroglossus minimus	X	-
Rousettus amplexicaudatus	X	-

Herpetofauna

827. During dry season survey, three (3) species of herpetofauna comprised of two (2) amphibians and one (1) lizard were recorded (**Table 3.1.43**). The two (2) species of amphibians

belong to two families namely Dicroglossidae (*Occidozyga laevis*) and Bufonidae (*Rhinella marina*); while the lizard belongs to family Gekkonidae (*Hemidactylus frenatus*).

828. Based on the result, there is not much of a difference with the species recorded in the six selected surveyed sites. Thirty-three (33) individuals of species of frogs and lizards are recorded. T1 has the highest number of individuals recorded with 18, next is T4 with 19, and T5 with 4 individuals of lizard.

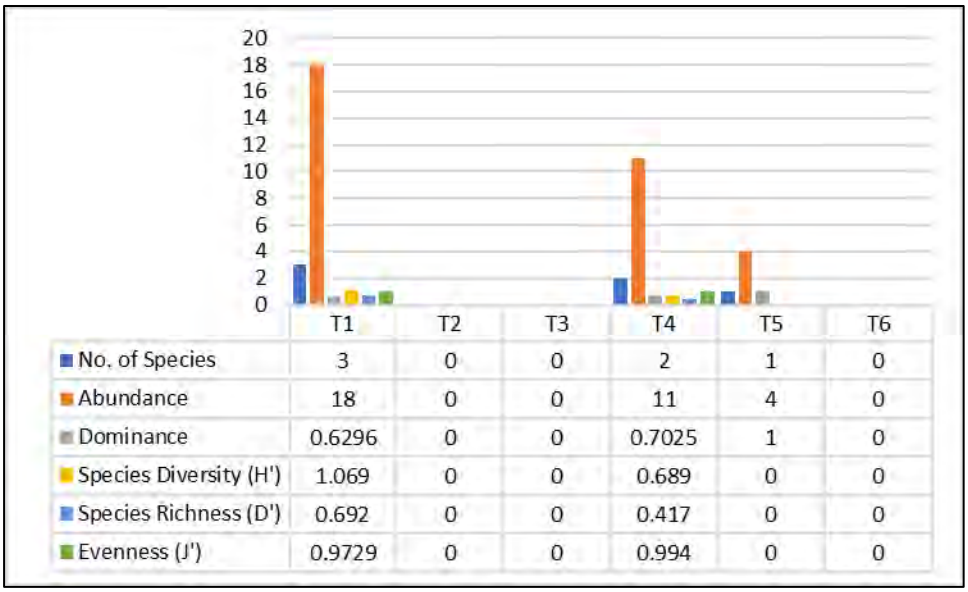
Table 3.1.43 List of Herpefauna Recorded in Six (6) Transects during Dry Season

Family	Scientific Name	Common Name	Habitat	Residency Status	Conservation Status	Transect					
						1	2	3	4	5	6
ANURANS											
Dicroglossidae	*Occidozyga laevis*	Puddle frog	Aquatic habitat type; puddle	Native	Least Concern	2	0	0	0	0	0
Bufonidae	*Rhinella marina*	Cane toad	All habitat types	Introduced	Invasive	6	0	0	6	0	0
REPTILES											
Gekkonidae	*Hemidactylus frenatus*	Common House Gecko	Diverse Habitat range	Native	Least Concern	10	0	0	5	4	0

829. The herpetofauna documented during the survey are highly adapted to degraded and man-made environments. Most of them are introduced that can thrive in a wide variety of habitats. Some of the species are considered invasive. These species kill native and endemic species of frogs like the *Rhinella marina* commonly known as “Bullfrog” which is noted to be the most abundant species in T1 and T4. *Hemidactylus frenatus* (Common House Gecko) was recorded with close proximity to human habituation or inside the houses.

830. Diversity indices can only be compared in three transects: T1, T4 and T5. **Figure 3.1.86** showed that values of diversity indices for herpetofauna in all the sites were very low in areas where the taxon is documented. Most of the sites are dominated by the invasive species *Rhinella marina* which is more terrestrial than aquatic and the common house lizard, *Hemidactylus frenatus*. The puddle frog was documented in Solis where there was a canal at the side of the railroad.

831. All values of diversity indices in the surveyed sites are very low. Species dominance is highest in T5 (Timugan) while it is lowest in T1 (Solis). Species diversity and richness in Solis are higher because it is where all 3 species of herpetofauna were recorded while evenness is higher in T5. The comparison of values of diversity indices between sites is presented in **Figure 3.1.86**.



	T1	T2	T3	T4	T5	T6
No. of Species	3	0	0	2	1	0
Abundance	18	0	0	11	4	0
Dominance	0.6296	0	0	0.7025	1	0
Species Diversity (H')	1.069	0	0	0.689	0	0
Species Richness (D')	0.692	0	0	0.417	0	0
Evenness (J')	0.9729	0	0	0.994	0	0

Figure 3.1.86 Diversity Indices of Species of Herpetofauna during Dry Season

832. The distribution and conservation status of amphibians and reptiles observed and recorded in the surveyed areas are mostly species that inhabit varied habitat types and appears to thrive even in degraded and man-made environments. Amphibians and reptiles were found in or near streams and pools, trees within agricultural areas or near settlements. Most of the recorded species are found in disturbed habitats (**Table 3.1.44**).

833. The recorded species of amphibians and reptiles in the surveyed sites needs less conservation management since most of the species observed are species that occur in a diverse range of habitats that can be classified as areas of high disturbance.

Table 3.1.44 Habitat, distribution and conservation status of amphibians and reptiles observed and recorded from three survey areas.

Species	Habitat	Residency Status	Conservation Status
Occidozyga laevis	Aquatic habitat type; puddle	Native	LC
Rhinella marina	All habitat types	Introduced	Invasive
Hemidactylus frenatus	Diverse Habitat range	Native	LC

834. No endemic species of amphibians and reptiles were recorded. There are only two residency status noted during the survey (Native and Introduced). Approximately 33% are introduced species and 67% are native species of amphibians and reptiles (**Figure 3.1.87**).

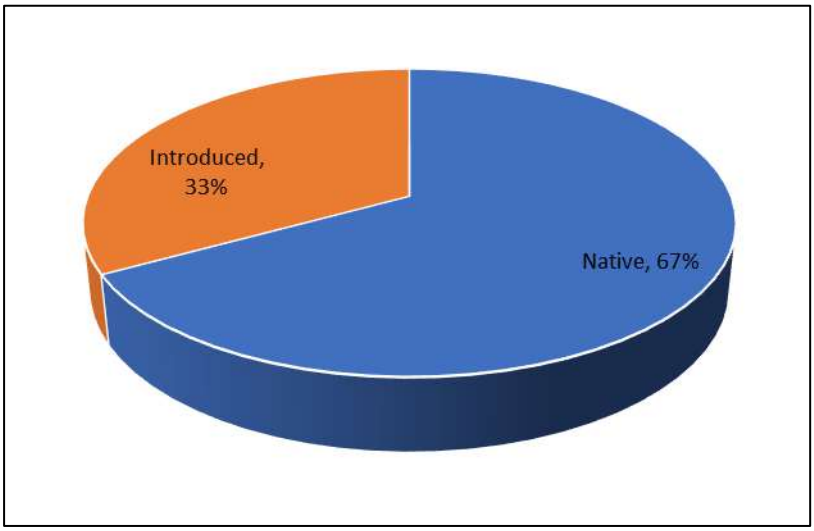


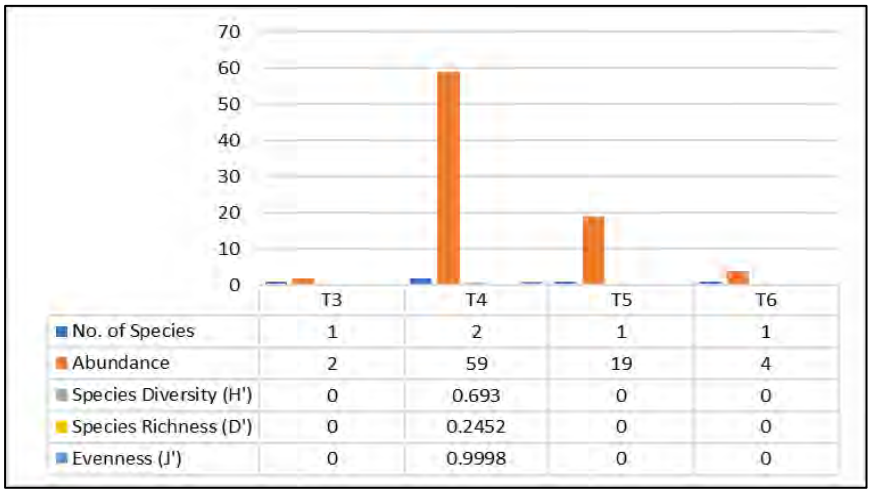
Figure 3.1.87 Herpetofauna Percentage Residency Status

835. During wet season survey, three (3) species of herpetofauna were observed and recorded at four (4) transects. All of which are Amphibians, belonging to three (3) families including the ubiquitous, exotic and invasive *Rhinella marina* which was the most common amphibian. (**Table 3.1.45**). Eighty-four (84) individuals of species of frogs are recorded. Transect 4 has the highest number of individuals recorded with 59, next is Transect 5 with 19, and Transect 6 with four (4) individuals. The herpetofauna documented during the survey are highly adapted to degraded and man-made environments. Most of them are introduced that can thrive in a wide variety of habitats. Some of the species are considered invasive. These species kill native and endemic species of frogs like the *Rhinella marina* commonly known as "Bullfrog" which is noted to be the most abundant species in Transect 4. All of the recorded species amphibians and reptiles are categorized as Least Concern based on IUCN like the recorded mammals and bird species.

Table 3.1.45 List of Herpefauna Recorded in Six (6) Transects

Family	Scientific Name	Common Name	Habitat	Residency Status	Conservation Status	Transect						Total
						1	2	3	4	5	6	
Bufonidae	Rhinella marina	Cane toad	Parks, residential areas and related areas	Introduced	Least Concern	-	-	2	35	0	4	41
Microhylidae	Kaloula pulchra	Asiatic painted frog	Parks, residential areas and related areas	Introduced	Least Concern	-	-	0	24	0	0	24
Ceratobatrachidae	Platymantis dorsalis	Dumeril's forest litter frog	Forest and forest-related habitat	Endemic	Least Concern	-	-	0	0	19	0	19
Total Number of Individuals						-	-	2	59	19	4	84
Total Number of Species						-	-	1	2	1	1	3
Total Number of Families						-	-	1	2	1	1	3

836. Two (2) types of feeding guilds were observed and recorded for all herpetofaunal at four (4) transects. Most (51%) of them are insectivores while some (49%) are carnivores. Majority (77%) of the recorded herpetofaunal species inhabit in parks, residential areas and related areas while some (23%) belong to the forest and forest-related habitat. Most of the sites are dominated by the invasive species *Rhinella marina* which is more terrestrial than aquatic. The comparison of values of diversity indices between sites is presented in **Figure 3.1.88**. All values of diversity indices in the surveyed sites are very low while evenness is high in Transect 4.



	T3	T4	T5	T6
No. of Species	1	2	1	1
Abundance	2	59	19	4
Species Diversity (H')	0	0.693	0	0
Species Richness (D')	0	0.2452	0	0
Evenness (J')	0	0.9998	0	0

Note: H' – Shannon index; D = Simpson's index; J – Evenness index
Diversity Index: vh – very high (3.50 above), h – high (3.00 – 3.49), m – moderate (2.50 – 2.99), l – low (2.00 – 2.49), vl – very low (1.99 – below); Evenness Index: vh – very high (0.75 – 1.00), h – high (0.50 – 0.74), m – moderate (0.25 – 0.49), l – low (0.15 – 0.24), vl – very low (0.05 – 0.14).

Figure 3.1.88 Diversity Indices of Species of Herpetofauna during Wet Season

Table 3.1.46 Comparison of Number of Herpetofaunal Species during Dry and Wet Season Surveys

Sites	No. of Species Per Monitoring Period	
	Dry	Wet
Overall	3	3
Solis	3	-
FTI	-	-
Cabuyao	-	1
Tadlac	2	2
Timugan	1	1
San Antonio-IRRI	-	1

837. Five species of herps were documented in both wet and dry seasons. Only *Rhinella marina* is common to both. There was only one species of reptile documented, *Hemidactylus frenatus* which was recorded during the dry season but not during the wet. The forest frog, *Platymantis dorsalis* was only recorded during the wet season (**Table 3.1.47**).

Table 3.1.47 Comparison of Herpetofaunal Species Present during Dry and Wet Season Surveys

Species	Monitoring Seasons 2018	
	Wet	Dry
Kaloula pulchra	X	
Occidozyga laevis		X
Platymantis dorsalis	X	

Species	Monitoring Seasons 2018	
	Wet	Dry
Rhinella marina	X	X
Hemidactylus frenatus		X

3.1.1.2. Impact Identification, Prediction and Assessment and Mitigation

(1) Pre-construction and Construction Phase

1) Vegetation Removal and Loss of Habitat

838. The Project will not pass through any protected area, reserved forest area, or natural forest area. The project alignment will traverse a highly built-up area, disturbed, and maintained areas and it is within the vicinity of heavy industrial facilities, residential areas, commercial establishments and infrastructures. The most notable ecological area is the MMFR which is approximately 4 km from Calamba Station of the Project.

839. While the Project will utilize the existing PNR ROW for its alignment from Paco Station to Calamba and along built-up areas from Solis station to Sta. Mesa station, removal of vegetation cover along the route is minimal. However, the removal of vegetation cover in a 22-ha depot will be significant for this is an agricultural area.

840. Although clearing of vegetation will be required along the railway, and for establishment of infrastructure such as borrow pits, laydown areas/construction yard, water bores, and access tracks, majority of plants recorded at the Project site are weeds species common to disturbed and degraded areas.

841. Few numbers of both endemic tree species were encountered in the transect plots. There are no threatened species recorded in all transect plots. Dominant families include Cannabaceae, Fabaceae, Verbenaceae, Anacardiaceae, Lamiaceae, Asteraceae and Moraceae.

842. Vegetation clearing and other site preparation activities will also destroy grasslands/marshland and some tree patches which serve as shelter and food for existing wildlife species. This will lead to loss of habitats particularly for birds, especially those which are migratory. The effects during pre-construction will increase or magnify during the construction period. This may result in the disappearance of some species which will not be able to withstand the perturbations brought about by the entry of equipment added by people trampling over the habitats of wildlife. Other disturbances which will affect species are dust and noise pollution which may drive fauna away from their habitats.

843. Earthworks, disturbance to vegetation, vehicle movement and other factors have the potential to introduce additional weeds to the area and to spread existing population of introduced flora along the length of the proposed rail alignment.

844. A complete census/inventory of flora along the alignment will be conducted after the completion of parcellary survey under the Detailed Engineering Design to determine the total counts of trees and other arborescent taxa that will be potentially affected during pre-construction and construction activities. The list of affected trees will be submitted to EMB and DENR for application of tree cutting permit.

845. Vegetation clearing will be kept to the minimum necessary for safe construction and operation of the railway, particularly in areas adjacent to vegetation of higher conservation significance. The design of the rail alignment will be refined, taking into account the locations of significant vegetation types and populations of significant flora, with the objective of avoiding these through final design.

846. Prior to clearing activities, a tree cutting permit will be acquired from the DENR. A detailed plan for the management of affected flora will be prepared by DOTr. Proper assessment of the mature trees will be conducted to determine appropriate method of removal, if it will be transferred/earth balled or cut. Earth Balling of trees (if there are any) will be coordinated with the DENR and LGUs including the site where the earth balled trees will be transplanted.

847. Mature trees will be transferred carefully to designated receiving areas. A detailed plan for transfer/earth balling of mature trees will be prepared prior to removal. The detailed plan shall include proper handling of the uprooted tree and preparation of the recipient site to ensure high survival rate of the trees. A system to periodically monitor and maintain survival of these species shall be set in place to assure high survival rate. DOTr will coordinate with the DENR and LGUs for the identification of relocation area for the potential trees that will be relocated.

848. Tree planting activities will also be conducted to replace trees and vegetation that will be removed and affected by site clearing. Native/endemic/indigenous species of trees, shrubs, and grasses should be cultivated/grown in nurseries. These will be used to restore habitats of wildlife at the buffer zone which will be established at the side of the railway. Buffer areas near or adjacent to the construction sites should be established where wildlife can flee or find shelter. Survival rate will also be monitored and replacement as necessary.

849. During construction, tree planting activities can be conducted where possible and regular monitoring of replanted trees will be conducted to check for survival. Any of failed trees will be replanted as necessary.

2) Threat to Existence and / Or Loss of Important Local Species

850. Vegetation clearing is inevitable during pre-construction and construction phase. This may affect the existence of the five (5) flora species that were found to be Philippine endemics or have natural habitat confined only in the country. Noteworthy among the list are critically endangered (CR) Smooth Narra (*Pterocarpus indicus*) (IUCN), and a premium tree species which is specifically used in railroad ties, Molave (*Vitex parviflora*) (DAO 2007-01). Consequently, vegetation clearing may also affect the fauna species in the area including the nine (9) bird species and one (1) mammal which are endemic.

851. To mitigate impacts to the existence of important local species, indigenous and native plant and tree species naturally growing in the Project site will be emphasized for conservation and protection planning in response to the conservation status reported in this report. Wildlings of endangered and threatened species, if any, will be collected before construction and placed in the nursery and will be given priority during nursery operation to be used for rehabilitation of areas that will be affected by the Project.

3) Threat to Abundance, Frequency and Distribution of Important Species

852. The construction of the railway will result in the clearing of vegetation in the depot site which is about 78 ha and along the existing PNR ROW which is characterized as predominantly built-up area. Moreover, there could be adverse effects on the insects, wildlife or other organisms that depend on the vegetation as a source of food for insects, wildlife, or other organisms.

853. Results of the plant diversity assessment revealed that the project area has low to moderately low biodiversity index value while evenness indices varied from very low to low.

854. Loss of habitat during land and site preparations prior to construction will result to the decrease in abundance and frequency of observed wildlife. Endemic species which may not be able to withstand disturbances (e.g. construction of structures, depots) may not thrive in the area.

855. To mitigate the impacts of the Project, wildlings of endangered and threatened species will be collected before construction and placed in the nursery and will be given priority during nursery operation to be used for rehabilitation of areas that will not be affected by the Project. Buffer areas near or adjacent to construction sites should be established where wildlife can flee or find shelter.

4) Hindrance to Wildlife Access

856. The amphibians will be mostly affected during pre-construction and construction phase. If the grassland/marshland is cleared, the area will dry up and access routes will be closed to these taxa. This may result in the disappearance of some species from the affected areas. Alternate access routes or corridors for amphibians and mammals may be set aside inside work sites to allow wildlife to traverse.

857. As for mammals, five (5) volant species consisting of four (4) fruit bats and one (1) species of insect bat and one (1) non-volant species which is an introduced species. The bats may have just been flying through from their feeding area returning to their roosts when caught in the nets. There were no trees which were suitable for roosting or feeding of bats along the project alignment.

858. The only natural habitat that could be considered significant to fauna is the open shrub to wooded land in the transect plots established in the proposed railway alignment which are being visited by local bird species in the area. Most of the areas are either intentionally cleared or occupied for residential purposes.

859. Construction Management Plan will be prepared and strictly implemented accordingly to minimize unnecessary removal of vegetation, generation of noise, vibration, illumination, and vehicular movement which can disrupt animal activities to minimize the ecological impact of construction activities in the vicinity to ecologically significant areas. After hiring, all construction workers will be provided with training and orientation on the Construction Management Plan including the potential ecological impacts of construction activities and the corresponding preventive and mitigative measures.

(2) Operation Phase

1) Vegetation Removal and Loss of Habitat

860. During the operation phase, no vegetation removal and clearing are expected. Tree planting activities will be conducted to replace trees and vegetation that were removed and affected by site clearing. Also, a regular monitoring of flora and fauna at sensitive area and survival of replanted trees will be conducted.

2) Threat to Existence and/or Loss of Important Local Species

861. During the operation phase, no vegetation removal and clearing are expected so there would be no threat to the existence and/or loss of important local flora species. As an additional consideration, implementation of vegetation management plan will be enforced including but not limited to the minimal use of herbicide and machineries.

862. Regular maintenance of ROW to control vegetation may involve the use of mechanical methods, such as mowing or pruning machinery, in addition to manual hand clearing and herbicide use, all of which can disrupt wildlife and their habitats. Noise, vibration, illumination, and vehicular movement can disrupt animal activities. Workers are provided training on ecological impact of construction activities.

3) Threat to Abundance, Frequency and Distribution of Important Species

863. As previously mentioned, no vegetation removal and clearing are expected during operation phase. For landscaping of open areas, use local or endemic species as much as possible.

4) Hindrance to Wildlife Access

864. The open and disturbed areas will be re-vegetated to allow wildlife to traverse. Additional measures include minimize noise, vibration, illumination and vehicular movement in consideration to the existing fauna at significant area/s.

Table 3.1.48 Summary of Impact Identification, Prediction, Assessment and Mitigation for Land

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
GENERAL				
Pre-construction, Construction and Operation activities	Land, Water, Air and People			• Comply with the relevant laws: - RA 6969: storage, transport, handling, treatment and disposal of hazardous waste - RA 9003: management and disposal of solid wastes - RA 8749: comprehensive air pollution control policy - RA 9275: comprehensive water quality management and for other purpose • Implementation of Emergency Response Plan and Health and Safety Management Plan to include but not limited to: - Distribution of manual/guideline for workers/employees on health and safety, environment management. - Orientation and continuous training of qualified workers/ employee/ operator on Environment Management, Basic and Construction Occupational Safety and Health, Scaffolding Safety, Fire Safety and Safe Use of Chemicals at Work. - Provision of earthquake, fire drills for workers - Provision of appropriate PPE for workers - Provision of security personnel. • Regular monitoring of site condition
PRE-CONSTRUCTION AND CONSTRUCTION				
Land acquisition for the Project ROW	Land use and Classification	Incompatibility with the Existing Land Use	C-	**[Pre-Construction]** • Maximise the use of existing PNR ROW from Blumentritt to Calamba. • Information sharing to the affected LGU to align and ensure that proposed Project will be accommodated in their future land use plan. • Identification of future land use of the surrounding areas that will result to a significant increase of transportation-oriented developments in cooperation with urban planners of LGUs to adopt in the future developments.
Construction of the proposed Project at the following: ● Areas with the existing old PNR structures ● Areas with high risk to typhoon	ECA	Incompatibility with Classification as an ECA	B-	**[Pre-Construction]** • Plan and design the site, structure foundation, and structure including construction activities in consideration to the ECAs. • Coordinate with relevant government agencies and stakeholders as required.

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
passage, high susceptibility to flooding ● Prime agricultural areas in the SCRP Depot				
Land acquisition for the Project ROW	Land Tenure	Involuntary resettlement of informal settlers who had encroached portion of the existing PNR ROW; settlements outside the existing PNR ROW between Solis to Sta. Mesa; agricultural area at Depot; and other government project sites	B-	**[Pre-Construction]** ● Implement Resettlement Action Plan in coordination with KSAs/ NHA, LGUs, lot owners and other concerned stakeholders and agencies to address the issue on land acquisition and relocation of informal settlers.
		Potential conflict with other government infrastructure projects	B-	**[Pre-Construction]** ● Coordinate with DPWH (depot site), and other relevant agencies.
Construction activities	Visual Aesthetic and Land Use	Visual impacts	B-	**[Pre-Construction/ Construction]** ● Design and install facilities to harmonise with the surrounding environments (shape, colour, size, etc.). ● Identify planting area within the ROW that will not be covered by development to act as buffer zone, green corridor and to lessen aesthetic sore brought by construction and railway structures, and plant trees. ● Adequately record the condition of roads, agricultural land and other infrastructure prior to starting to transport materials and construction. **[Construction]** ● Maintain the construction site/ yards tidy and clean and rehabilitate after construction. Reinstatement of land after completion of Project. ● Provision for temporary screens/ walls to minimise the visual impacts. ● Fully reinstate pathways, other local infrastructure, and agricultural land to at least their pre-project condition upon the completion of construction.
Generation and improper handling and disposal of domestic and	Land Value	Lowering of land values as a result of improper solid waste management	B-	**[Pre-Construction]** ● Prepare a Waste Management Plan (WMP) **[Construction]**

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
hazardous solid waste.				● Implement WMP including strict implementation of solid waste management plan and proper disposal by contractor in accordance with RA 9003, hazardous waste disposal in accordance with RA 6969. ● Include waste management in communities in Social Development Plan (SDP).
Generation and improper handling and disposal of excavated soil, leftover concrete by excavation activities (Excavated Soil)	Land Value	Lowering of land values as a result of improper handling of excavated soil Generation of surplus soil	B-	**[Pre-Construction/Construction]** ● Plan and implement the spoils management and disposal plan. ● Preparation of traffic plan to manage the ingress and egress of soil/rock hauling machines. ● Plan and implement recycling and reuse of excavated soil to be utilised for the project/ other project as much as possible. In case of excessive soil to be generated, identify the final spoil disposal site. **[Construction]** ● Regular hauling of excavated materials and storage in pads with appropriate soil protection facilities or management systems. ● Disposal of excavated materials in appropriate and licensed dump sites or spoils area and with adequate containment. ● A Construction Waste Management Plan/Muck Disposal Plan will be prepared for the project in order to appropriately handle and dispose excavated materials (including muck generated from tunneling work) and demolition debris) ● Comply with environmental permitting requirements for solid waste/soil management plan, which includes minimization of waste/soil generation, segregation, and proper disposal (including the temporary storage) by Contractors in accordance with RA 9003. ● Require vehicles transporting excavated soils to follow traffic rules strictly and limit speed not to exceed 30 kph and the load shall not exceed 25 tonnes if passing communities or commercial or sensitive areas (e.g. health premises, schools, educational institutions or religious institutions such as temples, mosques and churches).
Construction of embankment/slope protection	Topography	Permanent and major modification of the terrain and alteration of landform may cause ground failure	C-	**[Pre-Construction /Construction]** ● Formulate and implement appropriate design measures for the protection of slopes and banks, soil improvement / ground reinforcement to minimise ground failure during construction based on the results of the geological survey and geotechnical investigations. ● Minimize ground disturbance through avoidance of unnecessary excavations.

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
				● Ensure that roads repaired after surface works would follow the same slope conditions prior to construction.
Earthworks, (excavation, backfilling, stockpiling, tunneling/ underground, elevated tracks/platforms) and natural hazards	Geology/ Geomorphology	Ground Subsidence Liquefaction Landslide, Mud/ Debris Flow, etc. Foundation of piers of elevated structures may cause unequal settlement of road surfaces. Alteration of underground stress distribution Tunnel deformation/failure (for underground section) Ground movement	B-	**[Pre-Construction/Construction]** ● Design and implement appropriate foundation and structures based on combination of geotechnical, geodetic and hydrologic study, and seismicity studies, and in compliance with the National Building Code and the Structural Code of the Philippines and internationally accepted guideline. ● Design and install emergency escape route, early warning (alarm) system, emergency power supplies in the design of the structure particularly in the viaduct. ● Perform tunnel deformation analysis to determine how the hollowing of ground will affect underground stress regimes. ● Install piezometers to monitor groundwater pressure around tunnel. ● Plan and implement appropriate construction method, schedule, and activities based on combination of geotechnical and geological investigations, and seismicity studies in coordination with the PHIVOLCS. ● Design and construct facilities according to geo-mechanical properties of the rock/soil. ● Properly line tunnel wall with water-proof material. ● Conduct regular levelling surveys, deformational studies, visual monitoring and level survey to detect sinking of ground. **[Construction]** ● Install sufficient protection measure such as soil improvements during excavation activities and implement appropriate materials handling program or a site protection and rehabilitation program. ● Proper inspection of all installed and constructed/ ongoing construction structures and facilities. ● Coordinate with the PHIVOLCS during earthquake and volcanic events to adjust construction schedule. ● Conduct earthquake drills for workers. ● Use earth pressure balance (EPB) technique with the Tunnel Boring Machine (TBM) to prevent collapse of soil. ● Construct diaphragm wall using polymer and bentonite. ● Avoid simultaneous excavation in areas near waterways. ● Monitor land subsidence. ● Compact soil in excavation area.

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
				● The Contractors will be required to implement construction methods through underpinning of the existing structures to control vertical and horizontal settlement of road, bridges and other existing buildings. ● Install seismometers/accelographs. ● Real-time and continuous measurement of ground movement.
Clearing and removal of vegetation, stripping of soil cover, excavation of underlying rock, grading or construction of embankments and works in the SCRP Depot.	Pedology	Soil erosion/loss of top soil	B-	**[Pre-Construction/ Construction]** ● Design and install slope protection/soil erosion control to prevent or minimize slope failure during construction based on the results of the geo-hazard assessment and geotechnical investigations. **[Construction]** ● Minimize the removal of vegetation cover as much as possible, provision of slope stabilization measure/s, when necessary. ● Install surface water runoff drainage systems, protection of slope and bank as required. ● Provide drainage system with sedimentation pond and temporary ditches to collect runoff and settle sediments before discharge to the public drainage system. ● Clean and de-clog drainage canals surrounding the work sites and the SCRP Depot regularly. ● Implement appropriate materials handling program or a site protection and rehabilitation program including but not limited to the following: - Schedule clearing and excavation activities in a speedy manner during dry season, if possible. - Installation of temporary erosion ponds or silt traps around the major work areas. - Placement of excavated materials on appropriate staging site or spoils area and with adequate containment. Limit stock pile height up to 2 m high only. Cover stockpile of excavated soil. In addition, install silt traps, deviation channels, mounting, barriers or trenches around the stockpiles. - Installation of fence at the stockpiles of sand and gravel to reduce sediment transport during heavy rains including reduction of storage time in the work areas. - For bored pile construction, use of bentonite or polymer slurry to stabilize uncased borings in loose soils is highly recommended. ● Utilize heavy equipment for transporting, hauling and excavating material from one area to another so as to avoid spills into drainage system.

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
				● The contractor shall place construction materials in suitable areas, away from surface waters, canals and drains. ● Schedule excavation works, levelling of area, removal of public utilities, e.g. water pipes, drain pipes, electric poles, etc. during the dry season to avoid soil erosion problems. ● The Contractors will designate sufficient number of workers to be in-charge of cleaning the site and clearing the construction materials scraps such as soil, rock, sand, and lime that are scattered onto the construction areas and road surfaces every day or within 24 hours to avoid the obstruction of natural flow, especially during the wet season. ● For the underground structures, double steel sheet piles will be driven in the construction area near soil surface water sources to prevent soil erosion or soft soil displacement. ● Polymer solutions mixed with bentonite shall be used in holes to prevent soil erosion and to stabilize the soil, reduce seepage into sand layers and help in soil cohesion.
Accidental spills of fuels /lubricants from construction vehicles & machineries/ hazardous chemicals. Generation and improper handling/ disposal of construction/ domestic/ hazardous wastes.	Pedology	Degradation of soil quality because of soil contamination	B-	**[Construction]** ● Proper inspection and maintenance of machines and equipment. ● Strict implementation of solid waste management plan and proper disposal by contractor in accordance with RA 9003, hazardous waste disposal in accordance with RA 6969. ● Use of strong and durable materials for pipes to prevent leakage. ● Use of non-reactive materials for pipes and other buried components to ensure that soil contamination is prevented. ● Conduct soil quality monitoring in case of any possible contamination events occur.
Drilling and excavation at previously contaminated sites (e.g. Sucat Thermal Power Plant).	Pedology	Exposure to contaminated soil	C	**[Pre-Construction]** ● Identify a potentially contaminated site and conduct soil sampling survey, if necessary. ● Conduct Environmental Site Assessment if there is suspected contamination on the proposed location of facilities. In case that toxic substances are found within the project area and/or adjacent sites, prepare contaminated soil management plan and implement necessary remediation measures.

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
				● Storage, handling, transport, treatment and disposal of contaminated soil will be in accordance with RA 6969. **[Construction]** ● Conduct continuous monitoring of toxic level to ensure that contaminants will not pose hazards. In case traces are detected, construction activities on affected site will be paused until a soil management plan is developed and implemented in consultation to the DENR – EMB.
Removal of vegetation along the proposed Project particularly the trees at some areas along the ROW and at the SCRP Depot Generation of dust during construction	Terrestrial Ecology (Flora)	Loss of Habitat Threat to Existence and/or Loss of Important Local Species Threat to Abundance, Frequency and Distribution of Important Species Hindrance to Wildlife Access Accumulation of dust on leaf laminae	B-	**[Pre-Construction]** ● Design, plan and implement the project that will minimise vegetation clearing, alteration of landform, generation of noise, vibration, illumination, and vehicular movement particularly in areas adjacent to flora of higher conservation significance (i.e. Antipolo, Is-is, Narra) and in the vicinity of ecological significant areas. ● Conduct 100% inventory of the affected trees along the alignment to determine the total counts, category, and characteristics of affected trees and minimise removal particularly in areas adjacent to vegetation of higher conservation significance as much as possible. Native/ Endemic/ Indigenous species of trees, shrubs and grasses will be specified. ● Wildlings of endangered and threatened species, if any, will be collected before construction, placed in the nursery, and give priority during nursery operation to be used for rehabilitation of areas that will be affected by project. ● For tree replanting, areas not part of the development within the ROW, around the stations and depot will be prioritized for replanting activity to create buffer zone and to improve habitat for wildlife. For those that cannot be replanted within the project area, coordination with the DENR and LGUs on the identification of area for the potential trees that will be relocated. ● Earth balling of trees (if there are any) will be coordinated with the DENR and LGUs including the site where the earth balled trees will be transplanted. ● Secure tree cutting permit in compliance with DENR Memorandum Order No. 2012-02. **[Construction]** ● Prior to any clearing activity, clearly mark the ROW to avoid the unnecessary clearance of tree cutting.

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
				● Conduct tree planting activities to compensate site clearing activities. Conduct regular monitoring on survival of replanted trees and replant if necessary. ● Regular water sprinkling (especially during the dry season) along dusty areas.
Earthworks and vehicle movement. Generation of dust and noise, vibration, and illumination pollution.	Terrestrial Ecology (Fauna)	Loss of Habitat Threat to Existence and/or Loss of Important Local Species Threat to Abundance, Frequency and Distribution of Important Species Hindrance to Wildlife Access	B-	**[Pre-Construction/ Construction]** ● Minimise vegetation clearing, alteration of landform, generation of noise, vibration, illumination, and vehicular movement particularly in areas adjacent to flora of higher conservation significance (i.e. Antipolo, Is-is, Narra) and in the vicinity of ecological significant areas. ● Prepare and implement a tree and vegetation management plan as part of the construction plan considering the significance to fauna (local bird species) such as installing buffer zone, minimising the use of herbicide and machinery as much as possible. ● Coordinate with EMB-DENR and the Society for the Conservation of Philippine Wetlands (SCPW) for the conservation of migratory birds if required.
OPERATION				
Operation and maintenance of the Project	ECA	Incompatibility with the area that will be affected by natural calamities.	B-	● Coordinate with PAGASA/PHIVOLCS and adjustment of train schedules ● Implement proper inspection and prompt maintenance of drainage systems.
Presence of the proposed project structures (railway, passenger facilities, SCRP Depot, etc.)	Visual aesthetics	Impairment of visual aesthetic	C-	● Planting of trees to minimize the visual impact by the Project and harmonize with the surrounding environments in open areas within the ROW, SCRP Depot and around the stations, to create a green corridor.
Generation of domestic and hazardous wastes including accidental oil and lubricant spills from passenger facilities (station), SCRP Depot	Land value	Degradation of land value and soil quality due to improper handling of domestic and hazardous wastes	C-	● Conduct proper inspection and prompt maintenance of machines and equipment, and facilities. ● Strictly implement solid waste management plan in accordance to RA 9003, and treatment of hazardous chemicals and contaminated soil in accordance with RA 6969. ● Conduct of soil quality monitoring when necessary.

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
Generation of solid waste from office and service areas	Solid waste management	Degradation of the area of the facilities and surrounding communities	B-	● Provide solid waste segregation bins at each office area and at train stations. ● Coordinate with the concerned LGUs in the collection and disposal of segregated solid wastes. ● Maintain daily record of solid wastes generated and collected.
Generation of hazardous waste from maintenance area at SCRP Depot and related facilities	Toxic and hazardous waste management	Degradation of the area of the facilities and surrounding communities	B-	● Provide hazardous waste bins at the stabling yard. ● Record quantities of hazardous wastes generated. ● Commission the services of a Government-recognized hazardous waste transporter and treater.
Occurrence of landslides, volcanic hazards, ground shaking, and liquefaction Likely seismic events around the alignment	Subsidence, liquefaction, landslide, mud/debris flow, etc.	Damage to tracks Risk to the life of passengers and workers Damage to passenger facilities Failure of tunnel structure (for the subway)	B-	● Conduct inspection and levelling surveys in the event of natural hazard occurrence to assess damage of structures. ● Regular coordination with PHIVOLCS for earthquake and volcanic events to adjust the train schedule as necessary. ● Conduct earthquake drills for train users are also advised. ● Update tunnel deformation model to determine changes in underground stress regimes. ● Conduct proper inspection and prompt maintenance checks to every single installed structure and facility and enhance capacity when possible. ● Real-time and continuous measurement of ground movement. ● Upgrades or install new technological advances when available are also encourage for the continued operation of Project.
Operation of the proposed project and passenger facility, SCRP Depot, service vehicle Passenger movement	Terrestrial ecology	Threat to existence and/or loss of important local species Hindrance to wildlife access	C-	● Minimize noise, vibration, illumination, and vehicular movement in significant fauna area. ● Continuous planting of replacement trees, if needed. ● Conduct monitoring of survival of replanted trees and replant, if necessary. ● Implement vegetation management plan considering fauna species (local bird species) to minimize the use of herbicide and machinery as much as possible.

Note;
A+/-: Significant positive/negative impact is expected.
B+/-: Moderate positive/negative impact is expected to some extent.
C+/-: Minor positive/negative impact is expected to some extent
D: Extent of impact is unknown

3.2. WATER

3.2.1. Hydrology/Hydrogeology

3.2.1.1. Drainage Morphology

(1) **Natural Drainage System**

865. The hydrologic feature which affects the Project alignment is the Laguna de Bay. It is a freshwater lake with a surface area ranging from 911 to 949 km^2 and a watershed area of 3,820 km^2. It is fed by 21 major rivers draining the western and southern slopes of Sierra Madre Range and the eastern and northern slopes of the Taal-Makiling- Banahaw Volcanic Chain, as can be gleaned in **Figure 3.2-1**.

866. Major rivers from Sierra Madre which feed Laguna de Bay include Pagsanjan River, Santa Cruz River, Pangil River, Marikina River, Tanay River, Morong River and Siniloan River.

867. Major rivers from the Taal-Makiling-Banahaw Volcanic chain include Tunasan River, San Pedro River, Cabuyao River, San Cristobal River and Calamba River. The main channels of these rivers and their tributaries are intersected by the Project alignment from Bicutan to Bay, Laguna in 50 locations. These river – railway intersections are found within the Laguna Lakeshore area which is usually affected by the rise in lake water levels during the rainy season and/or major storm events.

868. The Laguna Lake's only outlet is the Napindan Channel which is connected to Manila Bay via the Pasig River.

869. The exit of Pasig River into Manila Bay resulted in the formation of a triangular sedimentary flood deposit known as the Manila Delta. The Project segments starting from Solis Station to Buendia Station traverse this delta and crossed the meandering Pasig River at three (3) locations near Paco Station and Sta. Mesa Station. The combination of these conditions makes these segments of the Project vulnerable to flooding during major rain events and high tides.

870. Overall, the Project alignment is intersected by rivers and streams at 35 locations as set out in **Table 3.2-2**. The Project alignment from Mamatid Station to Gulod Station runs parallel to a major irrigation canal.

871. **Figure 3.2-1** shows the plot of the 35 river or drainage crossings. The larger scale topographic maps showing the position of the river or stream crossings and the trace of the particular drainage system which will be intersected are found in **Annex 3-3**.

872. The hydrological and hydrogeological water resource assessment for the Senate-FTI underground section was undertaken through the collection and review of available secondary data and collection of primary data through field surveys. A walkthrough survey of the creeks in the vicinity of the proposed underground segment was also conducted, along with key informant interviews of representatives from various local government units to determine the current water use in the proposed expansion site.

873. During the walkthrough survey, it was noted that rivers within or in the vicinity of the underground section (i.e. Maricaban Creek and Don Galo Creek) consist of bedrock strata overlain with boulders and can be considered as artificially confined waterways. River bank easements along some sections of both creeks have been encroached by various types of structures.

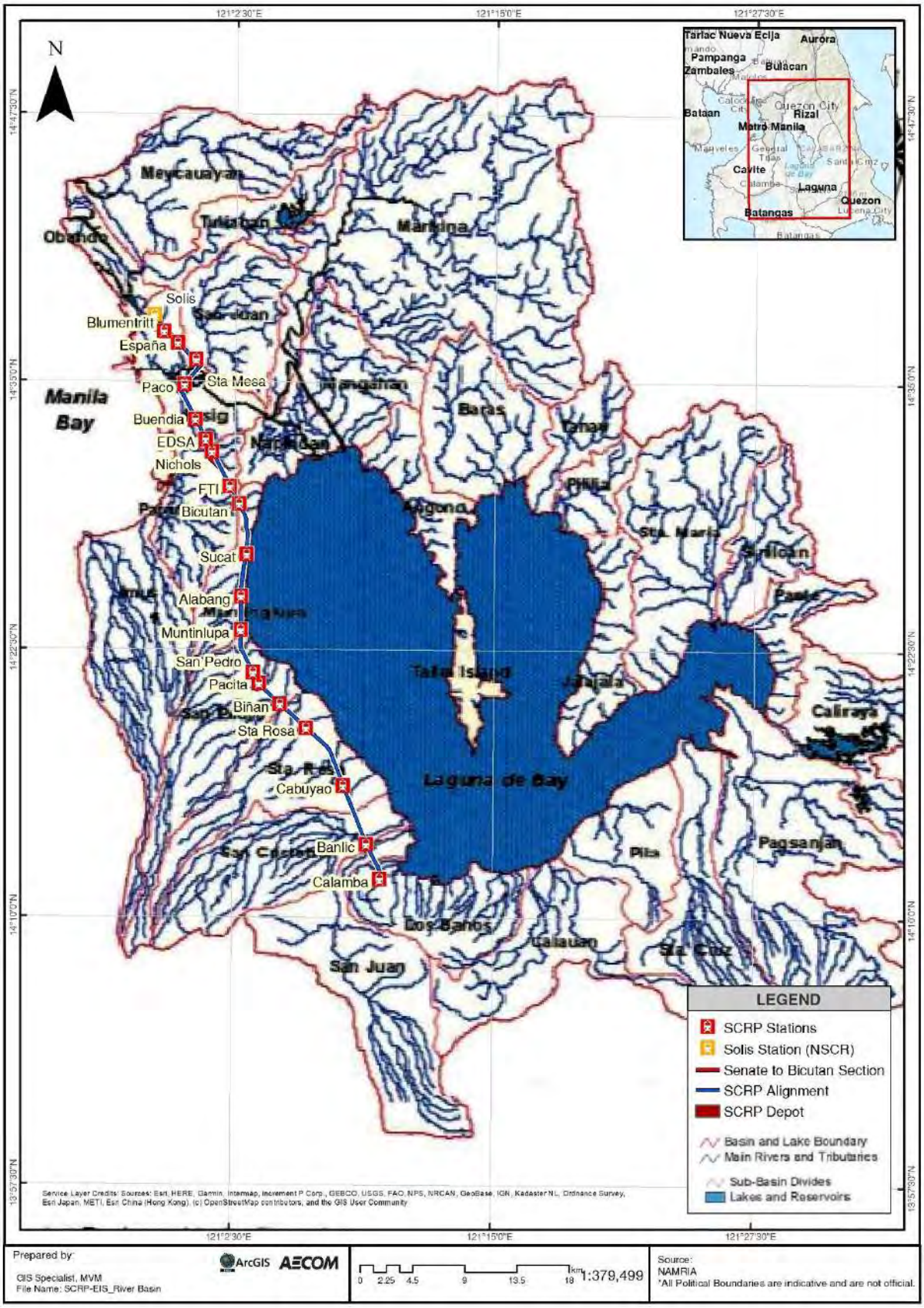


Figure 3.2-1 Pasig-Marikina-Laguna de Bay Rivers and Sub-basins

Table 3.2.1 Project Alignment and Corresponding River/Stream Crossings

Segment	No. of Crossings	Designation	River/Stream Name	Classification	Year Classified	Latitude	Longitude
Solis to Blumentritt	None	Not Applicable	Not Applicable	Unclassified	-	Not Applicable	Not Applicable
Blumentritt to España	None	Not Applicable	Not Applicable	Unclassified	-	Not Applicable	Not Applicable
España to Sta. Mesa	None	Not Applicable	Not Applicable	Unclassified	-	Not Applicable	Not Applicable
Sta. Mesa to Paco	3	CR1	Pasig River	C	N.I	14° 35' 42.1764"	121° 0' 47.232"
		CR2	Pasig River	C	N.I	14° 35' 21.9516"	121° 0' 31.4964"
		CR3	Pasig River	C	N.I	14° 35' 10.1256"	121° 0' 20.4948"
Paco to Buendia	None	Not Applicable	Not Applicable	Unclassified	-	Not Applicable	Not Applicable
Buendia to Pasay Road	1	CR4	No Name	Unclassified	-	14° 33' 12.3264"	121° 0' 34.5168"
Pasay Road to Edsa	None	Not Applicable	Not Applicable	Unclassified	-	Not Applicable	Not Applicable
Edsa to Nichols	2	CR5	No Name	Unclassified	-	14° 31' 56.2476"	121° 1' 17.7132"
		CR6	No Name	Unclassified	-	14° 31' 46.0128"	121° 1' 23.2248"
Nichols to FTI	None	Not Applicable	Not Applicable	Unclassified	-	Not Applicable	Not Applicable
FTI to Bicutan	None	Not Applicable	Not Applicable	Unclassified	-	Not Applicable	Not Applicable
Bicutan to Sucat	1	CR7	No Name	Unclassified	-	14° 28' 6.7692"	121° 3' 5.3172"
Sucat to Alabang	2	CR8	No Name	Unclassified	-	14° 26' 51.1692"	121° 3' 1.3644"
		CR9	Mangangate River	Unclassified	-	14° 25' 30.7128"	121° 2' 52.1052"
Alabang to Muntinlupa	2	CR10	Bagonan River	Unclassified	-	14° 24' 47.6928"	121° 2' 51.4536"
		CR11	No Name	Unclassified	-	14° 23' 35.7144"	121° 2' 51.7452"
Muntinlupa to San Pedro	3	CR12	Magdaong River	Unclassified	-	14° 23' 17.3616"	121° 2' 51.0432"
		CR13	No Name	Unclassified	-	14° 22' 16.7232"	121° 3' 0.3672"
		CR14	San Pedro River	C	N.I	14° 21' 55.8504"	121° 3' 12.2796"
San Pedro to Pacita	None	Not Applicable	Not Applicable	Unclassified	-	Not Applicable	Not Applicable
Pacita to Biñan	2	CR15	No Name	Unclassified	-	14° 20' 45.5784"	121° 3' 52.758"
		CR16	No Name	Unclassified	-	14° 20' 35.3472"	121° 4' 3.9684"
Biñan to Sta. Rosa	6	CR17	Biñan River	Unclassified	-	14° 19' 53.7888"	121° 4' 51.2364"
		CR18	No Name	Unclassified	-	14° 19' 36.1128"	121° 5' 11.0112"
		CR19	No Name	Unclassified	-	14° 19' 17.0904"	121° 5' 33.2196"
		CR20	No Name	Unclassified	-	14° 19' 4.7892"	121° 5' 46.752"

Segment	No. of Crossings	Designation	River/Stream Name	Classification	Year Classified	Latitude	Longitude
		CR21	Sta. Rosa River	B	1978	14° 18' 43.2864"	121° 6' 11.6064"
		CR22	No Name	Unclassified	-	14° 18' 22.4064"	121° 6' 33.5952"
Sta. Rosa to Cabuyao	4	CR23	No Name	Unclassified	-	14° 18' 7.7256"	121° 6' 50.6232"
		CR24	No Name	Unclassified	-	14° 17' 52.3248"	121° 7' 7.9644"
		CR25	No Name	Unclassified	-	14° 17' 22.9776"	121° 7' 20.4816"
		CR26	Cabuyao River	Unclassified	-	14° 17' 9.6504"	121° 7' 25.1004"
Cabuyao to Gulod	3	CR27	No Name	Unclassified	-	14° 16' 29.352"	121° 7' 42.2436"
		CR28	No Name	Unclassified	-	14° 16' 21.7056"	121° 7' 45.93"
		CR29	No Name	Unclassified	-	14° 16' 2.2836"	121° 7' 53.4972"
Gulod to Mamatid	4	CR30	No Name	Unclassified	-	14° 15' 13.5144"	121° 8' 13.2612"
		CR31	No Name	Unclassified	-	14° 14' 59.7732"	121° 8' 18.726"
		CR32	No Name	Unclassified	-	14° 14' 47.4756"	121° 8' 24.0936"
		CR33	No Name	Unclassified	-	14° 13' 59.2248"	121° 8' 43.5408"
Mamatid to Calamba	2	CR34	San Cristobal River	C	1978	14° 13' 18.5124"	121° 9' 0.3636"
		CR35	San Juan River	A/C	1978	14° 12' 38.8332"	121° 9' 21.0132"

Source: Water Bodies in the Philippines: Classification according to beneficial use, 2019, DENR EMB (Water Quality Management Section)

3.2.1.2. Local Drainage System

1) **Manila City**

874. Manila and suburbs are divided into two (2) areas by the Pasig River; namely, North Manila and its suburbs and South Manila and its suburbs. With a total length of about 25 km, the river provides the main drainage that links the Manila Bay with Laguna Lake.

875. The drainage and flood control system in the city is made up of the drainage main and laterals. The drainage is made of concrete pipes and culverts. The average size of concrete pipes for the drainage main is 30 inches in diameter and the culverts are from a minimum size of 1 m x 1 m to a maximum size of 1.60 m x 1 m. The laterals, on the other hand, are made of concrete pipes with an average diameter of 18 inches.

876. There are thirteen (13) existing pumping stations with flood gates, two (2) independent flood gates and thirteen (13) major esteros as listed in **Table 3.2-2**.

877. **Table 3.2-3** shows the inventory of flood control structures and related facilities.

Table 3.2-2 Pumping Stations and Independent Floodgates, 1997

Name of Pumping Station Independent Flood Gate	Total Pump Capacity (cms)	Fuel Storage Capacity (L)	Gate Width	Drainage Area (ha.)	Locations (Mouth of Esteros/Mains)
Aviles PS	14.1	55,000		365	Esteros de Sampaloc
Quiapo PS	9.5	52,700		225	Elizondo St., Quaipo
Valencia PS	10.5	50,400		246	Estero de Valencia, Sta. Mesa
Binondo PS	11.6	40,900		279	Estero de Bonondo
Paco PS	7.59	29,900		182	Estero de Paco
Pandacan PS	4.4	24,600		180	Estero de Pandacan
Sta. Clara PS	5.3	25,600		133	Estero de Sta.Clara, Sta. Ana
Tripa de Galina PS	56	95,000		1,769	Estero dele Tripa de Galina
Balete PS	2.5			52	Romualdes St., Ermita
Escolta PS	1.5	9,500		Included with Binondo PS	Estero dela Reina, Sta. Cruz
Vitas PS	32			578	Estero de Vitas, Tondo
Balut PS	2			49	Rodriguez St., Tondo
San Andres PS	19			365	Inviernes St., Sta. Ana
Padacan IF			4	37	Beata S., Pandacan
Sante Banez IZ			0	30	Cristobal St., Paco

Source: MCLUPZO (2005-2020), Manila City

Table 3.2-3 Inventory of Flood Control Structures and Related Facilities

Area	Drainage Pipe (lm)	Box Culvert	Lined/Open Earth Canal	Manhole	Inlet	Catch Basin
North Manila	115,594.70	9,428.40	4,369	6,938	1,634	2,614,1,026
South Manila	73,666.21		25,696	3,042	2,867	
Total	**189,260.91**	**9,428.40**	**30,065**	**9,980**	**4,501**	**3,640**

Area	Mains		Outfall		Interceptor	
	Number	Length (lm)	Number	Length (lm)	Number	Length (lm)
North Manila	15	12,874.80	1	866	1	2,943
South Manila	7	6,440.10				
Total	**22**	**19,314.90**	**1**	**866**	**1**	**2,943**

Source: MCLUPZO (2005-2020), Manila City

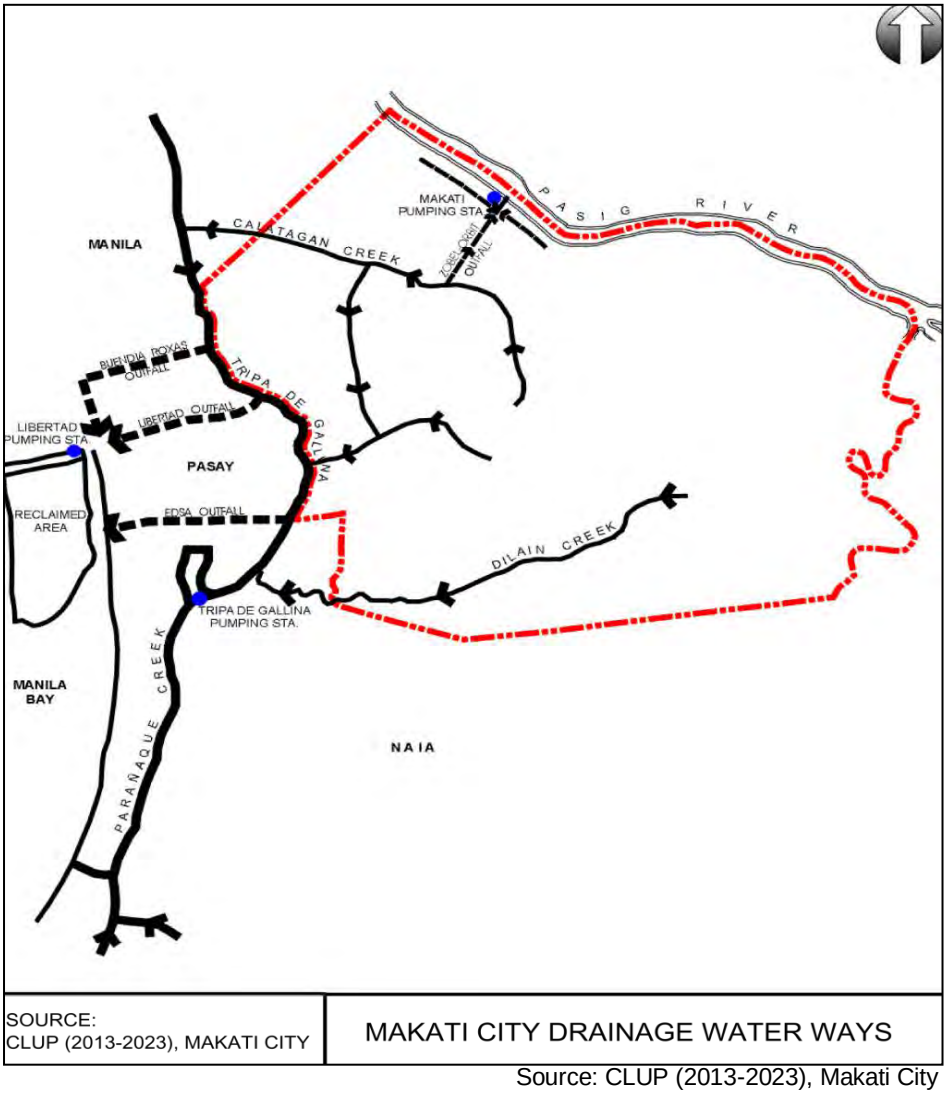
2) **Makati City**

878. There are seven low-lying barangays in Western Makati that are flood-prone: Singkamas, Tejeros, La Paz, San Antonio, Palanan, San Isidro, and Pio del Pilar. Insufficient drainage infrastructure connections and indiscriminate dumping of garbage on waterways cause flooding in these areas.

879. The city has four (4) types of drainage systems. These include open canal, covered open canal made of concrete, concrete hollow block walling, reinforced concrete covered pipe, and box culvert. Domestic and industrial wastes are discharged into storm drains and ultimately into the nine (9) rivers and creeks that extend from Del Pan Street to San Jose, Guadalupe as shown in **Figure 3.2-2**.

880. Among the flood-prevention measures being taken in Makati is the operation of the Makati Pumping Station. This station serves the barangays Poblacion, Valenzuela, and Bel-Air. It operates by collecting storm water and sewage through three (3) main

channels: (a) the Makati Headrace I which serves barangay Olympia from the north, (b) the Makati Headrace II from the south serving barangay Poblacion in the southeast, and (c) the Zobel-Orbit main which serves Bel-Air in the southwest. The Zobel-Orbit main also diverts floodwater and sewage from Santa Clara Creek to the retaining pond, from which these are pumped into Pasig River.



Source: CLUP (2013-2023), Makati City

Figure 3.2-2 Makati City Drainage Water Ways Map

3) Taguig

881. As of 2016, Taguig pumping station, located along C-6 at Taguig-Pateros drainage channel, has eight (8) units of submersible axial flow pumps that siphon 24 cubic meters of water per second (m^3/sec). It covers about 1,423 ha drainage area and serves approximately 8,700 m of estero.

882. Labasan drainage area is also located in Taguig. The drainage area served by the pumping station is 594 ha. The total installed pumping capacity is 9 m^3/sec. The pumped water is drained into Laguna de Bay. The current pumping capacity is not sufficient to prevent flooding during a two-day design rainstorm with a return time of 10 years, when about 25% of the drainage area gets flooded. It is proposed during PY1 to increase the pumping capacity to 32 m^3/sec.

4) **Parañaque City**

883. According to 2012 CLUP of Parañaque, several areas are considered flood-prone due to clogged drainage. These are: a portion of F.B. Harrison cor. Aguarra St. and Redemptorist Road Quirino Ave. in Baclaran and Monte Carlo (Fatima St.) in San Antonio. It was noted that these areas are not considered as impact areas in the Project.

5) **Muntinlupa City**

884. According to the 2016 Ecological Profile of the City of Muntinlupa, rivers and other tributaries collectively drain water into Laguna De Bay. Most of these river ways mark the natural boundary of the separation of each barangay. Like any continually developing areas, some river ways have already been covered by developments, which in turn is the reason why there is evident flooding on some parts of the city. This is aside from the fact that most of these river ways are already polluted and clogged. The drainage system of the city includes the ditch/culvert along the national road from Tunasan to Sucat and Arandia St. and Rodriguez St. in Tunasan.

6) **San Pedro City**

885. The primary drainage system is the San Pedro River. The direction of flow is from higher elevation areas in the west to lower elevation areas in the east towards Laguna de Bay.

886. The River System is not enough to effectively drain the large urban area of the city. Flooding occurs due to inadequate drainage facilities. Inundation is a common occurrence in the lower elevation areas most notably in the easternmost part of San Pedro near Laguna de Bay. These are barangays Cuyab, San Roque, and Landayan. The low-lying characteristic of this area makes it vulnerable to inundation due to the rise of water levels. Other factors such as the presence of structures along the waterways contribute to the flooding problem. Areas of higher elevation generally have no problem with flooding. Private subdivisions are required to have their own drainage system. However, this has not been confirmed and location of drainage outfalls is not determined. Past irrigation systems for agricultural use may have been used for drainage upon land conversion.

7) **Biñan City**

887. A combination of circular and rectangular channels is the existing drainage system in the entire City of Biñan. Most of the system is closed and entirely of pipe. Flooding in low-lying areas are caused by insufficiency of drainage structures, while some others are damaged. Informal settlers have also encroached river banks (2018-2027 CLUP Volume II, Biñan City).

8) **Sta. Rosa City**

888. Santa Rosa River at the western boundary, the Diezmo and Cabuyao Rivers at the eastern side, and the Laguna de Bay serve as receiving water bodies for storm water runoff. A system of storm drainage systems in the urban areas, residential areas and industrial estates convey runoff to these natural water bodies. These consist of reinforced-concrete pipes, open canals (either lined or unlined), and reinforced-concrete rectangular culverts. Flooding is limited to tidal flooding in the lakeshore areas and river overflows. An area of around 50 has within the Diezmo River Irrigation System is prone to flooding (2000-2015 CLUP, Sta. Rosa City).

9) Cabuyao City

889. Drainage and Sewerage. The absence of a modern sewerage system suggests that the creeks and rivers leading to Laguna de Bay receive all liquid wastes. Provided there are no hazardous effluents, the lake can still digest domestic wastes given primary treatment through individual septic tanks (Ecological Profile of Cabuyao City).

10) Calamba City

890. Based on the result of public-access flood hazard mapping, 59.07% (228.2 has) of Brgy. Pansol, Calamba area was determined to have high hazard to flooding, while 10.30% (37.39 has) and 23% (88.5 has) have moderate and low hazard to flooding, respectively. The remaining 7.63 % (24.49 has) was not prone to flooding. Interviews with residents, resort owners, business establishment owners and barangay officials were done to identify the social perspective as to why flooding occurs in their locality, typhoons and rainfall events which caused flooding and specific areas which are most affected by flood. Findings suggest poor drainage system as one of the contributing factors to flooding aside from low elevation.

(2) Stream and Lake Water Depth

891. The minor waterway crossings have estimated water depths of less than or equal to 30 centimeters (cm). The major crossings at Pasig, Biñan, Sta. Rosa, Cabuyao, San Cristobal and San Juan have inferred water depths of greater than 30 cm. These conditions are expected to increase during the rainy season. The average depth of Laguna de Bay is 2.5 m1.

(3) Flooding

892. Metro Manila suffered from serious flood damage in 1948, 1966, 1967, 1970, 1972, 1977, 1986, 1988, 1995, 1998, 1999, 2000, 2002, 2004, and 2009. Floods were caused by overflow of Pasig- Marikina-Napindan-San Juan River as well as inland drainage. Once this type of flooding occurs, low-lying areas in Metro Manila along the Manila Bay and the Laguna Lake are totally submerged. In addition to this type of flooding, local inundation takes place at a number of low-lying spots during heavy rain.

893. **Table 3.2-4** shows the summary of the situation and damage of major recent floods which occurred in Metro Manila.

[1] http://www.llda.gov.ph/index.php?option=com_content&view=article&id=74&Itemid=475

Table 3.2-4 Summary of the Situation and Damage of Major Recent Floods Occurred in Metro Manila

Typhoon Name/ **Date**	**Situation and Damage**
Typhoon 'Rosing' November 1995	Typhoon 'Rosing' brought strong winds and heavy rainfall that flooded the Marikina Valley and the low-lying shoreline areas of Laguna Lake because of the overflowing of the Marikina River and the high Laguna Lake water. The flood killed 21 persons and injured 253. Affected families were 109,254 or 519,030 persons. Damage for infrastructure was estimated at 71 million pesos.
Typhoon 'Loleng' October 1998	More than 900 families living along the Pasig River, Pateros Creek, Marikina River and Napindan River were swamped by flood caused by Typhoon 'Loleng', measuring depth 1 to 2 m. At least eighteen (18) low-lying barangays on or near the Pasig River and its tributaries were submerged under waist- and knee-high floodwaters.
Typhoon 'Seniang' November 2000.	The extensive flood was brought about by Typhoon 'Seniang' in early November 2000. The depth of inundation ranged from 0.2 m to 6 m. The highest flood levels were in Marikina City where flood waters ranged from 1 m to 5.5 m; Quezon City where sixteen (16) barangays suffered from floods of more than 1 m with the highest at 6 m; San Juan City where the flood waters ranged from 1 m to 3 m; and Rodriguez where five (5) of eight (8) barangays were under 1.5 m deep of water level with the deepest of 6 m. The flood affected a total of 22,174 families or 93,961 persons with ten (10) people confirmed dead and ten (10) injured. Number of evacuated families was 10,055 or 53,310 persons. Total damage was estimated at 129 million pesos.
Typhoon 'Aere' and Typhoon 'Chaba' August 25, 2004	Massive floods and landslides occurred on August 25, 2004 resulted from the continuous heavy rains accompanying typhoon 'Aere' and typhoon 'Chaba' affected thirteen (13) cities and two (2) municipalities in Metro Manila, mostly in Quezon City, in addition to nearby provinces. The flood affected a total of 4,392 families or 24,108 persons with eight (8) people confirmed dead and three (3) injured. For two consecutive days, Metro Manila experienced moderate to heavy rains that caused the submergence of lowland areas.
Tropical Storm 'Ondoy' September 26, 2009	Tropical Storm 'Ondoy' brought a heavy rain and caused devastating flood disasters in Regions I, II, III, IV-A, IV-B, V, VI, IX, XII, ARMM, CAR and NCR (Metro Manila) on September 26, 2009. The heavy rainfall of 455 mm/day observed at Science Garden in Quezon City brought a huge volume of flood discharge along the Pasig-Marikina River, resulting in the death/missing of about 500 people and causing massive damages

Source: JICA, The Preparatory Study for Pasig-Marikina River Channel Improvement Project (Phase III) Final Report Vol. 3 (October 2011)

894. The 1:50,000 geohazard maps (see **Figure *3.2-4***) prepared by the MGB classify susceptibility to flooding into three (3). "Areas with Low Susceptibility to Flooding experience floods with heights less than or equal to 0.5 m. Areas with Moderate Susceptibility to Flooding attain flood heights from 0.5 to one (1) m. Areas with High Susceptibility to Flooding attain flood heights greater than one (1) m."2

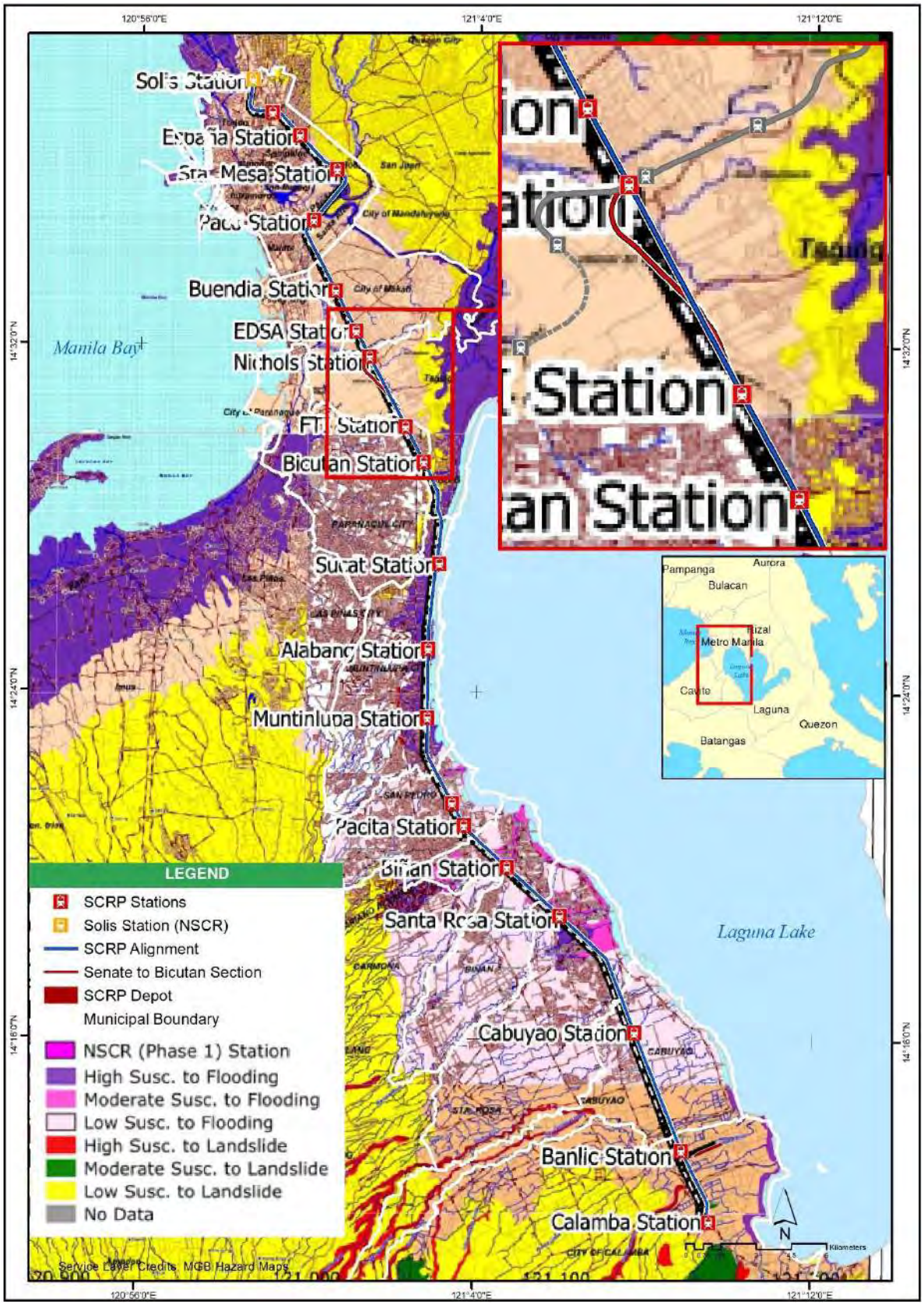
895. In general, the Project segments from Solis Station to Bicutan Station have low susceptibility to flooding with the exception of the immediate banks of the main channel of the meandering Pasig River which has high susceptibility. This high susceptibility affects the segment from Paco Station to Sta. Mesa Station.

896. The Project segment from Taguig to San Pedro has high susceptibility to flooding. This area falls within the Laguna Lakeshore which is affected by the rise in lake levels during major rain events.

897. The segment from San Pedro Station to Biñan Station has low susceptibility to flooding. The immediate bank of San Pedro River has high susceptibility to flooding. The segment from Biñan Station to Sta. Rosa Station has moderate susceptibility to flooding.

898. The segment from Sta. Rosa Station to Calamba has low susceptibility to flooding. The coastal area of Calamba from Baclaran to Bucal has high susceptibility to flooding. The railway segment in these areas is located above these flood prone sections of the LGU. **Figure 3.2-3** shows the Project line with respect to the Flood and Landslide Susceptibility map of the MGB for Southwest Luzon (NCR, Region IV-A).

[2] As described in the legend of the Landslide and Flood Susceptibility Maps published by MGB.



Source: Mines and Geosciences Bureau, 2010

Figure 3.2-3 Flood Susceptibility of Southwest Luzon (NCR, Region IV-A)

(4) Characteristics of Aquifers

899. The Mines and Geosciences Bureau (MGB)'s 1997 Groundwater Availability Map of the Philippines has classified the groundwater environment regions of the country based on aquifer type and potential yields. These classifications are summarized in a map showing regional groundwater availability based generally on the hydrogeologic characteristics of the area. The regional groundwater availability map for Metro Manila is shown in **Figure *3.2-4*** while the various classes of groundwater are summarized in **Table 3.2-5**.

Table 3.2-5 Philippine Groundwater Classes

Class	Description
Rocks in which flow is dominantly inter-granular	
Class I (A)	Extensive and Highly Productive Aquifers – with an average potential recharge of 0.5 m to 1 m, greater near influent rivers, with known production well yields mostly between 50 to 100 L/s but as high as 150 L/s at some sites. High to very high permeability.
Class I (B)	Fairly Extensive and Productive Aquifers – with average annual potential recharge of 0.3 m to 0.8 m; greater near influent rivers; with known production well yields mostly about 20 L/s but as high as 60 L/s at some sites. Moderate to high permeability.
Class I (C)	Local and Less Productive Aquifers – well yields mostly about 2 L/s but as high as 20 L/s in some sites.
Rocks in which flow is dominantly through fracture and/or solution openings	
Class II (A)	Fairly Extensive and Productive Aquifers with High Potential Recharge – includes limestone with production well flows up to 30 L/s in highly caustic areas and volcanic with production well flows up to 15 L/s and spring flows up to 60 L/s.
Class II (B)	Fairly to Less Extensive and Productive Aquifers with Low to Moderate Potential Recharge – includes massive to bedded limestone with few interconnected solution cavities, little groundwater development with domestic well yields 3 L/s or less. Strong spring yields reported in local but highly fractured rocks.
Local groundwater regions underlain by impermeable rocks generally without significant groundwater except ion residuum, sufficiently leached and/or fractured zone	
Class III (A)	Rocks with Limited Potential, Low to Moderate Permeability – includes Quaternary lava flows, fair to hard consolidated sandstone, shale's conglomerates, met sediments, mudstones etc.
Class III (B)	Rocks without any known significant groundwater obtainable through drilled wells – geological units as above but significantly less fractured, largely untested.

900. The same Groundwater Availability Map (MGB, 1997) shows that the Project Line from Solis Station to Pasay Road Station will traverse an area classified under "Local and Less Productive Aquifers". The segment from EDSA to Calamba City including the SCRP interconnecting line in Pasay City, Parañaque City, and Taguig City falls under "Fairly Extensive and Productive Aquifers with moderate to high permeability with known production well yields mostly about 20 L/s but as high as 60 L/s at some sites. as can be reflected in **Figure 3.2-5** and **Figure 3.2-6**. Groundwater occurs under unconfined conditions within the interstices of the two (2) cited classifications. In both cases, water table could be intersected from about 5 meters below ground level (m bgl) to around 15 m bgl. Water is extracted through shallow tube wells which are pumped manually or with the aid of low capacity centrifugal pumps. Yield from these shallow wells are used mainly for washing.

901. In 2004, the NWRB issued Resolution No. 001-0904, *Policy Recommendations for Metro Manila Critical Areas,* which revoked and suspended all water permits or reduced the authorized volume of extraction of existing deep wells in areas adequately served by the Metropolitan Waterworks and Sewerage System (MWSS). The resolution was issued based on findings under the "Water Resources Assessment for Prioritized Critical Areas (Phase I) of the NWRB which covered eight critical areas that were considered in need of urgent attention including Guiguinto, Bocaue, Marilao, and

Meycauayan in Bulacan, and North Caloocan, Navotas, Caloocan, West Quezon City, Makati, Mandaluyong, Pasig, Pateros, Paranaque, Pasay, Las Pinas, and Muntinlupa in Metro Manila, and Dasmarinas in Cavite. Based on the NWRB Resolution, "*groundwater extraction may be allowed to ensure that operation of vital services is not unduly hampered (e.g. hospitals, firefighting, etc.) provided that extraction shall be made only as back-up to commercial water supply.*

902. As of February 2020, a total of 62 water permittees have been granted by the NWRB within the 1 km radius from the SCRP interconnecting line. Recent hydro-census within the SCRP interconnecting line identified more than 100 groundwater extraction wells, majority of which are shallow wells (typically ~12 m deep) used by residents in the Barangays of Pasay, Taguig, and Makati for domestic, non-potable use only. These shallow wells do not have permits with the NWRB.

903. Semi-confined aquifers are inferred to occur beneath the unconfined aquifer that underlies the entire Project Line. Wells drilled through these semi-confined aquifers usually range in depth from 60 m to at least 200 m. The yields of these wells are used for domestic and industrial purposes.

904. The recent hydrocensus conducted within the 1-km radius from SCRP interconnecting line indicate that there are existing deepwells, mostly industrial and NWRB-permitted, with a depth of more than 100-m, with some even with a depth reaching 300-m. There is currently a data gap on the number and kinds of groundwater aquifers above and beyond the depth at which the underground section will be tunneled. Along the alignment, groundwater extraction wells were identified as shallow as 6 m and as deep as 305 m. See **Table 3.2.8** for details. Further studies are needed to determine actual depths of these groundwater aquifers and the potential interconnection that would be material information during the construction phase of the project.

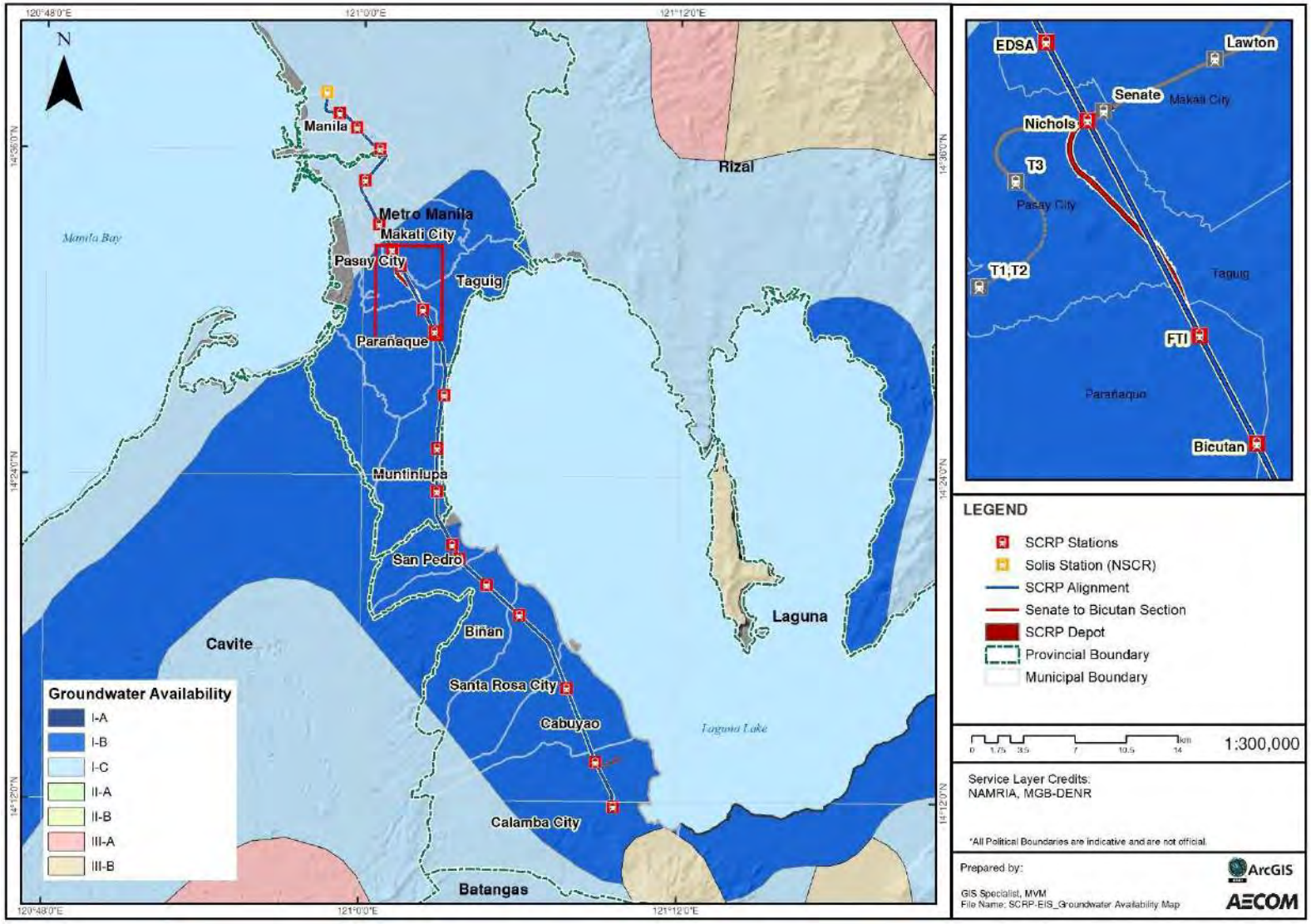


Figure 3.2-4 The Project Alignment as situated in the Groundwater Availability of Luzon

(5) Hydrogeological Characteristic of Wells nearby Banlic Depot

1) Well Inventory

905. Prior to well point inventory, available well data were collected to examine the hydrogeological characteristics of the geological units constituting the study areas. These data were also utilized to complete the well inventory.

906. Twenty-six (26) wells within the designated five (5) Housing Clusters and one (1) House (House-6) were inspected and tested for pH, Total Dissolved Solids (TDS), Conductivity, Salinity and Resistivity. Most of these wells which have depths from 18.52 meters to 55.55 meters are tapping the shallow unconfined aquifers. Most of these are operated by hand pumps, some have 0.75 to 1 HP motor pumps and pressure tanks.

907. Though initially classified as shallow wells, some of these wells can be classified as deepwells based on the classification made by the National Water Resources Board (NWRB). NWRB classified wells with depths of 25 meters and more as deepwells.

908. Two dugwells within the ricefield area, north of Housing Cluster 2 were also noted and investigated. Dugwells No.1 and No.2 have depths of 3.0 and 2.7 meters and measured depth to water of 2.7 and 2.3 meters, respectively.

909. In addition to these wells, one deepwell in Villa Palao, owned and operated by the Calamba Water District was also inspected. It has a reported depth of 150 meters with a discharge rate of 15 lps. Additional information on the Calamba Water District's 2 well in Banlic were requested but not provided yet.

910. Prior to well point inventory, available well data were collected to examine the hydrogeological characteristics of the geological units constituting the study areas. These data were also utilized to complete the well inventory.

2) Hydrogeologic Units

Shallow Aquifer (Unconsolidated and Semi-consolidated)

911. Shallow aquifers are generally within the alluvial deposits and upper section of the pyroclastic deposits which are semi-consolidated. Groundwater in the alluvium is generally within the sand and/or gravel deposits while those in the pyroclastic deposits are within the loosely cemented and slightly compacted sandstone and/or conglomeratic sandstone or weathered pyroclastics. Siltstone may also contain water but generally of insignificant quantity.

912. Wells at the different housing clusters and that at House-6 areas are generally tapping these shallow aquifers. Most of the shallow wells are being pumped manually. Some of them have small motor pumps and pressure tanks.

913. Water from shallow aquifers are generally susceptible to contamination.

Confined Aquifers

914. Groundwater which is of confined condition occurs mostly within the interstices of the tuffaceous sandstone and conglomeratic sandstone. The clayey and/or silty sequences in the deposits act as the confining beds or barriers to groundwater flow. The confined aquifers being tapped in most of the cities and municipalities of Laguna can be classified from fair to excellent.

915. In the Laguna area, deepwells tapping the confined aquifers which are generally about 100 meters deep to as deep as to more than 200 meters were noted in most of the subdivisions, industrial parks and manufacturing companies.

916. In Barangay Macabling and Pulong Sta. Cruz in Sta. Rosa, there are reported free-flowing wells with average borehole depth of 150mbgs. This is evident in the Coca-Cola Plant which has reported two free-flowing wells with an average discharge of 1.42 lps (Hydrowells, May 1988).

917. Some of deepwells in Banlic and nearby areas, though drilled within the recent alluvium are believed to be tapping the confined aquifers of the underlying pyroclastic deposits, especially those which are close to the geologic contacts of the Recent Alluvium and Taaf Tuff.

3) Groundwater Extraction

918. Most of the wells in Barangay Banlic are withdrawing groundwater from shallow wells which are tapping the shallow unconfined aquifers. Due to poor water quality, most of water from these shallow wells are not potable.

919. Two wells owned and operated by the Calamba Water District are reported to be located in Villa Palao, Barangay Banlic. One of these wells has a reported discharge rate of 15 lps.

920. Based on this information, it can be expected that at present there is no over extraction of groundwater both from the unconfined and confined aquifers in Barangay Banlic.

4) Groundwater Movement

921. Though no groundwater level contour can be produced because of the non-availability of wells where water levels can be measured, it can easily be stated that groundwater in the project area and nearby areas generally moves from west to east following the general flow direction of San Cristobal River.

5) Groundwater Recharge

922. Rainfall and San Cristobal River are main sources of recharge of the shallow unconfined aquifers. Water levels at the unconfined aquifers can even reached the ground level during periods of continuous heavy rainfalls.

923. The deeper confined aquifers are being recharged mainly through exposed sandstone and conglomeratic sandstone layers exposed along the river channels of San Cristobal River and other bodies of surface water located upstream of the project area.

(6) Hydrogeological Characteristic of Wells near SCRP Interconnecting Line

1) Well Inventory

924. A total of sixty-two (62) deep wells have been granted by the NWRB within a one (1) kilometer (km) radius of the SCRP interconnecting line as of March 2020. **Table 3.2-6** lists the number of deep wells registered with NWRB within a one (1) km radius of the segment as reflected in **Figure 3.2-5.**

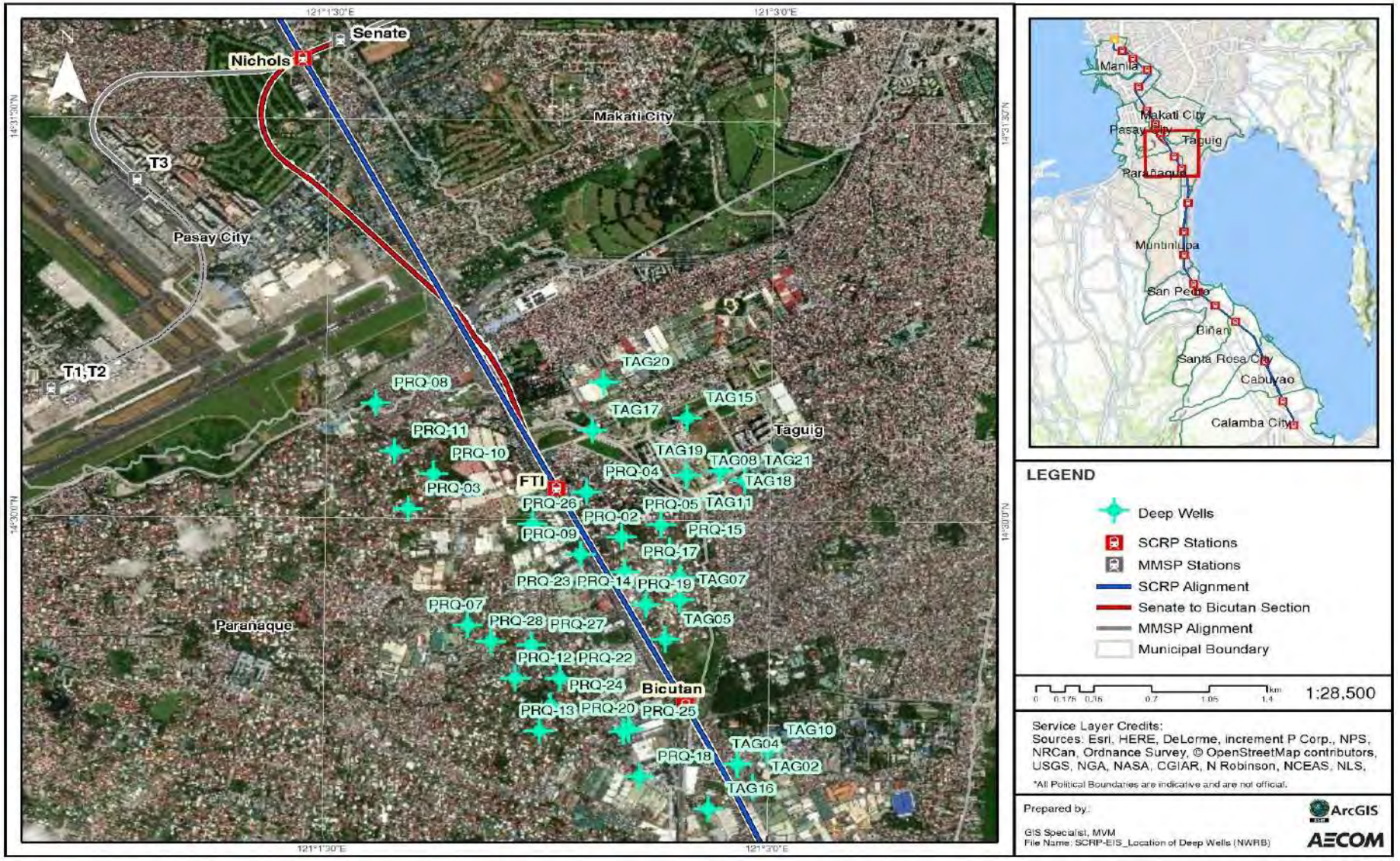


Figure 3.2-5 Locations of Deep Wells Based on NWRB Listings

Table 3.2-6 Water Grantee Permittees with NWRB

Locations	No. of Deep Wells within one (1) km radius from the alignment	Purpose
Taguig	21	Domestic – 12; Industrial – 6; Commercial – 2; Office – 1
Parañaque	28	Domestic – 18; Industrial – 6; Commercial – 2; Municipal - 2
Makati	13	Domestic – 12; Industrial – 1
Pasay	0	NA
Total	**62**	

2) Groundwater Supply and Use

925. Metro Manila's water supply is provided by the Manila Water Company, Inc. (MWCI), and Maynilad Water Services, Inc. (MWSI). Individual houses in Metro Manila not connected to MWCI's or MWSI's distribution system have their own wells or get their water from communal wells.

926. A walkthrough survey of some of the host communities of the SCRP interconnecting line in Taguig City, Makati City, Pasay City, and Parañaque City identified at least 107 groundwater extraction wells with approximate depths ranging from 9 to 305 m (based on information from well owners) as reflected in **Figure 3.2-6, Figure 3.2-7,** and **Figure 3.2-8**. These groundwater extraction wells are mostly not registered with the NWRB. Forty-four (44) groundwater extraction wells were identified beyond the one (1) km radius of the proposed SCRP interconnecting line. However, due to close proximity from the proposed segment, these wells might be affected as well.

927. **Table 3.2-7** lists the number of groundwater extraction wells identified during a walkthrough survey within a one (1) km radius of the proposed underground section. The survey was conducted with the assistance of the barangay local government units. Most of the barangays knew the locations of the wells located within their jurisdiction albeit formal monitoring or documented information from them.

928. These wells are used by residents mostly for domestic purposes such as bathing, gardening, washing clothes and cleaning. If the water service from MWCI and MWSI are uninterrupted and have a good water pressure, the residents' usage of these wells is considered minimal. These wells generally serve as back-up water source.

Table 3.2-7 Groundwater Extraction Wells Identified During a Walkthrough Survey

Locations	No. of Deep Wells within the one (1) km radius from the alignment	Purpose
Taguig	31	Domestic – 29; Industrial – 2
Parañaque	3	Domestic – 3
Makati	13	Domestic – 13
Pasay	60	Domestic – 60
Total	**107**	

Table 3.2-8 List of Identified Groundwater Extraction Wells

Groundwater extraction well	Purpose	Well Age	Well Depth (m)	Geographic Coordinates
DW01	Domestic	32	10	14°30'33.69"N 121° 2'41.21"E
DW02	Domestic	32	10	14°30'35.35"N 121° 2'43.94"E
DW03	Domestic	32	9	14°30'35.44"N 121° 2'44.11"E
DW04	Domestic	30	10	14°30'35.67"N 121° 2'44.79"E
DW05	Domestic	32	10	14°30'34.36"N 121° 2'42.31"E
DW06	Domestic	32	10	14°30'33.13"N 121° 2'42.19"E
DW07	Domestic	32	10	14°30'33.62"N 121° 2'41.83"E
DW08	Domestic	31	10	14°30'34.15"N 121° 2'41.66"E
DW09	Domestic	34	11	14°30'32.72"N 121° 2'42.16"E
DW10	Domestic	29	10	14°30'31.62"N 121° 2'42.84"E
DW11	Domestic	32	11	14°30'30.86"N 121° 2'41.50"E
DW12	Domestic	32	11	14°30'31.48"N 121° 2'44.31"E
DW13	Domestic	32	11	14°30'32.75"N 121° 2'44.66"E
DW14	Domestic	32	11	14°30'32.52"N 121° 2'44.36"E
DW15	Domestic	34	10	14°30'32.93"N 121° 2'44.49"E
DW16	Domestic	26	11	14°30'32.95"N 121° 2'44.09"E
DW17	Domestic	24	10	14°30'33.16"N 121° 2'44.46"E
DW18	Domestic	31	16	14°30'33.10"N 121° 2'43.65"E
DW19	Domestic	34	11	14°30'32.64"N 121° 2'43.48"E
DW20	Domestic	34	12	14°30'33.23"N 121° 2'43.11"E
DW21	Domestic	32	10	14°30'33.49"N 121° 2'45.03"E
DW22	Domestic	27	10	14°30'33.09"N 121° 2'45.22"E
DW23	Domestic	32	11	14°30'33.00"N 121° 2'45.33"E
DW24	Domestic	31	10	14°30'51.25"N 121° 2'22.06"E
DW25	Industrial	32	305	14°30'13.00"N 121° 2'51.00"E
DW26	Industrial	25	305	14°30'11.00"N 121° 2'50.00"E
DW27	Industrial	25	85	14°29'59.00"N 121° 2'12.00"E
DW28	Industrial	39	244	14°29'32.30"N 121° 2' 4.00"E
DW29	Industrial	39	244	14°29'31.50"N 121° 2' 5.00"E
DW30	Industrial	34	183	14°32'0.11"N 121° 1'55.19"E
DW31	Domestic	34	98	14°31'56.05"N 121° 2'27.04"E
DW32	Domestic	11	152	14°32'19.90"N 121° 2'59.00"E
DW33	Domestic	17	140	14°32'11.65"N 121° 2'50.96"E
DW34	Domestic	27	244	14°29'45.83"N 121° 2'59.93"E
DW35	Domestic	30	183	14°29'56.04"N 121° 3'2.37"E
DW36	Domestic	25	12	14°32'9.73"N 121° 3'24.49"E
DW37	Domestic	25	12	14°32'9.84"N 121° 3'23.56"E
DW38	Domestic	25	12	14°32'6.16"N 121° 3'25.22"E
DW39	Domestic	25	6	14°32'4.69"N 121° 3'24.93"E
DW40	Domestic	25	9	14°32'5.04"N 121° 3'26.02"E
DW41	Domestic	25	12	14°32'7.16"N 121° 3'24.72"E
DW42	Domestic	25	6	14°32'5.65"N 121° 3'25.66"E
DW43	Domestic	25	6	14°32'6.33"N 121° 3'25.95"E
DW44	Domestic	25	12	14°32'0.50"N 121° 3'19.94"E

Groundwater extraction well	Purpose	Well Age	Well Depth (m)	Geographic Coordinates
DW45	Domestic	25	12	14°32'0.43"N 121° 3'20.20"E
DW46	Domestic	25	12	14°32'0.36"N 121° 3'20.00"E
DW47	Domestic	25	12	14°32'0.35"N 121° 3'19.84"E
DW48	Domestic	25	12	14°32'0.28"N 121° 3'20.04"E
DW49	Domestic	25	12	14°31'42.28"N 121° 0'22.33"E
DW50	Domestic	25	12	14°31'51.64"N 121° 0'18.16"E
DW51	Domestic	25	12	14°31'45.76"N 121° 0'24.25"E
DW52	Domestic	25	12	14°31'51.88"N 121° 0'18.16"E
DW53	Domestic	25	12	14°31'44.83"N 121° 0'25.30"E
DW54	Domestic	25	12	14°31'43.90"N 121° 0'25.14"E
DW55	Domestic	25	12	14°31'43.33"N 121° 0'26.64"E
DW56	Domestic	25	12	14°31'44.27"N 121° 0'26.55"E
DW57	Domestic	25	12	14°31'43.97"N 121° 0'26.60"E
DW58	Domestic	25	12	14°31'44.14"N 121° 0'26.34"E
DW59	Domestic	25	12	14°31'43.98"N 121° 0'26.46"E
DW60	Domestic	25	12	14°31'46.23"N 121° 0'27.88"E
DW61	Domestic	25	12	14°31'44.40"N 121° 0'27.68"E
DW62	Domestic	25	12	14°31'43.20"N 121° 0'27.30"E
DW63	Domestic	25	12	14°31'44.58"N 121° 0'27.60"E
DW64	Domestic	25	12	14°31'44.56"N 121° 0'27.24"E
DW65	Domestic	25	18	14°31'46.00"N 121° 0'28.01"E
DW66	Domestic	25	18	14°31'48.25"N 121° 0'34.96"E
DW67	Domestic	25	12	14°31'47.56"N 121° 0'39.01"E
DW68	Domestic	25	36	14°31'27.66"N 121° 0'58.43"E
DW69	Domestic	25	12	14°31'48.27"N 121° 0'40.49"E
DW70	Domestic	25	18	14°31'35.50"N 121° 0'39.59"E
DW71	Domestic	25	18	14°31'34.78"N 121° 0'40.35"E
DW72	Domestic	25	18	14°31'38.94"N 121° 0'40.25"E
DW73	Domestic	25	18	14°31'39.83"N 121° 0'37.59"E
DW74	Domestic	25	30	14°31'54.98"N 121° 0'34.53"E
DW75	Domestic	25	30	14°31'55.52"N 121° 0'34.54"E
DW76	Domestic	25	30	14°31'55.82"N 121° 0'33.78"E
DW77	Domestic	25	42	14°31'54.56"N 121° 0'34.76"E
DW78	Domestic	25	30	14°31'54.39"N 121° 0'36.47"E
DW79	Domestic	25	30	14°31'53.98"N 121° 0'36.90"E
DW80	Domestic	25	30	14°31'54.65"N 121° 0'35.75"E
DW81	Domestic	25	30	14°31'54.13"N 121° 0'36.36"E
DW82	Domestic	25	30	14°31'53.65"N 121° 0'37.04"E
DW83	Domestic	25	24	14°31'53.33"N 121° 0'36.91"E
DW84	Domestic	25	24	14°31'53.27"N 121° 0'37.58"E
DW85	Domestic	25	24	14°31'52.44"N 121° 0'38.71"E
DW86	Domestic	25	30	14°31'52.06"N 121° 0'38.64"E
DW87	Domestic	25	24	14°31'51.84"N 121° 0'38.25"E
DW88	Domestic	25	12	14°31'51.94"N 121° 0'39.24"E
DW89	Domestic	25	24	14°31'51.34"N 121° 0'38.24"E
DW90	Domestic	25	24	14°31'50.83"N 121° 0'38.41"E

Groundwater extraction well	Purpose	Well Age	Well Depth (m)	Geographic Coordinates
DW91	Domestic	25	30	14°31'50.80"N 121° 0'39.48"E
DW92	Domestic	25	30	14°31'51.49"N 121° 0'39.05"E
DW93	Domestic	25	24	14°31'51.78"N 121° 0'37.74"E
DW94	Domestic	25	24	14°31'52.28"N 121° 0'37.42"E
DW95	Domestic	25	24	14°31'52.65"N 121° 0'37.18"E
DW96	Domestic	25	24	14°31'53.00"N 121° 0'36.63"E
DW97	Domestic	25	18	14°31'43.09"N 121° 0'22.64"E
DW98	Domestic	25	24	14°31'52.00"N 121° 0'18.74"E
DW99	Domestic	25	18	14°31'45.07"N 121° 0'24.05"E
DW100	Domestic	25	36	14°31'44.21"N 121° 0'25.53"E
DW101	Domestic	25	36	14°31'43.71"N 121° 0'25.28"E
DW102	Domestic	25	18	14°31'43.50"N 121° 0'25.82"E
DW103	Domestic	20	183	14°32'0.11"N 121° 1'55.19"E
DW104	Domestic	20	12	14°31'56.05"N 121° 2'27.04"E
DW105	Domestic	20	12	14°32'0.28"N 121° 3'20.04"E
DW106	Domestic	20	12	14°31'42.28"N 121° 0'22.33"E
DW107	Domestic	20	12	14°31'51.64"N 121° 0'18.16"E

3) Groundwater Movement

929. Though no groundwater level contour can be produced because of the non-availability of wells where water levels can be measured, it can easily be stated that groundwater in the area of the Senate-FTI underground section and nearby areas follows the general flow direction of east to east-southeast towards Laguna de Bay and its tributaries.

4) Groundwater Recharge

930. Groundwater is recharged naturally by rainfall and to a smaller extent by Laguna de Bay. These are the main sources of the shallow unconfined aquifers. Water levels at the unconfined aquifers can even reached the ground level during periods of continuous heavy rainfalls. Large unpaved areas in close proximity with the underground section that are considered groundwater recharge areas are Villamor Golf Course, Philippine Navy Golf Club, DOST complex in Central Bicutan, Philippine Navy Complex north of Lawton Avenue, and Philippine Army Complex south of Lawton Avenue.

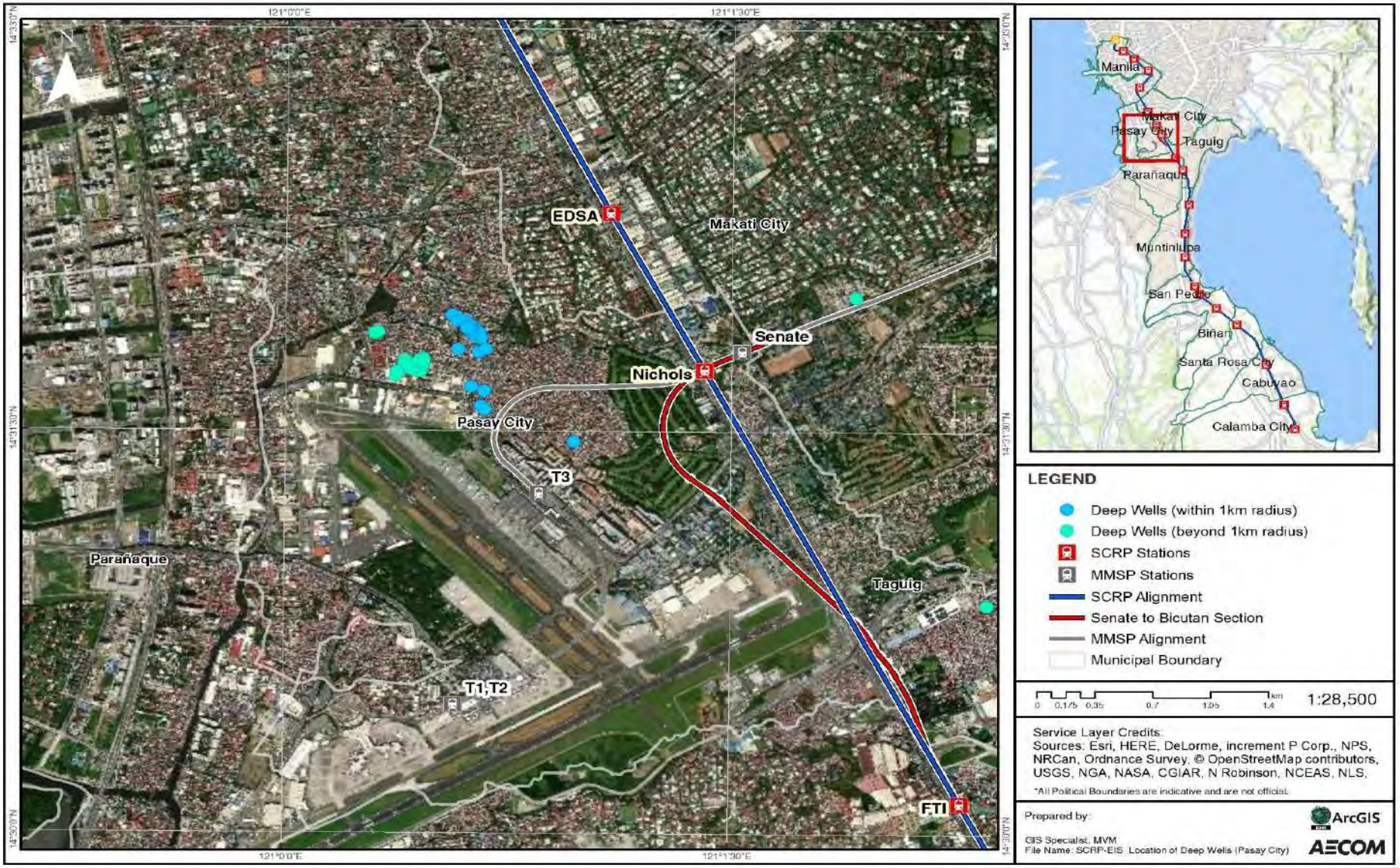


Figure 3.2-6 Locations of Deep Wells in Pasay City Identified During Walkthrough Survey

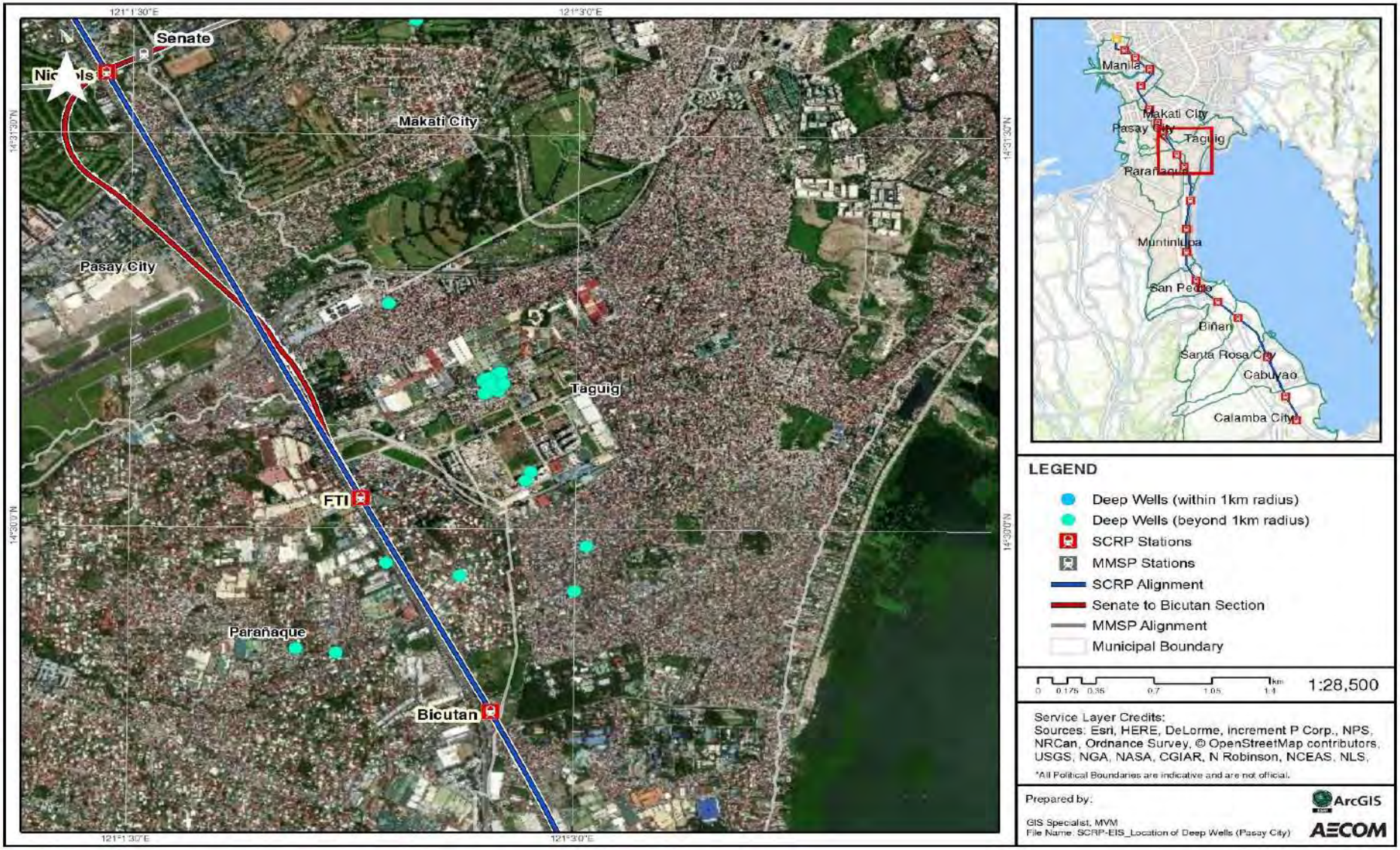


Figure 3.2-7 Locations of Deep Wells in Taguig City Identified During Walkthrough Survey

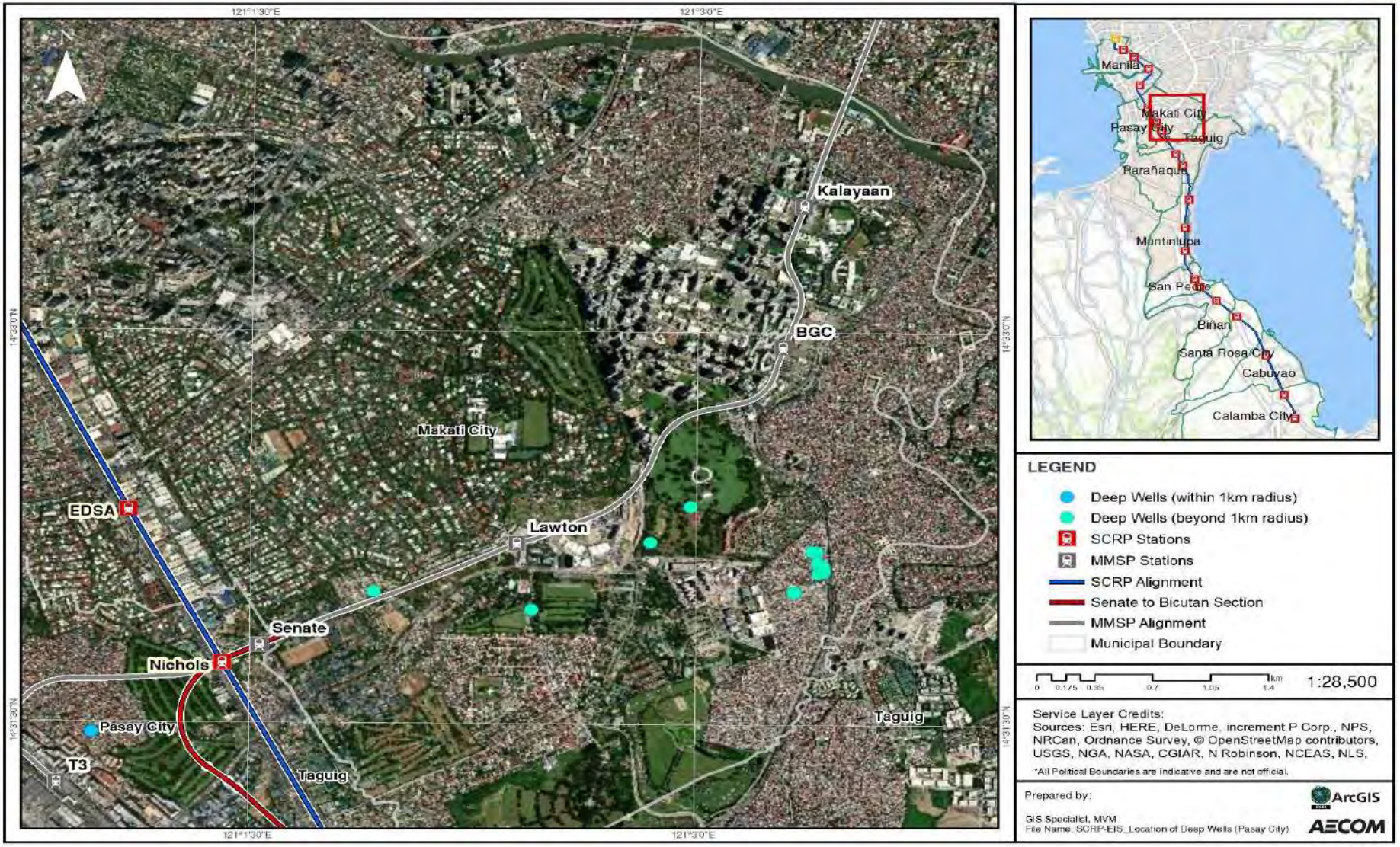


Figure 3.2-8 Locations of Deep Wells in Makati City Identified During Walkthrough Survey

3.2.1.3. Impact Identification, Prediction and Assessment and Mitigation

(1) Pre-construction and Construction Phase

1) Change in Drainage Morphology / Inducement of Flooding/Reduction in Stream / Volumetric Flow

a. **Impact Identification, Prediction, and Assessment**

Along the Proposed Alignment

931. The Project alignment goes through the flood prone zone of Metro Manila and Laguna area. In addition to the flood history in the Project alignment area, flood projections of PAGASA for 2020 and 2050 will have to be considered. This has predicted that rainfall increase is likely during the southwest monsoon (June-July-August) season until the transition (September-October-November) season in most areas of Luzon and Visayas, and also, during the northeast monsoon (December-January-February) season, particularly, in provinces/areas characterized as Type II climate in 2020 and 2050.

932. Extreme rainfall events (heavy daily rainfall) will continue to become more frequent, extreme rainfall is projected to increase in Luzon and Visayas only, in 2020 and 2050. The projected seasonal rainfall changes in 2020 and 2050 under the medium-range emission scenario in NCR and Laguna is presented in **Table 3.2-9**.

Table 3.2-9 Seasonal Rainfall Change (in %) in 2020 and 2050 under Medium Range Emission Scenario in Metro Manila and Province of Laguna

Province	Observed Baseline (1971-2000) mm				Change in 2020 (2006-2035)				Change in 2050 (2036-2065)			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
Metro Manila	107.5	198.5	1170.2	758.7	-12.8	-33.3	8.5	0.0	-17.3	-38.5	21.3	3.7
Laguna	629.2	386.8	845.0	1066.5	-20.2	-31.5	2.9	2.9	0.1	-34.8	6.8	0.4

Source: Climate Change in the Philippines, 2011 PAGASA

933. Aside from being a geomorphologically catch basin, another reason that aggravated the existing flooding problem of the affected areas is the blockage of natural waterways. Such a case was raised during public scoping in Calamba, Laguna. The existing pier of PNR blocks the waterway which causes sedimentation and flooding in the surrounding areas during heavy rainfall. Due to the construction of impervious structures such as the viaducts and bridge piers, stormwater run-off may increase that would change the flood storage capacity of waterways and its floodplains.

934. The construction of the project, specifically during site preparation, land clearing, excavation and earthworks may potentially cause drainage overflow, induce flooding and cause inundation due to sediment run-off and siltation. The improper handling, storage, and hauling of stockpiles of excavated materials/spoils may potentially result to clogged drainages and cause drainage overflow. Impact areas are generally flat and have portions that are already susceptible to flooding and frequently visited by typhoons. At present, most impact areas also have poor existing drainage systems.

935. The impact will be minor to moderate, since the activities will be confined to areas along the alignment and in active construction sites. If the excavated materials and spoils actually enter the waterways, they may get carried downstream and persist in the waterways long after the construction is done. However, if proper mitigation measures are implemented, the probability of this to occur will be very low.

936. Appropriate measures will be put in place and strictly complied with to mitigate the sediment run-off and siltation during site preparation, land clearing, excavation and earthworks. The DOTr will prepare and implement a construction plan indicating the contractor's commitment to proper disposal of demolition debris, construction spoils and solid wastes. These materials will not be put anywhere near watercourses and areas where it could be carried away into low-lying areas of the project or into the drainage system. Erosion controls such as vegetation on slope and silt traps will be implemented to address the issue. Solid wastes will be collected and disposed in accordance with RA 9003. The contractor will initiate erosion control measures before major earthmoving works begin. Upon the completion of the project, the contractor will take care of the disposal of all debris and waste materials into appropriate designated areas.

Banlic Depot

937. Shallow aquifers are generally within the alluvial deposits and upper section of the pyroclastic deposits which are semi-consolidated. Groundwater in the alluvium is generally within the sand and/or gravel deposits while those in the pyroclastic deposits are within the loosely cemented and slightly compacted sandstone and/or conglomeratic sandstone or weathered pyroclastics.

938. Wells at the various housing clusters and that at House-6 areas are generally tapping the shallow aquifers of the alluvial deposits.

939. Water being pumped from shallow aquifers are generally susceptible to contamination. Majority of the water from the inventoried wells are not suitable for drinking.

940. Depth of shallow groundwater level as observed from the two dugwells during the field investigation are from 2.3 to 2.7 meters below ground level.

941. Groundwater of confined condition occurs mostly within the interstices of the tuffaceous sandstone and conglomeratic sandstone. The confined aquifers being tapped in most of the cities and municipalities of Laguna can be classified from fair to excellent.

942. In the Laguna area, deepwells owned and operated by subdivisions, industrial parks and manufacturing companies are tapping the confined aquifers which are generally about 100 meters deep to as deep as to more than 200 meters.

943. Due to the limited thickness of the alluvial deposits, some of deepwells in Banlic and nearby areas, though drilled within the recent alluvium are believed to be tapping the confined aquifers of the underlying pyroclastic deposits, especially those which are close to the geologic contacts of the Recent Alluvium and Taaf Tuff.

944. The deepwell to be drilled and used in the depot is expected not to affect the shallow wells being used by the residents in the different Housing Clusters since it is going to tap the deeper confined aquifers.

Along Senate-FTI Underground Section

945. Ground disturbance during construction activities will consist of the erection of the reinforce concrete diaphragm wall, installation of road decking, and excavation and construction of the structure frame for the underground stations (using cut and cover method), shield tunneling/New Austrian Tunneling Method (NATM) or use of TBM for the construction of sections in between stations, and embankment works and retaining wall construction for the depot.

946. Earth pressure balance tunnel boring machines (EPB TBMs) are shield TBMs that are mainly used for the excavation of tunnels in soft ground beneath the water table to reduce or prevent surface settlements by applying pressure to the excavation face. For tunnels excavated in urban areas beneath the water table in permeable soil, both water inflow and surface settlements must be carefully controlled. (Mori, 2016).

947. The TBM-bored tunnels require a gasketed pre-cast concrete segmental lining to prevent the inflow of groundwater into the tunnel over the lined portion of the tunnel. The groundwater control measures should therefore, provide positive control of the inflow from the advancing tunnel face. Groundwater control during pressurized face tunneling using a convertible Earth Pressure Balance TBM is achieved by the formation of a soil plug inside the face plenum (i.e., excavation chamber) to balance earth and hydrostatic pressures. The face pressure is primarily maintained by the screw conveyor operations and the presence of a soil plug (Davidson, G., et. al., 2014). The lining in tunnels reduces water seepage but could cause a barrier effect because of aquifer obstruction (Font-Capó, 2012).

948. According to Oggeri, C. et al, in 2016, the ideal soil behavior for an EPB TBM generally includes good plastic deformation, pulpy to soft consistency, low inner friction, and low permeability. These characteristics are necessary in order to ensure that: 1) the soil as a fluid can transmit pressure from the bulkhead; 2) groundwater can be adequately sealed; 3) the drive torque can be minimized; 4) abrasive wear can be reduced. Ideal soils are therefore a clayey, soft soil with “toothpaste” consistency.

949. According to Holzhäuser, J. et al., in 2006, high groundwater head is a major challenge for tunneling in soft ground and weak rock. The high groundwater head has a strong impact on design and operation of Tunnel Boring Machines (TBMs) in order to prevent excessive groundwater inflow, to ensure face stability and to enable access to the cutterhead for maintenance, which can lead to an increase of the required construction period and budget. High groundwater pressure (above 4 bar) makes tunneling much more difficult and requires special knowledge of cutting-edge technologies during design and construction.

950. Unexpected high-water inflows constitute a major problem because they may result in the collapse of the tunnel face and affect surface structures. Such collapses interrupted boring tasks and led to costly delays during the construction of the Santa Coloma Sector of L9 (Line 9) of the Barcelona Subway (Font-Capó, 2012).

951. Tunnel excavation in strong, fine grained cohesive soils and rock under high groundwater pressure is generally not problematic for EPB-TBMs, as typically the face is stable and the amount of inflowing water is low due to low permeability of the ground (Holzhäuser, J. et al., 2006).

952. Depending on the level of the groundwater pressure, abrasiveness of the ground and the length of the corresponding tunnel sections, the TBM should include provisions for hyperbaric interventions using regular compressed air, mixed gases or saturation diving, depending on pressure level and duration of intervention time expected (Holzhäuser, J. et al., 2006).

953. During tunneling works using EPM-TBM, the known impact on groundwater was a moderate barrier effect (Pujades, et. al., 2015). The barrier effect is caused by underground impervious structures, (such as bored pile wall and the effect produced by the tunnel itself) located below the water table. These structures reduce the effective transmissivity of the aquifer, leading to a rise in the water table upgradient and to a drop downgradient (Ricci et al., 2007; Deveughèle and Zokimila, 2010).

954. The same study of Pujades, et. al., in 2015 noted the behavioral unpredictability of the groundwater during tunneling. Accordingly, this was caused by the connection of layers with different hydraulic heads. Drawdowns were observed in deep layers and increases in the shallower ones. This effect was greater than the maximum barrier effect expected from the bored pile wall.

955. In the event of a highly permeable section, Slurry Shield TBM may be used. Slurry Shield TBMs are widely used for non-cohesive soils, ranging from fine-grained sands to coarse-grained gravel, and use a pressurized bentonite slurry suited to counteract the prevailing groundwater and earth pressures. This bentonite slurry also acts as the carrier fluid for the excavated material (Connors, R., 2017).

956. Slurry Shield TBM works with sites where high groundwater pressures exist. The chamber containing the TBM cutter head is filled with pressurized slurry which applies pressure to the excavation face. The slurry acts as a ground support and transport medium for the excavated material, which is continuously circulated between the TBM and a slurry treatment plant (STP), where the excavated material is separated out for disposal or reuse.

957. Groundwater ingress into the tunnels during tunnel boring activities is certain during underground section construction. The subsequent dewatering activities may induce groundwater drawdown which could impact identified groundwater extraction wells within a 1-km radius. A further study is recommended such as hydraulic modelling to estimate the anticipated volume of groundwater inflow, drawdown, hydraulic radius of influence, and rate of groundwater depletion.

b. **Mitigation Measures**

958. Given that flooding is an existing environmental problem in the project area, DOTr will ensure that appropriate measures are put in place and strictly complied with.

959. A well-designed drainage system shall be installed for the Project in order to address the issue on flooding. Minimizing the removal of vegetation and alternation of topography during pre-construction would alleviate the problem as this would preserve the natural drainage system of the area.

960. Based on the results and recommendations of the hydrologic and hydraulic assessment and erosion analysis carried out during DD stage, a proper drainage system for the Project will be designed and installed in order to address the issue on flooding. The limits to changes in floods level will be 50mm increase in urbanized area and planned future urbanized area, and 100mm increase in rural area.

961. Based on the results and recommendations of the erosion analysis of river bed and river banks in the vicinity of bridge piers and bridge abutment carried out during DD stage, necessary river bed and bank scour protection, bridge abutments and bridge pier foundation will be provided as necessary such as installing gabion mattress, sheet pile depends on the site conditions.

962. The proponent will prepare and implement a Construction Environmental Management Plan indicating the contractor's commitment to proper disposal of demolition debris, construction spoils and solid wastes. These materials will not be put anywhere near watercourses and areas where it could be carried away into low-lying areas of the Project or into the drainage system. Solid wastes will be collected and disposed in accordance with RA 9003.

963. Erosion controls such as vegetation on slope and silt traps will be implemented to address the issue. Upon the completion of the Project, the contractor will take care of the disposal of all debris and waste materials into an appropriate designated area. The contractor will initiate erosion control measures before major earthmoving works begin.

964. To address this, project structures will be designed to have a clearance of above established flood level and discharges and to reduce bridge piers when possible, which will be established and included in the detailed design. When necessary, sump pumps will be installed at the lowest points to pump out accumulated floodwater along the railway track. Construction of new sufficient and effective drainage system will also be incorporated. The proponent will also coordinate with DPWH how to integrate both parties' drainage plans along the Project area. It is also important to share information to LGUs and incorporate their comments and inputs in the design to harmonize with existing drainage systems.

965. In the case of the underground section, all trench and foundation excavation will be backfilled, and ground restored to its original condition. Any impact in terms of increased volumetric rate of runoff attributed to alteration of ground surface is insignificant and

temporary. The tunnel will be located about 16 m underground on average, and tunneling works using TBM are not anticipated to impact river/stream waterflows.

966. TBM should include provisions for hyperbaric interventions using regular compressed air, mixed gases or saturation diving, depending on pressure level and duration of intervention time expected (Holzhäuser, J. et al., 2006)

2) Change in Stream or Lake Water Depth

967. While the Project alignment will pass through the rivers mentioned above, it will not pass through Laguna Lake. The elevation of the structures as viaducts will not in any way change the flows of water bodies like streams and rivers, nor affect the depth of these water bodies. One of the proposed sites for the Project station is the Sucat Thermal Power Plant (STPP) area which is located next to Laguna de Bay. The construction of the said station is not expected to affect the depth of the lake.

3) Depletion of Water Resources / Competition in Water Use

Along the Proposed Alignment

968. Concreting works at the stations and depot will bring about increase in water consumption due to the water used in the concrete mix. Based on the Bill of Quantities 28th September 2018 the estimated volume of concrete required for the viaduct, stations, piers, piles and pile caps is 1.62 million m^3. The following assumptions were made in estimating the amount of water to be used for construction concrete:

- 1 cubic meter of concrete will require 180 liters of water; and
- Viaduct, stations, piers, piles and pile caps shall be constructed for 30 months with six contract packages.

969. The amount of water required to supply for concreted is 1,620,000 m^3 concrete X 180 liters/m^3 = 291,600,000 liters = 291,600 m^3 of water.

970. For the duration of the construction program this would be 291,600 m^3 ÷ 900 days = 324 m^3 of water per day. With six packages in construction at the same time, this requirement will be spread across the different batching plants.

971. The domestic water consumption during construction and operation were estimated using the following:

- Pre-construction, construction and operation personnel of 26,680;
- Operation personnel shall be 3,675;
- Per capita water consumption of 100 liters per day

972. Six (6) contract packages with a maximum manpower of 6,200 at 21 major operation sites corresponding to the stations and depot which translates to 120 persons per site.

973. The estimated daily water consumption at the different stages of the Project development are presented in **Table 3.2-10**.

Table 3.2-10 Estimated Daily Water Consumption of the Project during Pre-Construction and Construction Stage

Project Stage	No. of Personnel	No. of Sites	Daily consumption per site (m^3)	Total Daily Consumption (m3)
Pre-Construction	200	1	20	20
Construction	26,680	6	478	2,668

974. As shown, the amount of water that will be consumed during construction of the Project is considerable which can be sourced from existing water sources of the LGUs, through the local water providers in the area or by sourcing out concrete mix from existing batching plant operations.

975. In practice, the drinking water supply is bought from commercial water providers within the LGUs. Water to be used for cleaning and toilet use come from the Level III system of the LGUs.

976. Overall, the impact of the Project on the water sources of the host LGUs is rated as low and not significant and will persist only during the period of construction. The mitigating measures identified include the implementation of a Water Conservation Program for the Project and regular monitoring of water consumption for domestic and construction purposes.

Banlic Depot

977. To prevent or minimize contamination of the shallow groundwater, taking a bath and washing of clothes within the immediate vicinity of the shallow wells should be avoided.

978. Dumping of solid and liquid wastes, petroleum products, toxic and other deleterious substances into the ground should be avoided.

979. The proposed deepwell at the depot has to be drilled at a depth of least 100 meters in order to tap the deeper confined aquifers. The upper 40 meters should be blank casings wherein the upper 30 meters has to be sealed by sand-cement-grout mixtures in order not to influence and affect the shallow wells being used by the local residents.

980. If required, a Geo-resistivity Survey can be conducted to determine the lateral and vertical extents of the water-bearing formation/s. Based on the results of this survey, a more precise well design can be made.

Senate-FTI Underground Section

981. Considering that the proposed project will not be extracting water from existing surface waters crossed by the project components or construct new wells, potential water competition as a result of project activities is unlikely.

982. The limited groundwater level information gathered from a few soil bore locations along the proposed underground section alignment from the Senate Station to FTI Station suggests that the intersected groundwater table ranges between 5 meters below ground level (m bgl) to around 15 m bgl. Due to the relatively shallow depth of the groundwater table, without mitigation measures groundwater is anticipated to flow into the underground tunnel during tunneling works, up to the completed construction phase of the project. This groundwater inflow could create a significant hydraulic gradient which could draw groundwater into the tunnel. As construction may not safely proceed with flooded tunnels, dewatering of the tunnels is expected to be conducted during construction works. Dewatering will further increase the induced groundwater drawdown which in effect will also increase the hydraulic radius of influence.

983. The degree of drawdown is dependent on a number of factors including the geology intersected, the hydrogeology and the tunnel configuration and depths. Within the alluvium, the groundwater levels are predicted to form a steep elongated cone of depression along the tunnel alignment. However, the depressed groundwater contours anticipated to be localized, extending no further than about 500 metres from the tunnels, indicating localized changes to groundwater flow patterns with negligible impacts on the regional groundwater flow. Depending on the protective measures that will be put in place for the underground tunnels and stations, dewatering may likely be conducted even after the construction to draw groundwater away from the tunnels and reduce the hydraulic pressure on the walls of the tunnel.

984. Mitigation measures will be as follows:

- Conduct regular monitoring of the ground water level and quality at nearby identified wells to ensure that the project is not causing any depletion of water supply.
- A water conservation management plan will be implemented. This will include utilization of recycled water and rainwater. A further study is recommended at DED such as hydraulic modelling to estimate the anticipated volume of groundwater inflow, drawdown, hydraulic radius of influence, and rate of groundwater depletion.

985. A three-dimensional numerical groundwater model should be developed during Detailed Engineering Design (DED) to simulate existing groundwater conditions, proposed tunnel alignment and associated subsurface ancillary infrastructure. The groundwater model shall be used to predict future groundwater conditions and potential impacts related to the project. The groundwater model shall use internationally accepted modeling software.

986. Groundwater levels should be monitored throughout the construction phase. Additional groundwater modelling is proposed to be conducted by the TBM contractor during construction using measured tunnel inflow rates and monitored groundwater drawdown to better calibrate the model and predict impacts.

4) Inducement of Flooding/ Reduction in Stream Volumetric Flow

987. Waterbodies within and in the vicinity of the underground interconnection section of the project in Taguig, Makati, Pasay, and Parañaque City include the Maricaban Creek and Don Galo Creek. The track from Lawton West Station going to FTI Station will cross a tributary of the Maricaban Creek, while the Don Galo Creek is located approximately 100 m west of the track going to FTI Station. Both the Maricaban Creek and Don Galo Creek drain into the Parañaque River, which in turn flow out to Manila Bay.

988. However, no construction works within waterways is anticipated to occur, therefore the inducement of flooding as a result of the construction of waterways and reduction of flow area is unlikely.

989. Along the tunnel alignment and train stations, it is likely that dewatering operations will be conducted to make the construction area workable. Pumped water from dewatering operation may be discharged to existing drainage system if the conveyance capacity is still sufficient to absorb the extra flow. In the event that this cannot already be absorbed by the existing drainage system, temporary flood attenuation pond/s will be constructed to contain the pumped water. Excess water from the ponds may be taken by tankers and disposed to designated waterways or disposed to existing drainage system in a gradual manner considering the conveyance capacity of the drainage system.

990. Groundwater inflows to the tunnels that would have the potential to impact surface water levels are unlikely for the section of the tunnels that would be constructed. This is because the section of the tunnels would be undrained (tanked) and the majority of the creeks and canals are concrete lined.

991. Temporary flooding from the interaction of groundwater and excavation may potentially occur during the construction phase. Applicable dewatering technique should be considered to address this concern such as well point method, educator wells, open sump pumping and deepwell point method. It is also expected that the following management techniques may be required for the contractors for this project.

Temporary Drainage

992. The Contractor shall design, construct and maintain, at his own cost, an effective system of surface drainage and wastewater disposal for the Temporary Facilities. All horizontal surfaces shall be suitably graded such that surface water will fall toward the drainage system. All channels, gullies and gratings shall be kept clear of debris and leaves.

Flood Mitigation Management

993. The Contractor shall ensure that any areas of the site liable to flooding are safeguarded from detrimental events as a result of flood waters. The Contractor shall construct temporary drainage structures such as ditches, culverts and pipe drains to prevent surface and run-off water from having a negative effect on local watercourses.

Maintenance of Local Water Drainage Capacity

994. The Contractor shall ensure that all existing waterways in the construction site are maintained at their existing capacity and that the capacity of waterways in its environs and not negatively affected by the works.

Control of Wastewater

995. The Contractor shall ensure that all wastewater arising from the site is disposed of through properly designed and constructed systems to prevent pollution of surface water bodies or pollution of ground water.

996. It is also anticipated that flooding will have minimum to insignificant impacts to construction activities given that a tunnel boring machine will be used for the tunnel sections of the project. Stations will be provided with temporary and permanent bund walls. The permanent bund walls will form part of the permanent structure.

997. The depot will be located at a higher level than the existing ground surface through formation of embankment. A drainage system will be provided in the depot area to collect surface runoff to designated outfalls and considering the existing drainage pattern.

998. Improper handling, storage, and hauling of demolition debris/excavated materials may clog existing drainage systems and block creeks, canals, and waterways and aggravate flooding in areas of the alignment that are moderately or highly susceptible to flooding. A Construction Waste Management Plan/Muck Disposal Plan will be prepared for the project in order to appropriately handle and dispose excavated materials (including muck generated from tunneling work) and demolition debris.

999. As seen in the Flood Hazard Maps, some sections of the underground section alignment will traverse areas with moderate to high flooding susceptibility. In order to protect project facilities from flooding hazards, temporary bund walls will be provided enclosing the depot, stations, and ventilation shafts construction areas.

1000. Water-sealed panels at station entrances will be installed, and the use of tempered glass and waterproof iron doors may be considered. Drainage pumping stations will be installed as redundancy in the unlikely event that flood flows infiltrate the stations

5) Ground Movement and Liquefaction

1001. Ground movement is an expected outcome of tunnelling projects. The ground movement anticipated is predominantly settlement (also termed subsidence). Upward ground movement (also termed heave) may also occur.

1002. The causes of ground movement due to tunneling can be classified as:

- Consolidation of the soil profile - due to water inflow into the tunnel resulting in groundwater drawdown in the overlying soil profile. This results in an increase in stress in the soil matrix as water is lost from the soil pores (settlement only).

- Tunnel induced movement - due to the change in stresses in the surrounding rock mass and ground loss caused by the tunnel excavation (settlement or upward heave).

(2) Operation Phase

1) Change in Drainage Morphology / Inducement of Flooding / Reduction in Stream

1003. The operation of the Project will not affect the intersected rivers and waterways. It will not contribute to the increase in the current vulnerability of the route to flooding. The Project will not result in the reduction of the flow of the intersected waterways. The drainage system of the Project will be properly designed and constructed. The climate change projections will be incorporated in the design of the drainage system. Regular inspection and prompt maintenance of drainage system will be implemented and when necessary, improvement and enhance of capacity will be done.

2) Change in Stream and Lake Water Depth

1004. The operation of the Project will not affect the water depths of the intersected rivers and the nearby Laguna de Bay.

3) Depletion of Water Resources / Competition in Water Use

1005. The water consumption during operation were estimated using the following:

- Per capita water consumption of passenger: 10 L/person, Staff: 76 L/person, Cleaning: 3 L/person.
- 30 staff at each station and 455 staff at depot

1006. The estimated daily water consumption at station and depot are presented in **Table 3.2-11**.

Table 3.2-11 Estimated Daily Water Consumption of the Project during Operation at the Station and Depot

Location	Water supply **Daily maximum volume (m^3/day)**	**Wastewater & Sewage Daily maximum volume (m3/day)**	Total Daily maximum volume **(m3/day)**
Station	2039	1477	3516
Depot	150	150	150
Total	**2189**	**1627**	**3666**

Source: JICA Design Team

1007. Water requirements at stations will not be significant and essentially limited to the drinking water requirement of the operations staff, maintenance of comfort rooms and the regular cleaning of the stations. Drinking water of the staff/personnel will be purchased from local water providers. The stations will be linked to the Level III System of the nearby water districts.

1008. However, for the depot, through the coordination with LGU, it was confirmed that water supply will be beyond the capacity of local supply and requires to supply from ground water. During DD, the impact has been assessed and it has been confirmed that water consumption at depot from ground water will not affect ground water level of nearby wells.

3.2.2. Water Quality

3.2.2.1. Groundwater Quality

1009. Uncontrolled discharge of wastewater or water-borne contaminants from project operation may percolate into ground and deteriorate the quality of the local groundwater,

limiting the use of the local groundwater. The construction of the railway columns down to the bedrock for elevated viaducts and bridges may encounter groundwater at shallow depths. The groundwater in column holes may be pumped out and may affect the nearby surface water. In addition, the quality of groundwater may influence the choice of material quality of the columns. These situations make the assessment of the existing or baseline groundwater quality relevant in this study.

(1) Field Survey

1010. Groundwater samples were collected on February 12-14, 2018 for dry season and on various days within the period from June 18 - July 19, 2018 for wet season at eight (8) groundwater sampling stations identified during EIA study. On May 29 - 30, 2019, groundwater samples were collected from additional four (4) pre-identified wells located within the vicinity of the proposed Banlic Depot for the detailed design phase. The descriptions of the sampling stations are presented in **Table 3.2-12** and shown in **Figure 3.2-9**.

1011. Primary data on groundwater quality in various locations along the proposed alignment during EIA study were generated from eight (8) groundwater sampling sites near the PNR stations in Solis, Buendia, Sucat, Alabang, Biñan, Cabuyao and Calamba, and four (4) sampling sites within the vicinity of the proposed Banlic Depot during the detailed design phase. It was in the presumption that groundwater occurs in a great span at varying quality along the proposed 57.1-km alignment and depot; hence, samples were collected and analyzed to determine the groundwater condition on the mentioned locations. Locating the sources of groundwater at shallow depths was one constraint because the use of the shallow tube wells is no longer popular in highly developed areas relying on local water utilities.

1012. The water samples were collected after sufficient purging of wells. The samples for the analysis of microbes were collected into sterilized small glass bottles and wrapped with aluminum foil. The samples for the analyses of organics were collected into amber glass bottle. The samples for the analysis of other parameters were collected into Polyethylene Terephthalate (PET) bottles. The collected groundwater samples were labeled, stored in ice-chest and submitted to Mach Union Laboratory, Inc., a DENR recognized laboratory in Las Piñas City, Metro Manila to measure the levels of 21 water quality indicators as follows:

- Primary Parameters: Color, Chloride (Cl-), Nitrate as Nitrogen (NO_3-N), Fecal Coliform
- Secondary Parameters: Inorganics: Sulfate (SO_4^{2-}), Metals: Arsenic (As), Cadmium (Cd), Chromium Hexavalent (Cr^{6+}), Lead (Pb), Total Mercury (Hg), Organics: Cyanide (CN)
- Others: Total Coliform, Calcium (Ca^{2+}), Magnesium (Mg^{2+}), Sodium (Na^{+}), Potassium (K^{+}), Bicarbonate (HCO^{3-})

1013. The Temperature, pH, Conductivity, Total Dissolved Solids (TDS) were measured on-site using a calibrated Thermo Scientific Orion Star A329 Water Quality Meter. Out of the 21 parameters measured, sixteen (16) are covered by PNSDW and DENR Groundwater Quality Guidelines (GQG). These are TDS, Na^{+}, NO_3-N, and Total Coliforms for PNSDW; temperature and Fecal Coliform for DENR GQG; color, pH, Cl^{-}, SO_4^{2-}, As, Cd, Cr^{6+}, Pb, Hg, and CN for both PNSDW and DENR GQG.

Table 3.2-12 Groundwater Quality Sampling Stations

Sampling Station	Description	Geographic Coordinates
GW-1	Hand pump tube well in front of 742E Interior 7, Benita St. Zone 16, Barangay 185, Gagalangin Tondo, Manila City (near Solis PNR Station)	14° 37' 47.00" N 120° 58' 33.10" E
GW-2	Hand pump tube well in front of 6857 Washington St., Barangay Pio del Pilar, Makati City (near Buendia PNR Station)	14° 33' 10.02" N 121° 00' 41.45"E
GW-3	Hand pump tube well in front of 6857 Washington St., Barangay Pio del Pilar, Makati City (Sucat PNR Station)	14° 27' 04.38" N 121° 03' 05.83"E
GW-4	Hand pump tube well inside a house in Montillano St. Purok 4, Alabang, Muntinlupa City (near Alabang PNR Station)	14° 25' 12.59" N 121° 02' 52.55"E
GW-5	Hand pump tube well in front of 186 Barangay. San Vicente, Biñan Laguna (near Biñan PNR Station)	14° 19' 51.68" N 121° 04' 54.80"E
GW-6	Hand pump tube well in front of a house in Alipit St., Purok Uno, Bgy. Bigaa Cabuyao City (near Cabuyao PNR Station)	14° 16' 50.36" N 121° 07' 34.69"E
GW-7	Hand pump tube well in front of a house in Criscor Homes, Bgy. Uno, Calamba Laguna (near Calamba PNR Station)	14° 12' 28.89" N 121° 09' 30.14"E
GW-8	Hand pump tube well at an apartment back (north) of the PNR Station office, Barangay Mayondon, Los Baños, Laguna (near Los Baños PNR Station)	14° 10' 55.30" N 121° 14' 24.95"E
DD GW-1	Hand pump in front of a house in Purok 6, Bgy. Banlic, Calamba, Laguna	14°13'19.90"N 121°09'23.30"E
DD GW-2	Hand pump in front of a house in Purok 7, Bgy. Banlic, Calamba, Laguna	14°13'23.60"N 121°09'33.10"E
DD GW-3	Hand pump inside a house in Purok 7, Bgy. Banlic, Calamba, Laguna	14°13'30.20"N 121°09'45.10"E
DD GW-4	Hand pump; Used as community well in Purok 7, Bgy. Banlic, Calamba, Laguna	14°13'39.70"N 121°09'47.30"E

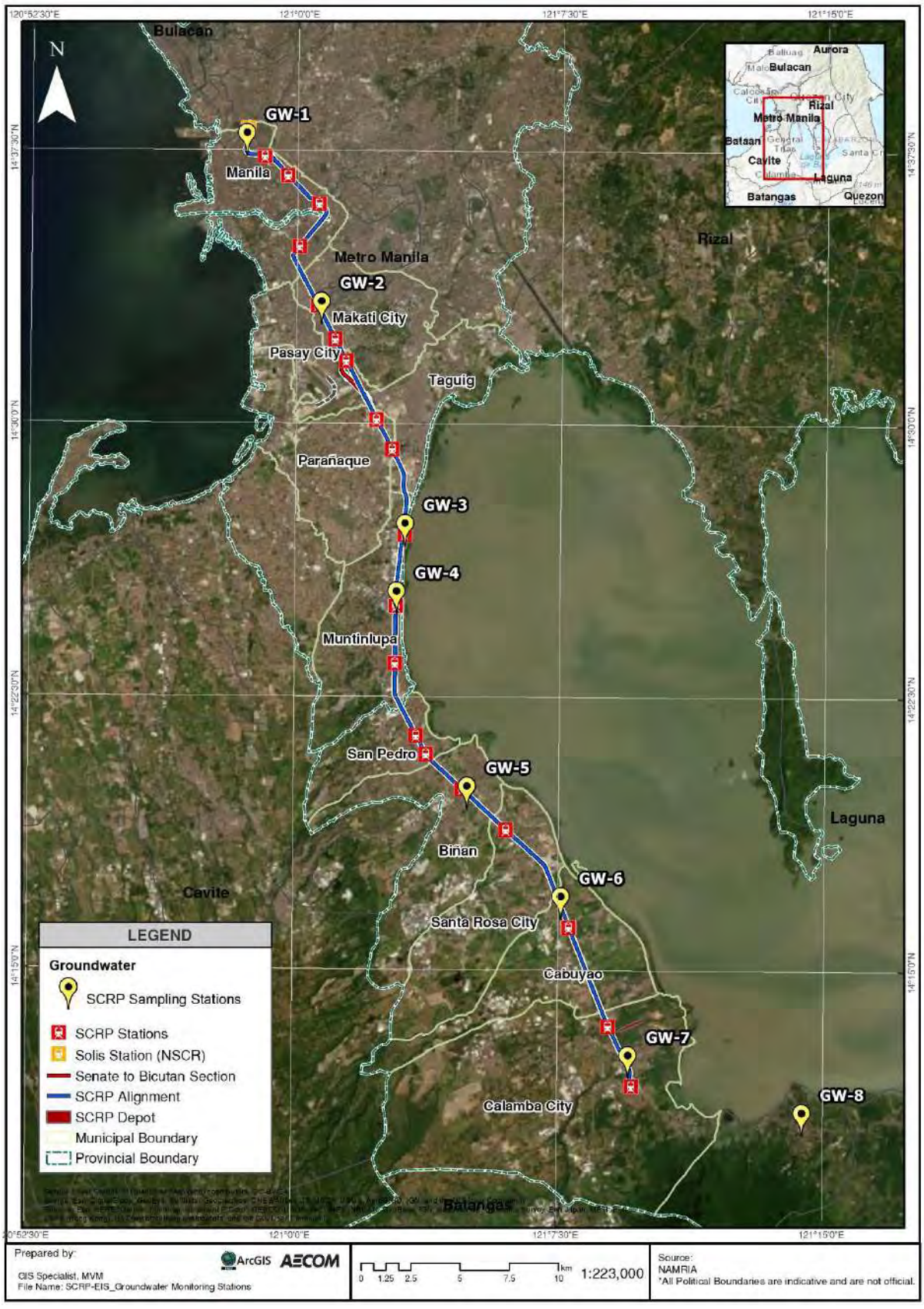


Figure 3.2-9 Groundwater Quality Sampling Stations of the SCRP

(2) Applied Standard

1014. The DOH Administrative Order (AO) 2017-0010 otherwise known as Philippine National Standards for Drinking Water (PNSDW) of 2017 was adopted, as well as the DAO 2016-08, which adopts the groundwater quality guidelines, with modification, based on intended beneficial use, as follows:

- Class A for source of potable water and other domestic use;
- Class B for bathing and other primary contact recreation; and
- Class C for irrigation, fish culture and livestock watering.

1015. The PNSDW and DENR GQG have no guideline values for conductivity, K^{+}, Ca^{2+}, Mg^{2+}, and HCO^{3-}.

(3) Results and Discussions

1016. Known well depths of the tubes in Solis (GW-1), Alabang (GW-4), and Cabuyao (GW-6) range from 24.4 – 42.7 m. Known ages range from 8 to 100 years. Usage varies from community drinking water supply, cooking, bathing and washing. The wells in Buendia (GW-2), and Los Baños (GW-8) are not regularly in use (**Table 3.2-13**). The wells yielded clear water (with persistent brown particles in Los Baños or GW-8). Odor ranged from no objectionable odor to objectionable odor. Bubbles, an indicator of significantly polluted water (from cleaning substances) appeared in the samples from Solis (GW-1) and Buendia (GW-2). Drinking water generally comes from the commercial "mineral" water or from the local water utility.

Table 3.2-13 Data of Inventoried Wells

Sampling Station	Depth	Well Age or Year Installed	Water Usage
GW-1	120 ft/ 36.6 m	2009 or 2010 (8 years)	Community well; Used for clothes washing
GW-2	No data	1998 or 1999 (20 years)	Community well; Used only when there is no water from local water utility
GW-3	No data	No data	Not for drinking
GW-4	140 ft/ 42.7 m	2005 (13 years)	Used for cooking, bathing, and washing
GW-5	No data	Over 100 years	Used for drinking when boiled; Used for cooking, bathing, and washing
GW-6	80 ft/ 24.4 m	No data	Community well; Used for cooking and washing
GW-7	No data	No data	Community well; Not regularly in use
GW-8	No data	No data	Not in use
DD GW-1	70 ft/ 21.3 m	No data	Washing, Bathing
DD GW-2	80 ft / 24.4 m	No data	Washing, Bathing
DD GW-3	No data	No data	Washing, Bathing
DD GW-4	120 ft / 36.6 m	No data	Community Well; Used for drinking

1017. **Table 3.2-14** below summarizes the trend for groundwater parameters during dry and wet seasons. Notable results of the assessment of seasonal groundwater quality data were listed below:

- **During EIA Study**
    - o For the paired seasonal values of the eight (8) sampling sites, there were 10 parameters with higher values during the dry season, 4 with similar values, and 7 with decreased values during the dry season, for the total of 21 parameters. Sampling site GW-3 located east of the Sucat PNR station exhibited the greatest number of parameters (14) with increased values in the dry season.

- For the paired seasonal values of 21 parameters and 8 sites, 82 cases of increased values were noted in dry season, 31 cases with retained values in both seasons and 5 cases of decreased values in dry season.
- The parameters with more apparent cases of increased values during the dry season (at least 5 sites out of 8) were temperature, electrical conductivity, total dissolved solids, potassium, magnesium, bicarbonate, nitrate, arsenic, and cyanide.
- The parameters with more apparent cases of decreased values during the dry season or higher in wet season were pH and sulfate.
- The parameters with retained values were the trace elements cadmium, lead, and total mercury which are undetected cases.
- The parameters which do not show cases of dominance were color, sodium, calcium, chloride, chromium, fecal coliform and total coliform.
- The parameters with apparent retained pattern in the relative values among the sites for both seasons were conductivity, total dissolved solids, potassium, bicarbonate, chloride and sulfate.

- **During Detailed Design Phase**

  - Four (4) samples were collected from DD GW-1, DD GW-2, DD GW-3 and DD GW-4 on May 30, 2019 during the detailed design phase of the Project. Only one of the four sources (DD GW-4) is being used as source for drinking water in the area while the remaining three are being used only for washing and bathing purposes.

Table 3.2-14 Table of Trends for Groundwater Parameters

Parameter	Season	Stations								Trend			Stations			
		GW-1	GW-2	GW-3	GW-4	GW-5	GW-6	GW-7	GW-8	Decreased	Retained	Increased	DD GW-1	DD GW-2	DD GW-3	DD GW-4
Physical Characteristics																
pH	Dry	7.12	6.79	6.7	6.77	6.95	6.82	6.53	6.58	2	0	6	6.97	7.42	6.74	7.58
	Wet	7.56	7.76	6.15	6.87	7.12	7.12	6.83	6.54				-	-	-	-
Color, TCU	Dry	10	40	10	<5	<5	<5	<5	5	2	3	3	<5	<5	<5	<5
	Wet	10	35	6.4	5	5	5	<5	5				-	-	-	-
Temperature, °C	Dry	29.4	31.2	30.5	30.1	30.8	29.8	31.1	30.8	7	0	1	27.9	27.9	27.9	27.9
	Wet	26	27.5	31.8	27.8	30.6	28.4	29.6	29.2				-	-	-	-
Elec. Conductivity uS/cm	Dry	1,348	1,039	1,743	1,429	847	867	903	794	6	0	2	2,604	2,065	2,170	2,016
	Wet	854	202	1,184	1,323	798	915	909	705				-	-	-	-
Total Dissolved Solids (TDS), mg/L	Dry	662	510	855	701	416	426	443	390	6	0	2	1,276	1,013	1,064	988.5
	Wet	419	99	581	649	377	449	446	346				-	-	-	-
Cations and Anions																
Sodium (Na), mg/L	Dry	424	59	242	87	90	29	29	24	4	0	4	70	122	156	46
	Wet	315	75	150	59	71	52	66	78				-	-	-	-
Potassium (K^+), mg/L	Dry	9.8	180	408	19	16	11	10	7.3	7	0	1	27	23	38	38
	Wet	8.9	27	22	20	6.9	9.3	9.5	6.5				-	-	-	-
Calcium (Ca), mg/L	Dry	4.2	62	130	30	82	33	51	38	4	0	4	50	69	75	14
	Wet	0.33	36	96	83	66	60	55	51				-	-	-	-
Magnesium (Mg), mg/L	Dry	4.4	106	132	16	37	21	23	12	7	0	1	33	57	45	15
	Wet	3.2	6.9	18	26	16	14	22	11				-	-	-	-
Bicarbonate (HCO3-), mg/L	Dry	582	364	551	505	414	356	375	313	7	0	1	222	242	184	243
	Wet	543	366	524	446	304	315	291	194				-	-	-	-
Chloride (Cl^-), mg/L	Dry	75	39	160	140	33	46	82	72	3	1	4	89.3	79.4	149	99.3
	Wet	76	60	150	133	34	57	67	72				-	-	-	-
Sulfate (SO_4^{2-}), mg/L	Dry	16	80	61	84	20	22	55	36	2	0	6	37.6	41.4	34.3	42.2
	Wet	28	242	48	87	23	21	60	86				-	-	-	-
Nitrate (NO3-N), mg/L	Dry	0.15	0.16	0.25	0.33	0.17	0.12	0.22	1.9	5	0	3	0.463	0.38	0.337	0.323
	Wet	0.23	0.11	0.078	0.24	0.79	0.096	3.2	0.52				-	-	-	-
Toxic and Other Deleterious Substances																
Arsenic (As), mg/L	Dry	0.0069	0.0035	0.002	0.0016	0.0011	0.001	0.0017	0.0038	7	0	1	<0.0009	<0.0009	<0.0009	<0.0009
	Wet	<0.0009	0.0008	<0.0009	<0.0009	0.0017	<0.0009	<0.0009	<0.0009				-	-	-	-

Parameter	Season	Stations								Trend			Stations			
		GW-1	GW-2	GW-3	GW-4	GW-5	GW-6	GW-7	GW-8	Decreased	Retained	Increased	DD GW-1	DD GW-2	DD GW-3	DD GW-4
Cadmium (Cd), mg/L	Dry	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0	5	3	<0.002	<0.002	<0.002	<0.002
	Wet	0.0047	0.0036	0.0002	<0.002	<0.002	<0.002	<0.002	<0.002				-	-	-	-
Chromium (Cr^{+6}), mg/L	Dry	<0.002	0.002	<0.002	<0.002	0.002	<0.002	<0.002	<0.002	1	3	4	0.0095	0.0086	0.0085	0.0082
	Wet	<0.002	<0.03	<0.03	0.0023	0.0032	0.0099	0.0045	<0.002				-	-	-	-
Cyanide (CN), mg/L	Dry	0.07724	0.03369	0.0229	0.0045	0.0085	0.012	0.0115	0.0101	8	0	0	0.0794	0.0668	0.0866	0.0679
	Wet	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001				-	-	-	-
Lead (Pb), mg/L	Dry	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	0	6	2	<0.006	<0.006	<0.006	<0.006
	Wet	<0.006	0.062	0.062	<0.006	<0.006	<0.006	<0.006	<0.006				-	-	-	-
Total Mercury (Hg), mg/L	Dry	<0.001	<0.001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0	5	3	0.0002	0.0002	0.0001	<0.0001
	Wet	<0.001	<0.001	<0.0001	<0.0001	0.0004	0.0002	<0.0001	0.0001				-	-	-	-
Biological Parameters																
Fecal Coliforms, MPN/100mL	Dry	<1.1	17	<1.1	<1.1	<1.1	>8.0	<1.1	>8.0	2	4	2	<1.1	<1.1	8	<1.1
	Wet	<1.1	>8.0	2.6	<1.1	4.6	<1.1	<1.1	>8.0				-	-	-	-
Total Coliforms, MPN/100mL	Dry	<1.1	17	<1.1	<1.1	<1.1	>8.0	<1.1	>8.0	2	4	2	<1.1	<1.1	8	<1.1
	Wet	<1.1	>8.0	2.6	<1.1	8	<1.1	<1.1	>8.0				-	-	-	-

1) **Results by Sampling Stations**

GW-1 PNR Solis Station

1018. During dry season, measured levels of pH, color, Cl^-, SO_4^{2-}, NO_3-N, As, Cd, Cr^{+6}, Pb, Hg and total coliform at Station GW-1 (PNR Solis Station) did not exceed the maximum allowable levels of PNSDW the DENR Groundwater Quality Guidelines. The levels of CN, Fecal Coliform and temperature exceeded the DENR GQG values while levels of TDS and Na^+ exceeded the PNSDW maximum allowable levels of 600 mg/L and 200 mg/L, respectively.

1019. During wet season, the result of the water quality measurement at Station GW-1 (PNR Solis Station) showed that all parameters did not exceed the maximum allowable levels of PNSDW and the DENR GQG, except for Na^+ and Cd. Na^+ exceeded the 200 mg/L maximum allowable level of PNSDW, while Cd exceeded the 0.003 mg/L maximum allowable level of PNSDW and DENR GQG.

GW-2 PNR Buendia Station

1020. During dry season, the water temperature exceeded the DENR GQG values of 26ºC - 30ºC. The color of the water also exceeded the maximum allowable level of 10 TCU of PNSDW but did not exceed the DENR GQG value of 50 TCU. The measured levels of pH, conductivity, TDS, Na^+, Cl^-, SO_4^{2-}, NO_3-N, heavy metals (As, Cd, Cr^{+6}, Pb and Hg) and CN^- did not exceed the maximum allowable levels of PNSDW and the DENR GQG. The level of fecal coliform exceeded the DENR GQG of <1.1 MPN/100 mL, while level of total coliform exceeded PNSDW maximum allowable level of <1.1 MPN/100 mL. This indicates that water is not safe for drinking unless appropriate water treatment is administered.

1021. During wet season, the result of the water quality measurement at Station GW-2 (PNR Buendia Station) showed that all parameters did not exceed the maximum allowable levels of PNSDW and the DENR GQG, except for Cd and Pb. Color exceeded the 10 TCU as set by PNSDW. The bacteriological analysis of the water showed that levels of both fecal coliform and total coliform are present and exceeded the maximum allowable level of <1.1 MPN/100 mL of DENR and PNSDW.

GW-3 PNR Sucat Station

1022. During dry season, most of the parameters measured at GW-3 (PNR Sucat Station) did not exceed the maximum allowable levels of PNSDW and the DENR GQG except for levels of water temperature, TDS and Na+. The water temperature measured at 30.5ºC exceeded the DENR guideline values of 26ºC - 30ºC, while levels of TDS and Na^+ exceeded the PNSDW of 600 mg/L and 200 mg/L, respectively.

1023. During wet season, most of the parameters measured at GW-3 did not exceed the maximum allowable levels of PNSDW and the DENRGQG except for pH, temperature, Pb, and fecal and total coliforms. Levels of water temperature and fecal coliform exceeded the DENR GQG values of 26-30ºC and <1.1MPN/100 ml, respectively; while level of total coliform exceeded the PNSDW maximum allowable level of <1.1MPN/100 ml. The pH was not within the allowable levels of PNSDW and DENR GQG values of 6.5-8.5. Measured level of Pb at 0.062 mg/L exceeded both the maximum allowable level of PNSDW and the DENR GQG guideline value of 0.01 mg/L.

GW-4 PNR Alabang Station

1024. During dry season, most of the parameters measured at GW-4 (PNR Alabang Station) did not exceed the maximum allowable levels of PNSDW and the DENR GQG except for water temperature and TDS. The water temperature at 30.1 ºC exceeded the DENR GQG

values of 26ºC-30ºC, while TDS at 701 mg/L exceeded the PNSDW maximum allowable level of 600 mg/L.

1025. During wet season, all parameters measured at Station GW-4 (PNR Alabang Station) did not exceed the PNSDW maximum allowable levels and the DENR GQG except for TDS. Level of TDS, which was measured at 649 mg/L, exceeded the PNSDW maximum allowable level of 600 mg/L.

GW-5 PNR Biñan Station

1026. During dry season, the result of the water quality measurement at Station GW-5 (PNR Biñan Station) did not exceed the maximum allowable levels of PNSDW and the DENR GQG except for water temperature level. The water temperature at 30.8 ºC has slightly exceeded the DENR GQG values of 26ºC-30ºC.

1027. During wet season, the measured levels of all parameters at Station GW-5 (PNR Biñan Station) did not exceed the maximum allowable levels of PNSDW and the DENR GQG. The water temperature, which was measured at 30.6ºC, exceeded the DENR GQG values of 26ºC -30ºC. The fecal coliform was present at 4.6 MPN/100 mL which exceeded the <1.1MPN/100 mL DER GQG. The total coliform measured at 8.0 MPN/100 exceeded the maximum allowable level of PNSDW of <1.1 MPN/100 mL.

GW-6 PNR Cabuyao Station

1028. During dry season, measured levels of all parameters measured at Station GW-6 (PNR Cabuyao Station) did not exceed the maximum allowable levels of PNSDW and the DENR GQG. The fecal coliform was present at >8.0 MPN/100 mL which exceeded the <1.1MPN/100 mL PNSDW and DENR guideline value.

1029. During wet season, the measured levels of pH, color, temperature, conductivity, TDS, Cations and Anions (Na^+, Cl^-, SO_4^{2-} and NO3-N) and toxic and other deleterious substances (As, Cd, Cr+6, Pb, Hg and CN^-) did not exceed the maximum allowable levels of PNSDW and the DENR GQG. The fecal coliform did not exceed the maximum allowable level of PNSDW and DENR GQG of <1.1MPN/100 mL.

GW-7 PNR Calamba Station

1030. During dry season, the water quality measurement at Station GW-7 (PNR Calamba Station) did not exceed the maximum allowable levels of PNSDW and the DENR GQG except for water temperature. The water temperature level recorded at 31.1 ºC during the sampling exceeded the DENR guideline values of 26ºC-30ºC.

1031. During wet season, the results of all the water quality measurement at Station GW-7 (PNR Calamba Station) did not exceed the maximum allowable levels of PNSDW and the DENR GQG.

GW-8 PNR Los Baños Station

1032. During dry season, measured levels of all parameters did not exceed the maximum allowable levels of PNSDW and the DENR GQG except for water temperature, and fecal and total coliforms. The fecal coliform was present at >8.0 MPN/100 mL, which exceeded the DENR GQG value of <1.1MPN/100 mL, while the total coliform count at >8.0 MPN/100 exceeded the maximum allowable level of PNSDW of <1.1MPN/100 mL. The water temperature measured at 31.1 ºC also exceeded the DENR GQG values of 26ºC-30ºC.

1033. During wet season, measured levels of all parameters did not exceed the maximum allowable levels of PNSDW and the DENR GQG except for the fecal and total coliforms. The fecal coliform was present at >8.0 MPN/100 mL which exceeded the DENR GQG value of <1.1MPN/100 mL, while the total coliform count at >8.0 MPN/100 also exceeded the maximum allowable level of PNSDW.

DD GW-1 (Located at Purok 6, Bgy. Banlic)

1034. During monitoring on May 29-30, 2019, measured levels of all parameters did not exceed the maximum allowable levels of PNSDW and DENR GQG except for TDS and CN. Level of TDS measured at 1,276 mg/L exceeded the 600 mg/L maximum allowable level of PNSDW, while level of CN at 0.0794 mg/L exceeded the maximum allowable levels of PNSDW and DENR GQG of 0.05 and 0.07, respectively.

DD GW-2 (Located at Purok 7, Bgy. Banlic)

1035. During monitoring on May 29-30, 2019, measured levels of all parameters did not exceed the maximum allowable levels of PNSDW and the DENR GQG except for TDS and CN. Level of TDS measured at 1,013 mg/L exceeded the 600 mg/L maximum allowable level of PNSDW, while level of CN at 0.0668 mg/L exceeded the maximum allowable level of PNSDW and DENR of 0.05 and 0.07 mg/L, respectively.

DD GW-3 (Located at Purok 7, Bgy. Banlic)

1036. During monitoring on May 29-30, 2019, measured levels of all parameters did not the maximum allowable levels of PNSDW and the DENR GQG except for TDS, CN, and fecal and total coliforms. Level of TDS measured at 1,064 mg/L exceeded the 600 mg/L maximum allowable level of PNSDW, while level of CN at 0.0866 mg/L exceeded the maximum allowable level of PNSDW and DENR GQG of 0.07 and 0.05 mg/L, respectively. The fecal coliform was present at 8.0 MPN/100 mL, which exceeded the maximum allowable level of PNSDW and DENR GQG value of <1.1MPN/100 mL.

DD GW-4 (Located at Purok 7, Bgy. Banlic)

1037. During monitoring on May 29-30, 2019, measured levels of all parameters did not exceed the maximum allowable levels of PNSDW and the DENR GQG except for TDS and CN. Level of TDS measured at 988.5 mg/L exceeded the 600 mg/L maximum allowable level of PNSDW, while level of CN at 0.0679 mg/L exceeded the maximum allowable level of PNSDW and DENR GQG of 0.07 and 0.05 mg/L, respectively.

Table 3.2-15 Results of Analysis of Groundwater Samples (1/3)

Parameters	GW-1 Solis PNR Station		GW-2 Buendia PNR Station		GW-3 Sucat PNR Station		GW-4 Alabang PNR Station		PNSD W 2017*	DENR GQ Guidelines	
										Class A	Class B
Use	Clothes washing		Domestic Use used only when there is no water from local water utility		Not for drinking		Domestic Use cooking, bathing, washing				
Date of sampling	02/14/2018	19/07/2018	02/14/2018	14/07/2018	02/14/2018	06/07/2018	02/13/2018	16/07/2018			
Time of sampling (H)	0900H	1122H	1225H	1215H	1800H	1552H	1700H	0711H			
Physical Characteristic											
pH	7.12	7.56	6.79	7.76	6.70	6.15	6.77	6.87	6.5-8.5	6.5-8.5	6.5-8.5
Color, TCU	10	10	40	35	10	6.4	<5	5	10	50	50
Water temperature, °C	29.4	26.0	31.2	27.5	30.5	31.8	30.1	27.8	-	26-30	26-30
Electrical Conductivity, uS/cm	1,348	854	1,039	202	1,743	1,184	1,429	1,323	-	-	-
Total Dissolved Solids (TDS), mg/L	662	419	510	99	855	581	701	649	600	-	-
Cations and Anions											
Sodium (Na), mg/L	424	315	59	75	242	150	87	59	200	-	-
Potassium (K^{+}), mg/L	9.8	8.9	180	27	408	22	19	20	-	-	-
Calcium (Ca), mg/L	4.2	0.33	62	36	130	96	30	83	-	-	-
Magnesium (Mg), mg/L	4.4	3.2	106	6.9	132	18	16	26	-	-	-
Bicarbonate (HCO_{3-}), mg/L	582	543	364	366	551	524	505	446	-	-	-
Chloride (Cl^{-}), mg/L	75	76	39	60	160	150	140	133	250	250	250
Sulfate (SO_4^{2-}), mg/L	16	28	80	242	61	48	84	87	250	250	250
Nitrate (NO3-N), mg/L	0.15	0.23	0.16	0.11	0.25	0.078	0.33	0.24	50	-	-
Toxic and Other Deleterious Substances											
Arsenic (As), mg/L	0.0069	<0.0009	0.0035	0.0008	0.002	<0.0009	0.0016	<0.0009	0.01	0.01	0.01
Cadmium (Cd), mg/L	<0.002	0.0047	<0.002	0.0036	<0.002	0.0002	<0.002	<0.0002	0.003	0.003	0.003
Chromium Hexavalent (Cr^{+6}), mg/L	<0.002	<0.002	0.002	<0.03	<0.002	<0.03	<0.002	0.0023	0.05	0.01	0.01
Cyanide (CN), mg/L	0.0724	<0.001	0.0369	<0.001	0.0229	<0.001	0.0045	<0.001	0.05	0.07	0.07
Lead (Pb), mg/L	<0.006	<0.006	<0.006	0.062	<0.006	0.062	<0.006	<0.006	0.01	0.01	0.01
Total Mercury (Hg), mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001	0.001	0.001
Microbes											
Fecal Coliforms, MPN/100mL	<1.1	<1.1	17	>8.0	<1.1	2.6	<1.1	<1.1	-	<1.1	100
Total Coliforms, MPN/100mL	<1.1	<1.1	17	>8.0	<1.1	2.6	<1.1	<1.1	<1.1	-	-

Note: Highlighted results do not conform with standards

Table 3.2-16 Results of Analysis of Groundwater Samples (2/3)

Parameters	GW-5 Biñan PNR Station		GW-6 Cabuyao PNR Station		GW-7 Calamba PNR Station		GW-8 Los Baños PNR Station		PNSD W 2017*	DENR GQ Guidelines	
										Class A	Class B
Use	Domestic Use, drinking when boiled, cooking, bathing, washing		Domestic Use, for cooking, washing		Domestic Use, not regularly in use		Domestic Use	not regularly in use			
Date of sampling	02/13/2018	25/06/2018	02/13/2018	28/06/2018	02/12/2018	27/06/2018	02/12/2018	27/06/2018			
Time of sampling (H)	1125H	1100H	0945H	1515H	1605H	1335H	1040H	1100H			
Physical Characteristic											
pH	6.95	7.12	6.82	7.12	6.53	6.83	6.58	6.54	6.5-8.5	6.5-8.5	6.5-8.5
Color, TCU	<5	5	<5	5	<5	<5	5	5	10	50	50
Water temperature, °C	30.8	30.6	29.8	28.4	31.1	29.6	30.8	29.2	-	26-30	26-30
Electrical Conductivity, uS/cm	847	798	867	915	903	909	794	705	-	-	-
Total Dissolved Solids (TDS), mg/L	416	377	426	449	443	446	390	346	600	-	-
Cations and Anions											
Sodium (Na), mg/L	90	71	29	52	29	66	24	78	200	-	-
Potassium (K), mg/L	16	6.9	11	9.3	10	9.5	7.3	6.5	-	-	-
Calcium (Ca), mg/L	82	66	33	60	51	55	38	51	-	-	-
Magnesium (Mg), mg/L	37	16	21	14	23	22	12	11	-	-	-
Bicarbonate (HCO_{3-}), mg/L	414	304	356	315	375	291	313	194	-	-	-
Chloride (Cl), mg/L	33	34	46	57	82	67	72	72	250	250	250
Sulfate (SO_4^{2-}), mg/L	20	23	22	21	55	60	36	86	250	250	250
Nitrate (NO3-N), mg/L	0.17	0.79	0.12	0.096	0.22	3.2	1.9	0.52	50	-	-
Toxic and Other Deleterious Substances											
Arsenic (As), mg/L	0.0011	0.0017	0.001	<0.0009	0.0017	<0.0009	0.0038	<0.0009	0.01	0.01	0.01
Cadmium (Cd), mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.003	0.003	0.003
Chromium Hexavalent (Cr^{+6}), mg/L	0.002	0.0032	<0.002	0.0099	<0.002	0.0045	<0.002	<0.002	0.05	0.01	0.01
Cyanide (CN), mg/L	0.0085	<0.001	0.012	<0.001	0.0115	<0.001	0.0101	<0.001	0.05	0.07	0.07
Lead (Pb), mg/L	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	0.01	0.01	0.01
Total Mercury (Hg), mg/L	<0.0001	0.0004	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	0.0001	0.001	0.001	0.001
Microbes											
Fecal Coliforms, MPN/100mL	<1.1	4.6	>8.0	<1.1	<1.1	<1.1	>8.0	>8	-	<1.1	100
Total Coliforms, MPN/100mL	<1.1	8	>8.0	<1.1	<1.1	<1.1	>8.0	>8	<1.1	-	-

Note: Highlighted results do not conform with standards

Table 3.2-17 Results of Analysis of Groundwater Samples (3/3)

Parameters	DD GW-1 Purok 6, Bgy. Balic	DD GW-2 Purok 7, Bgy. Balic	DD GW-3 Purok 7, Bgy. Balic	DD GW-4 Purok 7, Bgy. Balic	PNSDW 2017*	DENR GQ Guidelines	
						Class A	Class B
Use	Not for drinking	Not for drinking	Not for drinking	Community well; Used for drinking			
Date of sampling	05/30/2019	05/30/2019	05/30/2019	05/30/2019			
Time of sampling (H)	1057H	1044H	1647H	1149H			
Physical Characteristic							
pH	6.97	7.42	6.74	7.58	6.5-8.5	6.5-8.5	6.5-8.5
Color, TCU	<5	<5	<5	<5	10	50	50
Water temperature, °C	27.9	27.9	27.9	27.9	-	26-30	26-30
Electrical Conductivity, uS/cm	2,604	2,065	2,170	2,016	-	-	-
Total Dissolved Solids (TDS), mg/L	1,276	1,013	1,064	988.5	600	-	-
Cations and Anions							
Sodium (Na), mg/L	70	122	156	46	200	-	-
Potassium (K), mg/L	27	23	38	38	-	-	-
Calcium (Ca), mg/L	50	69	75	14	-	-	-
Magnesium (Mg), mg/L	33	57	45	15	-	-	-
Bicarbonate (HCO_{3-}), mg/L	222	242	184	243	-	-	-
Chloride (Cl), mg/L	89.3	79.4	149	99.3	250	250	250
Sulfate (SO_4^{2-}), mg/L	37.6	41.4	34.3	42.2	250	250	250
Nitrate (NO3-N), mg/L	0.463	0.38	0.337	0.323	50	-	-
Toxic and Other Deleterious Substances							
Arsenic (As), mg/L	<0.0009	<0.0009	<0.0009	<0.0009	0.01	0.01	0.01
Cadmium (Cd), mg/L	<0.002	<0.002	<0.002	<0.002	0.003	0.003	0.003
Chromium Hexavalent (Cr^{+6}), mg/L	0.0095	0.0086	0.0085	0.0082	0.05	0.01	0.01
Cyanide (CN), mg/L	0.0794	0.0668	0.0866	0.0679	0.05	0.07	0.07
Lead (Pb), mg/L	<0.006	<0.006	<0.006	<0.006	0.01	0.01	0.01
Total Mercury (Hg), mg/L	0.0002	0.0002	0.0001	<0.0001	0.001	0.001	0.001
Microbes							
Fecal Coliforms, MPN/100mL	<1.1	<1.1	8	<1.1	-	<1.1	100
Total Coliforms, MPN/100mL	<1.1	<1.1	8	<1.1	<1.1	-	-

Note: Highlighted results do not conform with standards

2) **Results by Parameter**

Color

1038. During dry season, the color ranged from <5 to 40 TCU with one (1) case of non-conformance [40 TCU of Buendia PNR Station (GW-2)] to the maximum allowable level of 10 TCU of PNSDW but conforming with the 50 TCU of the DENR GQG.

1039. During wet season, the color ranged from <5 to 35 TCU with no case of non-conformance with the PNSDW and the DENR GQG. Except for Buendia PNR Station (GW-2), all stations were conformant to the PNSDW and the DENR GQG.

1040. Except for Alabang PNR Station (GW-4), Biñan PNR Station (GW-5) and Cabuyao PNR Station (GW-6), the results of color during wet season either retained or decreased as compared to dry season.

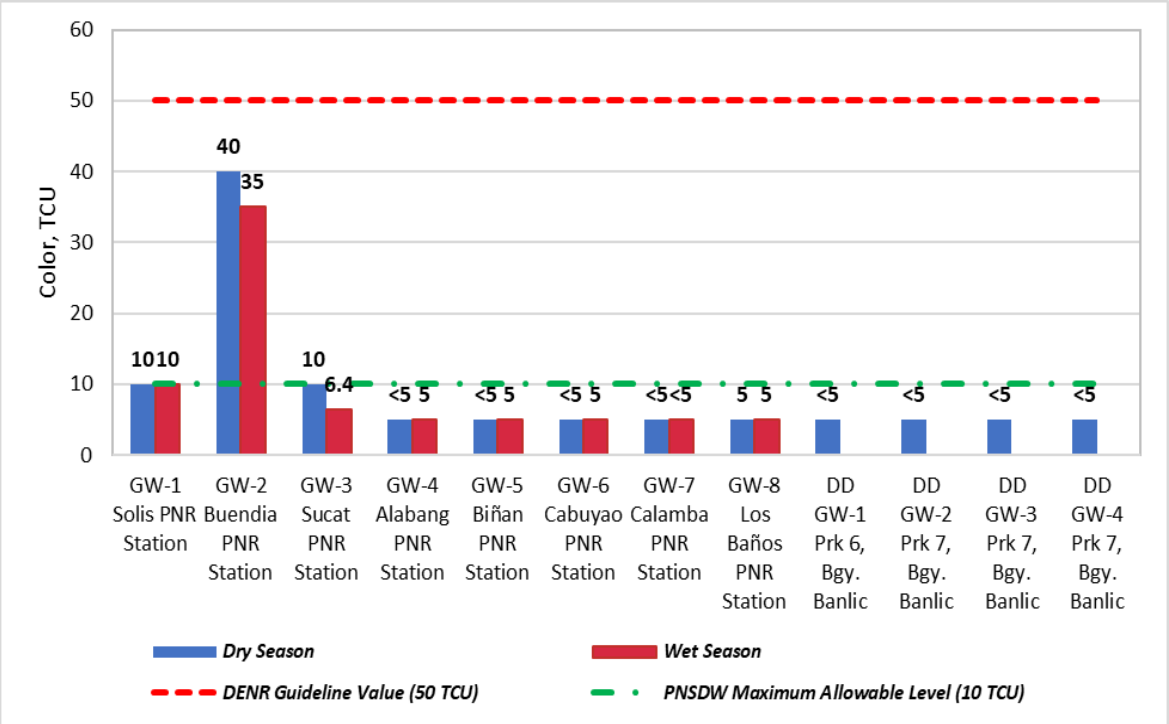


Figure 3.2-10 Results of Color Measurement of Groundwater Samples

Temperature

1041. During dry season, temperature ranged from 27.9ºC to 31.2ºC with six (6) cases of non-conformance with the DENR GQG range of 26ºC -30ºC. The non-conformance was recorded at Buendia PNR Station (GW-2), Sucat PNR Station (GW-3), Alabang PNR Station (GW-4), Biñan PNR Station (GW-5), Calamba PNR Station (GW-7) and Los Baños PNR Station (GW-8), however, the values may be taken as natural levels.

1042. During wet season, temperature ranged from 26ºC to 31.8ºC with two (2) cases of non-conformance with the DENR GQG range of 26ºC to 30ºC. The non-conformance was recorded at Sucat PNR Station (GW-3) and Biñan PNR Station (GW-5), however, these values may be taken as natural levels.

1043. Except for Sucat PNR Station (GW-3), temperature at all stations during wet season decreased in value as compared to during dry season

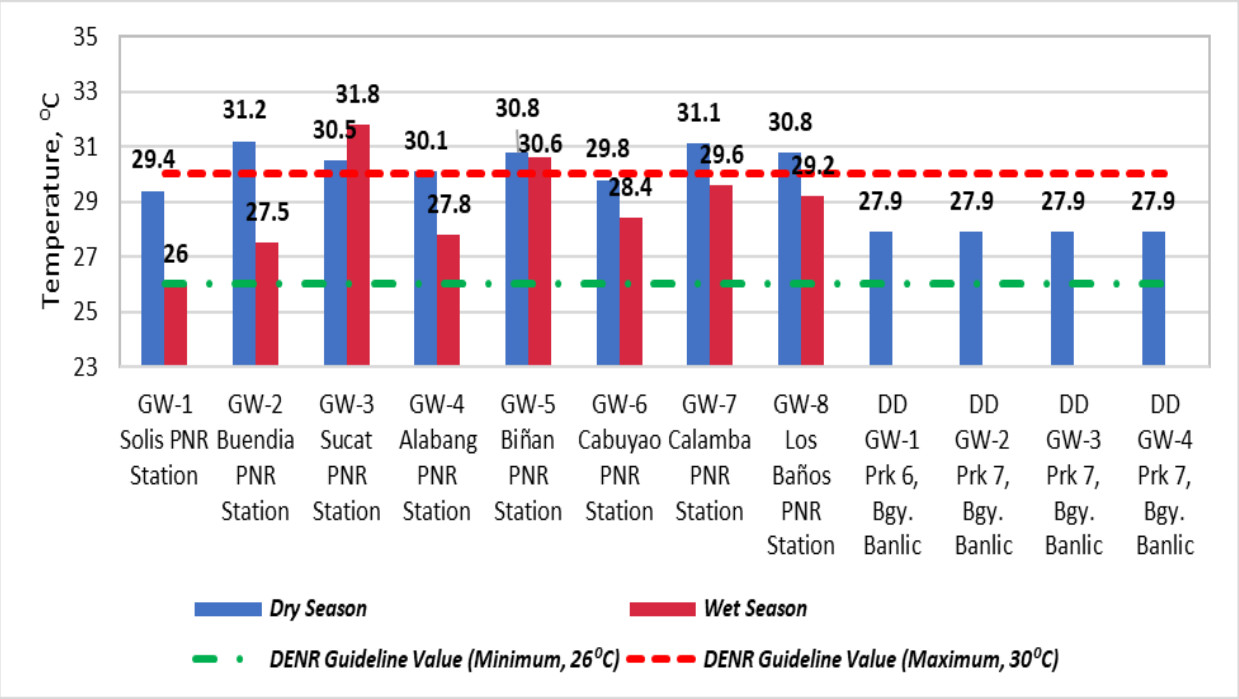


Figure 3.2-11 Results of Temperature Measurement of Groundwater Samples

pH Level

1044. During dry season, the pH ranged from 6.53 to 7.58 within the 6.5 - 8.5 range of PNSDW and the DENR GQG.

1045. During wet season, the pH ranged from 6.15 to 7.76 with one (1) case of non-conformance with the PNSDW and the DENR GQG range of 6.5 - 8.5. This was recorded in Sucat PNR Station (GW-3).

1046. Except at Sucat PNR Station (GW-3) and Los Baños PNR Station (GW-8), there was an increase in pH levels in all stations during wet season as compared to dry season. This may be due to dilution caused by higher volume of water during wet season

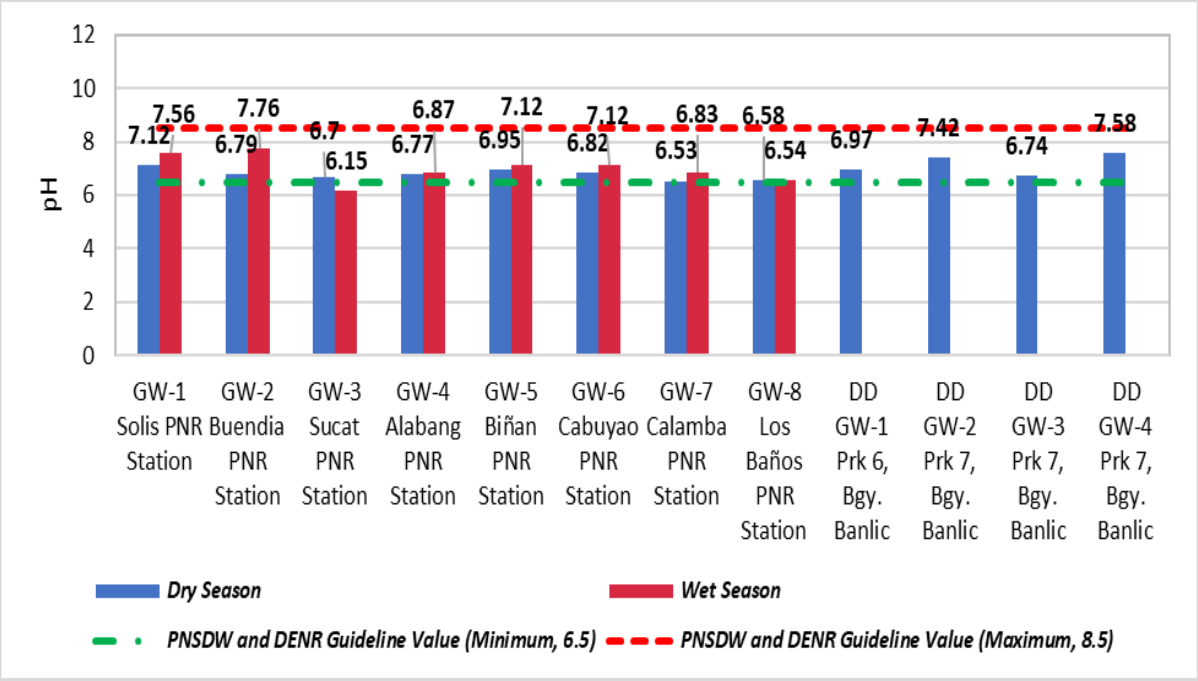


Figure 3.2-12 Results of pH Measurement of Groundwater Samples

Conductivity

1047. During dry season, the electric conductivity of the groundwater in twelve (12) stations ranged from 794 to 2,604 µS/cm. The highest was recorded in Purok 6 of Bgy. Banlic (DD GW-1) and the lowest was in Los Baños PNR Station (GW-8).

1048. During wet season, the electric conductivity of the groundwater in the eight (8) stations ranged from 705.4 to 1,323 µS/cm. The highest was recorded in Alabang PNR Station (GW-4) and the lowest was in Los Baños PNR Station (GW-8).

1049. Except at Cabuyao PNR Station (GW-6) and Calamba PNR Station (GW-7), conductivity at all stations decreased during wet season as compared to dry season, maybe due to availability of greater water volume for dilution.

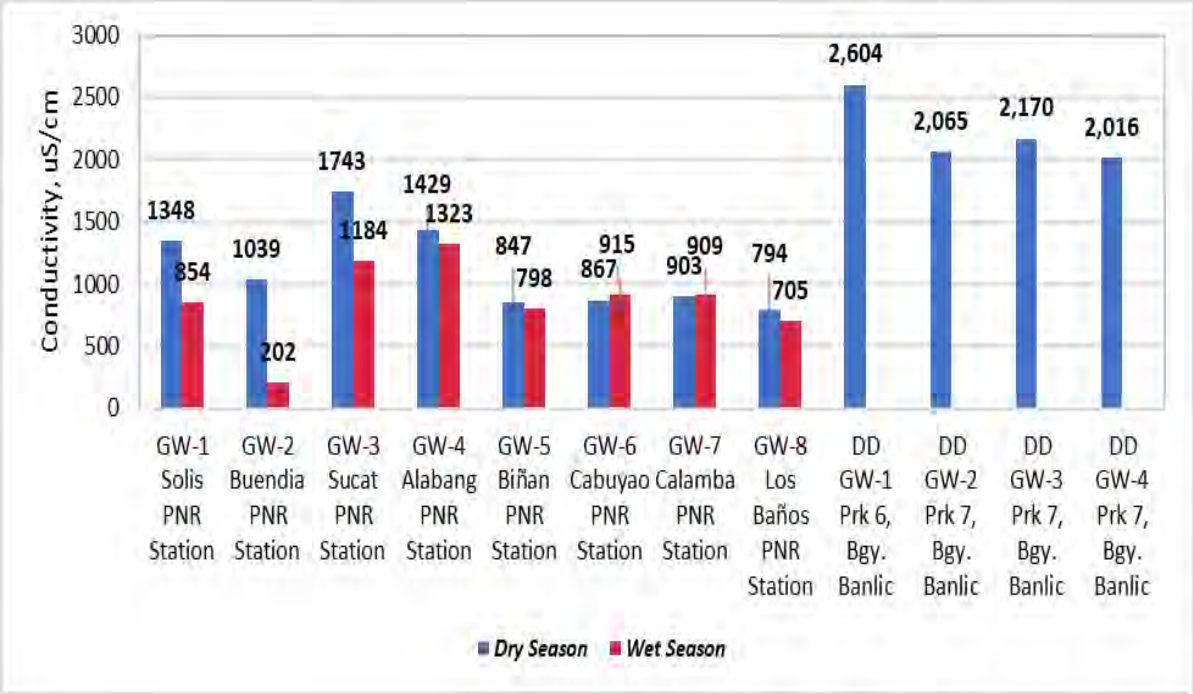


Figure 3.2-13 Results of Electrical Conductivity Measurement of Groundwater Samples

Total Dissolved Solids

1050. During dry season, the equivalent Total Dissolved Solids (TDS) of the twelve (12) stations ranged from 390 to 1,276 mg/L, with the highest one recorded was in Purok 6 of Bgy. Banlic (DD GW-1) and the lowest was in Los Baños PNR Station (GW-8). Overall, there were seven (7) cases of non-conformance with the 600 mg/L PNSDW maximum allowable level; those are the Solis, Sucat and Alabang PNR Stations, and all four (4) additional stations within the vicinity of the proposed Banlic Depot.

1051. During wet season, the equivalent TDS of the eight (8) stations ranged from 99.33 to 648.6 mg/L, with the highest recorded in Alabang PNR Station (GW-4) and the lowest in Buendia PNR Station (GW-2). Overall, there was one (1) case of non-conformance with the PNSDW maximum allowable level of 600 mg/L. This was recorded in Alabang PNR Station (GW-4).

1052. The trend with TDS followed that of the electrical conductivity, in that its value decreased in all stations except at GW-6 and GW-7 during wet season as compared to dry season values

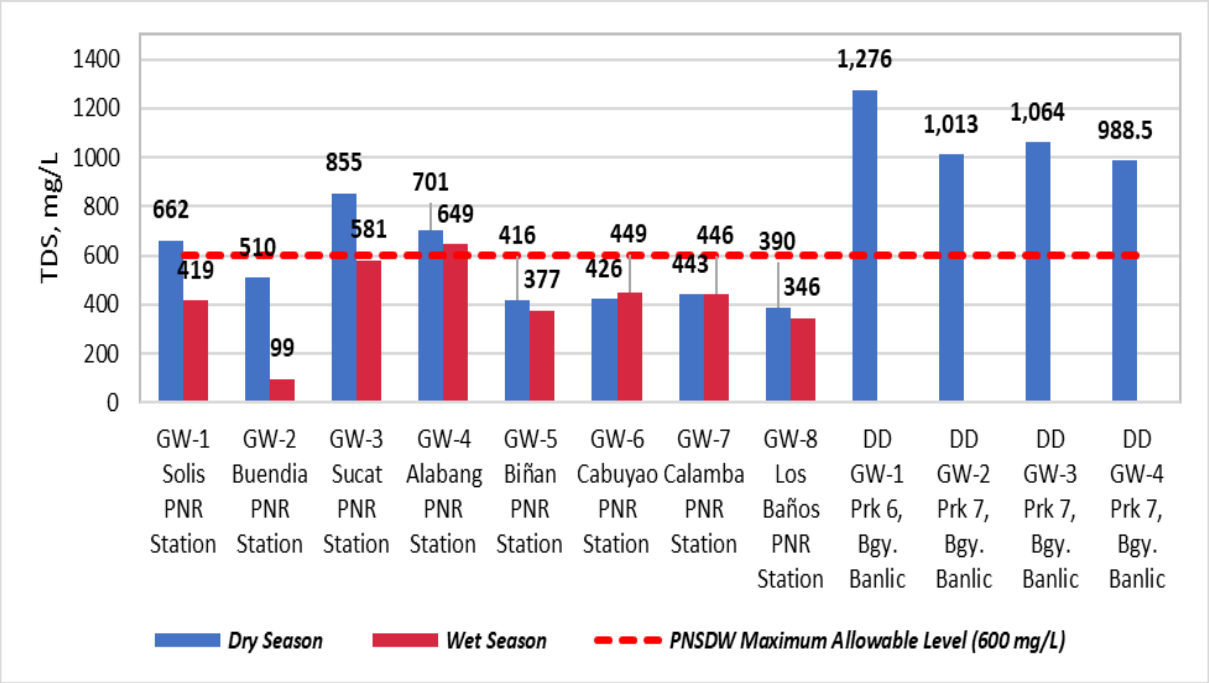


Figure 3.2-14 Results of Total Dissolved Solids Measurement of Groundwater Samples

Sodium

1053. During dry season, the Sodium (Na+) concentrations of the stations ranged from 24 to 424 mg/L with two (2) cases of non-conformance (GW-1 Solis and GW-3 Buendia) with the PNSDW maximum allowable level of 200 mg/L. The highest was recorded in Solis PNR Station (GW-1) and the lowest in Los Baños PNR Station (GW-8).

1054. During wet season, the Na+ concentrations of the stations ranged from 52 to 315 mg/L with one (1) case of non-conformance with the PNSDW maximum allowable level of 200 mg/L. The highest one was recorded in Solis PNR Station (GW-1) and the lowest in Cabuyao PNR Station (GW-6).

1055. Equal number of stations decreased and increased in Na+ concentrations during wet season as compared to dry season. The highest reduction occurred in Solis PNR Station (GW-1) while the highest increase occurred in Los Baños PNR Station (GW-8)

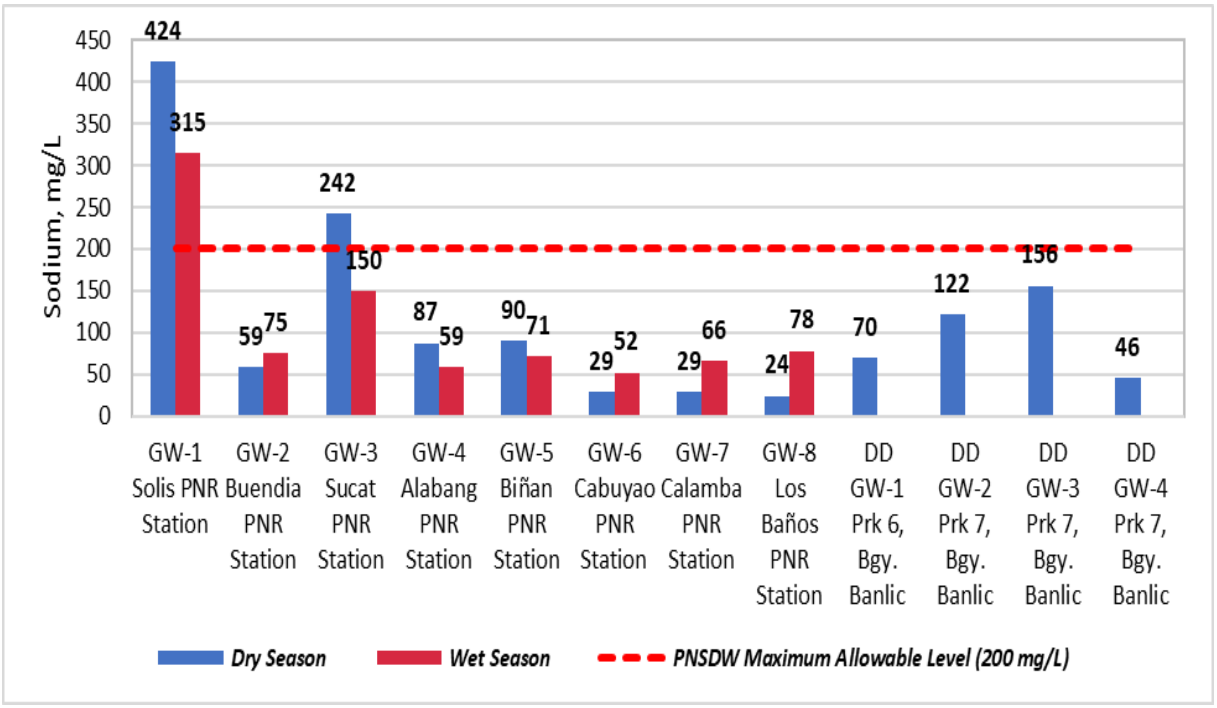


Figure 3.2-15 Results of the Sodium Measurement of Groundwater Samples

Potassium

1056. During dry season, the Potassium (K+) concentrations of the groundwater in all stations ranged from 7.3 to 408 mg/L. The highest concentration was recorded in Sucat PNR Station (GW-3) and the lowest was in Los Baños PNR Station (GW-8).

1057. During wet season, the K+ concentrations of the groundwater in the stations ranged from 6.5 to 27 mg/L. The highest concentration was recorded in Buendia PNR Station (GW-2) and the lowest was in Los Baños PNR Station (GW-8).

1058. Compared to dry season, the K+ concentrations during wet season decreased at all stations except in Alabang PNR Station (GW-4).

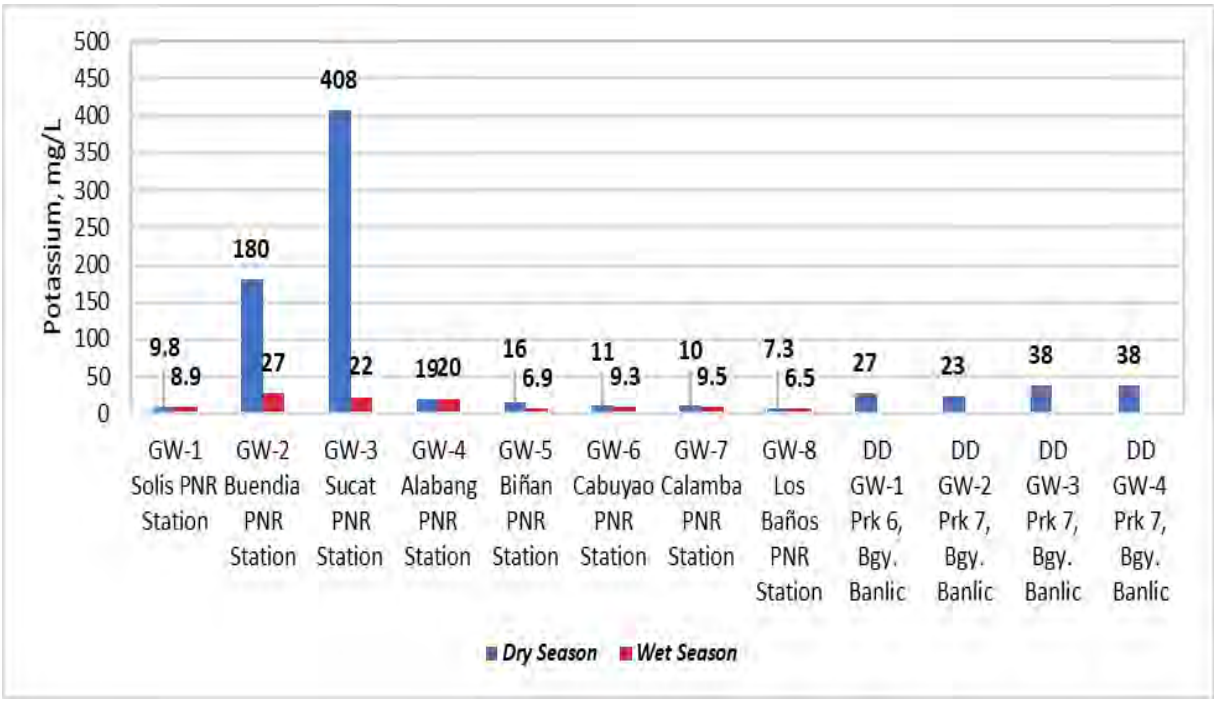


Figure 3.2-16 Results of Potassium Measurement of Groundwater Samples

Calcium

1059. During dry season, the Calcium (Ca^{2+}) concentrations of the groundwater in the stations ranged from 4.2 to 130 mg/L. The highest concentration was recorded in Sucat PNR Station (GW-3) and the lowest was in Solis PNR Station (GW-1).

1060. During wet season, the Ca^{2+} concentrations of the groundwater in the stations ranged from 0.33 to 96 mg/L. The highest concentration was still recorded in Sucat PNR Station (GW-3) and the lowest was still in Solis PNR Station (GW-1).

1061. Equal number of stations decreased and increased in Ca^{2+} concentrations during wet season as compared to dry season. The highest reduction occurred in Sucat PNR Station (GW-3), while the highest increase occurred in Alabang PNR Station (GW-4).

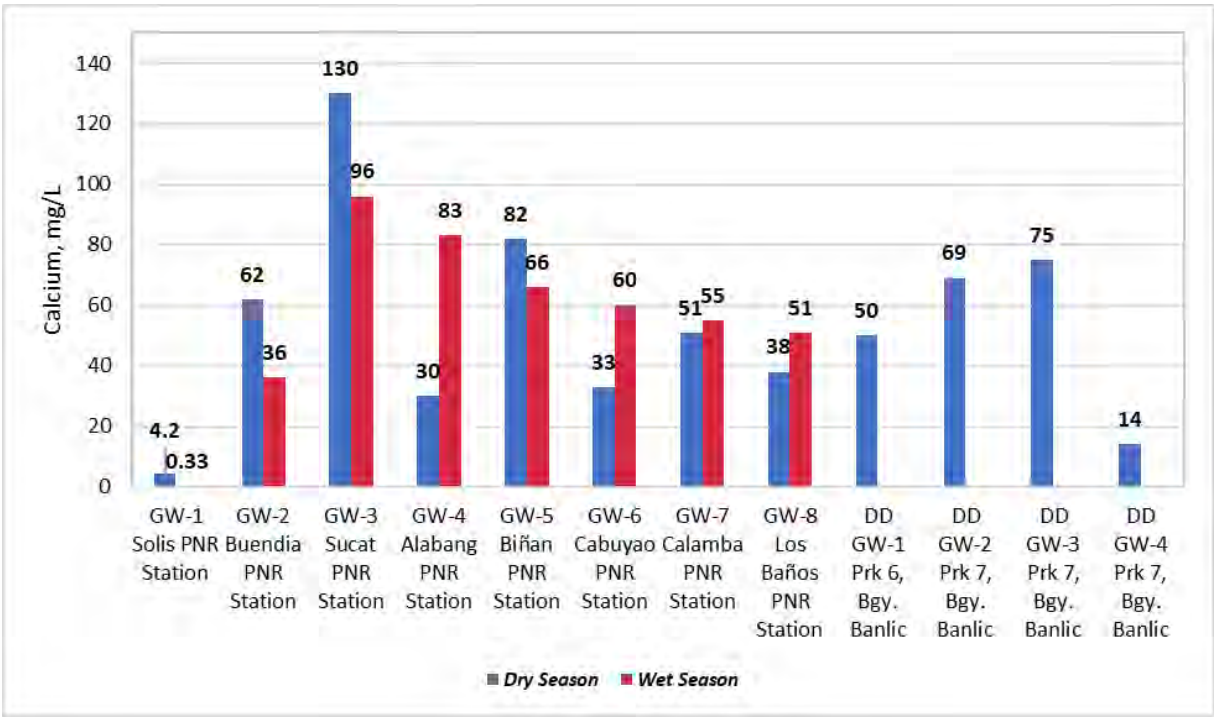


Figure 3.2-17 Results of Calcium Measurement of Groundwater Samples

Magnesium

1062. During dry season, the Magnesium (Mg2+) concentrations of the groundwater in the stations ranged from 4.4 to 132 mg/L. The highest concentration was recorded in Sucat PNR Station (GW-3) and the lowest was in Solis PNR Station (GW-1).

1063. During wet season, the Mg2+ concentrations of the groundwater in the stations ranged from 3.2 to 26 mg/L. The highest concentration was recorded in Alabang PNR Station (GW-4) and the lowest was still in Solis PNR Station (GW-1).

1064. Compared to dry season, Mg2+ concentrations at all stations during wet season decreased except in Alabang PNR Station (GW-4).

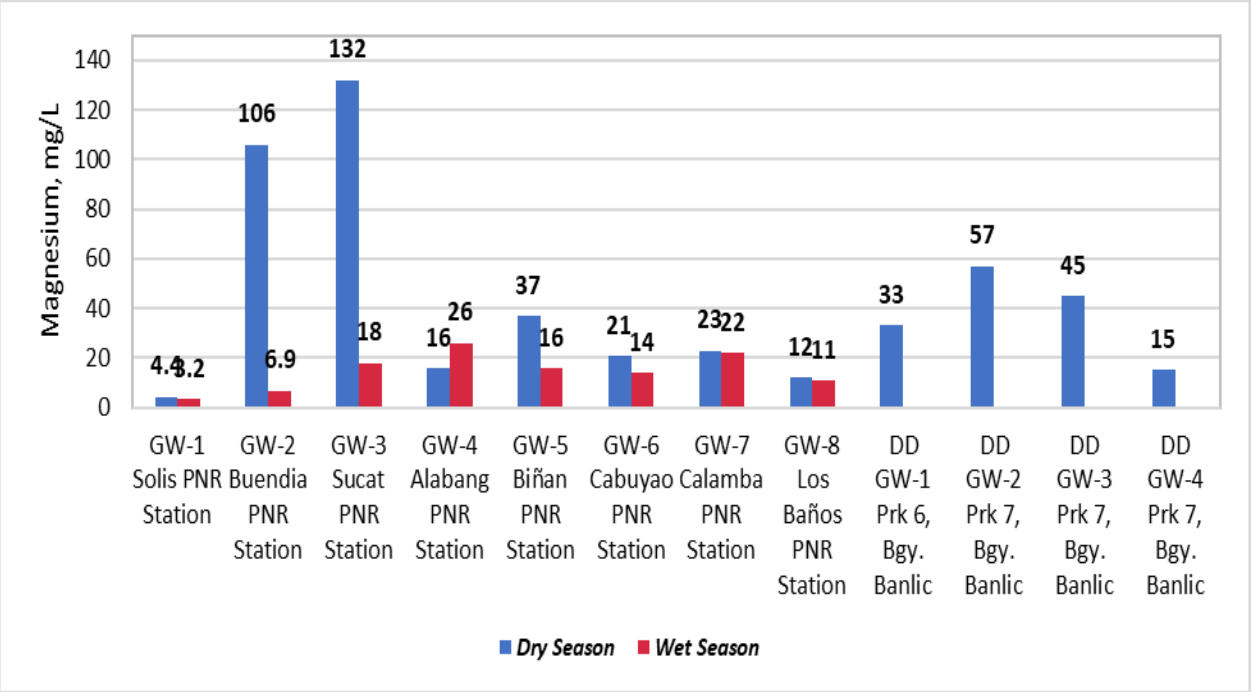


Figure 3.2-18 Results of Magnesium Measurement of Groundwater Samples

Bicarbonate

1065. During dry season, the Bicarbonate (HCO3-) concentrations of the groundwater in the stations ranged from 184 to 582 mg/L. The highest concentration was recorded in Solis PNR Station (GW-1) and the lowest was in Purok 7 of Bgy. Banlic (DD GW-3).

1066. During wet season, the HCO3- concentrations of the groundwater in the stations ranged from 194 to 543 mg/L. The highest concentration was still recorded in Solis PNR Station (GW-1) and the lowest was still in Los Baños PNR Station (GW-8).

1067. Compared to dry season, the HCO3- concentrations at all stations during wet season decreased except in Buendia PNR Station (GW-2).

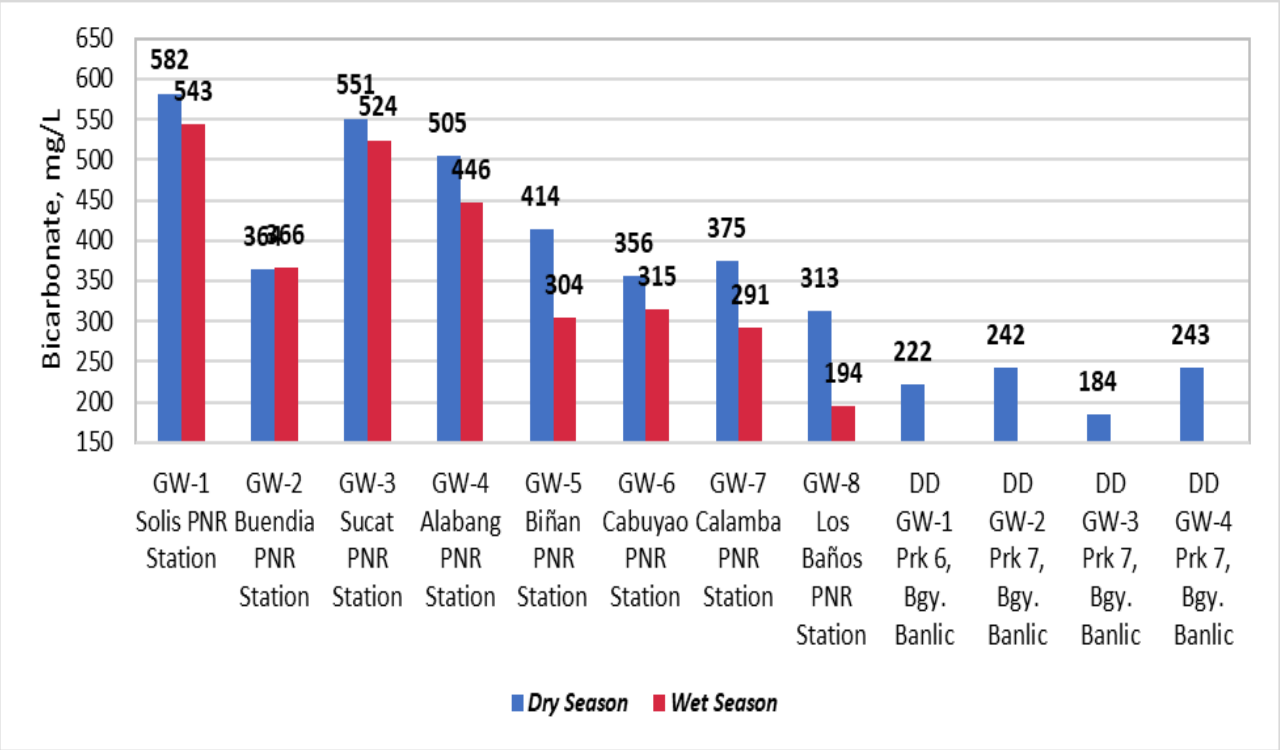


Figure 3.2-19 Results of Bicarbonate Measurement of Groundwater Samples

Chloride

1068. During dry season, the Chloride (Cl^-) concentrations for the twelve (12) stations ranged from 33 to 160 mg/L and were all below the PNSDW maximum allowable level and the DENR GQG of 250 mg/L. The highest was recorded in Sucat PNR Station (GW-3) and the lowest was in Biñan PNR Station (GW-5).

1069. During wet season, the Cl^- concentrations for the eight (8) stations ranged from 34 to 150 mg/L and were all below the PNSDW maximum allowable level and the DENR GQG of 250 mg/L. The highest was recorded in Sucat PNR Station (GW-3) and the lowest was in Biñan PNR Station (GW-5).

1070. Compared to dry season, three (3) stations decreased and four (4) stations increased in Cl^- concentrations during wet season. The highest decrease occurred in Calamba PNR Station (GW-7) while the highest increase occurred in Buendia PNR Station (GW-2).

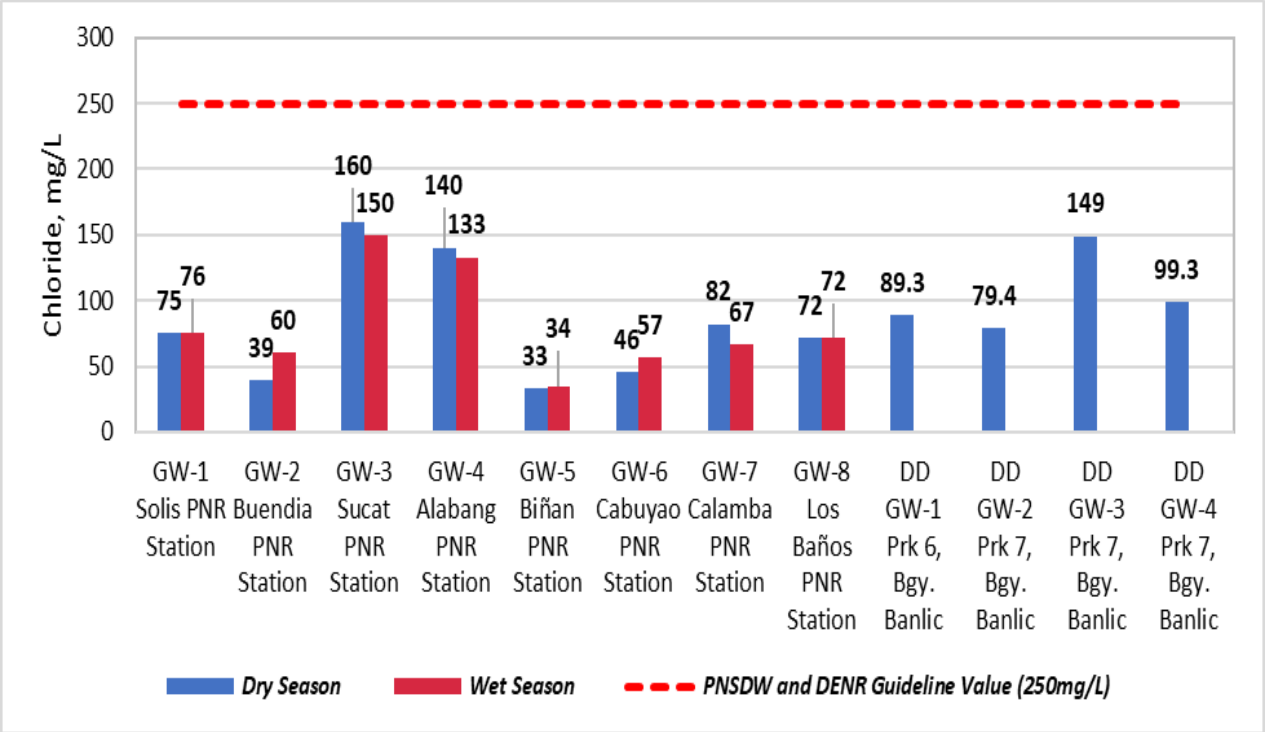


Figure 3.2-20 Results of Chloride Measurement of Groundwater Samples

Sulfate

1071. During dry season, the Sulfate (SO_4^{-2}) concentrations in all PNR stations were below the PNSDW maximum allowable level and the DENR GQG of 250 mg/L. The SO_4^{-2} concentrations ranged from 16 to 84 mg/L. The highest was recorded in Alabang PNR Station (GW-4) and the lowest was in Solis PNR Station (GW-1).

1072. During wet season, the SO_4^{-2} concentrations in all PNR stations were below the PNSDW maximum allowable level and the DENR GQG of 250 mg/L. The sulfate concentrations in all stations ranged from 21 to 242 mg/L. The highest was recorded in Buendia PNR Station (GW-2) and the lowest was in Cabuyao PNR Station (GW-6).

1073. Compared to dry season, except in Sucat PNR Station (GW-3) and Cabuyao PNR Station (GW-6), SO_4^{-2} concentrations increased in all stations during wet season.

1074.

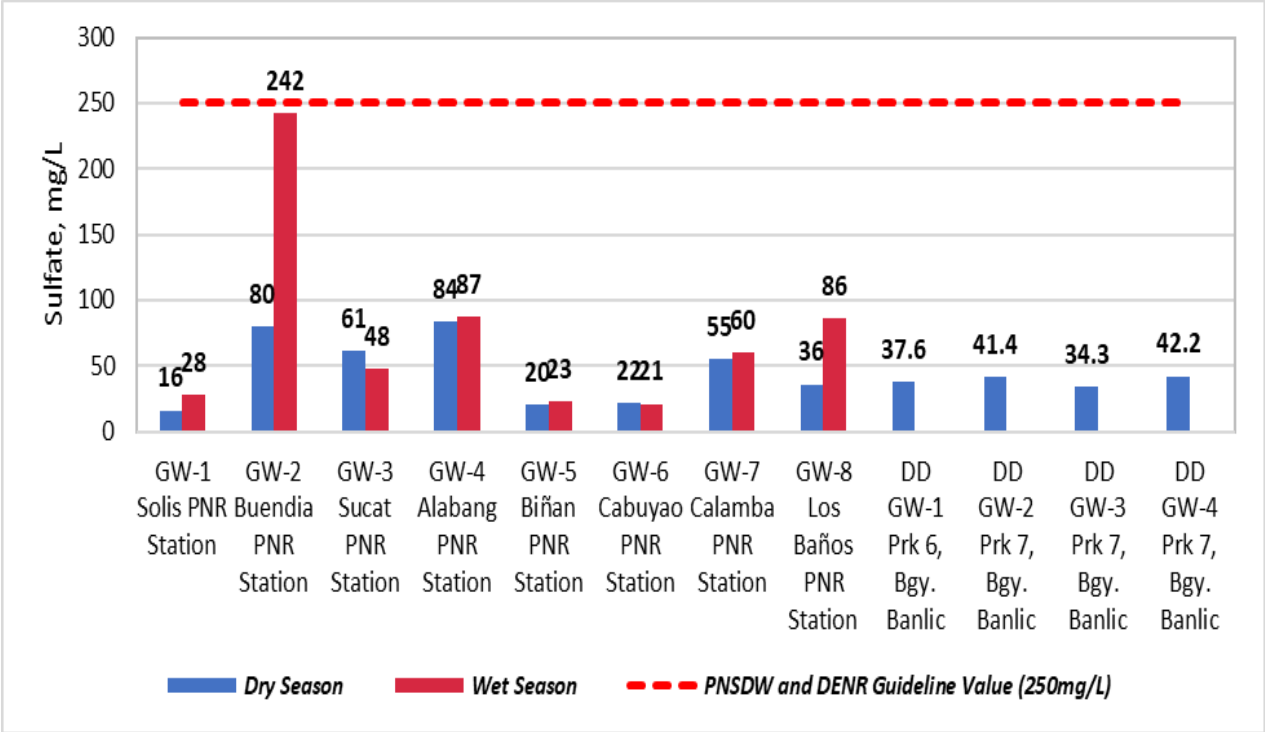


Figure 3.2-21 Results of Sulfate Measurement of Groundwater Samples

Nitrate

1075. During dry season, the Nitrate (NO_3-N) concentrations ranged from 0.12 to 1.9 mg/L and were all below the PNSDW maximum allowable level of 50 mg/L and the DENR GQG of 7 mg/L. The highest concentration was recorded in Los Baños PNR Station (GW-8) and the lowest was in Cabuyao PNR Station (GW-6).

1076. During wet season, the NO_3-N concentrations ranged from 0.078 to 3.2 mg/L and were all below the PNSDW maximum allowable level of 50 mg/L and the DENR GQG of 7 mg/L. The highest concentration was recorded in Calamba PNR Station (GW-7) and the lowest was in Sucat PNR Station (GW-3).

1077. Except at Solis PNR Station (GW-1), Biñan PNR Station (GW-5) and Calamba PNR Station (GW-7), there were decrease in NO_3-N concentrations in all stations during wet season as compared to dry season.

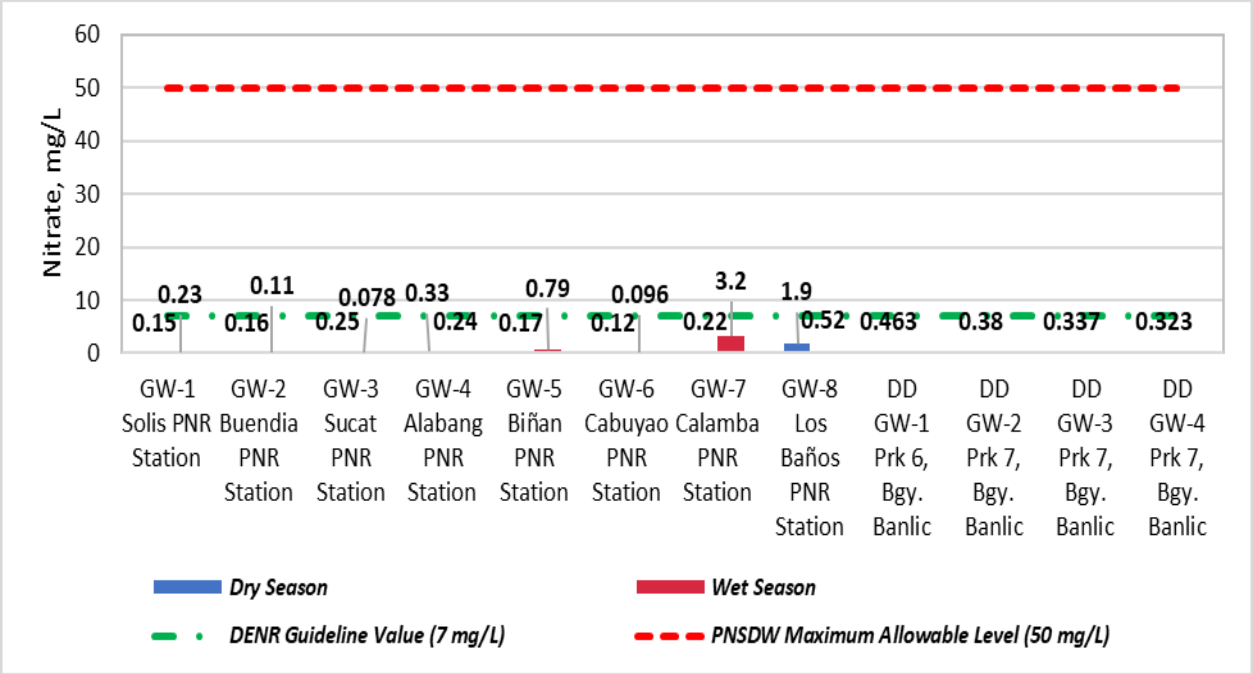


Figure 3.2-22 Results of Nitrate Measurement of Groundwater Samples

Arsenic

1078. During dry season, the Arsenic (As) concentrations ranged from <0.0009 to 0.0069 mg/L and were all below the PNSDW maximum allowable level and the DENR GQG of 0.01 mg/L. The highest concentration was recorded in Solis PNR Station (GW-1).

1079. During wet season, the As concentrations ranged from <0.0009 to 0.0017 mg/L and were all below the PNSDW maximum allowable level and the DENR GQG of 0.01 mg/L. The highest concentration was recorded in Biñan PNR Station (GW-5).

1080. Except at station Biñan PNR Station (GW-5), there were decrease in As concentrations during wet season as compared to dry season in all stations.

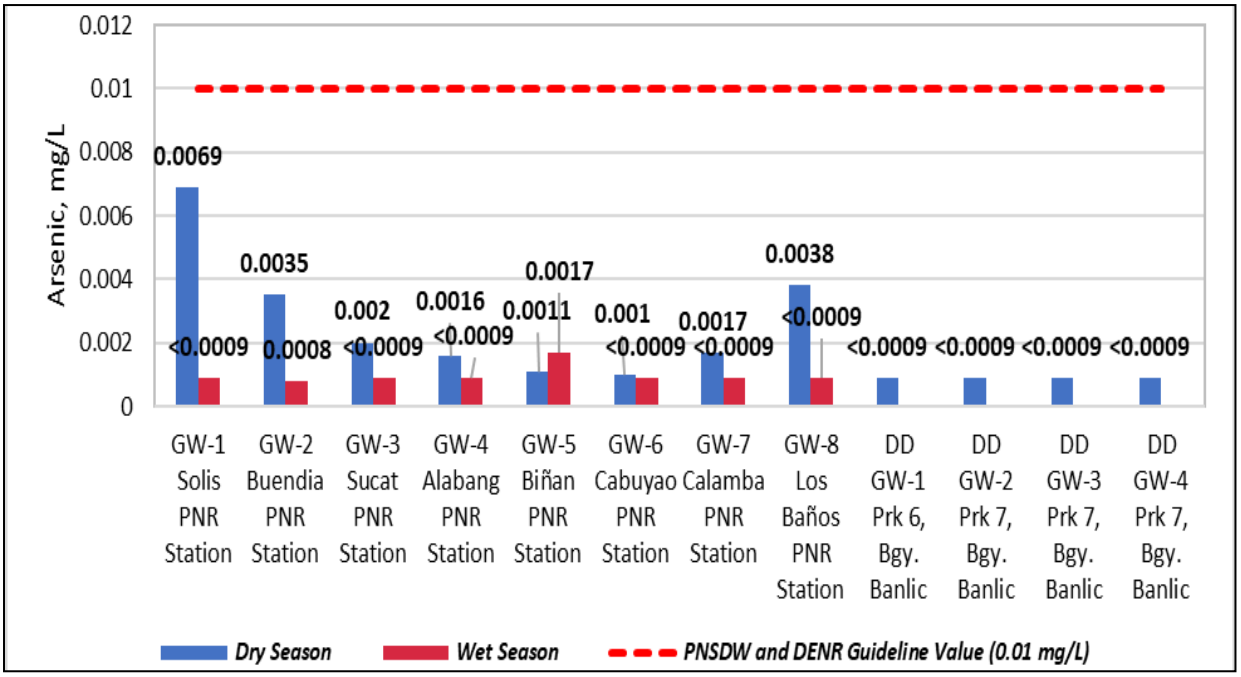


Figure 3.2-23 Results of Arsenic Measurement of Groundwater Samples

Cadmium

1081. During dry season, the Cadmium (Cd) concentrations in all stations were <0.002 to 0.002 mg/L which were all below the PNSDW maximum allowable level and the DENR GQG of 0.003 mg/L.

1082. During wet season, the Cd concentrations ranged from <0.0002 to 0.0047 mg/L and were all below the PNSDW maximum allowable level and the DENR GQG of 0.003 mg/L except at Solis PNR Station (GW-1) and Buendia PNR Station (GW-2). The highest concentration was recorded in Solis PNR Station (GW-1) at 0.0047 mg/L.

1083. There was an increase in the Cd concentrations at Solis PNR Station (GW-1) and Buendia PNR Station (GW-2) and decrease at Sucat PNR Station (GW-3) and Alabang PNR Station (GW-4) during wet season as compared to dry season. It remained <0.002 mg/L at other stations.

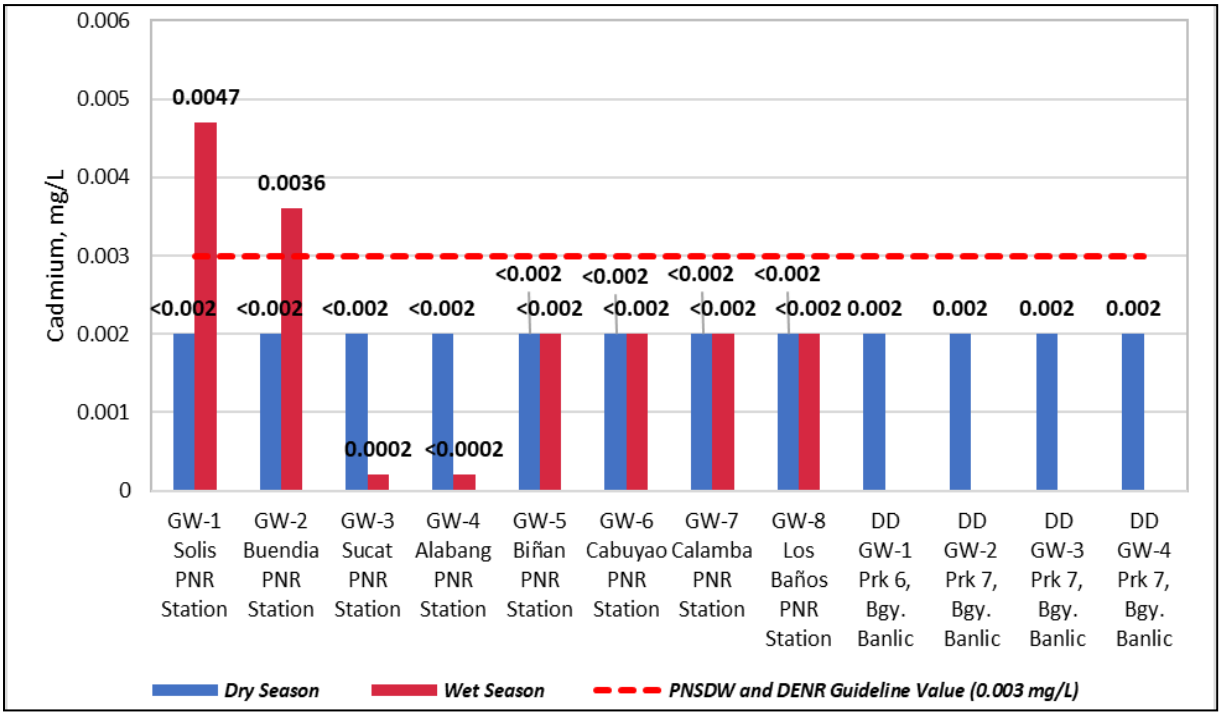


Figure 3.2-24 Results of Cadmium Measurement of Groundwater Samples

Chromium hexavalent

1084. During dry season, the Chromium hexavalent (Cr^{+6}) concentrations were present in all sampling sites and were below the PNSDW maximum allowable level of 0.05 mg/L and the DENR GQG of 0.01 mg/L. The Cr^{+6} concentrations in all stations ranged from <0.002 to 0.0095 mg/L. The highest were recorded in Purok 6 of Bgy. Banlic (DD GW-1).

1085. During wet season, the Cr^{+6} concentrations in all PNR stations were below the PNSDW maximum allowable level of 0.05 mg/L and the DENR GQG of 0.01 mg/L. Cr^{+6} concentrations in all stations ranged from <0.002 to 0.0099 mg/L. The highest was recorded in Buendia PNR Station (GW-2).

1086. Compared to dry season, there was a decrease in the Cr^{+6} concentrations at Buendia PNR Station (GW-2), while there was an increase in Alabang PNR Station (GW-4), Biñan PNR Station (GW-5), Cabuyao PNR Station (GW-6) and Calamba PNR Station (GW-7).

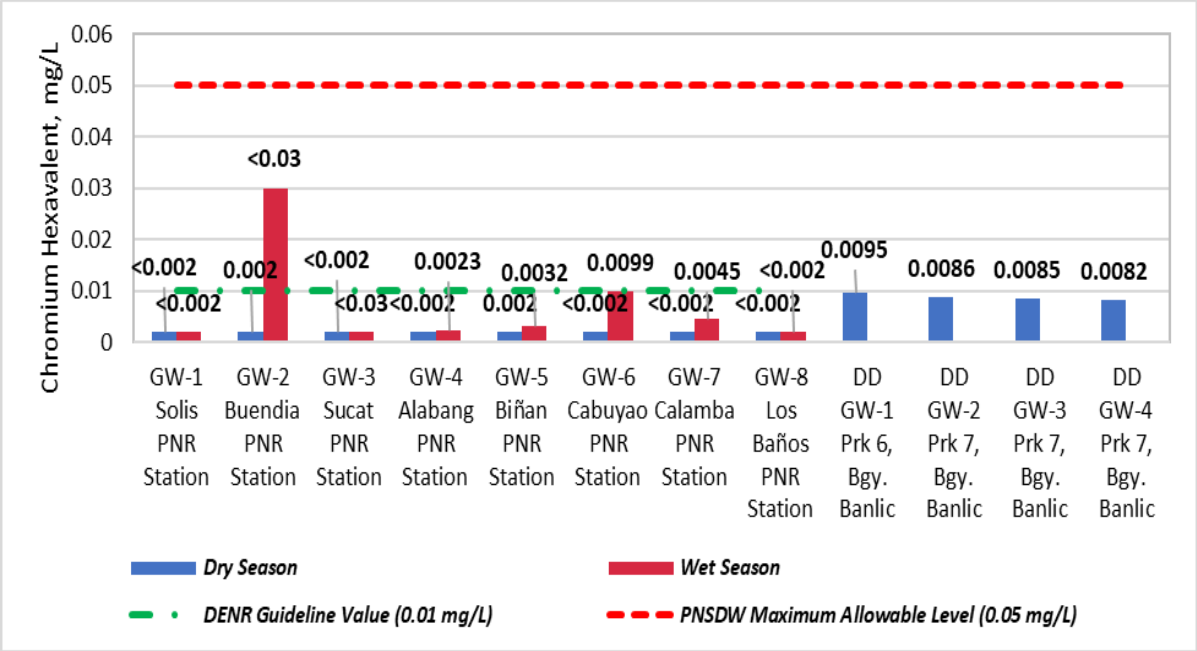


Figure 3.2-25 Results of Chromium Hexavalent Measurement of Groundwater Samples

Cyanide

1087. During dry season, the Cyanide (CN^-) concentrations in all stations were in conformance to the standards except for Solis PNR Station (GW-1), and stations DD GW-1 and DD GW-3, which exceeded both the PNSDW maximum allowable level of 0.05 mg/L and the DENR GQG of 0.01 mg/L. Stations DD GW-2 and DD GW-4 exceeded the PNSDW but did not exceed the DENR GQG. The station with the highest concentration is the DD GW-3 at 0.0866 mg/L and the lowest was in Alabang PNR Station (GW-4) at 0.0045 mg/L.

1088. During wet season, the CN^- concentrations were <0.001 mg/L at all stations which were below the PNSDW maximum allowable level of 0.05 mg/L and the DENR GQG of 0.01 mg/L.

1089. Compared to dry season, cyanide concentrations during wet season decreased to <0.001 mg/L at all stations.

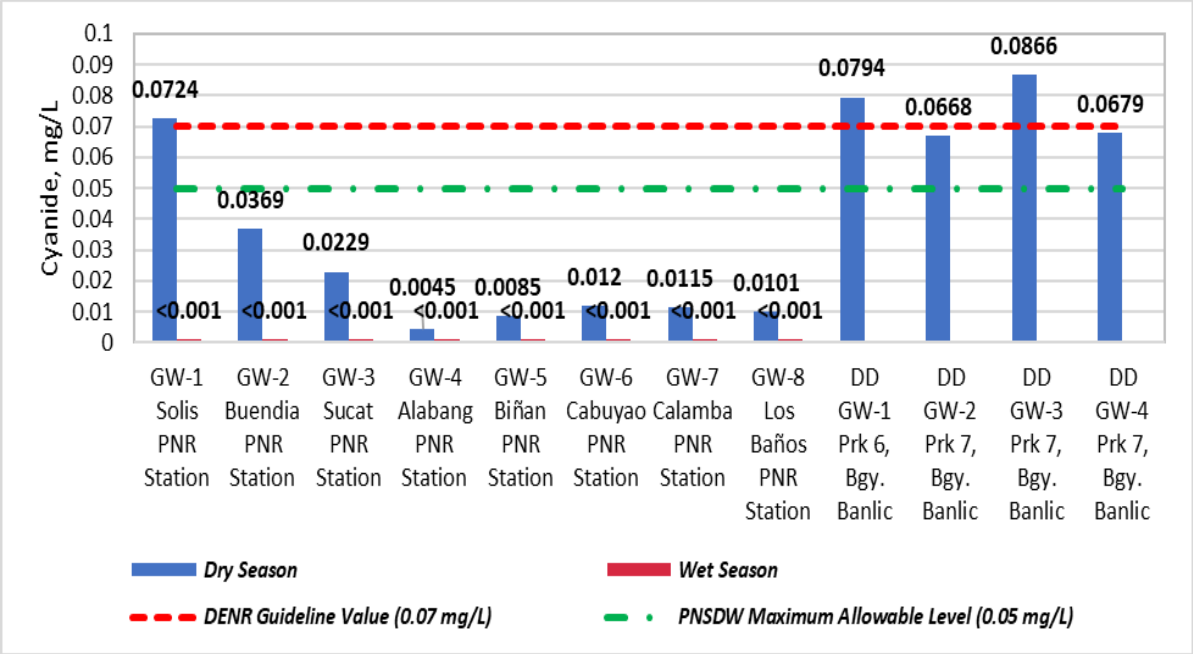


Figure 3.2-26 Results of Free Cyanide Measurement of Groundwater Samples

Lead

1090. During dry season, the Lead (Pb) concentrations were <0.006 mg/L at all stations which were all below the PNSDW maximum allowable level and the DENR GQG of 0.01 mg/L.

1091. During wet season, except at Buendia PNR Station (GW-2) and Sucat PNR Station (GW-3), all stations were <0.006 to 0.006 mg/L. Results at GW-2 and GW-3 exceeded the PNSDW maximum allowable level and the DENR GQG of 0.01 mg/L. Lead contamination may have come from nearby sources and got into the groundwater through seepage.

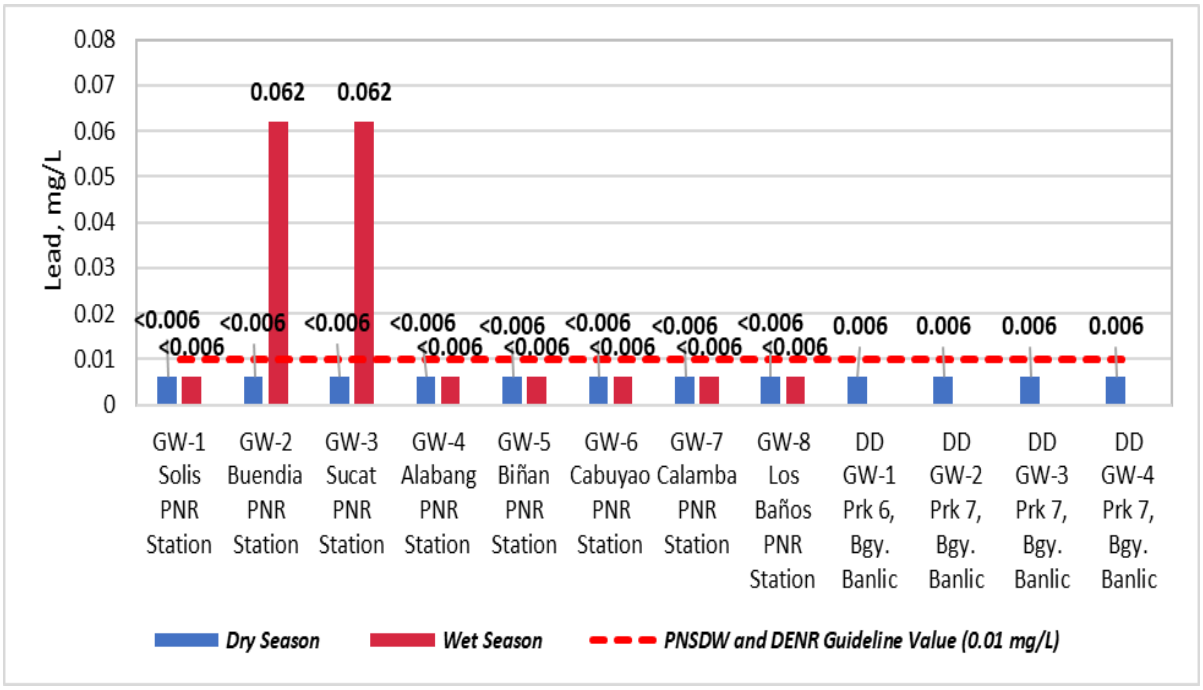


Figure 3.2-27 Results of Lead Measurement of Groundwater Samples

Mercury

1092. During dry season, the Mercury (Hg) concentrations ranged from <0.0001 to 0.0002 mg/L at all stations which were all below the PNSDW maximum allowable level and the DENR GQG of 0.001 mg/L. The highest concentration was recorded in DD GW-1 and DD GW-2 at 0.0002 mg/L.

1093. During wet season, except at Biñan PNR Station (GW-5), Cabuyao PNR Station (GW-6) and Los Baños PNR Station (GW-8), all stations were <0.0001 mg/L. All stations have levels below the PNSDW maximum allowable level and the DENR GQG of 0.001 mg/L.

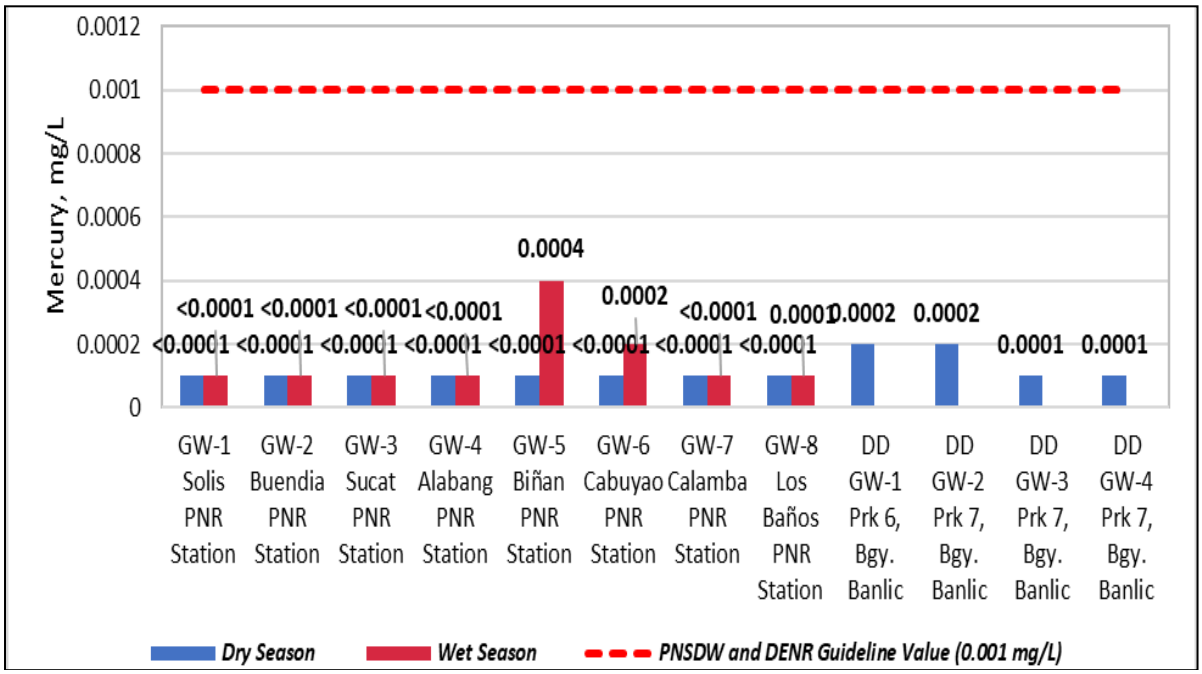


Figure 3.2-28 Results of Mercury Measurement of Groundwater Samples

Fecal Coliforms

1094. During dry season, fecal coliforms ranged from <1.1 to 17 MPN/100 ml. Four (4) cases of detection, which exceeded the DENR GQG of <1.1 MPN/100mL were noted in Buendia PNR Station (GW-2), Cabuyao PNR Station (GW-6), Los Baños PNR Station (GW-8) and in a well located in Purok 7 of Bgy. Banlic (DD GW-3).

1095. During wet season, fecal coliforms and total coliforms ranged from <1.1 to >8 MPN/100 ml. Four (4) cases of detection, which exceeded the DENR GQG of <1.1 MPN/100mL were noted in Buendia PNR Station (GW-2), Sucat PNR Station (GW-3), Biñan PNR Station (GW-5), and Los Baños PNR Station (GW-8).

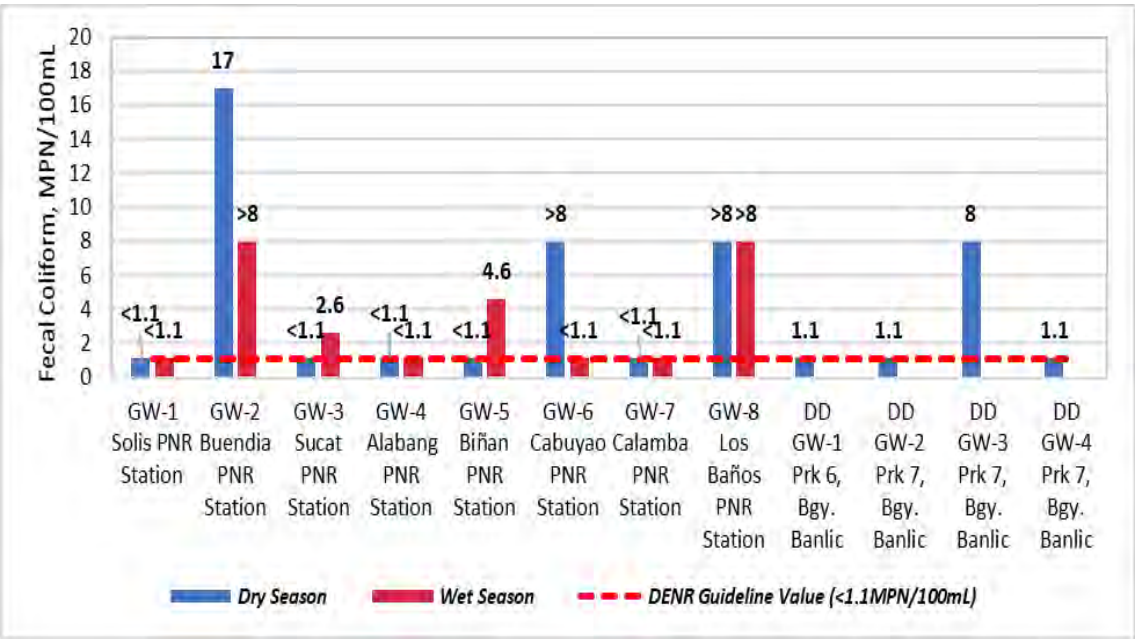


Figure 3.2-29 Results of Fecal Coliforms Measurement of Groundwater Samples

Total Coliforms

1096. During dry season, total coliforms ranged from <1.1 to 17 MPN/100 ml. Three (3) cases of detection, which exceeded the PNSDW maximum allowable level of <1.1 MPN/100mL were noted in Buendia PNR Station (GW-2), Cabuyao PNR Station (GW-6), and Los Baños PNR Station (GW-8).

1097. During wet season, total coliforms ranged from <1.1 to >8 MPN/100 ml. Four (4) cases of detection, which exceeded the PNSDW maximum allowable level of <1.1 MPN/100mL were noted in Buendia PNR Station (GW-2), Sucat PNR Station (GW-3), Biñan PNR Station (GW-5), and Los Baños PNR Station (GW-8).

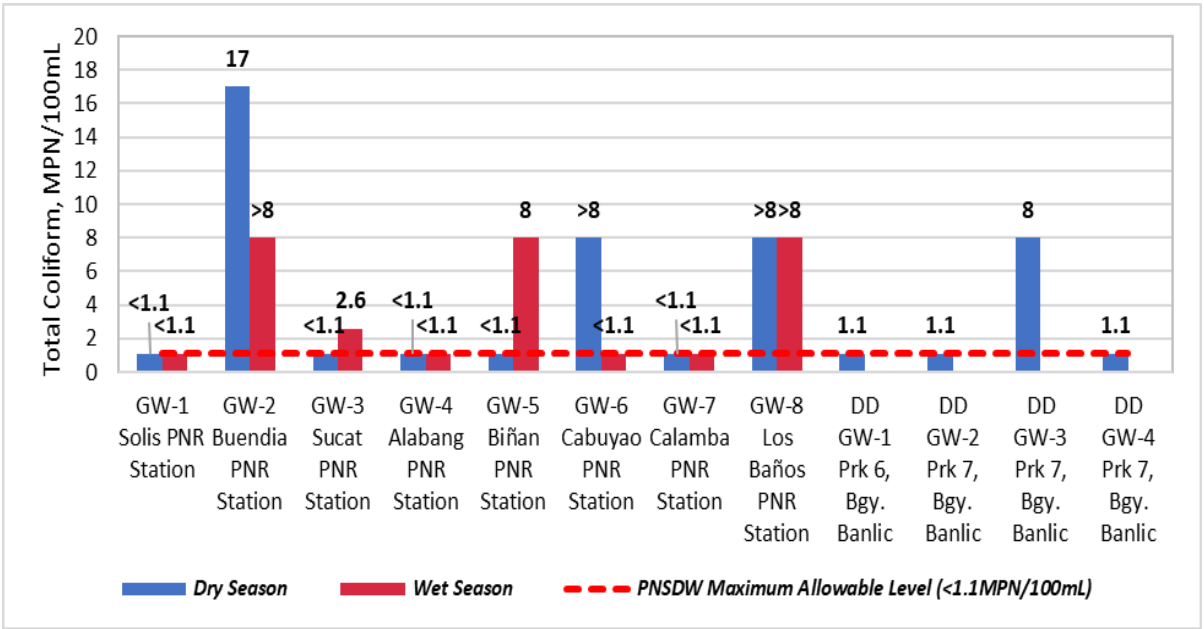


Figure 3.2-30 Results of Total Coliforms Measurement of Groundwater Samples

3.2.2.2. Groundwater Quality at Banlic Depot

1098. Twenty-six wells nearby Banlic depot site, which are within the designated five (5) Housing Clusters and House-6 were inspected and tested for some parameters. Most of these wells which have depths from 18.52 meters to 55.55 meters are tapping the shallow unconfined aquifers. Most of them are operated by hand pumps, some have 0.75 to 1 HP motor pumps and pressure tanks.

(1) In-situ Tests

1099. In-situ tests of Total Dissolved Solids (TDS), Conductivity (µS/cm), pH, Salinity (PSU) and resistivity (ohm-cm) were conducted on the inventoried wells at the different Housing Clusters and House-6. Results of these tests are presented in **Table 3.2-18**.

Table 3.2-18 In-situ Test Results of Inventoried Wells in the Vicinity of the Proposed Banlic Depot

Well No.	TDS (mg/L)	Conductivity(µS/cm)	pH	Salinity (PSU)	Resistivity (Ohm-cm)	Sampling Station
Housing Cluster 1						
Well 1	1,058	2,158	6.78	1.153	463.4	
Well 2	953.7	1,945	7.20	1.039	574.0	
Well 3	1,276	2,604	6.97	1.395	384.1	DD GW-1
Well 4	858	1,750	6.85	0.935	571.4	
Well 5	962.3	1,963	6.82	1.048	509.5	
Well 6	-	-	-	-	-	No Access
Housing Cluster 2						
Well 1	969.5	1,978	7.42	1.056	505.7	
Well 2	995.8	2,031	7.39	1.085	492.3	
Well 3	1,013	2,065	7.42	1.103	484.2	DD GW-2
Well 4	1,028	2,098	7.49	1.118	476.7	
Well 5	1,016	2,072	7.48	1.107	482.6	
Well 6	1,011	2,063	7.37	1.102	484.7	
Well 7	1,011	2,062	7.49	1.102	484.9	
Well 8	999.8	2,039	7.44	1.087	490.4	
Housing Cluster 3						
Well 1	1,057	2,155	7.39	1.151	464	
Well 2	1,118	2,281	6.86	1.219	438.5	
Housing Cluster 4						
Well 1	1,013	2,067	7.61	1.104	483.9	
Well 2	974.4	1,987	7.42	1.062	503.2	
Well 3	987.1	2,013	7.58	1.076	496.7	
Well 4	1,064	2,170	6.74	1.159	460.8	DD GW-3
Housing Cluster 5						
Well 1	-	-	-	-	-	No Access
Well 2	1,000	2,040	7.56	1.090	490.3	
Well 3	986.3	2,012	7.51	1.075	497.0	
Well 4	1,021	2,083	7.57	1.115	480.2	
Well 5	1,008	2,056	7.31	1.098	486.5	
House 6	988.5	2,016	7.58	1.077	496.0	DD GW-4
House 7	-		-	-	-	No Access

1100. High concentrations of Total Dissolved Solids (TDS) and Conductivity were noted on the tested water from the inventoried wells. The presence of dissolved solids in water may affect its taste. The palatability of drinking water has been rated by panels of tasters in relation to its TDS

level as follows: excellent, less than 300 mg/liter; good, between 300 and 600 mg/liter; fair, between 600 and 900 mg/liter; poor, between 900 and 1200 mg/liter; and unacceptable, greater than 1200 mg/liter. Water with extremely low concentrations of TDS may also be unacceptable because of its flat, insipid taste.

1101. Water containing TDS concentrations below 1000 mg/liter is usually acceptable to consumers, although acceptability may vary according to circumstances. However, the presence of high levels of TDS in water may be objectionable to consumers owing to the resulting taste and to excessive scaling in water pipes, heaters, boilers, and household appliances.

1102. TDS in water supplies originate from natural sources, sewage, urban and agricultural run-off, and industrial wastewater.

(2) **Perception Survey**

1103. A perception survey was conducted to determine the residents' current sources of drinking water, water for bathing and washing, adequacy of water supply, change in water quality, and causes of water pollution in the area.

1104. Based on the results of the survey it appears that majority of the residents in the area are drinking bottled water (57.7%), then followed by water from the shallow wells (34.6%) and few from the deepwell (7.7%). All respondents said that the daily water supply is still adequate. Majority (96.2%) of them indicated that there are no changes in water quality for the past years. However, two persons (7.7%) said that the water has bad odor, four (15.4%) said that the water has discoloration, and three (11.5%) noted that the presence of solids, mostly sand.

1105. From the conducted survey domestic and industrial wastes appear to be the major sources of water contamination.

3.2.2.3. Groundwater Quality at Senate-FTI Underground Section

1106. Water quality results of the seven (7) soil boring locations sampled along the alignment of the Senate-FTI underground section of the project on May 2019 by AMH Philippines, Inc. show that concentrations of the various water quality parameters analyzed meet the PNSDW (2017) except for sodium in IS-89A, and chloride in BGC-5 and IS-89A. **Table 3.2-19** shows the summary of the groundwater quality results.

1107. Groundwater extraction wells identified near these sampling locations are used only for domestic purposes such as such as bathing, gardening, washing clothes and cleaning.

Table 3.2-19 Test Results of Groundwater Sampling of Soil Boring Locations in Underground Interconnection Section alignment

Parameters	BGC-5	LWS-4	IS-85	IS-89A	IS-97	KTS-3	FTI-7	PNSDW 2017
Metals								
Calcium	132.73	111.60	41.35	190.60	66.35	69..98	59.85	-
Magnesium	80.72	60.03	45.29	87.54	14.26	17.71	14.18	-
Potassium	20.19	7.89	10.29	28.29	8.39	13.29	4.39	-
Sodium	150.21	46.69	41.34	484.25	72.35	48.76	58.44	200
Wet Chemistry								
pH	7.0	7.1	7.3	7.3	6.8	7.0	6.8	6.5 – 8.5
Conductivity	1674	754	497.5	3357	801.4	678.4	663.8	-
Chloride	303.7	49.9	29.7	858.2	117.2	32.8	35.0	250
Sulfate	68	42	43	129	37	56	25	250
Bicarbonate as $CaCO^3$	315.6	228.1	139.7	215.1	169.8	256.3	257.3	-

3.2.2.4. Surface Water Quality

1108. The Project alignment is intersected by rivers and streams at 35 locations. The major rivers that intersect the alignment include Pasig River, Tunasan River, San Pedro River, Cabuyao River, San Cristobal River and Calamba River.

1109. Massive population growth, infrastructure development and increased economic activities led to the deterioration of water bodies in Metro Manila. In 1990, the Pasig River was pronounced as dead and incapable of sustaining marine life. As of 2003, the DENR formally declared four (4) more rivers as biologically dead; the Navotas-Malabon-Tenejeros-Tullahan (NMTT) River, Paranaque River, Marikina River and San Juan River.

1110. The Project alignment will cross rivers and streams which are potential impact areas of project construction and operations. The natural waterways covered in this study were aimed at obtaining a general picture of the range of quality of surface water bodies, through various parameters, as a guide in the detailed water pollution prevention planning and implementation. For the selected sites, the data gathered would serve as part of baseline data for wet season. Surface water quality data at these sites during wet season would be collected prior to and during project implementation.

(1) Desktop Survey

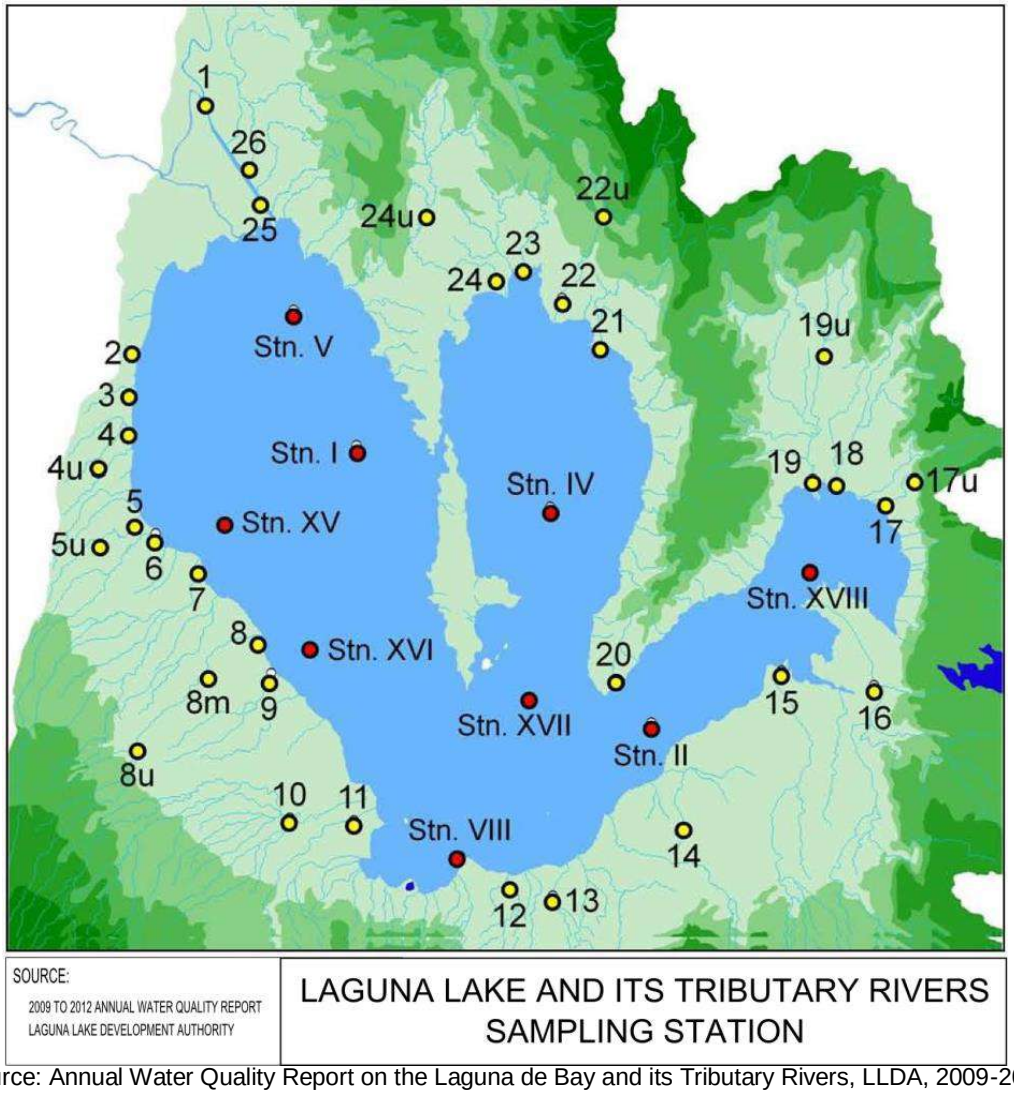
1) Quality of Laguna Lake Water

1111. The secondary data were collected from monitoring reports of DENR and LLDA. A total of eighteen (18) sampling stations were monitored within LLDA. Twelve (12) of these stations were for Laguna Lake tributaries and six (6) were within Laguna Lake as presented in **Table 3.2-20** and shown in **Figure 3.2-31**. Available data were annualized monthly of DO, BOD, total coliform, NO_3-N, and PO_4-P for each station for the years 2009-2017. The LLDA data also include the annualized monthly averages of turbidity, BOD, total coliform, NO_3-N, and PO_4-P for the three Laguna Lake bay fronting San Pedro, Sta. Rosa and Los Baños. Table 3.2-21 and **Table 3.2-22** present the range and average values of annualized monthly DO, BOD, total coliform, NO_3-N, and PO_4-P for 2009-2017 from the monitoring of LLDA in the Laguna Lake tributaries and the 2012-2017 data within the lake, respectively. **Table 3.2-23** presents the DENR compliance rating of Pasig River.

Table 3.2-20 LLDA Data Sampling Sites

LLDA Data Sampling Sites			
Stn XV -	San Pedro	6	San Pedro River
Stn XVI -	Sta. Rosa	7	Biñan River
Stn VIII -	Los Baños	8u	Sta. Rosa River - Upstream
2	Bagumbayan River (Taguig)	8m	Sta. Rosa River - Midstream
3	Buli Creek (Taguig)	8	Sta. Rosa River - Downstream
4u	Mangangate River – Upstream (Muntinlupa)	9	Cabuyao River
4	Mangangate River – Downstream (Muntinlupa)	10	San Cristobal River
5u	Tunasan River – Upstream (Muntinlupa)	11	San Juan River
5	Tunasan River – Downstream (Muntinlupa)	12	Molawin River (Los Baños)

Source: Annual Water Quality Report on the Laguna de Bay and its Tributary Rivers, LLDA, 2009-2012



Source: Annual Water Quality Report on the Laguna de Bay and its Tributary Rivers, LLDA, 2009-2012

Figure 3.2-31 Laguna Lake and Its Tributary Rivers Sampling Station

Table 3.2-21 Range and Average of 2009-2017 Annualized Monthly DO, BOD, Total Coliform, Nitrate and Phosphate as Measured by LLDA in Laguna Lake Tributaries

Monitoring Station		DO, mg/L		BOD, mg/L		Total Coliform, MPN/100 mL		NO3-N, mg/L		PO4-P, mg/L	
		Range	Ave	Range	Ave	Range	Ave	Range	Ave	Range	Ave
3	Buli Creek	0.1 - 1.7	0.4	72 – 489	184	3.50 E+06 - 8.15 E+11	1.02E+11	0.05 - 2.57	0.41	1.40 - 7.95	2.45
5u	Tunasan River – Upstream	1.7 - 4.9	3.6	5 – 38	15	1.95 E+05 -6.03 E+06	2.18E+06	0.35 - 1.30	0.76	0.70 - 1.48	1.15
5	Tunasan River - Downstream	0.1 - 0.9	0.2	129 - 426	240	7.00 E+06 - 4.67 E+10	5.88E+09	0.05 - 2.45	0.42	1.24 - 17.43	4.04
6	San Pedro River	0.2 - 2.7	1.3	11 – 24	17	6.40 E+05 - 1.19 E+08	1.71E+07	0.06 - 0.91	0.47	0.95 - 8.56	2.49
7	Biñan River	0.5 - 1.6	0.9	21 – 45	27	6.73 E+05 - 4.70 E+06	3.10E+06	0.04 - 0.34	0.20	0.61 - 1.39	1.05
9	Cabuyao River	0.6 - 3.5	1.1	11 – 30	20	1.44 E+06 - 1.02 E+07	4.84E+06	0.05 - 0.43	0.16	0.53 - 3.78	1.36
10	San Cristobal River	0.3 - 4.3	1.6	33 – 99	56	3.54 E+06 - 7.54 E+07	2.16E+07	0.06 - 0.79	0.24	0.43 - 1.58	0.65
11	San Juan River	2.8 - 6.0	4.4	4 – 9	5	1.29 E+05 - 8.65 E+06	1.62E+06	3.20 - 6.82	4.66	0.54 - 2.19	0.91
12	Molawin River	3.1 - 4.4	3.7	3 – 4	4	6.17 E+04 - 4.50 E+05	1.83E+05	0.54 - 1.02	0.70	0.29 - 0.49	0.41
	Range		0.2 – 6.4		4 – 240		1.83E+05- 1.19E+11		0.13– 4.66		0.66 – 4.04
	Class C Guideline		5 min		7		200		7		0.163

Note: The monitoring stations are located downstream unless specified.

Source: LLDA

Table 3.2-22 Range and Average of 2012-2017 Annualized Monthly Turbidity, BOD, Total Coliform, Nitrate & Phosphate Measured by LLDA in Laguna Lake Bay Stations

Monitoring Station		Turbidity, cm		BOD, mg/L		Total Coliform, MPMN/100 m		NO3-N, mg/L		PO4-P, mg/L	
		Range	Ave.	Range	Ave.	Range	Ave.	Range	Ave.	Range	Ave.
1	Stn XV - San Pedro	37 - 65	53	1.8 - 5.0	2.8	37- 938	362	0.04 - 0.45	0.19	0.05 - 0.14	0.10
2	Stn XVI -Sta. Rosa	40 - 72	54	1.6 - 7.5	3.5	40 - 892	381	0.04 - 0.56	0.20	0.04 - 0.14	0.09
3	Stn VIII - Los Baños	44 - 73	56	1.4 - 4.0	2.3	47 - 1373	510	0.13 - 0.70	0.28	0.06 - 0.11	0.09

Note 1: Turbidity is the depth of the visibility of the standard white secchi disc lowered from the surface water of Laguna Lake. No turbidity data in 2017.

Source: LLDA

Table 3.2-23 DENR Compliance rating of Pasig River to Class C waters

Parameter	Compliance Rating No. of Compliance / No. of Observations	Reference value DAO 1990-34, Class C mg/L
DO, mg/L	3 / 68	5
BOD, mg/L	1 / 68	7
Phosphate, mg/L	3 / 433	0.4
Nitrates, mg/l	388 / 433	10

Source: DENR

2) Surface water bodies along the SCRP Interconnecting Line

1112. Maricaban Creek was identified as the freshwater body that may be potentially influenced by the SCRP Interconnecting Line's construction and operation activities. A section of Maricaban Creek traverses the SCRP alignment. Maricaban Creek is a tributary of Paranaque River, which is categorized as a Water Quality Management Area by the DENR. WQMAs are defined in DAO 2005-10 as "*areas that have similar hydrological, hydrogeological, meteorological, or geographic conditions which affect the physicochemical, biological, and bacteriological reactions and diffusions of pollutants in the water bodies, or otherwise share common interest or face similar development programs, prospects, or problems."* Each WQMA will be governed by a governing board that will formulate strategies *"to coordinate policies necessary for the effective implementation of the Clean Water Act in accordance with those established in the framework and monitor the compliance with the action plan."* Moreover, the WQMA aims to serve a number of ecosystem services and benefits including fishing, industrial, enhance recreation, aesthetic, health (e.g. reduced risk of infection from bathing), opportunities for wildlife and biodiversity and other uses to serve the best interest of communities and stakeholders.

(2) Field Survey

1) SCRP Main Line

1113. Freshwater samples were collected on February 12-14 and 22, 2018 for dry season and on various days within the period from June 18 – July 19 , 2018 from fourteen (14) surface water sampling sites identified along the proposed alignment, representing small to large flow river systems, generally in highly urbanized and industrialized areas in Metro Manila segment down to Laguna segment within agricultural areas. **Table 3.2-24** and **Figure 3.2-32** present the description of the freshwater quality sampling stations.

1114. Each freshwater sampling site was characterized for 23 parameters, with reference to DENR Water Quality Guidelines for Freshwater as presented below. Meanwhile, there is no guideline values for conductivity and total coliforms.

- **Primary paremeters:** temperature, pH, DO, color, BOD, TSS, Cl, NO_3-N, PO_4-P, fecal coliforms
- **Secondary parameters:** Metals: As, Cu, Cd, Cr^{+6}, Pb, Hg
- **Organics:** CN, oil/grease (Petroleum Ether Extracts), MBAS, organophosphate, phenolic substances as phenols

1115. In-situ measurements include temperature, pH, and conductivity using Thermo Scientific Orion Star A329. DO was also measured using Trans Instruments DO meter. The water samples for microbes analysis were collected into sterilized small glass bottles and wrapped with aluminum foil; for oil and grease into wide-mouth bottles, organics into amber glass bottle; and the rest of the parameters into PET bottles. The labeled samples were stored in ice-chest and brought for laboratory analyses with a Chain-of-Custody Form within 24 hours to Mach Union Laboratory, Inc., a DENR recognized laboratory in Las Piñas City.

Table 3.2-24 Surface Water / Freshwater Quality Sampling Stations

Sampling Point	Description	Coordinates	Sampling Date	
			Dry Season	Wet Season
SW-1	Pasig River, Manila City	14° 35' 39.69"N 121° 00' 44.28"E	02/14/2018	07/19/2018
SW-2	Laguna Lake, Muntinlupa City	14° 27' 07.20"N 121° 03' 14.95"E	02/14/2018	07/12/2018
SW-3	Buli River, Muntinlupa City	14° 26' 46.96"N 121° 03' 00.82"E	02/13/2018	06/18/2018
SW-4	Tunasan River, Muntinlupa City	14° 22' 10.33"N 121° 03' 03.81"E	02/13/2018	06/18/2018
SW-5	San Pedro River, San Pedro City	14° 21' 50.99"N 121° 03' 14.92"E	02/13/2018	06/28/2018
SW-6	Biñan River, Biñan City	14° 19' 49.74"N 121° 04' 56.04"E	02/13/2018	06/25/2018
SW-7	San Cristobal River, Calamba City	14° 13' 12.47"N 121° 09' 04.78"E	02/13/2018	06/28/2018
SW-8	San Juan River, Calamba City	14° 12' 31.98"N 121° 09' 25.14"E	02/12/2018	06/27/2018
SW-9	Bgy Bucal River, Calamba City	14° 11' 02.19"N 121°10' 30.46"E	02/12/2018	06/28/2018
SW-10	Alligator Lake, Los Baños	14° 10' 51.04"N 121°12' 28.44"E	02/12/2018	06/28/2018
SW-11	Dampalit River, Los Baños	14° 10' 34.23"N 121°12' 58.29"E	02/12/2018	06/28/2018
SW-12	Saran River (Bgy Anos), Los Baños	14° 10' 55.16"N 121°13' 51.76"E	02/12/2018	06/27/2018
SW-13	Molawin River, Los Baños	14° 10' 13.23"N 121°15' 08.34"E	02/12/2018	06/27/2018
SW-14	Buot Creek, Los Baños	14° 9'53.83"N 121°15'22.86"E	02/22/2018	06/27/2018

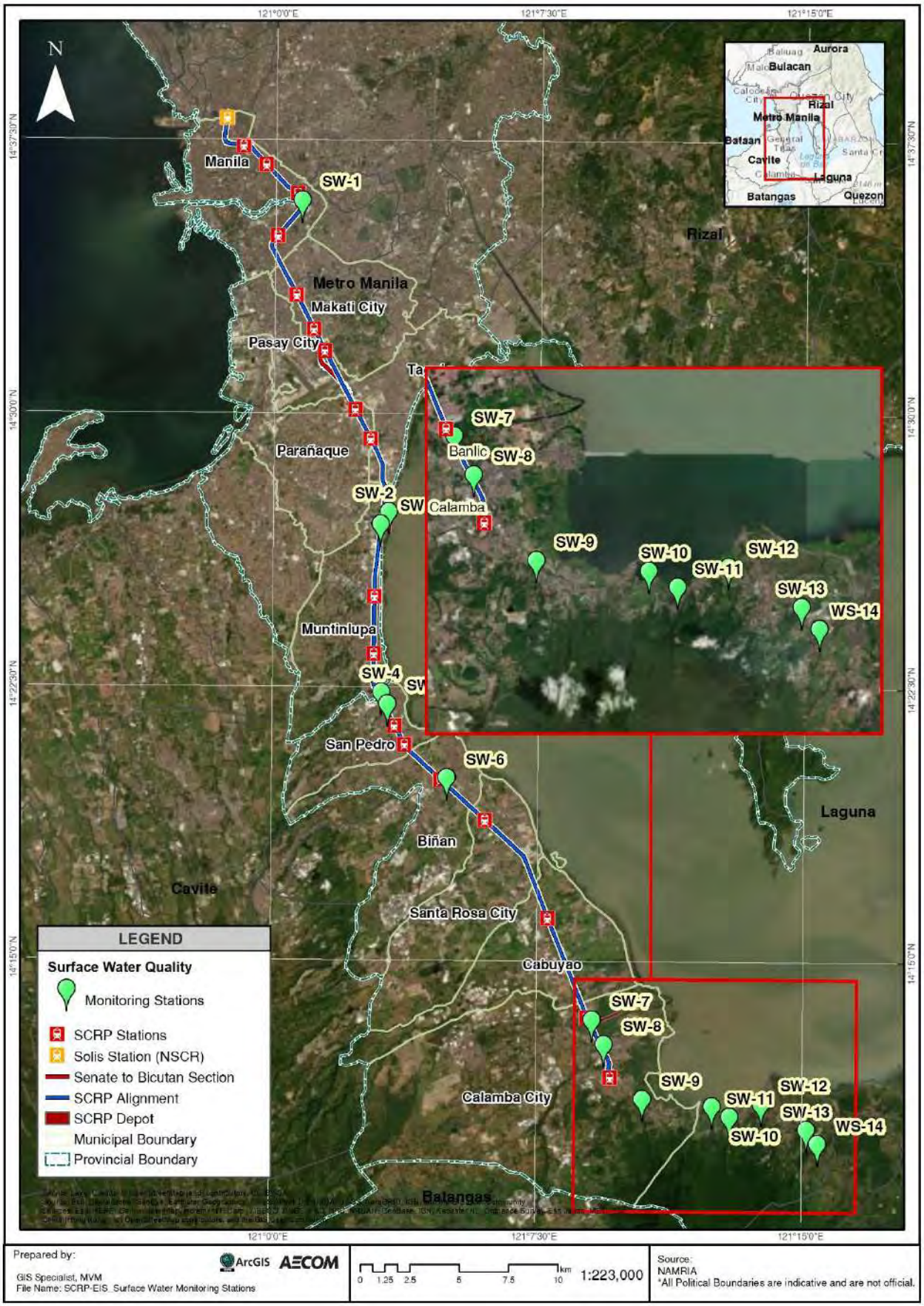


Figure 3.2-32 Surface Water Quality Monitoring Stations of SCRP Main Line

2) SCRP Interconnecting Line

1116. For the SCRP interconnecting line, the water quality assessment was based on DENR monitoring data for the Maricaban Creek and Paranaque River. The locations of the DENR water quality monitoring sites used for this study are shown in **Table 3.2-25** and **Figure 3.2-33**.

Table 3.2-25 DENR Water Quality Monitoring Stations – Maricaban Creek and Paranaque River

Sampling Date	Sampling ID	Sampling Station	Location	Coordinates
Maricaban Creek				
11 April 2019	S1	Diego Silang	Bridge along Diego Silang St.	N 14°31'11.06" E 121° 1'54.22"
	S2	Maricaban SLEX	Bridge along south super highway	N 14°31'40.55" E 121° 1'25.91"
	S3	Villamor	Bridge along Villamor	N 14°31'4 7. 98 " E 121° 1'5.18"
Parañaque River				
03 June 2019	1	Tramo Station	Aurora-Tram o Bridge, Aurora Blvd., Brgy. 186, Zone 19, Pasay City	N14°31. 9 1 5' E121°0 0. 2 3 3'
	1a	Narra Station	Don Chino Roces Ave, San Antonio, Makati City	N14°33. 7 2 6' E121°0 0. 6 6 1'
	1b	Dilain Creek	C. Jose St., Brgy. 178 Zone 19, Maricaban, Pasay City	N14°31. 9 2 4' E121°0 0. 4 0 0'
	2	MIA Road Station	Airport Road Bridge, Baclaran, Parañaque City	14°34'54.03" N 120°58' 2 1. 4 9"E
	3	Multinational Station	Multinational Bridge, Sto. Niño, Parañaque City	N14°29. 6 8 3' E121°0 0. 1 3 1'
	3a	Ibayo Creek	Ibayo Bridge, Multinational Village. Kaingin St., Sto. Nino, Paranaque City	N14°29. 9 9 4' E121°0 0. 5 2 6'
	4	Global Station	Global Bridge, San Dionisio, Parañaque City	N14°29. 7 0 6' E120°5 9. 6 4 8
	4a	AMVEL Station	AMVEL Bridge, AMVEL Land, Inc,. Ninoy Aquino Ave., San Dionisio Paranaque City	N14°29. 5 2 3' E120°5 9. 5 3 7'
	5	Sto. Niño Station	Ninoy Aquino Bridge, Sto. Niño, Parañaque City	N14°29. 9 4 2' E121°0 0. 1 3 1'
	6	La Huerta Station	Quirino Ave. Bridge, La Huerta, Parañaque City	N14°30. 1 0 9' E120°5 9. 5 5 9

Source: DENR-EMB-NCR

1117. Other relevant secondary sources considered for the water quality assessment include:

- Water quality monitoring data from DENR for Paranaque River, and Maricaban Creek;
- Data from the MMSP EIS (2017);
- Data from available Comprehensive Land Use Plans (CLUP) of cities that will be traversed by the underground interconnection section; and
- Data from other published technical information.

Source: (DENR-E M B, 2017 EIS, MMSP EPRMP 2019)

Figure 3.2-33 Location of Surface Water Sampling Stations along the SCRP Interconnecting Line

(3) Applied standard

1118. Republic Act 9275 (RA 9275) or the Philippine Clean Water Act of 2004 is the overarching legislation which sets the objectives and policies for the comprehensive water quality management of water bodies in the Philippines. It covers all water bodies and primarily applies to the abatement and control of pollution from land-based sources. Guidelines for the implementation of the Clean Water Act are provided in DAO 2005-10.

1119. An important component of water quality management in the country is the classification of water bodies since these forms the regulatory basis for determining allowable water quality limits for discharge waters. The DENR is responsible for classifying or reclassifying all water bodies in the country according to their beneficial usages. Water body classifications are defined by the DENR in DAO 2016- 08, or the Water Quality Guidelines and General Effluent Standards of 2016. Water body classifications for freshwater provided in the DAO 2016-08 are presented in **Table 3.2-26**.

1120. The DAO 2016-08 also provides Water Quality Guidelines (WQG), which refer to "the level for a water constituent or numerical values of physical, chemical, biological, and bacteriological or radiological parameters which are used to classify water resources and their use, which do not result in significant health risk" The WQG are not intended for direct enforcement but rather for water quality management purposes only. Enforceable water quality limits are referred to as General Effluent Standards (GES), and are also provided in the DAO 2016-08.

Table 3.2-26 DENR Compliance Rating of Pasig River to Class C waters

Classification	Intended Beneficial Use
Class AA	Public Water Supply Class I – Intended primarily for waters having watersheds, which are uninhabited and/or otherwise declared as protected areas, and which require only approved disinfection to meet the latest PNSDW.
Class A	Public Water Supply Class II – Intended as sources of water supply requiring conventional treatment (coagulation, sedimentation, filtration, and disinfection) to meet the latest PNSDW.
Class B	Recreational Water Class I – Intended for primary contact recreation (bathing, swimming, etc.)
Class C	Fishery Water for the propagation and growth of fish and other aquatic resources. Recreational Water Class II – For boating, fishing, or similar activities. For agriculture, irrigation, and livestock watering.

Note: For unclassified water bodies, classification shall be based on the beneficial use as determined by the Environmental Management Bureau

1) Water body classification

1121. Fourteen (14) surface water sampling sites were identified along the proposed alignment. These waterways are part of small to large flow river systems and are located in highly urbanized and industrialized areas of Metro Manila segment and the agricultural areas of Laguna **Table 3.2-26** provides the locations and description of these sampling stations. All water quality results from these water bodies were compared with DAO 2016-08 Class C water quality guidelines.

1122. In the case of the underground section, stream water quality monitoring results were evaluated using the ambient water quality criteria provided in DAO 2016-08 for fresh surface waters based on their DENR classifications. Paranaque Rivers monitoring stations that were covered by the assessment are currently classified by the DENR as Class C waters except for Maricaban Creek, which is currently not classified. Class C waters have an intended beneficial use of fishery water for the propagation and growth of fish and other aquatic resources, for boating, fishing, or similar activities, and for agriculture, irrigation, and livestock watering based on DAO 2016-08. Given that Maricaban Creek is considered a tributary of Paranaque River, DAO 2016-08 Class C WQG was used as the regulatory standard for comparison purposes

2) Analysis of Result for SCRP Main Alignment

1123. The set of primary data obtained covered fourteen (14) sampling sites for twelve (12) rivers and creeks west to south of Laguna Lake, one (1) station in Laguna Lake and one (1) station in Tadlac (Alligator) Lake. **Table 3.2-27** presents the results of freshwater quality monitoring at fourteen (14) stations within the project area.

1124. The results of measurements in the fourteen (14) surface water sampling sites for the 23 parameters were taken as baseline and examples of surface water quality along the proposed alignment. The sampling sites represented different natural features, land use and flowrates which are factors of water quality. **Table 3.2-27** summarizes the trend for surface water parameters during dry and wet seasons. Notable results of the assessment of seasonal surface water quality data were listed below:

- On the average for each of the 14 sampling sites, there were about 10 parameters with higher values during the dry season, three (3) with similar values, and 10 with lower values during the dry season. This means there was no definite seasonal pattern for the parameters, collectively. SW-12 in Saran River (in Bgy. Malinta, Los Baños) was the sampling site with 14 parameters, the most number of parameters with values in Feb greater than in Jun-Jul sampling programs; while, SW-10 in Tadlac (Alligator) Lake with six (6) parameters or least number.
- For the sampling sites and parameters, there were 143 cases of higher values in dry season, 40 cases with similar values in both seasons and 139 cases of lower values in dry season.
- The parameters with more apparent cases of higher values during the dry season (at least 9 sites or 2/3 of the sites, arbitrarily) were temperature, conductivity, chloride, phosphate, chromium, cyanide, and phenols.
- Conductivity, which is a measure on the quantity of ionic composition, is lower in wet season when large volume dilution water for ions are available. However, overland flow rainwater may carry elements and substances that may increase the loading to the water bodies.

1125. The parameters with more sites (in at least 9 sites, arbitrarily) which showed lower values during the dry season (i.e., higher in wet season) were color, pH, dissolved oxygen, lead, mercury, and surfactants.

1126. Similar values were noted for the undetected organophosphate.

1127. The parameters which do not show cases of dominance in the three scenarios, collectively for the sampling sites were total suspended solids, biochemical oxygen demand, fecal coliform, total coliform, nitrate, copper, arsenic, cadmium, and oil & grease.

1128. Arsenic was detected in sampling sites from San Juan River in Calamba (SW-8) to Buot Creek (SW-14), a manifestation of the geothermal nature of the area, where hot springs are found.

1129. Lead was detected in the wet season in 12 sampling sites, while mercury was detected only in the wet season and in 10 sites. The presence of lead and mercury may indicate contamination from nearby sources, washed into the bodies of water by precipitation. Most stations were observed to be in urban areas and are heavily polluted.

1130. There were 13 sites where phenol was detected only during the dry season.

Table 3.2-27 Trends for Surface Water Parameters

Parameters	Season	Monitoring Station														Trend		
		SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	SW-9	SW-10	SW-11	SW-12	SW-13	SW-14	DEC	RET	INC
Color, TCU	Dry	65	28	5	5	5	10	5	<5	<5	5	5	10	5	40	3	0	11
	Wet	20	13	21	100	25	83	10	20	33	<5	42	100	63	831			
TSS, mg/L	Dry	97	98	60	188	25	43	20	8.5	26	2.5	11	213	84	8.7	6	0	8
	Wet	56	16	206	175	76.7	740	164	13	13	3.6	15	85	48	11			
Temperature, ºC	Dry	28.4	28.4	29.4	30.6	30.3	28.5	27.2	30.1	31.3	29	27.2	29.9	25.7	28.8	10	0	4
	Wet	26.7	19.4	27.5	28.8	29.7	28.9	29.5	28.8	27.65	31	24.6	27.1	27.7	26.9			
pH	Dry	6.7	6.79	6.95	7.02	6.44	7.25	7.06	7.17	7.34	6.81	6.38	6.4	7.8	7.03	4	0	10
	Wet	7.4	7.37	7.76	7.06	6.86	7.2	7.08	7.06	6.94	8	7	7.02	7.3	7.27			
DO, mg/L	Dry	3.8	3.8	0.1	3.1	0.3	2.1	0.1	6.4	5.2	5.6	6.7	0.7	6.2	2.9	1	0	13
	Wet	4.7	4.7	5.2	4.4	2.7	4.75	3.805	5	7.02	9.07	7.24	5.75	6.94	5.77			
BOD, mg/L	Dry	31	38	99	175	45	66	33	7	15	11	11	49	15	9	6	0	8
	Wet	22	21	186	341	23	33	16	39	24	12	23	32	24	11			
Fecal Coliform MPN/ 100mL	Dry	4.6E5	4.9E3	7E5	24E5	79E5	9200	92E5	16E4	13E5	22	24E3	54E5	54E3	54E4	7	0	7
	Wet	21E3	9.4E3	11E5	220E6	54E4	17E5	24E5	27E3	4E3	34	54E3	54E4	24E4	54E3			
Total Coliform, MPN/ 100mL	Dry	46E4	35,000	7E5	24E5	24E6	9,200	16E6	16E4	24E5	49	24E3	54E5	54E3	54E4	6	0	8
	Wet	35E4	54,000	22E5	54E7	92E4	54E5	35E5	92E4	16E4	1,600	16E4	92E4	35E4	92E3			
Conductivity, uS/cm	Dry	547	580	1097	1637	1325	1200	982	738	1355	829	228	674	346	518	12	0	2
	Wet	462	809	202	1644	812	295	760	598	265	684	109	283	121	257			
Chloride (Cl), mg/L	Dry	81	68	96	220	63	120	98	50	250	120	8.2	32	15	29	11	1	2
	Wet	54	122	13	18	46	26	59	42	36	120	17	16	9.6	16			
Nitrate as N (NO_3-N), mg/L	Dry	0.4	0.4	0.45	0.13	0.13	0.11	0.13	1.24	0.43	0.84	0.14	0.1	0.38	0.22	8	0	6
	Wet	0.128	0.133	0.075	0.073	0.735	0.153	0.193	0.171	0.185	0.107	0.223	0.188	0.225	0.353			
Phosphate as P (PO4-P), mg/L	Dry	0.6	0.97	5.06	8.33	6.62	2.72	1.44	1.12	0.19	0.44	0.02	1.03	0.09	0.39	9	0	5
	Wet	2.09	0.615	0.08	3.84	1.8	1.41	1.73	1.51	0.751	0.226	1.84	0.745	0.088	0.079			
Copper (Cu), mg/L	Dry	<0.005	<0.005	0.028	0.021	0.031	0.369	0.021	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.007	6	1	7
	Wet	0.006	<0.005	0.022	0.0107	0.0062	0.0153	0.0067	0.0047	0.0047	0.0041	0.0046	0.007	0.0061	0.0055			
Arsenic (As), mg/L	Dry	<0.00009	<0.0009	<0.00009	<0.0009	<0.0009	<0.0009	<0.00009	0.0048	0.0249	0.0094	0.0095	0.0108	0.0023	0.0024	5	7	2
	Wet	<0.00009	<0.0009	<0.00009	<0.0009	<0.0009	<0.0009	<0.00009	0.0016	0.0154	0.0119	<0.0009	<0.00009	<0.00009	0.0103			
Cadmium (Cd), mg/L	Dry	<0.002	0.01	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.005	<0.002	0.002	0.011	<0.002	<0.002	4	7	3
	Wet	<0.002	<0.002	0.0004	0.0002	0.0003	<0.002	<0.00007	<0.002	<0.0003	0.0006	<0.0003	<0.002	<0.002	<0.002			
Chromium (Cr^{+6}), mg/L	Dry	0.008	0.004	0.042	0.017	0.02	0.006	0.002	0.003	0.005	0.002	0.004	0.005	0.005	0.014	9	1	4
	Wet	0.005	0.122	<0.03	<0.03	0.022	<0.002	0.013	<0.002	<0.002	0.024	<0.002	<0.002	<0.002	<0.002			

Parameters	Season	Monitoring Station														Trend		
		SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	SW-9	SW-10	SW-11	SW-12	SW-13	SW-14	DEC	RET	INC
Lead (Pb), mg/L	Dry	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	0.02	0	2	12
	Wet	<0.006	0.035	0.026	0.053	0.012	<0.006	0.009	0.0397	0.0015	0.0059	0.0112	0.0416	0.0383	0.0309			
Mercury (Hg), mg/L	Dry	<0.00001	<0.0001	<0.00001	<0.0001	<0.0001	<0.001	<0.00001	<0.00001	<0.0001	<0.00001	<0.0001	<0.00001	<0.00001	<0.00001	0	4	10
	Wet	<0.00001	<0.0001	<0.00001	<0.0001	0.00023	0.00019	0.0002	0.0003	0.00021	0.00057	0.0002	0.0002	0.0003	0.00026			
Cyanide (CN), mg/L	Dry	0.032	0.015	0.01	0.011	0.093	0.091	0.068	0.057	0.056	0.072	0.02	0.019	0.03	0.005	12	0	2
	Wet	0.0297	0.002	0.028	0.013	<0.001	0.0138	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001			
Oil and Grease (O&G)	Dry	1.5	1.5	3.2	5.3	6.7	2.4	1.3	<0.5	<0.5	<0.5	3.3	<0.5	<0.5	0.7	7	1	6
	Wet	1.41	1.35	1.94	4.52	3.01	<0.5	2.5	2.9	3.8	0.63	3.3	8	8.6	<0.5			
Organo-phosphates, mg/L	Dry	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0	14	0
	Wet	<0.00022	<0.00022	<0.00022	<0.00022	<0.00022	<0.00022	<0.00022	<0.00022	<0.00022	<0.00022	<0.00022	<0.00022	<0.00022	<0.00022			
Phenols, mg/L	Dry	3.6	1.9	1.9	7.2	1.2	1.3	0.7	0.01	0.02	0.02	0.02	0.03	0.04	<0.01	12	2	0
	Wet	<0.01	<0.01	<0.01	0.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Surfactants (MBAS), mg/L	Dry	<0.007	<0.007	2.19	0.388	4.81	0.373	0.204	<0.007	<0.007	<0.007	0.094	2.58	<0.007	0.036	5	0	9
	Wet	0.132	0.317	0.399	0.253	0.594	<0.007	0.529	0.212	0.509	0.0287	0.595	1.04	1.66	1.93			

Results by Sampling Stations

1131. The following is a discussion of the results by sampling site:

SW-1 Pasig River

1132. The sampling site is located just downstream (west) of Paco-Sta. Mesa Bridge or Pandacan Bridge, City of Manila or just upstream of the existing railway alignment. The river water flowed towards Manila Bay. The river is deep with a width of about 100 m at the sampling site. The river is about 25 km long connecting Laguna Lake and Manila Bay and is technically a tidal estuary with flow direction reversals depending on the water levels of Manila Bay and Laguna Lake. The river is classified as Class C water.

1133. During dry season, the six (6) nonconforming parameters were TSS, DO, BOD, Fecal coliform, PO_4-P and phenols. During wet season, among the 23 parameters measured at Pasig River, four (4) parameters (DO, BOD, Fecal coliforms and PO_4-P) were nonconformant with the DENR standards for Class C waters.

1134. A DENR Report covering the years 2006-2013 indicates that Pasig River showed low compliance rating in DO, BOD and PO_4-P, but relatively high for NO_3-N.

SW-2 Laguna Lake

1135. The sampling site is located about 120 m east of the large fuel tanks of the decommissioned Sucat Thermal Plant. The lake is classified as Class C water.

1136. During dry season, fourteen (14) parameters were in conformance with DENR standards for Class C waters. The seven (7) nonconforming parameters were TSS, DO, BOD, fecal coliform, PO_4-P, Cadmium, and phenols. During wet season, six (6) parameters were nonconformant (Temperature, DO, BOD, Fecal coliforms, PO_4-P, and Cr^{+6}) with DENR standards for Class C waters.

1137. Results of LLDA monitoring for BOD, NO_3-N, PO_4-P, total coliform and turbidity at the Laguna Lake particularly in stations fronting San Pedro, Sta. Rosa and Los Baños are shown in **Table 3.2.20**. In general, the concentrations of BOD, NO_3-N and PO_4-P remained within their respective DENR Class C guidelines, of not more than 7 mg/L, 7mg/L, and 0.5 mg/L, respectively. Total coliform range 37-1,373 MPN/100 ml. Cases of less than the 200 MPN/100 ml maximum guideline value of total coliform for DENR standards for Class C waters occurred in 2016.

SW-3 Buli River

1138. The sampling site is located just downstream (east) of the railway bridge in Buli River, Muntinlupa City. It is a small river with 5.4 m width slowly moving. The river is not yet classified.

1139. During dry season, only twelve (12) parameters were in conformance with DENR standards for Class C waters. The nine (9) nonconforming parameters were DO, BOD, fecal coliform, PO_4-P, Cu, Cr^{+6}, O&G, phenols, and surfactants. The levels indicate serious water pollution. Floating garbage piles were observed just upstream. During wet season, seventeen (17) parameters were in conformance with DENR standards for Class C waters. The four (4) nonconforming parameters were TSS, BOD, fecal coliform and Cu.

1140. The 2009-2017 LLDA data showed similar non-conformance to standards in levels of DO, BOD, coliform, and PO_4-P.

SW-4 Tunasan River

1141. The sampling site is located just downstream (east) of the railway bridge in Tunasan River, San Pedro Laguna. It is a small river with shallow depth along 3.9 m wide flowing water. The river is not yet classified.

1142. During dry season, only twelve (12) parameters were in conformance with DENR standards for Class C waters. The nine (9) nonconforming parameters were TSS, DO, BOD, fecal coliform, PO_4-P, Cu, Cr^{+6}, O&G, and phenols. The levels indicate serious water pollution. During wet season, nine (9) parameters were nonconformant (Color, TSS, DO, BOD, Fecal coliforms, PO_4-P, Pb, Oil and Grease, and phenols) with DENR standards for Class C waters.

1143. The 2009-2017 LLDA data showed similar non-conformance to standards in levels of DO, BOD, coliform, and PO_4-P.

SW-5 San Pedro River

1144. The sampling site is located just downstream (east) of the railway bridge in San Pedro River, San Pedro Laguna. It is a small murky river. The sampling site about 4 m wide and 20 cm deep. The river is classified as Class C water.

1145. During dry season, only eleven (11) parameters were in conformance with DENR standards for Class C waters. The ten (10) nonconforming parameters were pH, DO, BOD, fecal coliform, PO_4-P, Cu, Cr^{+6}, O&G, phenols, and surfactants. The levels do indicate serious water pollution. During wet season, fifteen (15) parameters were in conformance with DENR standards for Class C waters. The six (6) nonconforming parameters were DO, BOD, fecal coliform, PO_4-P, Cr^{+6}, and O&G.

1146. The 2009-2017 LLDA data showed similar non-conformance to standards in levels of DO, BOD, coliform, and PO_4-P.

SW-6 Biñan River

1147. The sampling site is just downstream (east) of the railway bridge in Biñan River, Biñan, Laguna, shallow, about 10 m wide. The river is not yet classified. During dry season, only fourteen (14) parameters were in conformance with DENR standards for Class C waters. The seven (7) nonconforming parameters were DO, BOD, fecal coliform, PO_4-P, Cu, O&G, and phenols. The levels indicate serious water pollution.

1148. During wet season, six (6) parameters (Color, TSS, Do, BOD, Fecal coliforms, and PO_4-P) were nonconformant with DENR standards for Class C waters. The 2009-2017 LLDA data showed similar non-conformance to standards in levels of DO, BOD, coliform, and PO_4-P.

SW-7 San Cristobal River

1149. The sampling site is just downstream (east) of the railway bridge in San Cristobal River, Calamba City. It is a small river, shallow and about 6 m wide. Water appeared turbid and greenish. Per interview, the river is used for swimming by children downstream. The river is classified as Class C water.

1150. During dry season, the six (6) nonconforming parameters were DO, BOD, fecal coliforms, PO_4-P, Cu and phenols. During wet season, seven (7) parameters (TSS, DO, BOD, fecal coliforms, PO_4-P, Cr^{+6} and O&G) were nonconformant with DENR standards for Class C waters.

1151. The 2009-2017 LLDA data showed similar non-conformance to standards in levels of DO, BOD, coliform, and PO_4-P.

SW-8 San Juan River

1152. The sampling site is located just downstream (east) of the railway bridge in San Juan River, Calamba City. The river is about 16 m wide and 0.5 deep, clear with children found swimming upstream. The river is classified as Class C water.

1153. During dry season, nineteen (19) parameters were in conformance with DENR standards for Class C waters. The two (2) nonconforming parameters were fecal coliform and PO_4-P. During wet season, four (4) parameters (BOD, Fecal coliforms, PO_4-P, and O&G) were nonconformant with DENR standards for Class C water. The 2009-2017 LLDA data showed similar non-conformance to standards in levels of coliform, and PO_4-P.

SW-9 Bgy Bucal River

1154. The sampling site is located about 50 m downstream (north) of Bucal Bridge in Southspring Villa Subdivision, Barangay Bucal, Los Baños, Laguna. It is a small river, 3.5 m wide and 20 cm deep. It is not yet a classified river.

1155. During dry season, sixteen (16) parameters were in conformance with DENR standards for Class C waters. The five (5) non-conforming parameters include temperature, BOD, fecal coliform, PO_4-P and As. During wet season, four (4) parameters (BOD, Fecal coliforms, PO_4-P and O&G) were nonconformant with DENR standards for Class C waters.

SW-10 Tadlac (Alligator Lake)

1156. The sampling site is southeast of Tadlac (Alligator) Lake, about 40 m NNW of Balai Inday in Lakewood Subdivision, Barangay Tadlac, Los Baños, Laguna. It is not yet a classified water body. During dry season, nineteen (19) parameters were in conformance with DENR standards for Class C waters. The two (2) nonconforming parameters were BOD, and PO_4-P.

1157. During wet season, three (3) parameters (BOD, PO_4-P and Cr^{+6}) were nonconformant with DENR standards for Class C waters. The Tadlac (Alligator) Lake, as a reference water body which is far from the alignment, meets the Class B (recreational) guidelines for the various parameters except for BOD.

SW-11 Dampalit River

1158. The sampling site is located just downstream (north side) of the railway bridge in Dampalit River, Barangay Bambang, Los Baños, Laguna. It is a small fast flowing river about 1.5 m wide and 15 cm at the sampling site. It is not yet a classified river.

1159. During dry season, seventeen (17) parameters were in conformance with DENR standards for Class C waters. The four (4) nonconforming parameters were pH, BOD, fecal coliform, and O&G.

1160. During wet season, five (7) parameters (temperature, BOD, fecal coliform, PO_4-P and O&G) were nonconformant with DENR standards for Class C waters.

SW-12 Saran River

1161. The sampling site is just downstream (north side) of railway bridge of Saran River in Barangay Malinta, and 105 m NW of Anos Bridge, Los Baños, Laguna. It is a small river with water about 2 m wide and 15 cm deep at the sampling site. Domestic wastes were seen along the black muddy river bed. It is unclassified.

1162. During dry season, only fourteen (14) parameters were in conformance with DENR standards for Class C waters. Seven (7) non-conforming parameters were TSS, pH, DO, BOD, fecal coliform, PO_4-P, and surfactants. During wet season, six (6) parameters (Color, TSS, BOD, fecal coliform, PO_4-P and O&G) were nonconformant with DENR standards for Class C waters.

SW- 13 Molawin River

1163. The sampling site is located just downstream (east side) of the railway bridge in Molawin (Maulauen) River, west of the International Rice Research Institute (IRRI) Los

Baños, Laguna. The river criss-crosses the campus of the University of the Philippines Los Baños and some areas of the town of Los Baños. It is a small river, with water about 4.5 m wide and 13 cm deep. It is not yet a classified river.

1164. During dry season, eighteen (18) parameters were in conformance with DENR standards for Class C waters. Three (3) nonconforming parameters with DENR Class C guidelines were TSS, BOD, and fecal coliform. During wet season, four (4) parameters (BOD, fecal coliform, O&G, and surfactants) were nonconformant with DENR standards for Class C waters.

1165. The 2009-2017 LLDA data showed non-conformance to standards in levels of DO, coliform, and PO_4-P.

SW-14 Buot Creek

1166. The sampling site is located just downstream (east side) of the Railway Bridge in Buot Creek, south of the International Rice Research Institute (IRRI) Los Baños, Laguna. It is small unclassified river.

1167. During dry season, seventeen (17) parameters were in conformance with DENR standards for Class C waters. Four (4) non-conforming parameters with Class C guidelines were DO, BOD, fecal coliform, and Cr^{+6}. During wet season, four (4) parameters (Color, BOD, fecal coliform, and surfactants) were nonconformant with DENR standards for Class C waters.

Table 3.2-28 Results of Surface Water Quality Sampling (1/3)

Parameters	Season	SW-1 Pasig River	SW-2 Laguna Lake	SW-3 Buli River	SW-4 Tunasan River	SW-5 San Pedro River	DAO 2016-08 Class C
Depth, m	Dry	3	1.25	0.55	0.09	0.2	-
	Wet	3.58	140	15.24	1.016	15.24	
Width, m	Dry	>100	-	5.4	7.7	4	-
	Wet	>100	-	5	1.5	3	
Flowrate, m/s	Dry	0.3	-	minimal flow	0.4	0.4	-
	Wet	0.26	-	minimal flow	0.53	0.478	
Color, TCU	Dry	65	28	5	5	5	75
	Wet	20	13	21	100	25	
Total Suspended Solids (TSS), mg/L	Dry	97	98	60	188	25	80
	Wet	56	16	206	175	76.7	
Temperature, °C	Dry	28.4	28.4	29.4	30.6	30.3	25-31
	Wet	26.7	19.4	27.5	28.8	29.7	
pH	Dry	6.7	6.79	6.95	7.02	6.44	6.5-9.0
	Wet	7.4	7.37	7.76	7.06	6.86	
Dissolved Oxygen (DO), mg/L	Dry	3.8	3.8	0.1	3.1	0.3	5 (Minimum)
	Wet	4.7	4.7	5.2	4.4	2.7	
Biochemical Oxygen Demand (BOD), mg/L	Dry	31	38	99	175	45	7
	Wet	22	21	186	341	23	
Fecal Coliforms, MPN/100mL	Dry	460,000	4,900	700,000	2,400,000	7,900,000	200
	Wet	21,000	9,400	1,100,000	220,000,000	540,000	
Total Coliforms, MPN/100mL	Dry	460,000	35,000	700,000	2,400,000	24,000,000	-
	Wet	350,000	54,000	2,200,000	540,000,000	920,000	
Conductivity, uS/cm	Dry	547	580	1097	1637	1325	-
	Wet	462	809	202	1644	812	
Chloride (Cl^-), mg/L	Dry	81	68	96	220	63	350
	Wet	54	122	13	18	46	
Nitrate (NO_3-N), mg/L	Dry	0.4	0.4	0.45	0.13	0.13	7
	Wet	0.128	0.133	0.075	0.073	0.735	
Phosphate as P (PO_4-P), mg/L	Dry	0.6	0.97	5.06	8.33	6.62	0.163
	Wet	2.09	0.615	0.0798	3.84	1.8	
Copper (Cu), mg/L	Dry	<0.005	<0.005	0.028	0.021	0.031	0.02
	Wet	0.006	<0.005	0.022	0.0107	0.0062	
Arsenic (As), mg/L	Dry	<0.0009	<0.0009	<0.0009	<0.0009	<0.0009	0.02
	Wet	<0.0009	<0.0009	<0.0009	<0.0009	<0.0009	
Cadmium (Cd), mg/L	Dry	<0.002	0.01	<0.002	<0.002	<0.002	0.005
	Wet	<0.002	<0.002	0.0004	0.0002	0.0003	
Chromium Hexavalent (Cr+6), mg/L	Dry	0.008	0.004	0.042	0.017	0.02	0.01
	Wet	0.005	0.122	<0.03	<0.03	0.022	

Parameters	Season	SW-1 Pasig River	SW-2 Laguna Lake	SW-3 Buli River	SW-4 Tunasan River	SW-5 San Pedro River	DAO 2016-08 Class C
Lead (Pb), mg/L	Dry	<0.006	<0.006	<0.006	<0.006	<0.006	0.05
	Wet	<0.006	0.035	0.026	0.053	0.012	
Mercury (Hg), mg/L	Dry	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.002
	Wet	<0.0001	<0.0001	<0.0001	<0.0001	0.00023	
Cyanide (CN), mg/L	Dry	0.032	0.015	0.01	0.011	0.093	0.1
	Wet	0.0297	0.002	0.028	0.013	<0.001	
Oil and Grease (O&G)	Dry	1.5	1.5	3.2	5.3	6.7	2
	Wet	1.41	1.35	1.94	4.52	3.01	
Organophosphates, mg/L	Dry	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.003
	Wet	<0.00022	<0.00022	<0.00022	<0.00022	<0.00022	
Phenols, mg/L	Dry	3.6	1.9	1.9	7.2	1.2	0.05
	Wet	<0.01	<0.01	<0.01	0.06	<0.01	
Surfactants (MBAS), mg/L	Dry	<0.007	<0.007	2.19	0.388	4.81	1.5
	Wet	0.132	0.317	0.399	0.253	0.594	

Note: Highlighted results do not conform with the standard.

a Reference values are maximum allowable level unless specified as range or minimum (min). b The reference values under the column of PO4-P are conversions (0.3261) of the 0.5 mg/L and 5 mg/L PO_4 values in DAO 2016-08
* Environmental Quality Standards for conservation of the Living Environment, Rivers, Class C

** Environmental Quality Standards for conservation of the Living Environment, Lakes, Class B

Table 3.2-29 Results of Surface Water Quality Sampling (2/3)

Parameters	Season	SW-6 Biñan River	SW-7 San Cristobal River	SW-8 San Juan River	SW-9 Bgy Bucal River	SW-10 Tadlac (Alligator) Lake	DAO 2016-08 Class C
Depth, m	Dry	-	1	0.5	0.2	Deep	-
	Wet	90	60.69	43	30	Deep	
Width, m	Dry	10	6	16	3.5	-	-
	Wet	10	10	16	3	-	
Flowrate, m/s	Dry	-	1.2	0.5	0.1	-	-
	Wet	0.67	0.36	0.52	0.34	-	
Color, TCU	Dry	10	5	<5	<5	5	75
	Wet	83	10	20	33	<5	
Total Suspended Solids (TSS), mg/L	Dry	43	20	8.5	26	2.5	80
	Wet	740	164	13	13	3.6	
Temperature, °C	Dry	28.5	27.2	30.1	31.3	29	25-31
	Wet	28.9	29.5	28.8	27.65	31	
pH	Dry	7.25	7.06	7.17	7.34	6.81	6.5-9.0
	Wet	7.2	7.08	7.06	6.94	8	
Dissolved Oxygen (DO), mg/L	Dry	2.1	0.1	6.4	5.2	5.6	5 (Minimum)
	Wet	4.75	3.805	5	7.02	9.07	
Biochemical Oxygen Demand (BOD), mg/L	Dry	66	33	7	15	11	7
	Wet	33	16	39	24	12	
Fecal Coliforms, MPN/100mL	Dry	9,200	9,200,000	160,000	1,300,000	22	200
	Wet	1,700,000	2,400,000	27,000	4,000	34	
Total Coliforms, MPN/100mL	Dry	9,200	16,000,000	160,000	2,400,000	49	-
	Wet	5,400,000	3,500,000	920,000	160,000	1,600	
Conductivity, uS/cm	Dry	1200	982	738	1355	829	-
	Wet	295	760	598	265	684	
Chloride (Cl^-), mg/L	Dry	120	98	50	250	120	350
	Wet	26	59	42	36	120	
Nitrate (NO_3-N), mg/L	Dry	0.11	0.13	1.24	0.43	0.84	7
	Wet	0.153	0.193	0.171	0.185	0.107	
Phosphate as P (PO_4-P), mg/L	Dry	2.72	1.44	1.12	0.19	0.44	0.163
	Wet	1.41	1.73	1.51	0.751	0.226	
Copper (Cu), mg/L	Dry	0.369	0.021	<0.005	<0.005	<0.005	0.02
	Wet	0.0153	0.0067	0.0047	0.0047	0.0041	
Arsenic (As), mg/L	Dry	<0.0009	<0.0009	0.0048	0.0249	0.0094	0.02
	Wet	<0.0009	<0.0009	0.0016	0.0154	0.0119	
Cadmium (Cd), mg/L	Dry	<0.002	<0.002	<0.002	0.005	<0.002	0.005
	Wet	<0.002	<0.0007	<0.002	<0.0003	0.0006	
Chromium Hexavalent	Dry	0.006	0.002	0.003	0.005	0.002	0.01

Parameters	Season	SW-6 Biñan River	SW-7 San Cristobal River	SW-8 San Juan River	SW-9 Bgy Bucal River	SW-10 Tadlac (Alligator) Lake	DAO 2016-08 Class C
(Cr+6), mg/L	Wet	<0.002	0.013	<0.002	<0.002	0.024	
Lead (Pb), mg/L	Dry	<0.006	<0.006	<0.006	<0.006	<0.006	0.05
	Wet	<0.006	0.009	0.0397	0.0015	0.0059	
Mercury (Hg), mg/L	Dry	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.002
	Wet	0.00019	0.0002	0.0003	0.00021	0.00057	
Cyanide (CN), mg/L	Dry	0.091	0.068	0.057	0.056	0.072	0.1
	Wet	0.0138	<0.001	<0.001	<0.001	<0.001	
Oil and Grease (O&G)	Dry	2.4	1.3	<0.5	<0.5	<0.5	2
	Wet	<0.5	2.5	2.9	3.8	0.63	
Organophosphates, mg/L	Dry	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.003
	Wet	<0.00022	<0.00022	<0.00022	<0.00022	<0.00022	
Phenols, mg/L	Dry	1.3	0.7	0.01	0.02	0.02	0.05
	Wet	<0.01	<0.01	<0.01	<0.01	<0.01	
Surfactants (MBAS), mg/L	Dry	0.373	0.204	<0.007	<0.007	<0.007	1.5
	Wet	<0.007	0.529	0.212	0.509	0.0287	

Note: Highlighted results do not conform with the standard. [a] Reference values are maximum allowable level unless specified as range or minimum (min). [b] The reference values under the column of PO_4-P are conversions (0.3261) of the 0.5 mg/L and 5 mg/L PO_4 values in DAO 2016-08. * Environmental Quality Standards for conservation of the Living Environment, Rivers, Class C.

** Environmental Quality Standards for conservation of the Living Environment, Lakes, Class B

Table 3.2-30 Results of Surface Water Quality Sampling (3/3)

Parameters	Season	SW-11 Dampalit River	SW-12 Saran River (Bgy Malinta)	SW-13 Molawin River	SW-14 Buot Creek	DAO 2016-08 Class C
Depth, m	Dry	0.23	0.11	0.12	0.16	-
	Wet	25.4	25.4	30.48	12.7	
Width, m	Dry	3.3	3.3	7.1	4.5	-
	Wet	1	2	2.5	1	
Flowrate, m/s	Dry	0.4	-	0.3	0.3	-
	Wet	0.58	0.08	0.79	3.03	
Color, TCU	Dry	5	10	5	40	75
	Wet	42	100	63	831	
Total Suspended Solids (TSS), mg/L	Dry	11	213	84	8.7	80
	Wet	15	85	48	11	
Temperature, °C	Dry	27.2	29.9	25.7	28.8	25-31
	Wet	24.6	27.1	27.7	26.9	
pH	Dry	6.38	6.4	7.8	7.03	6.5-9.0
	Wet	7	7.02	7.3	7.27	
Dissolved Oxygen (DO), mg/L	Dry	6.7	0.7	6.2	2.9	5 (Minimum)
	Wet	7.24	5.75	6.94	5.77	
Biochemical Oxygen Demand (BOD), mg/L	Dry	11	49	15	9	7
	Wet	23	32	24	11	
Fecal Coliforms, MPN/100mL	Dry	24000	5400000	54000	540000	200
	Wet	54000	540000	240000	54000	
Total Coliforms, MPN/100mL	Dry	24,000	5,400,000	54,000	540,000	-
	Wet	160,000	920,000	350,000	92,000	
Conductivity, uS/cm	Dry	228	674	346	518	-
	Wet	109	283	121	257	
Chloride (Cl^-), mg/L	Dry	8.2	32	15	29	350
	Wet	17	16	9.6	16	
Nitrate (NO_3-N), mg/L	Dry	0.14	0.1	0.38	0.22	7
	Wet	0.223	0.188	0.225	0.353	
Phosphate as P (PO_4-P), mg/L	Dry	0.02	1.03	0.09	0.39	0.163
	Wet	1.84	0.745	0.088	0.079	
Copper (Cu), mg/L	Dry	<0.005	<0.005	<0.005	0.007	0.02
	Wet	0.0046	0.007	0.0061	0.0055	
Arsenic (As), mg/L	Dry	0.0095	0.0108	0.0023	0.0024	0.02
	Wet	<0.0009	<0.0009	<0.0009	0.0103	
Cadmium (Cd), mg/L	Dry	0.002	0.011	<0.002	<0.002	0.005
	Wet	<0.0003	<0.002	<0.002	<0.002	
	Dry	0.004	0.005	0.005	0.014	0.01

Parameters	Season	SW-11 Dampalit River	SW-12 Saran River (Bgy Malinta)	SW-13 Molawin River	SW-14 Buot Creek	DAO 2016-08 Class C
Chromium Hexavalent (Cr+6), mg/L	Wet	<0.002	<0.002	<0.002	<0.002	
Lead (Pb), mg/L	Dry	<0.006	<0.006	<0.006	0.02	0.05
	Wet	0.0112	0.0416	0.0383	0.0309	
Mercury (Hg), mg/L	Dry	<0.0001	<0.0001	<0.0001	<0.0001	0.002
	Wet	0.0002	0.0002	0.0003	0.00026	
Cyanide (CN), mg/L	Dry	0.02	0.019	0.03	0.005	0.1
	Wet	<0.001	<0.001	<0.001	<0.001	
Oil and Grease (O&G)	Dry	3.3	<0.5	<0.5	0.7	2
	Wet	3.3	8	8.6	<0.5	
Organophosphates, mg/L	Dry	<0.00001	<0.00001	<0.00001	<0.00001	0.003
	Wet	<0.00022	<0.00022	<0.00022	<0.00022	
Phenols, mg/L	Dry	0.02	0.03	0.04	<0.01	0.05
	Wet	<0.01	<0.01	<0.01	<0.01	
Surfactants (MBAS), mg/L	Dry	0.094	2.58	<0.007	0.036	1.5
	Wet	0.595	1.04	1.66	1.93	

Note: Highlighted results do not conform with the standard.

[a] Reference values are maximum allowable level unless specified as range or minimum (min). [b] The reference values under the column of PO_4-P are conversions (0.3261) of the 0.5 mg/L and 5 mg/L PO_4 values in DAO 2016-08. * Environmental Quality Standards for conservation of the Living Environment, Rivers, Class C

** Environmental Quality Standards for conservation of the Living Environment, Lakes, Class B

Results by Parameter

Colour

1168. During dry season, true colour measured from fourteen (14) sampling sites ranged from <5 to 65 TCU or within the DENR Class C guideline of not more than 75 TCU. The highest was measured in Pasig River (SW-1) and the lowest were in San Juan (SW-8) and Bgy. Bucal Rivers (SW-9).

1169. During wet season, true color measured from fourteen (14) sampling sites ranged from <5 to 100 TCU. The highest was measured in Tunasan River (SW-4) and Saran River (SW-12) and the lowest is in Tadlac Lake (SW-10). Measurements greater than the 75 TCU DENR Class C guideline were noted in Tunasan River (SW-4), Biñan River (SW-6), Saran River (SW-12) and Buot Creek (SW-14).

1170. It is observed that compared with the dry season, there is an increase in the intensity of color during wet season except in the cases of Pasig River (SW-1), Laguna Lake (SW-2) and Tadlac Lake (SW-10) where the color decreased (**Figure 3.2-34**).

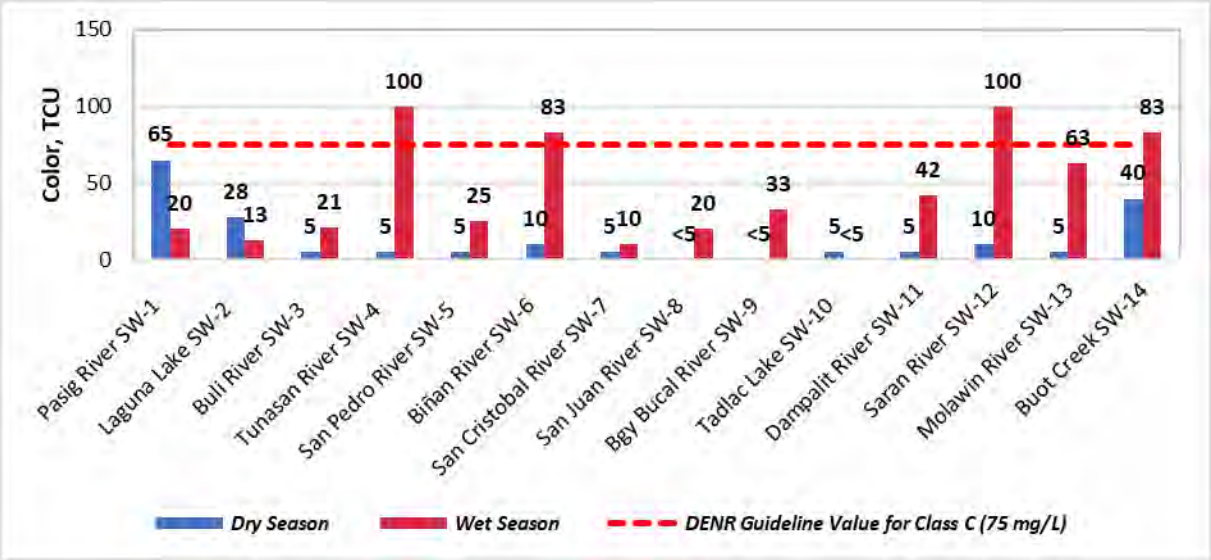


Figure 3.2-34 Results of Color Measurement of Surface Water Samples

Total Suspended Solids

1171. During dry season, the Total Suspended Solids (TSS) concentrations ranged from 2.5 to 213 mg/L. Cases of levels greater than the 80 mg/L DENR Class C maximum allowable limit were noted in Pasig River (SW-1), Laguna Lake (SW-2), Tunasan River (SW-4), Saran River (SW-12), and Molawin River (SW-13).

1172. During wet season, the TSS concentrations ranged from 11 to 740 mg/L. Cases of levels greater than the 80 mg/L DENR Class C maximum allowable limit were noted in Buli River (SW-3), Biñan River (SW-6), San Cristobal River (SW-7) and Saran River (SW-12).

1173. In the case of Pasig River (SW-1), Laguna Lake (SW-2), Tunasan River (SW-4), Bucal River (SW-9), Saran River (SW-12), and Molawin River (SW-13) have higher TSS concentration during the dry season while the other 8 surface waters have higher TSS concentration during wet season. This may be due to soil and silt washed by rainfall to the bodies of water monitored (**Figure 3.2-35**).

1174. In the turbidity annual average from LLDA using the depth at which a Secchi Disc is visible from the surface, three (3) monitoring stations San Pedro, Sta. Rosa, and Los Baños bays in the lake, turbidity (disc visibility) measured only 37-73 cm deep in 2012-2016, with decreasing visibility depth of around 70 cm to 40 cm since 2013, an indication of increasing turbidity.

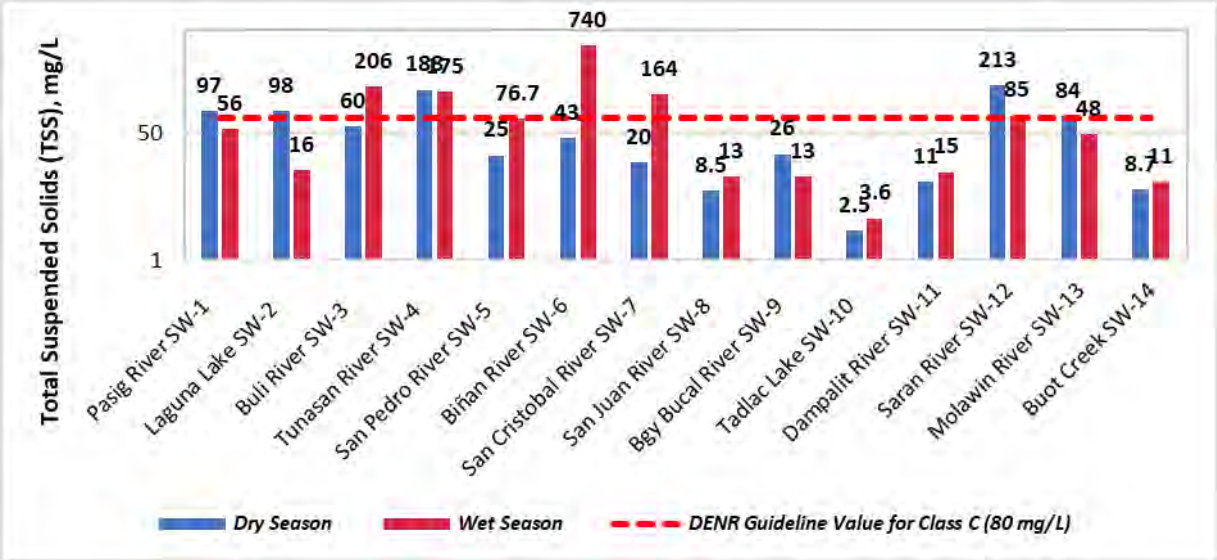


Figure 3.2-35 Results of Total Suspended Solids Measurement of Surface Water Samples

Temperature

1175. During dry season, temperatures of all stations ranged from 25.7°C to 31.3°C. The maximum was observed in Bgy. Bucal River (SW-9) exceeding the 31ºC upper limit of DENR standards for Class C water. All the rest were within the upper and lower limits set by DENR for Class C water.

1176. During wet season, temperatures of all stations ranged from 19.4°C to 31°C. The highest temperature was observed in Tadlac Lake (SW-10) and the lowest was in Laguna Lake (SW-2). Temperature level at Laguna Lake fall below the lower limit (25°C) set by DENR for Class C water. All the rest were within the DENR standards.

1177. Most of the surface waters were noted to have a higher recorded temperature during the dry season with the exceptions of Biñan River (SW-6), San Cristobal River (SW-7), Tadlac Lake (SW-10), and Molawin River (SW-13) that have higher temperature records during the wet season (**Figure 3.2-36**).

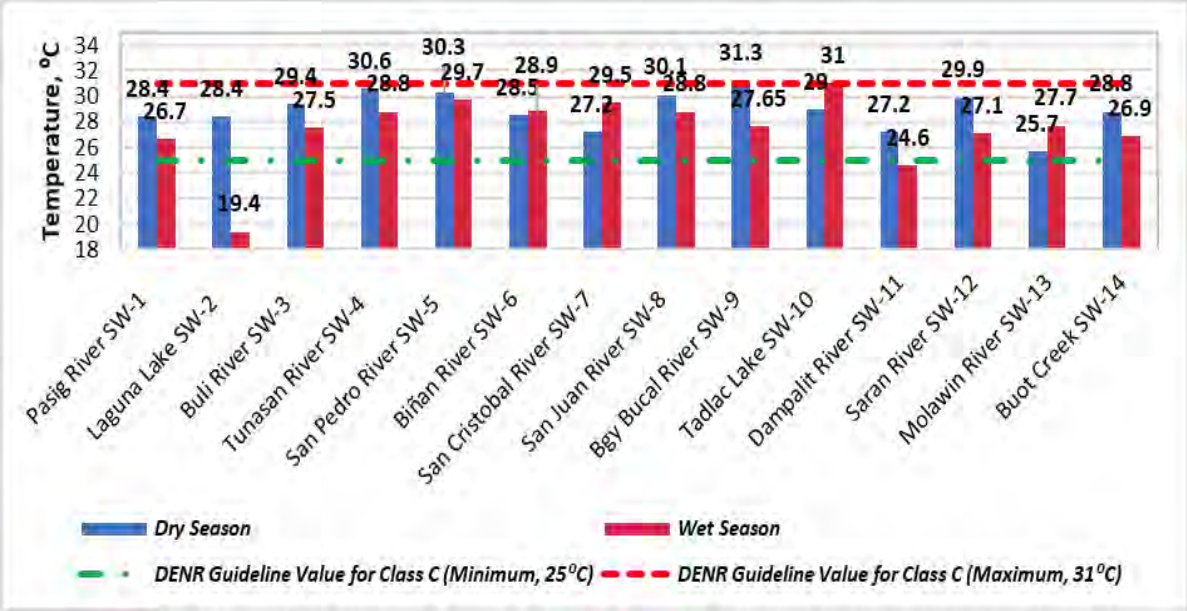


Figure 3.2-36 Results of Temperature Measurement of Surface Water Samples

pH Level

1178. During dry season, the pH ranged from 6.38 to 7.80. The pH values less than the minimum requirement of 6.5 was observed in San Pedro River (SW-5), Dampalit River (SW-11), and Saran River (SW-12). No stations exceeded the maximum allowable limit of DENR which is 9.0.

1179. During wet season, the pH ranged from 6.86 to 8.0. The pH values of all stations were within the minimum and maximum allowable limit of DENR which is 6.5-9.0.

1180. Most of the stations have higher pH values compared to dry season except Biñan River (SW-6), San Juan River (SW-8), Bucal River (SW-9) and Molawin River (SW-13) that have higher pH values during the dry season (**Figure 3.2-37**).

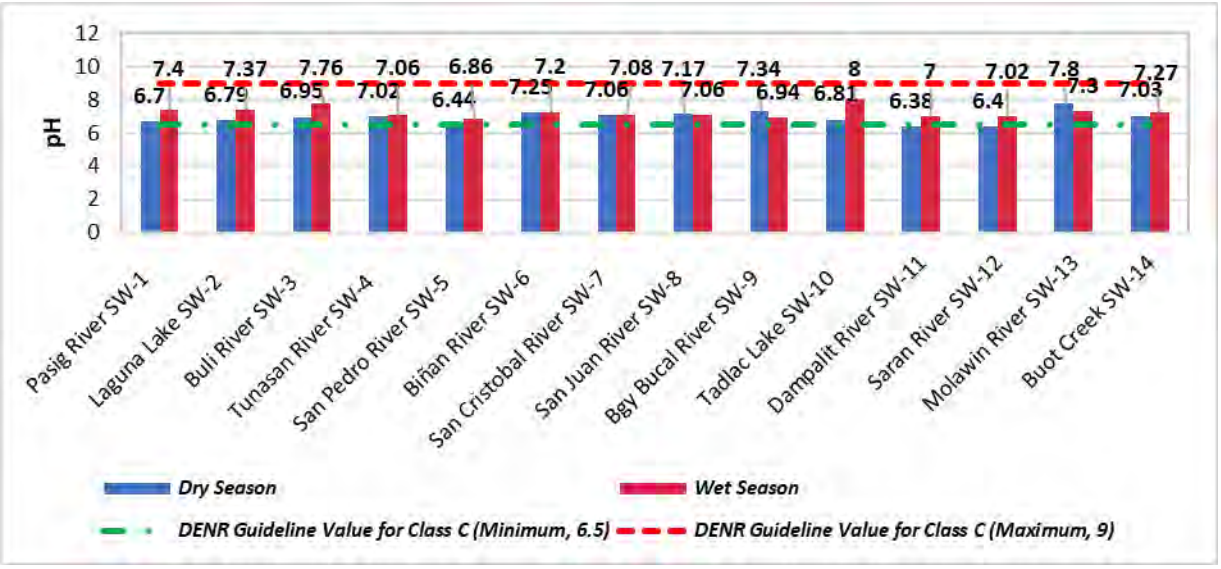


Figure 3.2-37 Results of pH Measurement of Surface Water Samples

Dissolved Oxygen

1181. During dry season, the Dissolved Oxygen (DO) concentrations ranged from 0.1 to 6.7 mg/L. Pasig River (SW-1), Laguna River (SW-2), Buli River (SW-3), Tunasan River (SW-4), San Pedro River (SW-5), Biñan River (SW-6), San Cristobal River (SW-7), Saran River (SW-12) and Buot River (SW-14) did not conform with the 5 mg/L Class C minimum requirement of DENR Standard.

1182. During wet season, the DO concentrations ranged from 2.695 to 9.07 mg/L. Pasig River (SW-1), Laguna River (SW-2), Tunasan River (SW-4), San Pedro River (SW-5), Biñan River (SW-6), San Cristobal River (SW-7) did not conform with the 5 mg/L Class C minimum requirement of DENR Standard.

1183. Most of the stations during wet season have a recorded higher concentration of dissolved oxygen with Tadlac Lake (SW-10) having the highest concentration, except San Juan River (SW-8) that has a higher dissolved oxygen concentration during the dry season (**Figure 3.2-38**).

1184. In the LLDA river monitoring stations, the average of the annualized monthly DO measurements per tributary station in 2009-2017 ranged 0.2-6.4 mg/L (**Table 3.2-20**). Cases of conformance with the minimum 5 mg/L were noted in the upstream station in Sta. Rosa River (in all cases), and in San Juan River.

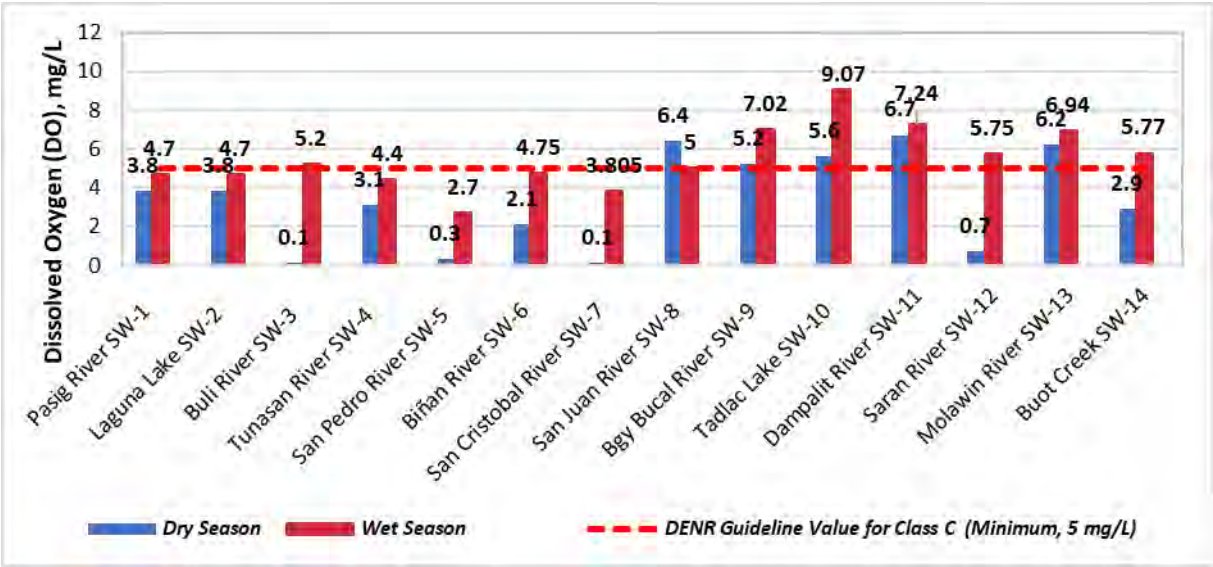


Figure 3.2-38 Results of Dissolved Oxygen Measurement of Surface Water Samples

Biochemical Oxygen Demand

1185. During dry season, the Biochemical Oxygen Demand (BOD) concentrations ranged from 7 to 175 mg/L. Only San Juan River (SW-8) conformed to the 7 mg/L maximum allowable limit of DENR standards for Class C waters, and the highest BOD recorded was in Tunasan River (SW-4) with 175 mg/L.

1186. During wet season, the BOD concentrations ranged from 11 to 341 mg/L. All of the stations are nonconforming to the DENR Standard of 7 mg/L. The highest BOD concentration recorded was in Tunasan River (SW-4) with 341 mg/L (**Figure 3.2-39**).

1187. Pasig River (SW-1), Laguna Lake (SW-2), San Pedro River (SW-5), Biñan River (SW-6), San Cristobal River (SW-7) and Saran River (SW-12) have higher BOD levels during the dry season, while the remaining 8 stations have higher BOD concentrations during the wet season.

1188. In the LLDA river monitoring stations, the average of the annualized monthly BOD measurements per tributary station in 2009-2017 ranged 4-240 mg/L as shown in **Table 3.2-20**. Cases of conformance with the minimum 7 mg/L were noted in the San Juan River and Molawin River. Annual BOD measurement within Laguna Lake remained less than 7 mg/L except the 7.5 mg/L in Sta Rosa bay station in 2017 as presented in **Table 3.2-21**.

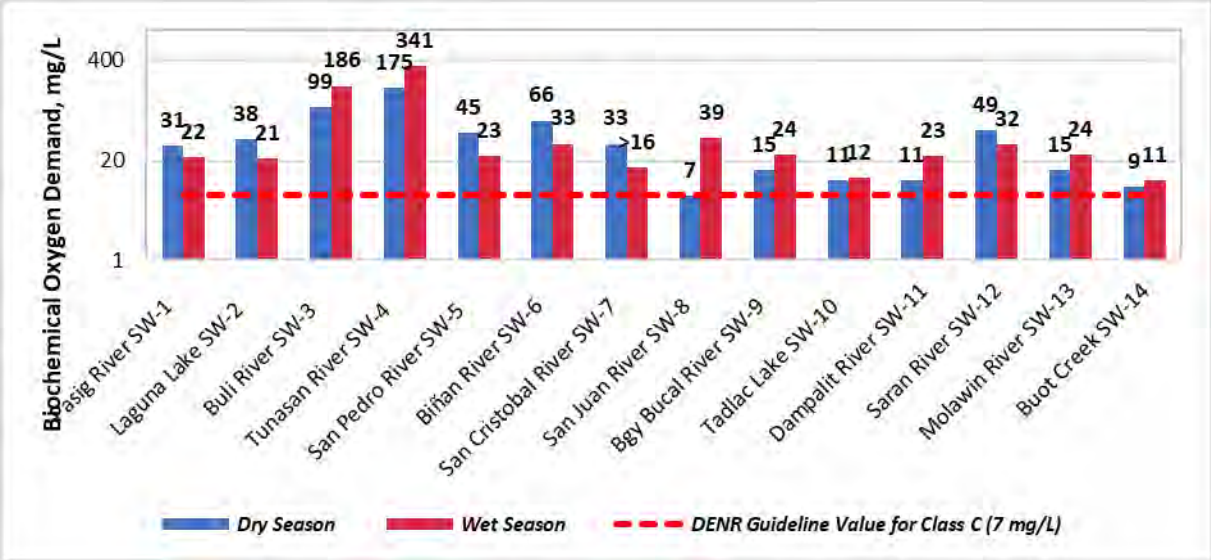


Figure 3.2-39 Results of Biochemical Oxygen Demand Measurement of Surface Water Samples

Fecal Coliform

1189. During dry season, fecal coliform counts ranged from 22 to 9,200,000 MPN/100 ml. Only Tadlac Lake (SW-10) conformed to the 200 MPN/100 ml maximum allowable limit of DENR standards for Class C waters. All the rest exceeded with the DENR guideline with highest fecal coliform count in San Cristobal River (SW-7).

1190. During wet season, fecal coliform counts ranged from 34 to 220,000,000 MPN/100 ml. Only SW-10 (Tadlac Lake) conformed to the 200 MPN/100 ml Class C maximum allowable limit. The highest fecal coliform count was in Tunasan River (SW-4).

1191. Pasig River (SW-1), San Pedro River (SW-5), San Cristobal River (SW-7), San Juan River (SW-8), Bucal River (SW-9), Saran River (SW-12) and Buot Creek (SW-14) have higher fecal coliform count during the dry season as compared to the remaining stations that have higher fecal coliform count during the wet season (**Figure 3.2-40**).

1192. In the LLDA river monitoring stations, the average of the annualized monthly total coliform measurements per tributary station in 2009-2017 ranged very high at 183,000 – 1.1E+11 MPN/100 ml as given in **Table 3.2-14**. The total coliform annual geometric means within Laguna Lake ranged at lower values of 37-1,373 MPN/100 ml as shown in **Table 3.2-14**.

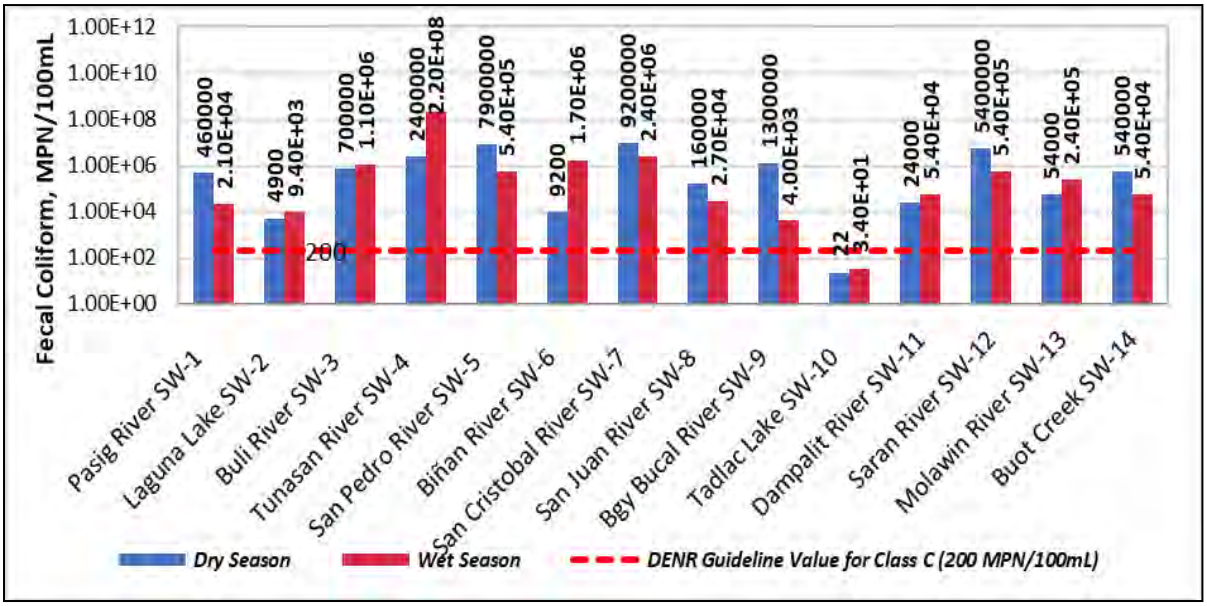


Figure 3.2-40 Results of Bar Graph of Fecal Coliform by Surface Water Samples

Total Coliform

1193. During dry season, total coliform ranged from 49 to 24,000,000 MPN/100 ml. Tadlac Lake Station (SW-10) has the lowest result at 49 MPN/100ml and the highest total coliform count was recorded at San Pedro River Station (SW-5) at 24,000,000 MPN/100 ml.

1194. During wet season, total coliform ranged from 1,600 to 5,400,000 MPN/100 ml the highest total coliform count is measured in Biñan River (SW-5).

1195. Higher total coliform count during wet season were recorded in Laguna Lake (SW-2), Buli River (SW-3), Tunasan River (SW-4), Biñan River (SW-6), San Juan River (SW-8), Tadlac Lake (SW-10), Dampalit River (SW-11) and Molawin River (SW-13) (**Figure 3.2-41**).

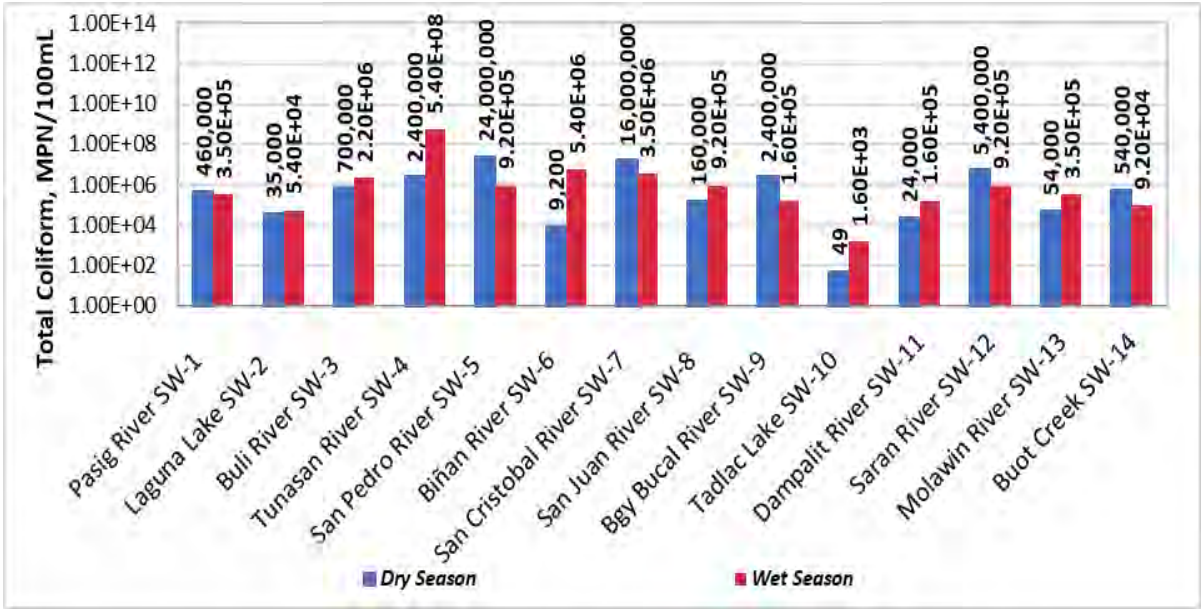


Figure 3.2-41 Results of Bar Graph of Total Coliform by Surface Water Samples

Conductivity

1196. During dry season, conductivity measurements ranged from 228 to 1,637 µS/cm. The highest conductivity was measured in Tunasan River (SW-4) at 1,637 µS while the lowest was measured in Dampalit River with 228 µS.

1197. During wet season, conductivity measurements ranged from 109.1 to 1,644 µS/cm. The highest conductivity was measured in Tunasan River (SW-4) at 1,644 µS while the lowest was measured in Dampalit River with 109.1 µS.

1198. Most of the stations have a higher conductivity measurement during the dry season except Laguna Lake (SW-2) and Tunasan River (SW-4) that have higher conductivity during the wet season. The lower conductivity during wet season may be attributed to dilution of bodies of water due to greater recharge and precipitation rates (**Figure 3.2-42**).

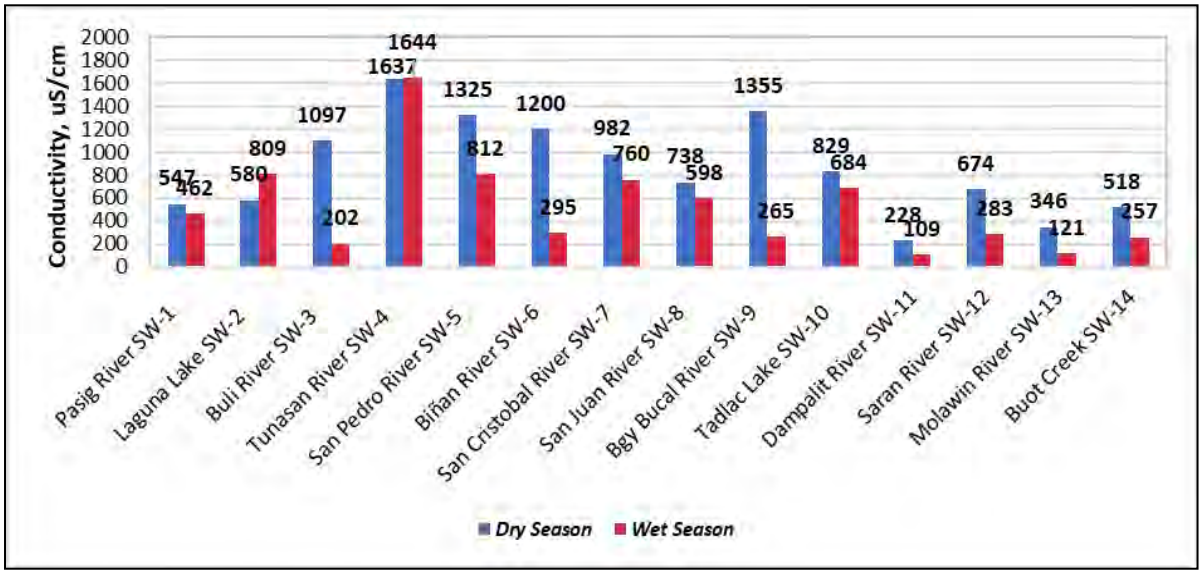


Figure 3.2-42 Results of Conductivity Measurement of Surface Water Samples

Chloride

1199. During dry season, the Chloride concentrations ranged from 8.2 to 250 mg/L or within DENR Class C guideline of not more than 350 mg/L. The highest chloride concentration was measured in Bgy. Bucal River (SW-9) while the lowest was measured in Dampalit River (SW-11).

1200. During wet season, the Chloride concentrations ranged from 9.6 to 120 mg/L or within DENR Class C guideline of not more than 350 mg/L. The highest chloride concentration was measured in Tadlac Lake (SW-10) while the lowest was measured in Molawin River (SW-13).

1201. Most stations during the dry season have higher concentrations of chloride except Laguna Lake (SW-2) and Dampalit River (SW-11) that have a higher Chloride concentration during the wet season (**Figure 3.2-43**).

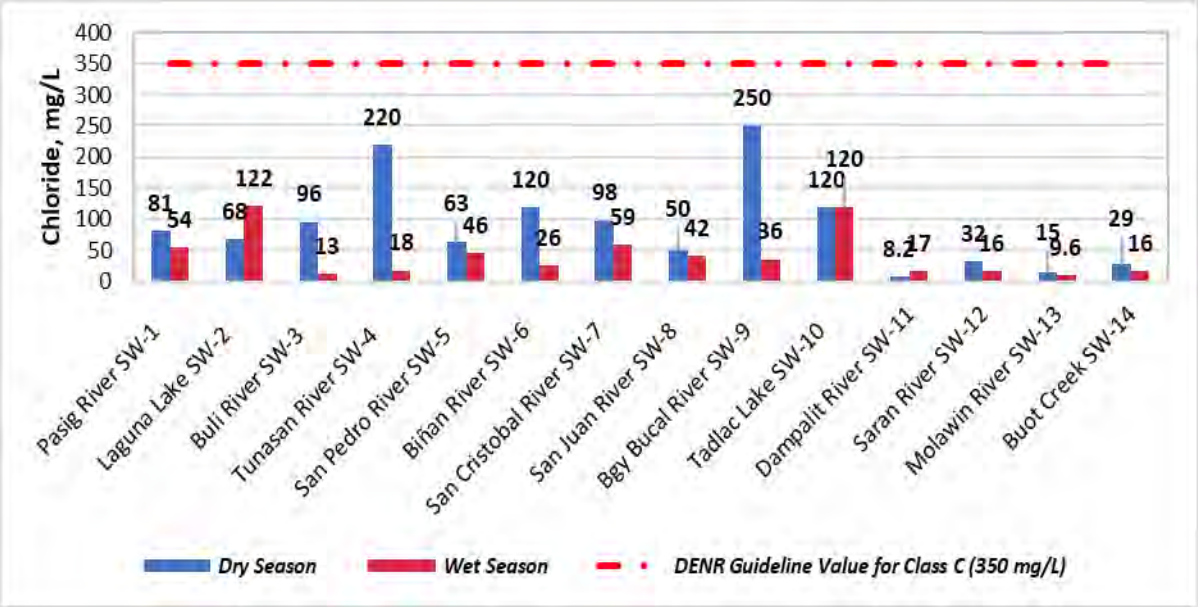


Figure 3.2-43 Results of Chloride Measurement of Surface Water Samples

Nitrate

1202. During dry season, the Nitrate (NO_3-N) concentrations ranged from 0.10 to 1.24 mg/L which is within DENR Class C guideline of not more than 7 mg/L. The 1.24 mg/L came from San Juan River (SW-8) which prominently had higher nitrate concentration.

1203. During wet season, the NO_3-N concentrations ranged from 0.075 to 0.735 mg/L which is within DENR Class C guideline of not more than 7 mg/L. The highest concentration came from San Pedro River (SW-5) while the lowest was measured in Buli River (SW-3).

1204. Most of the stations showed a higher nitrate concentration during the dry season with exception to San Pedro River (SW-5), Biñan River (SW-6), San Cristobal River (SW-7), Dampalit River (SW-11), Saran River (SW-12) and Buot Creek (SW-14) (**Figure 3.2-44**).

1205. From the LLDA monitoring data, the average of the annualized monthly NO_3-N measurements per tributary station in 2009-2017 ranged from 0.13 to 4.66 mg/L., or within Class C guideline. Elevated nitrate concentrations were also observed in Molawin River as set out in **Table 3.2.19**. NO_3-N concentration within the Laguna Lake stations were less than 1 mg/L as presented in **Table 3.2.24**.

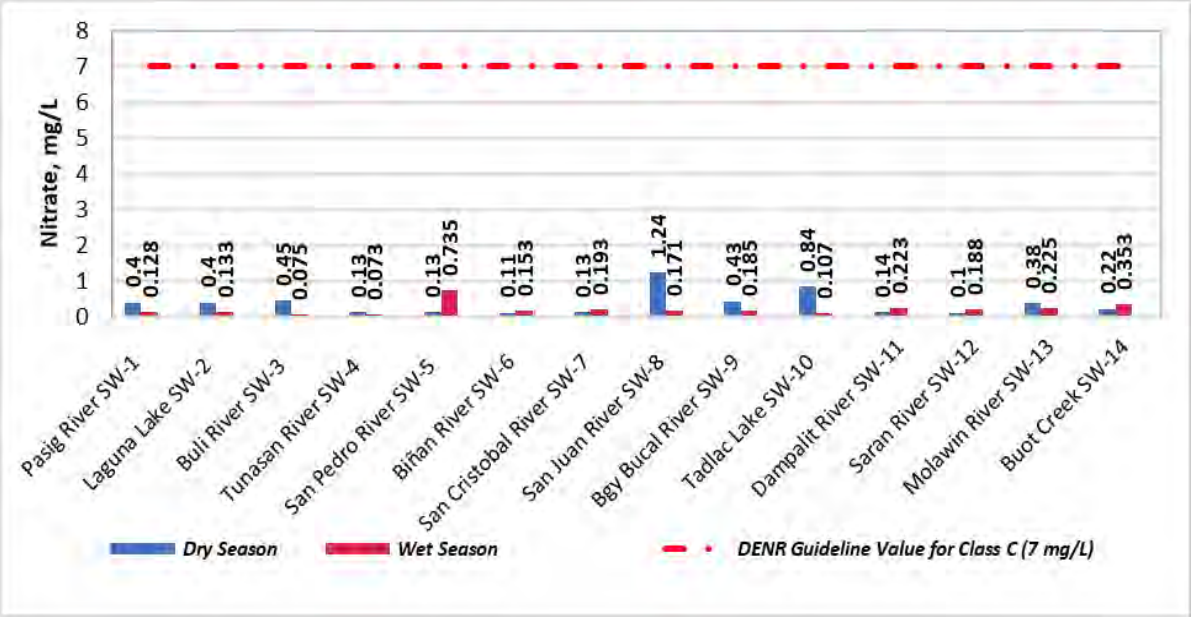


Figure 3.2-44 Results of Nitrate Measurement of Surface Water Samples

Phosphate

1206. During dry season, the Phosphate (PO_4-P) concentrations ranged from 0.02 to 8.33 mg/L. Only Dampalit River (SW-11) and Molawin River conformed to the DENR Class C guideline of not greater than 0.163 mg/L. High concentrations were measured at Buli River, Tunasan River, San Pedro River, and Biñan River.

1207. During wet season, the PO_4-P concentrations ranged from 0.079 to 1.84 mg/L. Only Buli River (SW-13), Molawin River (SW-13) and Buot Creek (SW-14) conformed to the DENR Class C guideline of not greater than 0.163 mg/L. Highest concentrations were measured in San Pedro River (SW-5) and Dampalit River (SW-11).

1208. Most of the stations have displayed higher phosphate concentrations during dry season compared to wet season except Pasig River (SW-1), San Cristobal River (SW-7), San Juan River (SW-8), Bucal River (SW-9), and Dampalit River (SW-11) (**Figure 3.2-45**).

1209. In comparison, LLDA data have a range of 0.66 to 4.04 mg/L on average annual monthly concentrations of PO_4-P in 2009-2017 in the tributaries of Laguna Lake or more than the Class C limits as given in **Table 3.2.19**. PO_4-P concentrations were within the Class C guideline as shown in **Table 3.2.20**.

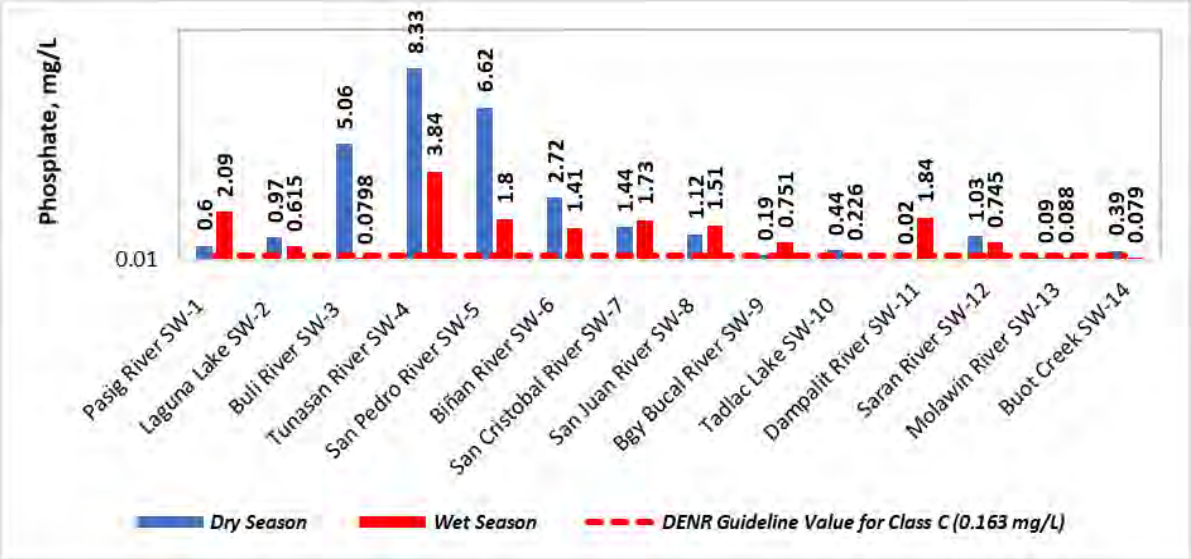


Figure 3.2-45 Results of Phosphate Measurement of Surface Water Samples

Organophosphates

1210. The maximum allowable organophosphate concentration based from the DENR standards is 0.003 mg/L. For the fourteen (14) stations surveyed, the results gathered showed that the stations contained insignificant amounts of Organophosphates in both dry and wet seasons (**Table 3.2.24**).

Copper

1211. During dry season, the Copper (Cu) concentrations ranged from 0.005 to 0.369 mg/L. Levels greater than 0.02 mg/L DENR Class C ceiling were noted in four samples: Buli River (SW-3), Tunasan River (SW-4), San Pedro River (SW-5), and Biñan River (SW-6). During wet season, the Cu concentrations ranged from 0.0041 to 0.0223 mg/L. Measurement greater than 0.02 mg/L DENR Class C ceiling is noted only in Buli River (SW-3).

1212. Most of the stations displayed higher amount of Cu concentration during the dry season compared to wet season (**Figure 3.2-46**).

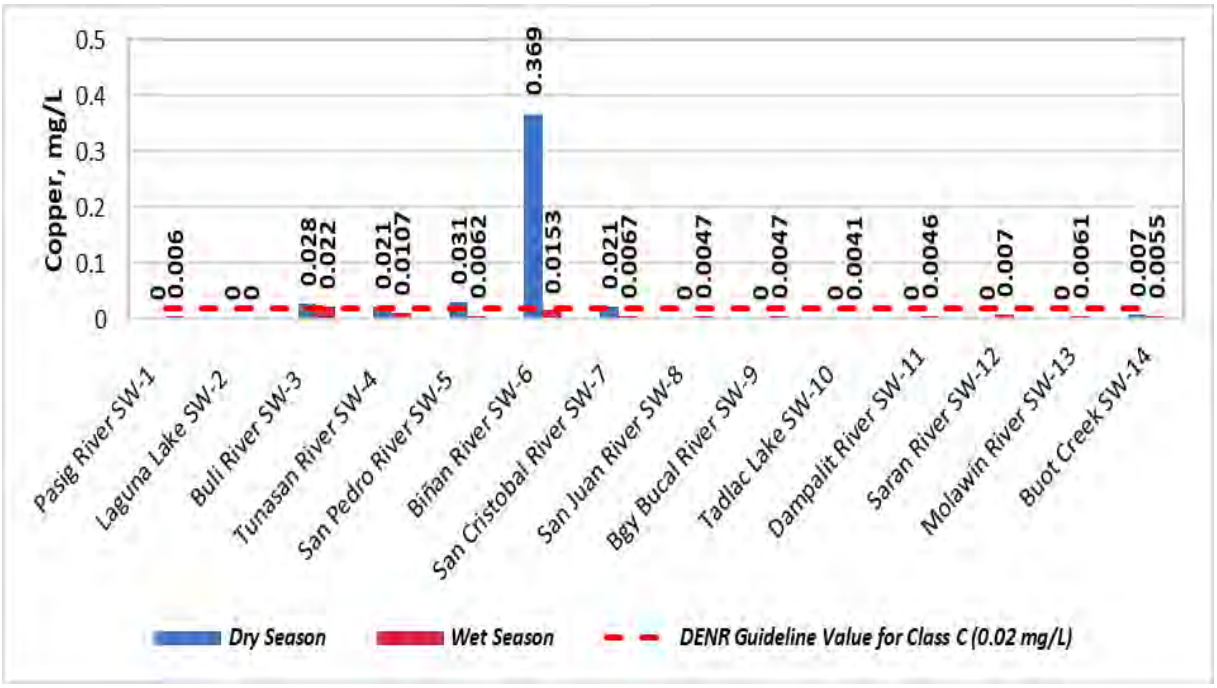


Figure 3.2-46 Results of Copper Measurement of Surface Water Samples

Arsenic

1213. During dry season, the concentration of Arsenic (As) observed from the fourteen (14) surface water sampling stations ranged from <0.0009 to 0.0249 mg/L. Bucal River (SW-9) failed to conform with the DENR Class C guideline. All other stations were in conformance to the DENR guideline.

1214. During wet season, the concentration of As observed from the fourteen (14) surface water sampling stations ranged from <0.0009 to 0.0016 mg/L. All of the stations were in conformance with the DENR Class C guideline. Highest level of arsenic at 0.0154 mg/L is measured in Bucal River (SW-9).

1215. San Juan River (SW-8), Bucal River (SW-9), Dampalit River (SW-11), Saran River (SW-12) and Molawin River (SW-13) have higher arsenic concentrations during dry season compared to wet season. Higher arsenic concentrations during the wet season were observed in Tadlac Lake (SW-10) and Buot Creek (SW-14). The remaining stations have no arsenic content detected (**Figure 3.2-47**).

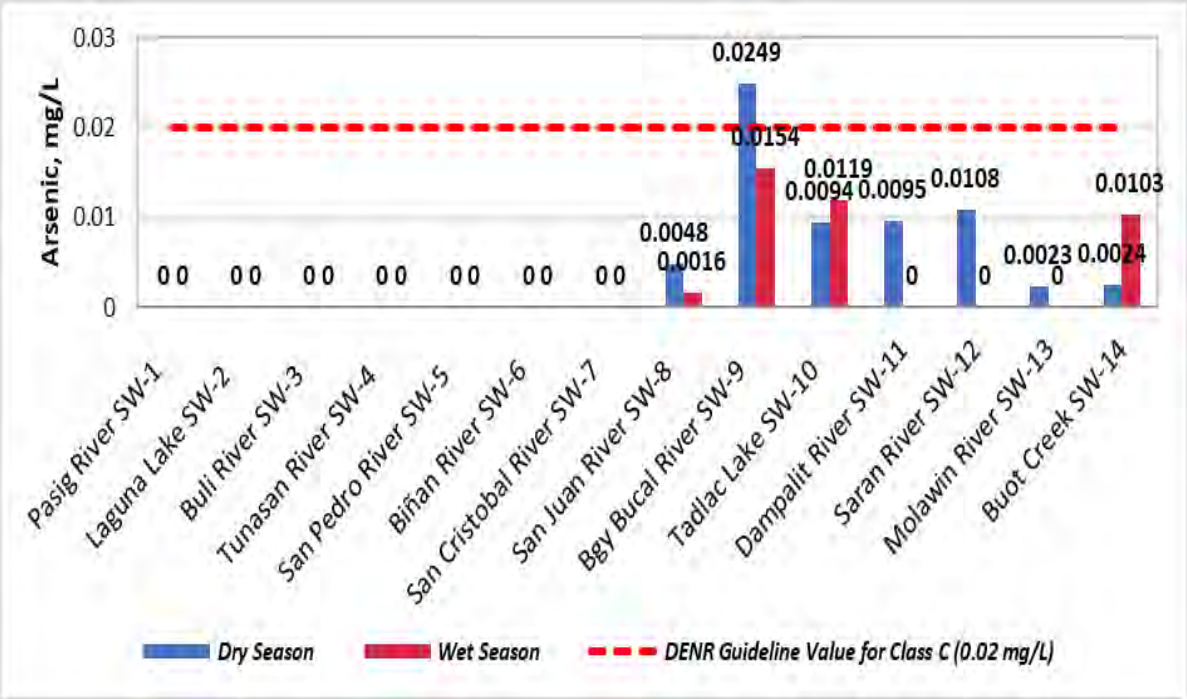


Figure 3.2-47 Results of Arsenic Measurement of Surface Water Samples

Cadmium

1216. During dry season, of the fourteen (14) stations sampled for Cadmium (Cd) content, four (4) stations were found to contain Cd. Brgy. Bucal and Dampalit Rivers were in conformance with the DENR guideline. Laguna Lake and Saran River were nonconformant with DENR guideline. During wet season, all of the fourteen (14) stations sampled for Cd content were in conformance with the DENR guideline with highest reading of 0.0006 mg/L at San Cristobal River (SW-7).

1217. Laguna Lake (SW-2), Bucal River (SW-9), Dampalit River (SW-11) and Saran River (SW-12) have showed higher Cd concentrations during the dry season compared to wet season while Tadlac Lake (SW-10) have detected lower level of Cd during the dry season. The other stations have minute concentrations of Cd (**Figure 3.2-48**).

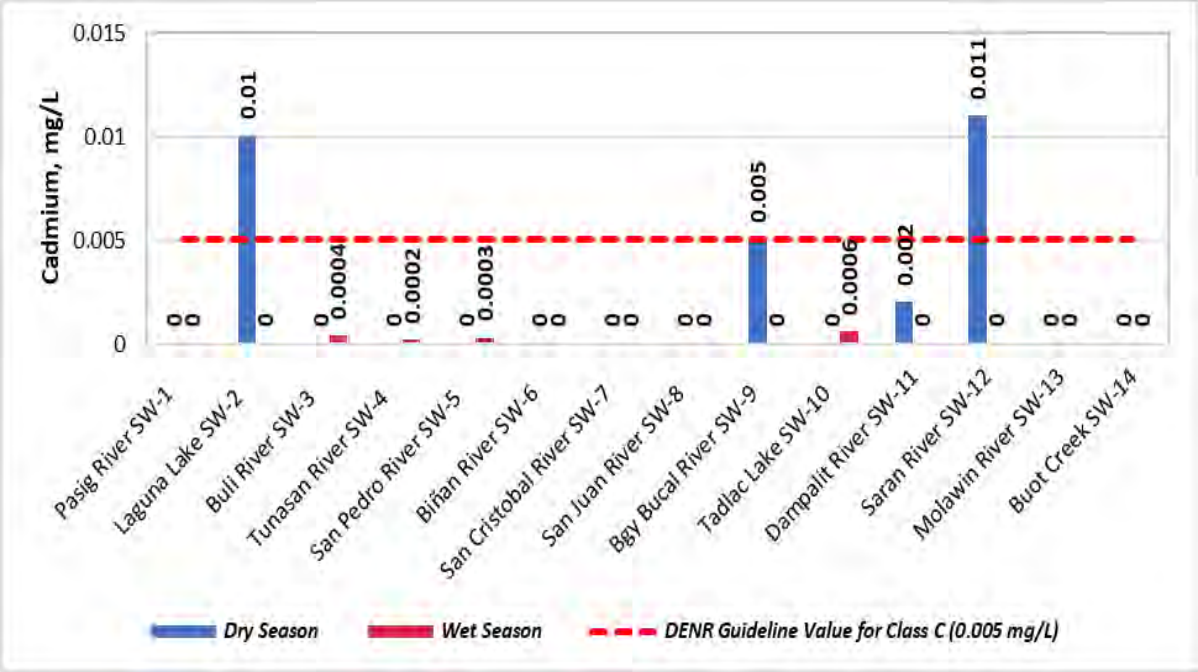


Figure 3.2-48 Results of Cadmium Measurement of Surface Water Samples

Chromium Hexavalent

1218. During dry season, all the fourteen (14) surface water sampling stations studied were conformant with the DENR guideline for chromium hexavalent (Cr^{+6}). Highest concentration was observed in Buli River station (SW-3).

1219. During wet season, only Laguna Lake (SW-2) surface water sampling stations was non-conformant with the DENR guideline. The concentration of chromium hexavalent in SW-2 is 0.122 mg/L.

1220. Most of the stations have a higher chromium hexavalent concentration detected during the dry season compared to wet season except for the stations of Laguna Lake (SW-2), San Pedro River (SW-5), San Cristobal River (SW-7) and Tadlac Lake (SW-10). There was a significant increase in chromium hexavalent levels at Laguna Lake, which may indicate higher discharges from industrial sources surrounding the lake (**Figure 3.2-49**).

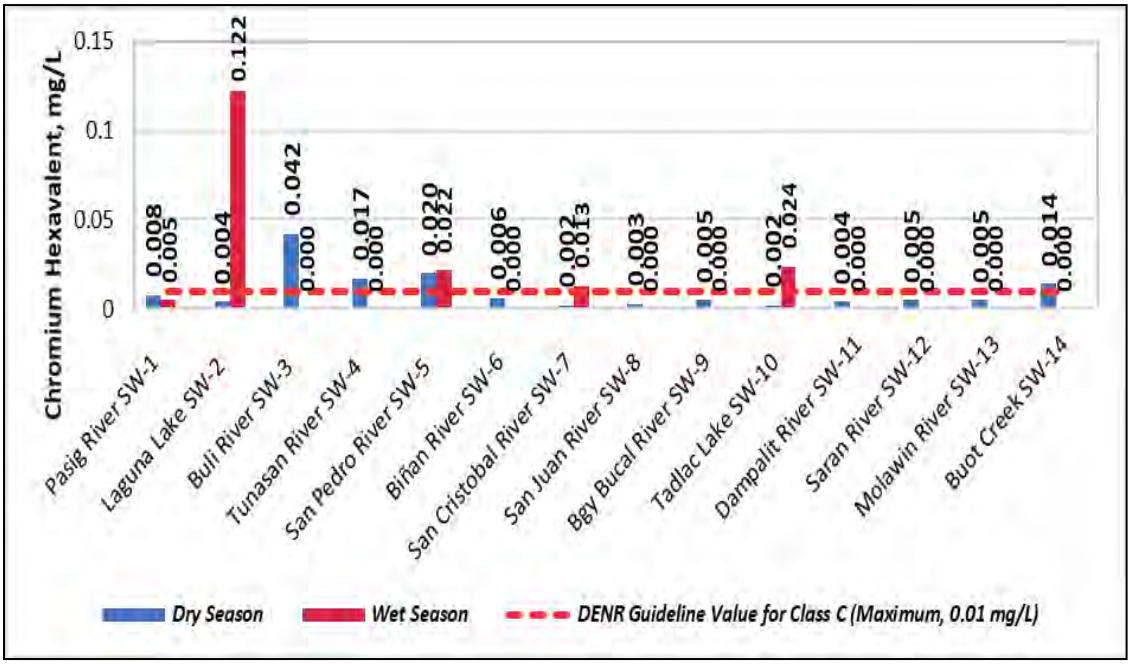


Figure 3.2-49 Results of Chromium Measurement of Surface Water Samples

Lead

1221. During dry season, among the fourteen (14) surface water sampling stations sampled for Lead (Pb) content, only Buot Creek was confirmed to have a presence of Pb.

1222. During wet season, only Tunasan River (SW-4) surface water sampling stations was non-conformant with the 0.05 mg/L values for DENR guideline for Class C. Recorded concentration is 0.053 mg/L.

1223. Most of the stations displayed higher concentrations of Pb during the wet season. Two (2) stations have no Pb concentrations detected (**Figure 3.2-50**).

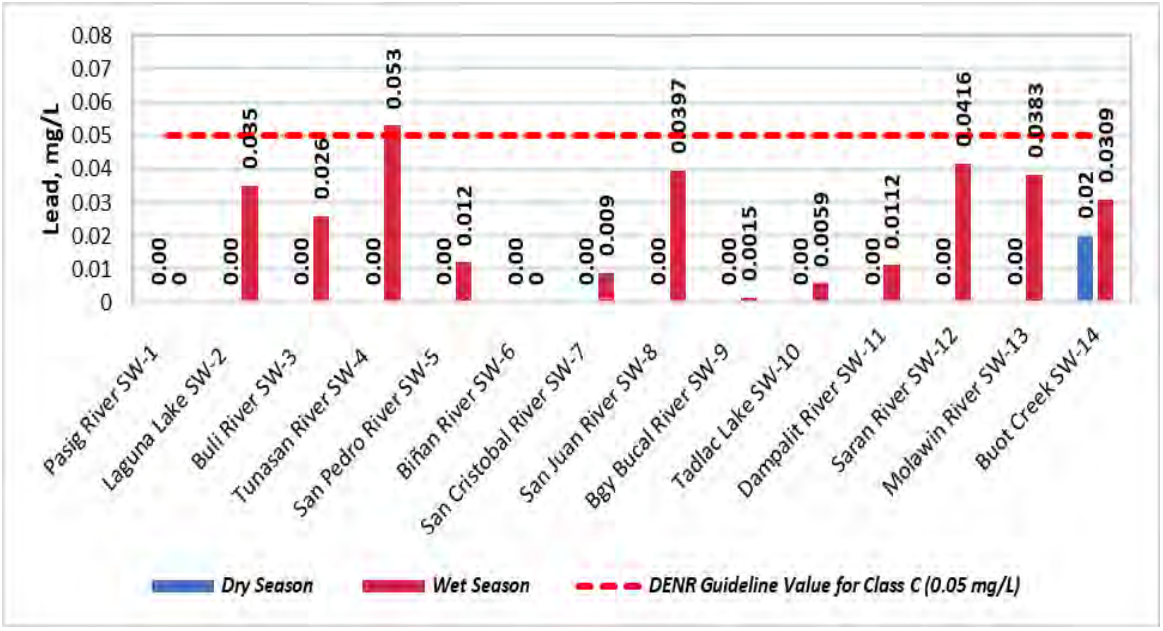


Figure 3.2-50 Results of Lead Measurement of Surface Water Samples

Mercury

1224. During dry season, results showed that levels of Mercury (Hg) in all fourteen (14) stations were in compliance with the DENR guideline for Class C during the dry and wet seasons. Most of the stations displayed higher concentrations of mercury during the wet season. Four (4) stations have no mercury concentrations detected (**Figure 3.2-51**).

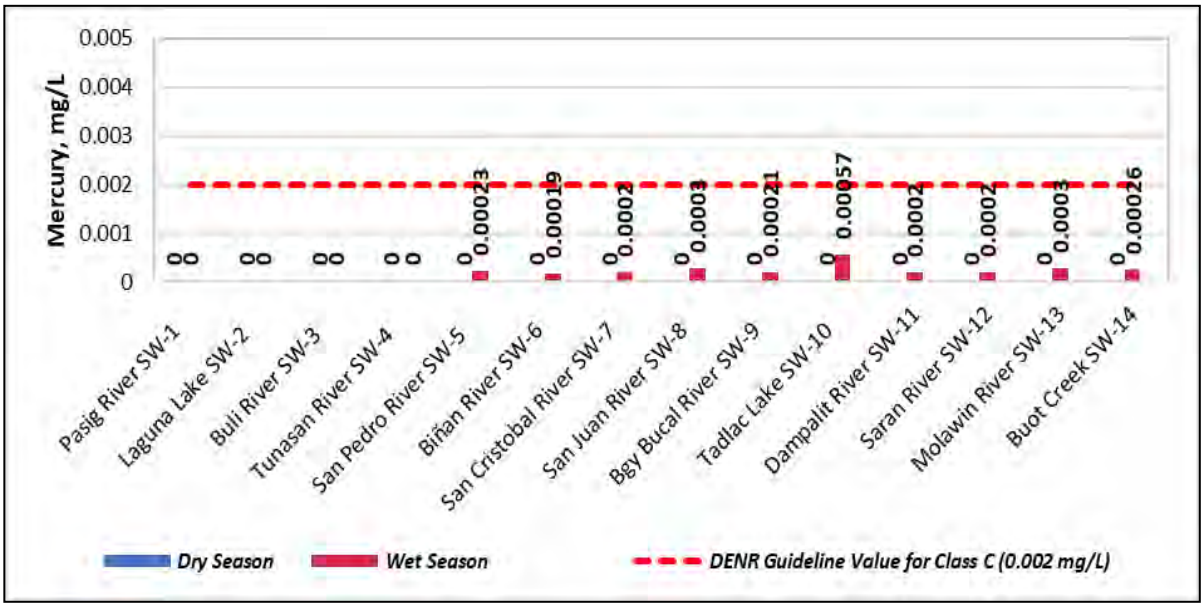


Figure 3.2-51 Results of Mercury Measurement of Surface Water Samples

Cyanide

1225. During dry season, Cyanide (CN) concentration in all the stations are within the DENR guideline for Class C. The highest concentration of CN was observed in San Pedro River (SW-5).

1226. During wet season, Cyanide (CN) concentration in all the stations passed the DENR guideline for Class C.

1227. Most of the stations displayed higher concentrations of CN during the dry season with the exception of few that have no lead concentrations detected. Buli River (SW-3) and Tunasan River (SW-4) have higher CN concentrations measured during the wet season (**Figure 3.2-52**).

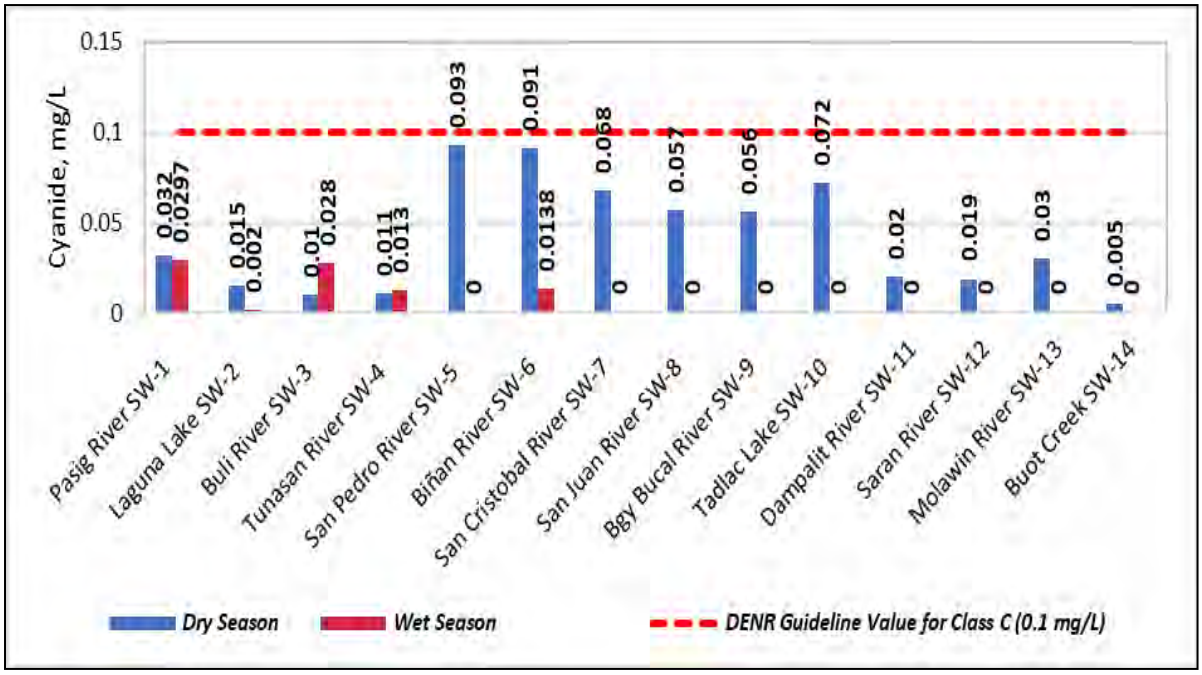


Figure 3.2-52 Results of Free Cyanide Measurement of Surface Water Samples

Oil and Grease

1228. During dry season, the concentration of Oil and Grease (O&G) in all fourteen (14) stations ranged from 0.5 to 6.7 mg/L. Levels of O&G in Buli, Tunasan, San Pedro, Biñan, and Dampalit Rivers were non-compliant with the DENR guideline for Class C water. The highest concentration of O&G was recorded in San Pedro River.

1229. During wet season, the concentration of O&G in all fourteen (14) stations ranged from <0.5 to 8.59 mg/L. Levels of O&G in San Pedro River (SW-5), San Cristobal River (SW-7), San Juan River (SW-8), Bucal River (SW-9), Dampalit River (SW-11), Saran River (SW-12) and Molawin River (SW-13) were non- compliant with the DENR guideline for Class C water of 2 mg/L. The highest concentration of O&G was recorded in Molawin River (SW-13) at 8.59 mg/L.

1230. During the dry season, most of the stations have higher O&G concentration except several of the stations that do not have detected O&G concentration. San Cristobal River (SW-7), San Juan River (SW-8), Bucal River (SW-9), Tadlac Lake (SW-10), Saran River (SW-12) and Molawin River (SW-13) have higher oil and grease measured during the wet season (**Figure 3.2-53**).

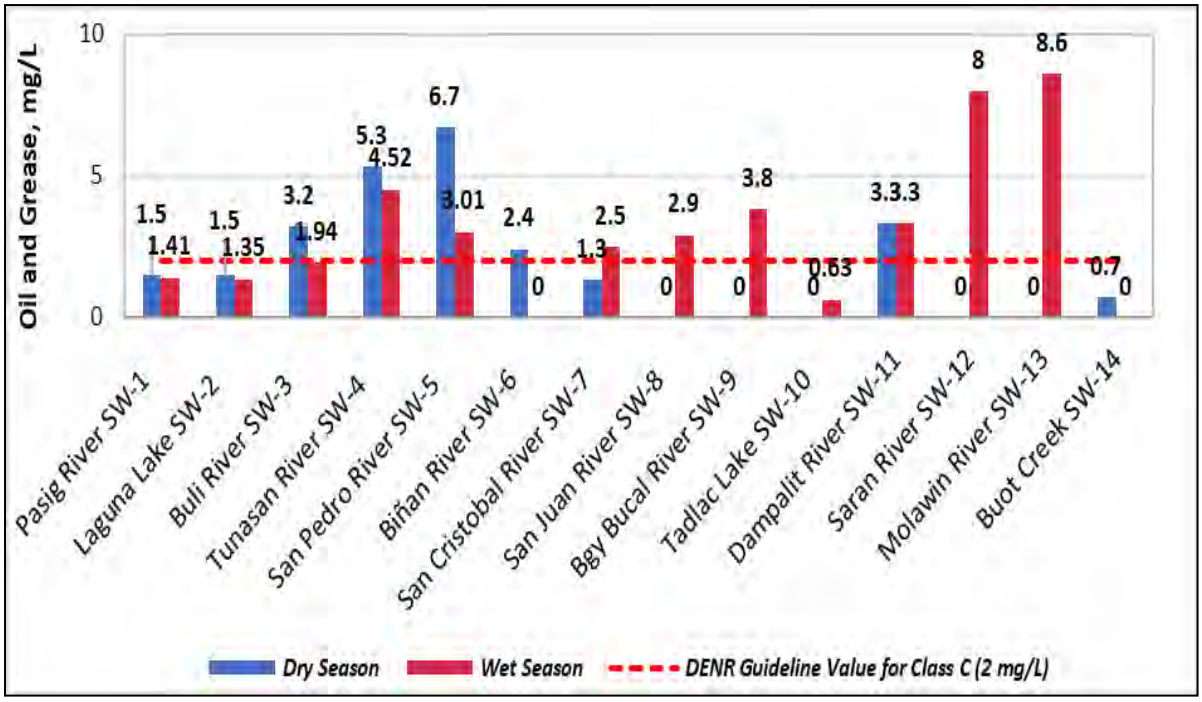


Figure 3.2-53 Results of Oil and Grease Measurement of Surface Water Samples

Phenols

1231. During dry season, the concentration of phenol in all fourteen (14) stations ranged from <0.01 to 7.20 mg/L. Levels of phenol in SW-1 to SW-7 were non-conformant with the DENR guideline for Class C water. The highest phenol level was recorded in Tunasan River (SW-4) at 7.2 mg/L.

1232. During wet season, the maximum allowable Phenols concentration based from the DENR standards is 0.05 mg/L. Tunasan River sampling station (SW-4) recorded a phenol concentration of 0.06 mg/L which beyond the limit.

1233. Most of the stations have measured higher levels of phenols during the dry season compared with the wet season. Some sampling stations do not have any phenol concentration detected (**Figure 3.2-54**).

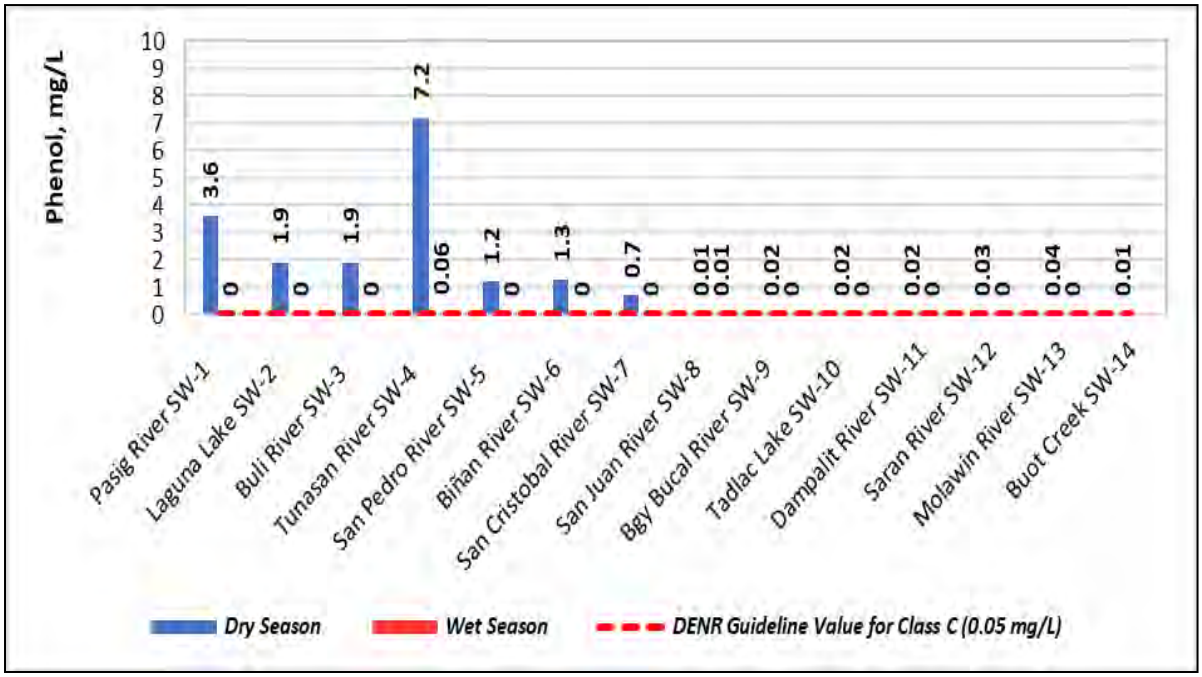


Figure 3.2-54 Results of Phenols Measurement of Surface Water Samples

Surfactants

1234. During dry season, concentration of MBAS in fourteen (14) stations ranged from 0.007 to 4.810 mg/L. Three (3) stations were non-conformant with the DENR guideline for Class C waters. These are Buli (SW-3), San Pedro (SW-5), and Saran Rivers (SW-12).

1235. During wet season, concentration of MBAS in fourteen (14) stations ranged from <0.007 to 1.93 mg/L. Of the fourteen (14) stations studied, two (2) stations were non-conformant with the DENR guideline for Class C waters. These are Molawin River (SW-13) and Buot Creek (SW-14).

1236. During the wet season, most of the stations have a higher concentration of surfactants detected except the Buli River (SW-3), Tunasan River (SW-4), San Pedro River (SW-5), Biñan River (SW-6) and Saran River (SW-12) that have higher surfactants during the dry season (**Figure 3.2-55**).

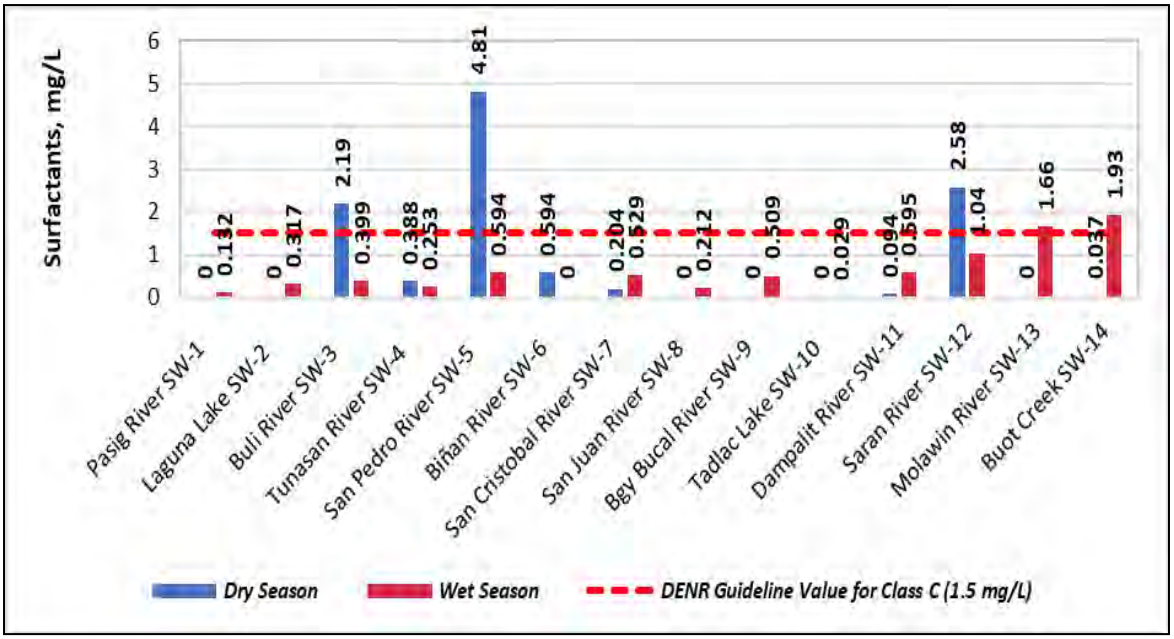


Figure 3.2-55 Results of Surfactants Measurement of Surface Water Samples

3) Analysis of Result for SCRP Interconnecting Line

1237. The water quality data from the DENR's monitoring stations showed that the water quality in Paranaque River and Maricaban Creek were heavily polluted and have poor water quality (**Table 3.2-31** and **Table 3.2-32**). Primarily, the elevated levels of BOD in both waterways can potentially indicate organic pollution. In Maricaban Creek, most of the parameters tested (i.e DO, BOD, TSS, Fecal Coliform, Phosphates) across all three monitoring stations exceeded the DAO 2016-08 WQG Class C except for Color and Nitrates. No concentration of DO was detected across three monitoring stations in Maricaban Creek. This may be associated with the elevated levels of BOD, which ranged between 81 mg/L to 141 mg/L. TSS levels, fecal coliform, and phosphate levels ranged from 61 mg/L to 100 mg/L, $2.80x10^{+09}$ MPN/100 mL to $9.20x10^{+08}$ MPN/100mL, and 2.17 mg/L to 3.41 mg/L, respectively (**Table 3.2-33** and **Plate 3.2-1**)

1238. In Paranaque River, all stations met the DAO 2016-08 Class C WQG for TSS and color (**Table 3.2-34** and **Plate 3.2-2**). For the other monitored parameters, the DAO 2016-08 Class C WQG was generally met by all stations except for the slightly acidic pH in Station 1a, and; slight exceedances in the temperature recorded in stations 3 to 4a. The BOD levels across all stations, which ranged between 41 mg/L to 109 mg/L, did not meet the Class C WQG (7 mg/L). No DO was detected across the ten stations in Paranaque river, thereby failing to meet the Class C WQG (5 mg/L minimum).

1239. Metro Manila is the highest generator of pollutants in the Manila Bay Area, because pollution load generation is directly proportional to population and urbanization (NEDA, 2018). Factors that contribute to the degradation and poor water quality of the Maricaban Creek, and Paranaque River as well as to the rest of the rivers draining Metro Manila include inadequate management of wastes from domestic, commercial, and industrial activities and wastewater discharges from households, commercial/institutional establishments, and industries. Metro Manila generates an estimated 1.3 million cubic meters of wastewater per day (NEDA, 2018). As of 2017, MWCI's and MWSI's sewerage coverage in Metro Manila is only at about 15% and 14%, respectively (NEDA, 2018).

Table 3.2-31 DENR Water Quality Monitoring Results – Maricaban Creek

Parameters	Station 1 (Diego Silang)	Station 2 (Maricaban SLEX)	Station 3 (Villamor)	DENR (Class C) Guideline
DO, mg/ L	0	0	0	5 (min)
BOD, mg/ L	141	81	81	7
TSS, mg/ L	99	100	61	80
Color, TCU	20	25	25	75
Fecal Coliform, MPN/100mL	$9.20x10^{+08}$	$9.20x10^{+08}$	$2.80x10^{+09}$	200
Nitrates, mg/ L	0.07	0.07	0.08	7
Phosphates, mg/ L	2.17	2.44	3.41	0.5

Note: Colored cells indicate failed results

Source: Metro Manila Subway Project EPRMP 2019

Plate 3.2-1 Maricaban Creek DENR Water Quality Monitoring Stations

Table 3.2-32 DENR Water Quality Results - Parañaque River

Stations		Time of Sampling	pH	Temp, °C	TDS, g/L	Turbidity, NTU	Salinity, ppt	Conductivity, mS/cm	BOD, mg/L	DO, mg/L	Color, TCU	TSS, mg/L	PO_4-P, mg/L	NO_3-N, mg/L	Fecal Coliform, MPN/100mL
DENR Guideline			6.5 - 9.0	25 - 31	-	-	-	-	7	5 min	75	80	0.5	7	200
1	Tramo Stn	11:55	6.42	29.57	0.42	37.80	0.30	0.66	65	0	25	32	2.92	0.37	9.20E+07
1a	Narra Stn	11:27	6.25	29.64	0.50	74.30	0.40	0.78	109	0	20	64	3.04	0.45	3.50E+08
1b	Dilain Cr.	12:23	6.53	30.08	0.38	39.70	0.30	0.60	41	0	20	36	3.07	0.32	2.20E+07
2	Mia Rd	12:52	6.61	30.20	1.38	41.00	1.10	2.16	61	0	25	56	2.97	0.35	5.40E+07
3	Multinational Stn	15:09	7.23	31.13	0.58	56.50	5.10	9.15	81	0	25	38	2.96	0.40	1.10E+08
3a	Ibayo Cr.	15:28	7.08	31.13	0.41	67.60	0.30	0.64	95	0	25	48	3.07	0.58	2.80E+08
4	Global Stn	15:53	6.97	31.25	8.84	71.20	8.20	14.30	63	0	25	52	3.21	0.90	3.50E+07
4a	Amvel Stn	15:46	6.94	31.74	7.47	104.00	6.70	11.90	52	0	25	44	1.90	1.01	3.50E+07
5	Sto. Niño Stn	15:58	7.01	30.80	8.89	50.50	8.30	14.30	58	0	20	42	2.85	0.43	9.20E+07
6	La Huerta Stn	16:19	7.04	30.75	7.84	46.30	7.20	12.60	65	0	25	48	2.37	0.38	1.60E+08
Average			**6.81**	**30.63**	**3.67**	**58.89**	**3.79**	**6.71**	**69**	**0**	**24**	**46**	**2.84**	**0.52**	**8.56E+0 7**

Note: Colored cells indicate failed results

Source: Metro Manila Subway Project EPRMP 2019

Monitoring Station 2, April 3, 2019

Monitoring Station 3, April 3, 2019

Monitoring Station 4, April 3, 2019

Monitoring Station 1a, June 3, 2019

Monitoring Station 4a, June 3, 2019

Monitoring Station 5, June 3, 2019

Plate 3.2-2 Paranaque River DENR Water Quality Monitoring Stations

3.2.2.5. Impact Identification, Prediction and Assessment and Mitigation

Pre-construction and Construction Phase

1) Degradation of Groundwater Quality

1240. During construction of the main railway line (Solis to Calamba), there will be no significant impact or change in the quality of groundwater along the project alignment, train stations and depot. No toxic chemicals will be introduced into the railway under surface columns that will go deep to the bedrock. Risk of groundwater contamination may come from accidental spillage of oil and fuel from storage tanks or encountering a parcel of land with previously unknown contamination issues. This can be addressed by having proper storage, handling and use of substances that can potentially harm the groundwater resource, in accordance with the requirements RA 6969 and its implementing rules and regulations. Inventory of chemicals to be used and site-specific layout of work areas and measures will be laid down during the mobilization phase. The workers will also have proper training on proper waste disposal and will have sufficient knowledge on the handling of potential groundwater-contaminating substances.

1241. With regard to the groundwater quality of wells nearby the proposed depot site, the tested water from the inventoried wells have high concentrations of Total Dissolved Solids and Conductivity. For the tested toxic and other deleterious substances, the tested heavy metals are within the acceptable limits, however, the amount of cyanide on the tested water samples are beyond the acceptable limits. The deep well to be drilled and used in the depot is expected not to affect the shallow wells being used by the residents in the different Housing Clusters since it is going to tap the deeper confined aquifers.

1242. In the case of the underground section (Senate to Bicutan), underground works will be undertaken such as station construction and tunneling activities where groundwater dewatering may potentially contaminate groundwater resources. Dewatered groundwater from tunneling activities should meet DAO 2016-08 standards prior to disposal. Further to this, small volumes of fuel or oil and grease from vehicles, machinery and heavy equipment may accidentally spill or be discharged into the ground and the nearest water source. Fuel storage facilities also have the potential to contaminate surface waters in case of accidental leaks. Domestic wastes and general refuse may also contaminate waterways and groundwater sources if these wastes are improperly disposed. Where wastewater is discharged from the STP into the existing drainage system, the general contractor must ensure that the site drainage meets the Philippine Effluent Standards as implemented by the DENR-EMB, and secure necessary discharge permit as appropriate.

1243. Soil and groundwater quality monitoring in close proximity with the underground section where potential sources of hydrocarbons (such as gasoline stations) are present should be pursued during FTI station construction and tunneling works to monitor the quality of both soil and groundwater during the construction of the project. To avoid potential groundwater pollution, a more detailed groundwater impact study including 3-dimensional groundwater modeling shall be undertaken during the detailed engineering design stage.

2) Degradation of Surface Water Quality

1244. Construction works like ground excavations, leveling, stockpiling, and dewatering of railway column holes within or near the river banks would cause observable but short-term increase of total suspended solids of surface water, more pronounced during rainy season. This can be addressed by scheduling the construction period on a dry season and having erosion controls. Erosion controls which shall be implemented for the Project are the following: siltation ponds with silt traps, silt curtains, geo-membranes, avoidance of side tipping of earth spoils into water bodies, construction of silt barriers immediate compacting, hauling of excess

spoil to designated spoil disposal areas located away from water bodies. Fencing, prior to major earthworks in Banlic depot, would be a significant measure.

1245. The spoils will be hauled into pre-designated disposal areas where soil erosion control measures will be applied such limiting the height of storage, compacting, and maintenance of vegetative cover. Water in spoils will be drained on-site to avoid spillages along the hauling routes. Prior to leaving hauling trucks will be covered and dirt on the side and tires will be removed. During rainy periods, tire trucks with mud will be washed in on-site temporary wash area using high pressure pipe-water.

1246. The concentration of total suspended solids (TSS) in the receiving water body is a relevant parameter in assessing the performance of erosion control. Water quality guideline for total suspended solids in the Laguna Lake Region (Class C) is set at 80 mg/L according to LLDA Board Resolution 523 series of 2017 which adopted DAO 2016-08. LLDA has jurisdiction over the project area by virtue of RA 4850 (1966), as amended, which is "An Act Creating the Laguna Development Authority, prescribing its Powers, Functions and Duties, Providing Fund Therefor, and for other Purposes." RA 4850 is supplemented by EO 927 (1983), "Further Defining Certain Functions and Powers of the Laguna Lake Development Authority."

1247. In the construction of railway bridges and piers in waterways, the DOTr will coordinate with and/or secure necessary permits from NWRB, DPWH, LLDA, and concerned LGUs. At this stage, water quality management protocols will be implemented to minimize water quality degradation based on applicable freshwater quality standards.

1248. Wastewater from construction support temporary facilities like toilets, canteens, and wash area would cause short-term deterioration of nearby water bodies. Such facilities will be located away from water bodies and will be provided with waste water containment structure for treatment or delivery to waste water treatment facility. Other possible surface water contaminating substances should be handled properly by having proper storage for each substance.

1249. Risk of surface water contamination in depot area, may come from accidental spillage of oil and fuel from storage tanks. The risk can be addressed by having proper storage, handling and use of substances that can potentially harm surface water, in accordance with the requirements RA 6969 and its implementing rules and regulations. Inventory of chemicals to be used and site-specific layout of work areas and measures will be laid down during the mobilization phase. The workers will also have proper training on proper waste disposal and will have sufficient knowledge on the handling potential groundwater-contaminating substances.

1250. Further, small volumes of fuel or oil and grease from vehicles, machinery and heavy equipment may accidentally spill or be discharged into streams and rivers during the construction activities of the project. Fuel storage facilities may also potentially contaminate the surface waters in case accidental leaks occur. Moreover, domestic wastes and wastewater may also contaminate waterways if these are improperly disposed. To effectively manage waste materials that will be generated during the construction and operational phase of the project, a waste management program is required to be implemented for the Project. Construction and operational workforce personnel will be briefed on proper waste disposal procedures. All vehicles and machinery should be regularly maintained, and vehicle wash downs should occur away from waterways and drainage channels. Fuel storage facilities should have adequate spillage protection (e.g. bunded, double skinned, etc.) to allow safe operational maintenance and servicing. Used oil and other hazardous wastes will be temporarily stored at the work sites in appropriate containers and storage areas and subsequently disposed of through a DENR accredited hazardous waste facility. Accidental

spills will be cleaned up immediately following emergency response procedures for spill containment and clean up. Spill containment kits will always be available on-site.

1251. It should be noted that contractors will be required to submit a wastewater management plan. Temporary sanitation facilities will be installed in the construction camp to manage wastewater.

1252. Surplus soil generated from the construction phase of the Project should be properly disposed away from any potentially affected waterways, or in the designated disposal areas. Alternatively, the surplus soil can be used for backfilling during the construction of the stations.

1253. During the TBM tunneling process, slurry will be created as the TBM progressively excavates the tunnel. The slurry generated by the TBM is typically treated in a slurry treatment plant. Lime slurry wastes, if any are produced during the tunnel boring process, is considered hazardous if it has a pH above 12.5. Alkali wastes such as lime slurry will be neutralized and treated prior to disposal. Any hazardous wastes collected during the construction of the Project must be properly collected by a DENR accredited hauler, treated and disposed by a DENR accredited treater.

1254. Regular monitoring of the waterways will also be conducted, focusing on TSS, turbidity, oil and grease, metals, and other relevant parameters.

(2) Operation Phase

1) Degradation of Groundwater Quality

1255. During project implementation, long term overland discharge of untreated wastewaters or domestic discharges from commuter station and depot may potentially cause deterioration in nearby groundwater. Wastewater would typically contain wash water and used oil. Each commuter station and depot will have a sewage treatment plant (**STP**) such as septic tank and a separate treatment facility for non-sewage waste waters that meets the applicable effluent standards. Handling of potential contaminants during operation phase will be compliant with RA 6969.

2) Degradation of Surface Water Quality

1256. During project implementation, long term overland discharge of untreated wastewaters from commuter station and depot may cause deterioration in nearby surface water. Wastewater would typically contain washwater and used oil. Each commuter station and depot will have a sewage treatment facility and a separate treatment facility for non-sewage wastewaters to meet the applicable effluent standards.

1257. Service areas are the most likely locations where such contamination occurs because of the concentration of parked vehicles and fuel stands. Depot will therefore be equipped with an interceptor tank to remove oil and fuel grease from surface water before discharge. A wastewater treatment facility with oil removal will be constructed at the Depot. Treatment facilities such as septic tanks designed to appropriate standards will be installed from every station to treat domestic sewage. All kinds of wastewater with oil will be stored and treated at Depot's WTF. The DOTr will conduct regular surface water quality monitoring activities in order to check the quality of the surface water from time to time. DOTr will also secure a DP from DENR for the disposal of treated wastewater to the waterbodies.

1258. During the operations phase of the project facilities including underground interconnection section, wastewater will be treated to meet the appropriate DENR standards prior to discharge. Appropriate discharge permits from the DENR or LLDA will be secured prior to discharging treated effluent. An effluent quality monitoring will be conducted as required.

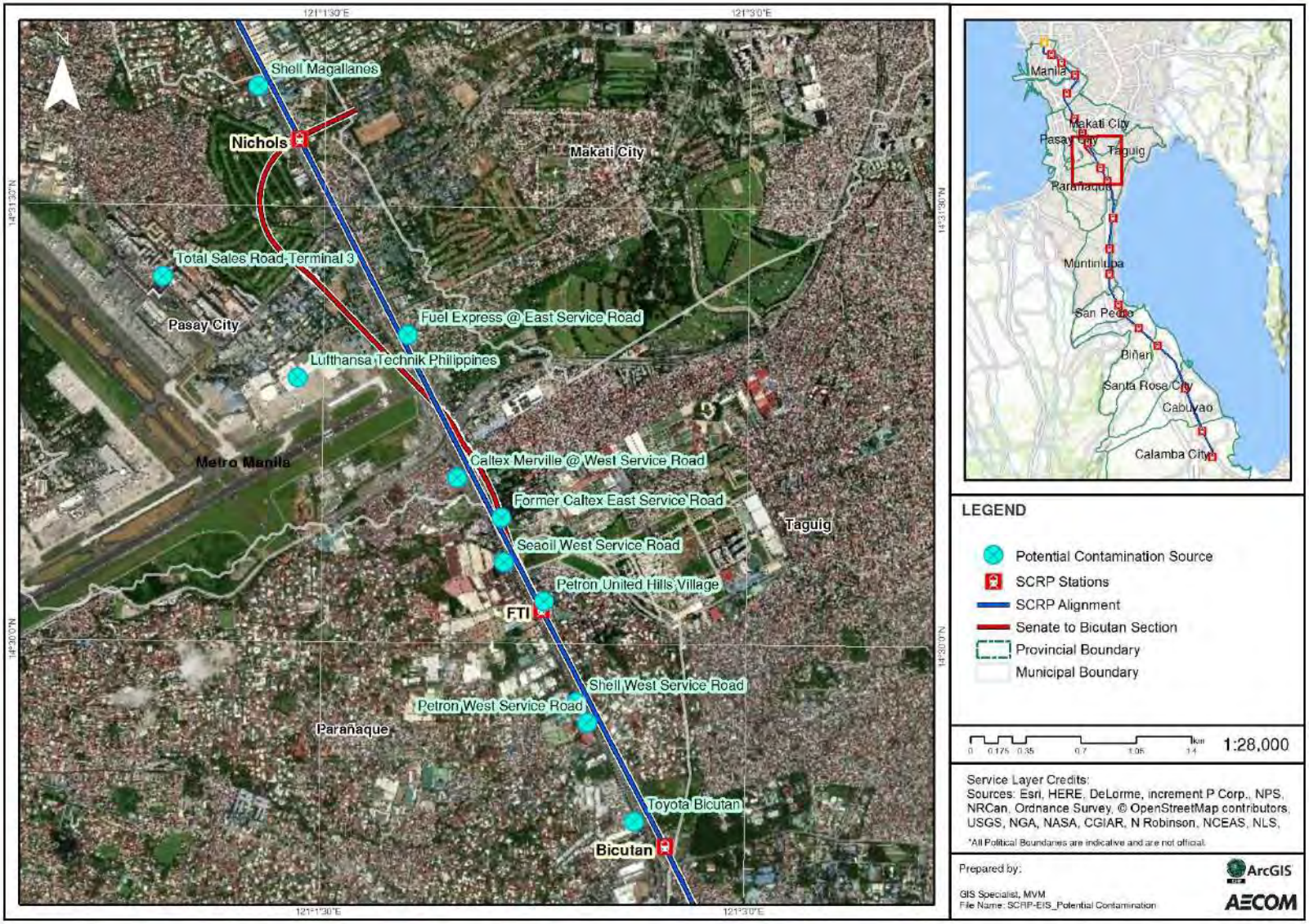


Figure 3.2-56 Potential Contamination Sources Identified During Walkthrough Survey

3.2.3. Freshwater Ecology

1259. Aquatic biodiversity is one of the most essential characteristics of the aquatic ecosystem for maintaining its stability and means of coping with any environmental change. Phytoplankton plays the role of primary producer in the river's food chain while zooplankton organisms occupy a central position in the food webs of aquatic ecosystem. The importance of zooplankton is well recognized as these have vital part in food chain and play key role in cycling of organic matter in an aquatic ecosystem. Similarly, the macro-invertebrates act as the secondary producers in the aquatic ecosystem. They are an important link in the food web of aquatic ecosystem.

1260. A field survey was conducted to determine the existing aquatic biodiversity at major river crossings at the project alignment.

3.2.3.1. Field Survey

1261. The freshwater ecology along the alignment of the Project were assessed by collecting biological samples at the same stations established for surface water quality assessment on February 8-9, 2018.

1262. A total of thirteen (13) stations were surveyed at the project site which are presented in **Figure 3.2-56**. The coordinates of the sampling stations were determined using GPS and their relative locations are presented in **Table 3.2-33** and **Figure 3.2-57**.

1263. At each station, physical features were characterized including general land use, bank conditions, general riparian vegetation features and type of sediment. Instream variables such as average width and depth (Barbour et al. 1999) were also measured. Water quality meters were used to obtain on-site measurements of basic limnological variables such as DO, conductivity, pH and temperature. The average depths and widths of freshwater stations were measured using a meter stick and transect tape.

1264. Plankton sampling was conducted at a total of thirteen (13) stations in reaches with open or partly open canopies (>50%); riffles not pools, with moderate water velocity (between 10 and 60 cm/sec). Plankton samples were obtained by passing a total volume of 100 l water through a plankton net, with a mesh size of 64 ⌈ and a mouth diameter of 0.3 m (Photo 1). Three replicate samples of zooplankton and of phytoplankton were collected from each station. Samples were placed in properly- labelled, 500-ml capacity plastic containers, immediately fixed in formalin (5% by volume) and brought to the laboratory for processing and further analysis. Plankton enumeration was done using the Sedgewick counting chamber observed under a binocular microscope. Plankton were identified to the lowest possible taxa using taxonomic keys such as those of Mamaril et al. (1986), Segers (2004; 2007) and Bellinger and Sigee (2010).

1265. A total of 39 sediment samples were collected for the macrobenthos study. Collections were undertaken at three (3) replicate zones at each station. For each station, ten (10) trowelful of sediments were obtained from each replicate zone, which covered an area of about 1 m2. The underside of rocks and stones were also checked for the presence of macrobenthos, and when present were hand-picked. Collected macrobenthos and sediment samples were placed in properly-labeled Ziploc plastic bags and preserved in 5% formalin. Samples were brought to the laboratory for further processing. In the laboratory, sediment samples were passed through a 1-mm mesh-sized sieve and all animals retained in the sieve were collected and sorted. Macrobenthos were transferred in plastic containers and preserved with 5% formalin and identified to the lowest possible taxa using Haynes (2001) and Gapud and Raros (1986). Their abundances were recorded and expressed as number of animals/

m2. Methods of macrobenthos collection, preservation, and processing generally followed Barbour et al. (1999).

1266. Locals were interviewed regarding the general river-use and types of fishes and other aquatic animals caught in the area.

Table 3.2-33 Coordinates and Elevation of Surveyed Stations

Sampling Stations	Sampling Station Description	Northing Coordinates	Sampling date
SW1	Pasig River, Manila City Open canopy, wide and deep river channel; turbid water; near bridge; concrete pathway at the right bank and buildings at the left bank; densely- populated area; receives domestic and industrial sewage and other effluents from buildings, industrial areas and houses; water hyacinth floating instream	14° 35' 39.69"N 121° 00' 44.28"E	February 8, 2018
SW2	Laguna Lake, Muntinlupa City Near slum area and oil depot with huge amounts of garbage/ waste along the lakeshore; turbid water, relatively deep; dense cover of water hyacinth near shore; with minor fishing activity	14° 27' 07.20"N 121° 03' 14.95"E	February 8, 2018
SW3	Buli River, Muntinlupa City Near slum area; heavily polluted; foul smell; muddy silty substrate; repository of domestic wastes, all types of garbage observed instream; shallow, narrow river with open canopy	14° 26' 46.96"N 121° 03' 00.82"E	February 8, 2018
SW4	Tunasan River, Muntinlupa City Shallow, narrow river with open canopy; highly turbid, polluted river with numerous houses along banks; concrete banks; solid wastes instream	14° 22' 10.33"N 121° 03' 03.81"E	February 8, 2018
SW5	San Pedro River, San Pedro City Polluted waters with garbage instream; turbid waters; several houses along banks; open canopy; shallow, narrow river; concrete and sandy banks	14° 21' 50.99"N 121° 03' 14.92"E	February 8, 2018
SW6	San Cristobal River, Calamba City Shallow river with concrete, sloping right bank, and sandy, grassland area at the left bank; open canopy; garbage observed at the instream area as well as banks	14° 13' 12.47"N 121° 09' 04.78"E	February 8, 2018
SW7	San Juan River, Calamba City Clear shallow waters with garbage instream; sloping concrete right bank and sandy area at left bank; with minor fishing activity	14° 12' 31.98"N 121° 09' 25.14"E	February 9, 2018
SW8	Bgy Bucal River, Calamba City Open canopy; shallow, narrow river channel; huge amounts of garbage instream; highly populated (slum area)	14° 11' 02.19"N 121°10' 30.46"E	February 9, 2018
SW9	Alligator Lake, Los Baños Clear, deep lake; La Resio Resort and houses along lakeshore; trees, grasses and shrubs along lake margin	14° 10' 51.04"N 121°12' 28.44"E	February 9, 2018
SW10	Dampalit River, Los Baños Shallow, narrow stream with several houses along banks; concrete sloping, steep banks; domestic sewage and effluents directly discharged into the stream; serve as dumping grounds of wastes (garbage observed instream and along banks)	14° 10' 34.23"N 121°12' 58.29"E	February 9, 2018
SW11	Saran River (Bgy Anos), Los Baños Shallow, narrow stream; receives effluents from houses; sewage directly discharged into the river; concrete right bank; few trees and shrubs at left bank; white, opaque water; garbage instream	14° 10' 55.16"N 121°13' 51.76"E	February 9, 2018
SW12	Maulauen River, Los Baños Clear, shallow stream with trees and grass along banks; 25% overhanging vegetation; with rocks and pebbles instream and few boulders at banks	14° 10' 13.23" 121°15' 08.34"	February 9, 2018
SW13	Buot Creek, Los Baños	14° 9'53.83"N 121°15'22.86"E	February 22, 2018

Sampling Stations	Sampling Station Description	Northing Coordinates	Sampling date
	Clear, shallow but dirty water with solid wastes instream and along banks; banks with several houses; receives all types of domestic wastes; few trees and shrubs along banks		

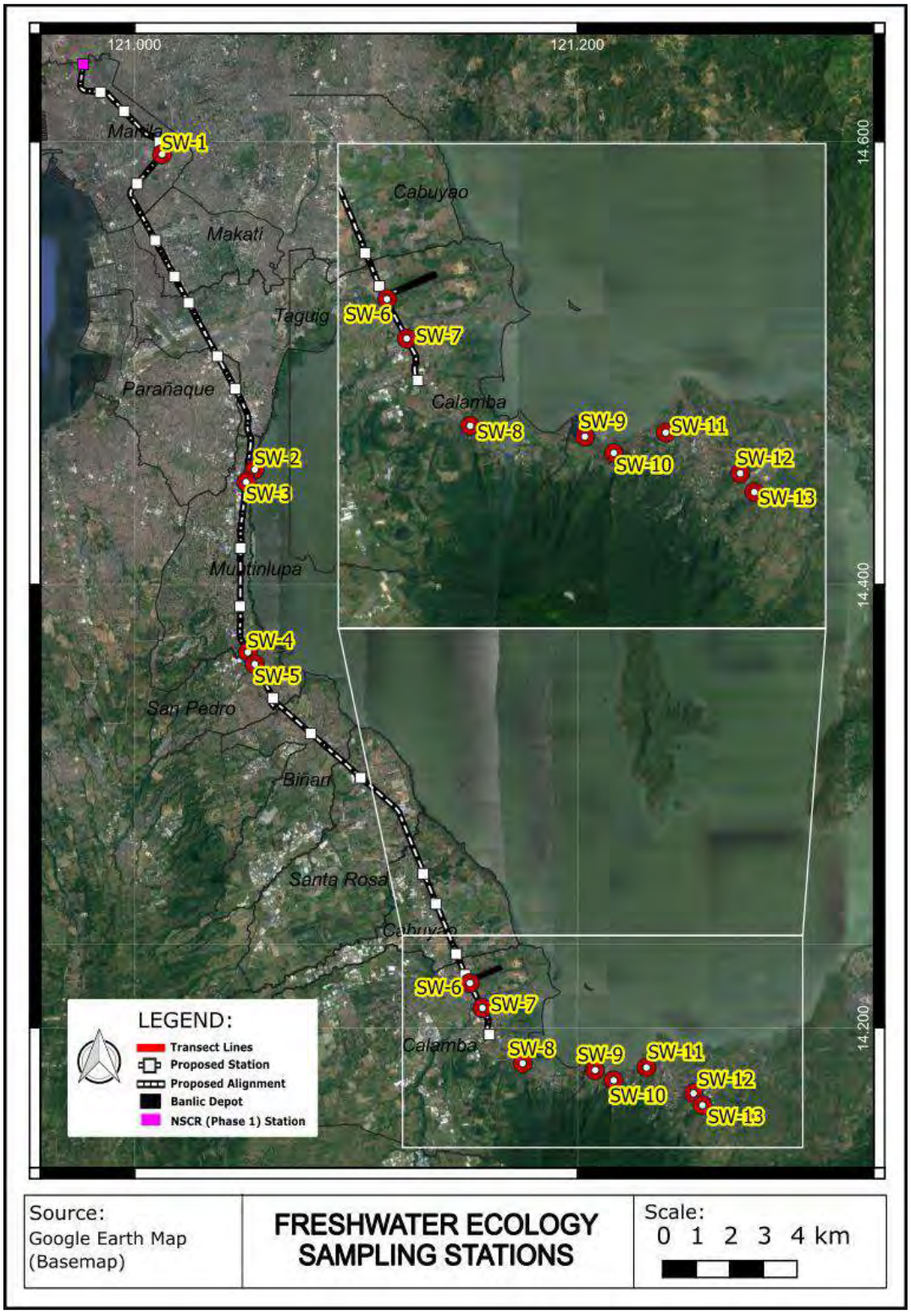


Figure 3.2-57 Freshwater Ecology Monitoring Stations of SCRP Main Railway

1267. Additionally, rapid stream visual assessment using visual habitat predictors and ecosystem quality parameters were performed on two identified waterways (i.e., Maricaban Creek, Don Galo Creek) situated in proximity to the underground interconnection section i.e. FTI Station and Bicutan Station. No collection of biological parameters (e.g., phytoplankton, zooplankton, benthic macro invertebrates, fish fauna) were performed for the two abovementioned running waters, especially since these waterways are deemed to be minimally impacted by the underground section .

1268. Both Maricaban Creek and Don Galo Creek are situated at the heart of the highly urbanized area of Metro Manila, which comprises a cocktail of residential houses, industrial parks, road connections, and other built-up structures. Surveyed portions of the Maricaban Creek started from a woodland patch near the Essensa East Forbes Condominium (near BGC Station); followed the sections along the perimeter of Bonifacio Heights Condominium (in between Lawton and Senate Station); and lastly up to the reaches near the perimeter of Villamor Air Base Golf Club (between Senate Station and T3 Station). On the other hand, visual evaluation of stream health for the Don Galo Creek started near the vicinity of Merville Park Subdivision and followed along the entire stretch of the Moonwalk Access Road near the C-5 Extension Road.

1269. Published literature involving rapid stream assessment and visual habitat evaluation were used as a basis in the formulation of a rapid assessment among the two waterways potentially impacted by the underground section line. **Table 3.2-34** summarizes the secondary data sources used in the rapid habitat assessment of stream ecosystems.

Table 3.2-34 Sources of Secondary Information for Stream Visual Assessment

Information / Data / Document Description of Title	Author and Date Published / Generated
Modified Visual Stream Assessment Protocol: A Field Guide	Magbanua et al. (2013)
The use of a Stream Visual Assessment Protocol to determine ecosystem integrity in an urban watershed in Puerto Rico	de Jesús-Crespo, R., & Ramirez, A. (2011).
Australian river assessment system: AusRivAS physical assessment protocol	Parsons, et al. (2002)

1270. The geographical location, approximate channel length, estimated stream width, and approximate distance from the underground section of all surveyed stream sections are listed in **Table 3.2-35** and shown in **Figure 3.2-57** to **Figure 3.2-58** and **Plate 3.2-3** to **Plate 3.2-6**. A total of 30 survey points was assessed using visual stream habitat predictors across Maricaban Creek, whereas an overall of 14 survey points were for Don Galo Creek. The former is approximately 6.3 km in total length and 3.5 m wide, while the latter is about 5.2 km long and 13.6 m wide. In terms of relative distances with respect to the underground section alignment, Maricaban Creek's nearest point is approximately 25 m away, while Don Galo's creek nearest stream section is 550 m away.

Table 3.2-35 Summary of Site Descriptions Across Surveyed Sections of Maricabban Creek and Don Galo Creek

Site name	Survey Point Number	Latitude	Longitude	Distance from Underground Section Alignment (m)
Maricaban Creek	1	14° 32' 32.907" N	121° 2' 46.853" E	120.79
	2	14° 32' 09.304" N	121° 2' 10.451" E	95.90
	3	14° 32' 08.699" N	121° 2' 08.919" E	98.56

Site name	Survey Point Number	Latitude	Longitude	Distance from Underground Section Alignment (m)
	4	14° 32' 08.650" N	121° 2' 08.544" E	101.94
	5	14° 32' 08.352" N	121° 2' 07.590" E	105.78
	6	14° 32' 07.707" N	121° 2' 07.071" E	93.10
	7	14° 32' 06.816" N	121° 2' 05.718" E	86.23
	8	14° 32' 06.023" N	121° 2' 05.019" E	73.05
	9	14° 32' 04.818" N	121° 2' 04.386" E	47.57
	10	14° 32' 04.365" N	121° 2' 03.998" E	39.87
	11	14° 32' 03.862" N	121° 2' 03.030" E	38.20
	12	14° 32' 15.151" N	121° 2' 21.649" E	120.68
	13	14° 32' 03.348" N	121° 2' 02.054" E	36.29
	14	14° 32' 02.387" N	121° 2' 01.104" E	21.62
	15	14° 32' 03.666" N	121° 1' 57.546" E	102.43
	16	14° 31' 47.290" N	121° 1' 14.090" E	203.59
	17	14° 31' 47.178" N	121° 1' 13.716" E	206.56
	18	14° 31' 47.532" N	121° 1' 12.690" E	232.31
	19	14° 31' 48.884" N	121° 1' 09.973" E	313.87
	20	14° 31' 49.763" N	121° 1' 08.724" E	358.20
	21	14° 31' 49.676" N	121° 1' 06.893" E	391.81
	22	14° 31' 49.398" N	121° 1' 06.267" E	398.16
	23	14° 32' 14.859" N	121° 2' 21.503" E	114.22
	24	14° 31' 48.576" N	121° 1' 05.596" E	394.47
	25	14° 32' 14.264" N	121° 2' 20.780" E	106.09
	26	14° 32' 13.444" N	121° 2' 20.130" E	88.07
	27	14° 32' 11.252" N	121° 2' 18.395" E	49.80
	28	14° 32' 10.750" N	121° 2' 17.904" E	41.67
	29	14° 32' 10.124" N	121° 2' 16.433" E	42.71
	30	14° 32' 09.673" N	121° 2' 11.777" E	89.33
Don Galo Creek	1	14° 30' 20.472" N	121° 1' 40.518" E	818.15
	2	14° 30' 08.909" N	121° 1' 00.447" E	1996.70
	3	14° 30' 08.739" N	121° 1' 00.658" E	1998.74
	4	14° 29' 58.720" N	121° 0' 47.296" E	2305.53
	5	14° 29' 59.068" N	121° 0' 32.181" E	2373.75
	6	14° 29' 59.309" N	121° 0' 32.349" E	2365.29
	7	14° 30' 18.962" N	121° 1' 24.763" E	1242.13
	8	14° 30' 18.688" N	121° 1' 25.120" E	1239.18
	9	14° 30' 15.735" N	121° 1' 18.915" E	1440.41
	10	14° 30' 14.250" N	121° 1' 17.676" E	1498.02
	11	14° 30' 10.297" N	121° 1' 13.585" E	1669.79
	12	14° 30' 07.813" N	121° 1' 11.585" E	1764.50
	13	14° 30' 08.324" N	121° 1' 05.967" E	1884.65
	14	14° 30' 08.220" N	121° 1' 06.018" E	1885.49

1271. Using the Modified Stream Visual Assessment Protocol (Magbanua, et al., 2013), the major streams/waterways (i.e., Maricaban Creek, Don Galo Creek) located near the proposed interconnecting stations of the underground section alignment (i.e., FTI Station, Bicutan Station) were surveyed to evaluate current habitat status and ecological integrity. Opportunistic ocular inspection among accessible areas per stream site was highly considered during course of the rapid site assessment based on 15 habitat predictors of ecosystem health (see **Table 3.2-36**). As mentioned before, no actual sampling of aquatic biota (i.e., phytoplankton, zooplankton, benthic macroinvertebrates, fish fauna, and aquatic macrophytes) was performed during the visual survey.

Table 3.2-36 List of 15 Habitat Parameters for Evaluating Freshwater Ecosystems based on the Modified Stream Visual Assessment Protocol (MSVAP; Magbanua et al., 2013)

Habitat Perimeter	Description
Channel flow	Amount of water present in the stream channel
Channel alteration	Measure of changes in the shape of the stream channel
Velocity/Depth regime	Patterns of velocity and depth in the stream
Bank stability	Measure of erosion likelihood in the stream banks
Bank vegetative protection	Measure of vegetative protection on the stream bank
Riparian vegetative zone width	Width of natural vegetation zone along the channel
Canopy cover	Visual estimate of the stream reach shaded by the canopy
Water appearance	Visual characteristics (i.e., color, turbidity) of water
Nutrient enrichment	Measure of algal and macrophyte coverage as signs of nutrient load
Sediment deposition	Measure of accumulated sediments in pool sections
Riffle embeddedness	Extent to which riffle areas are surrounded by fine sediment
Barriers to species movement	Estimate of potential barriers that limit passage of aquatic biota
Fish habitat complexity	Microhabitat types suitable for fish fauna
Aquatic invertebrate habitat complexity	Microhabitat types suitable for aquatic invertebrates
Aquatic invertebrate habitat community	Ability of stream to support diverse invertebrates

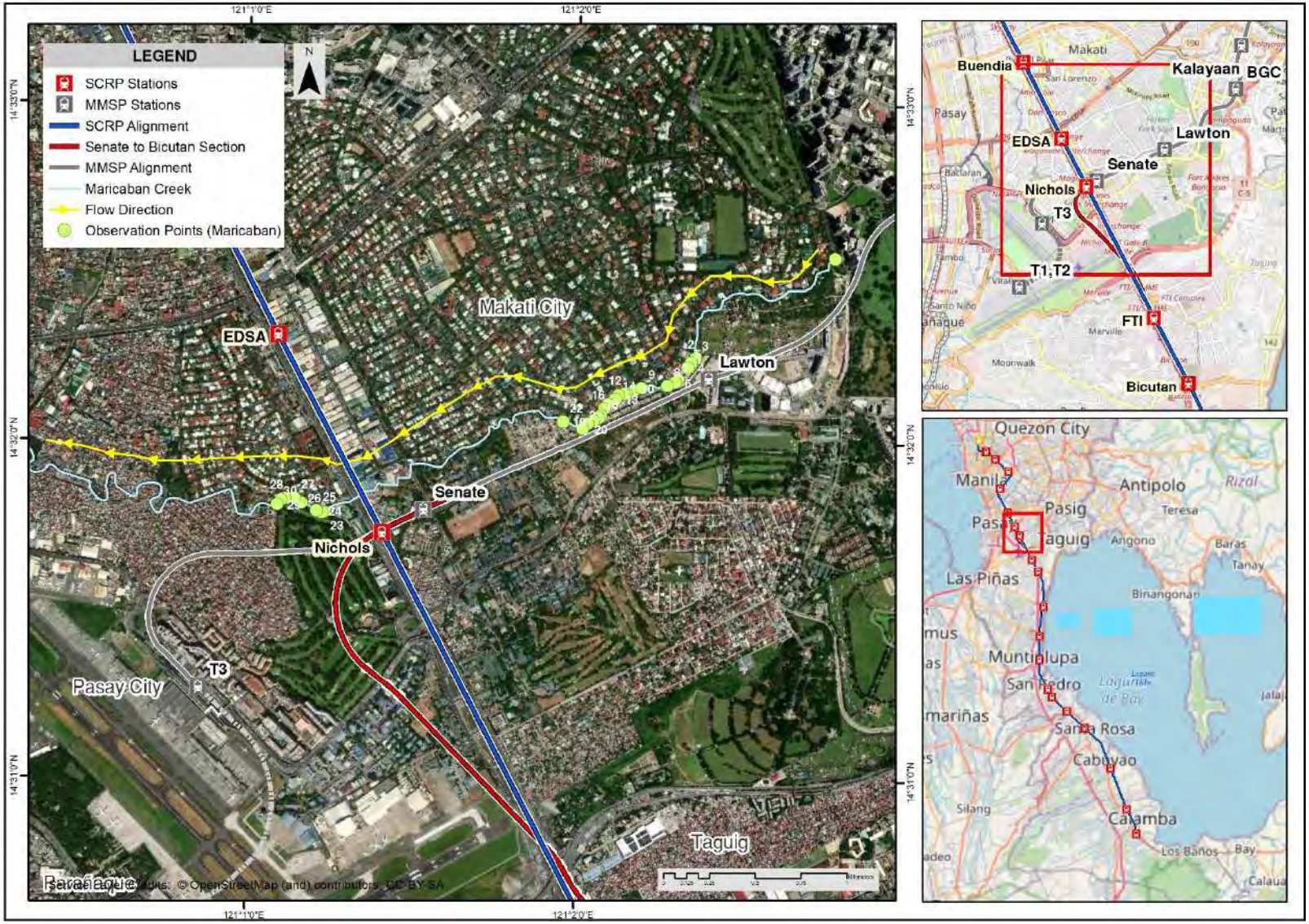


Figure 3.2-58 Freshwater Ecology Observation Points across Maricaban Creek

Plate 3.2-3 Site Photographs of each Survey Point Across the Channel of Maricaban Creek (Point 1 to Point 8)

Plate 3.2-4 Site Photographs of each Survey Point Across the Channel of Maricaban Creek (Point 9 to Point 16)

Plate 3.2-5 Site Photographs of each Survey Point Across the Channel of Maricaban Creek (Point 17 to Point 24)

Plate 3.2-6 Site Photographs of each Survey Point Across the Channel of Maricaban Creek (Point 25 to Point 30)

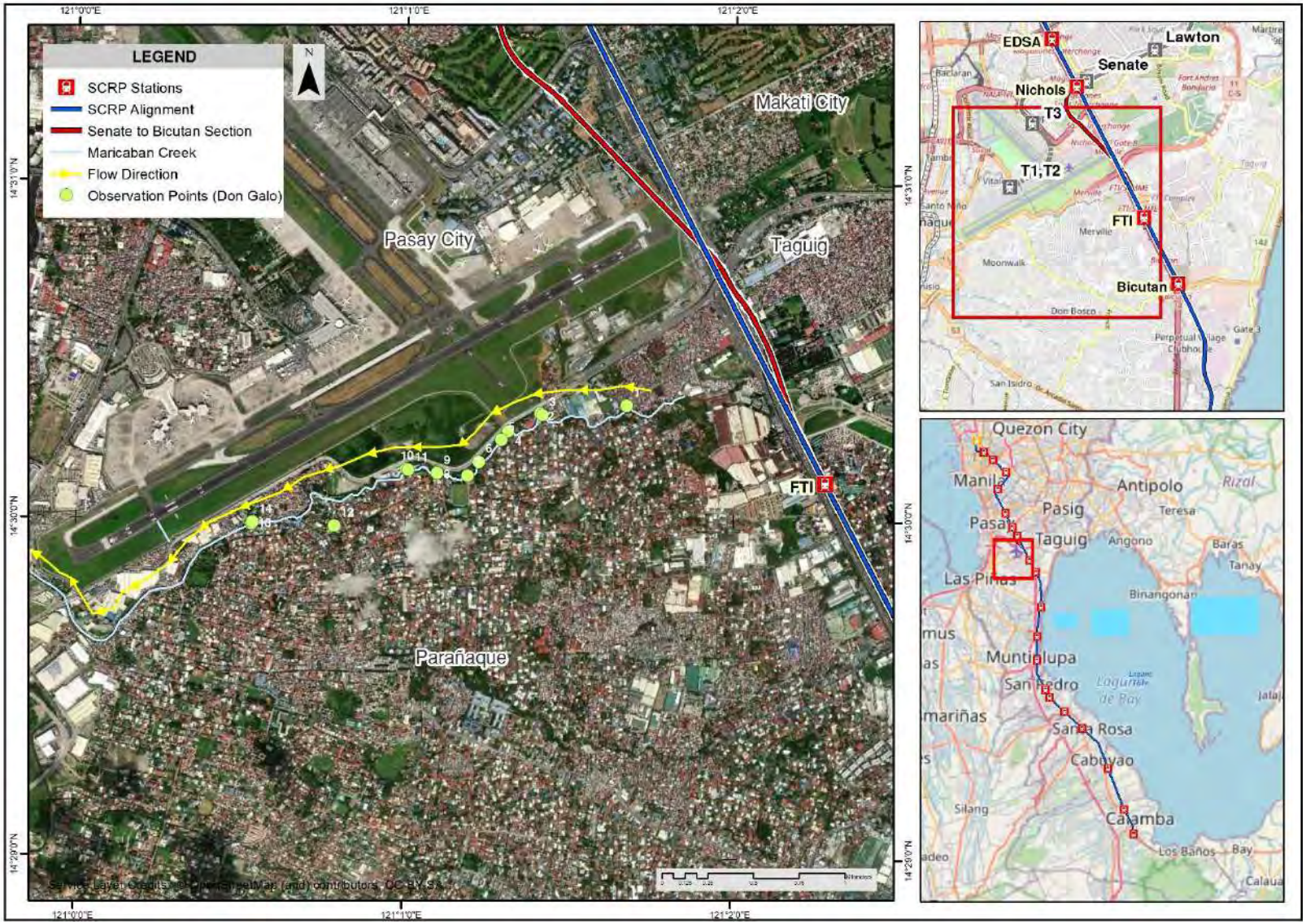


Figure 3.2-60 Freshwater Ecology Observation Points across Don Galo Creek

Plate 3.2-7 Site Photographs of each Survey Point Across the Channel of Don Galo Creek (Point 1 to Point 8)

Plate 3.2-8 Site Photographs of each Survey Point Across the Channel of Don Galo Creek (Point 9 to Point 14)

3.2.3.2. Survey Result and Analysis

1272. The conditions of freshwater bodies at the vicinity of the proposed site of the Project ranged from good to poor, which are reflective in the water quality and biological data. Bioindicator species of phytoplankton such as *Pediastrum, Melosira* and *Fragilaria*, and the occurrence of Rotifera species, such as *Brachionus urceolaris* are suggestive of these conditions. The dominance of Oligochaeta, *Melanoide*s and Chironomidae, which are known indicators of poor quality further corroborates with these observations. Also, low DO at several stations and high conductivity levels at all stations indicate poor water quality. Disturbances at aquatic bodies could be largely attributed to domestic and industrial activities.

(1) Species Diversity

1) Plankton Community

Phytoplankton

1273. The phytoplankton community at thirteen (13) stations combined at the vicinity of Project comprised at least thirteen (13) taxa representing three (3) algal divisions. Cyanophyta (blue-green algae) largely dominated the phytoplankton community comprising 68.2% of the total count. Relatively lower proportions were recorded for Chlorophyta (green algae) and Bacillariophyta (diatoms), representing 18.3% and 13.5%, respectively, of the total phytoplankton. Five (5) diatom taxa, five (5) green algal taxa and three (3) blue-green algal taxa were recorded at the study site as presented in **Table 3.2-37**.

1274. Phytoplankton mean abundances varied among sampling stations, ranging from 1 cell/l to 873 cells/l. SW4 had the highest mean algal density (873 cells/l), followed by those recorded at SW3 (277 cells/l), SW7 (207 cells/l), SW9 (199 cells/l) and at SW13 (186 cells/l)/. Moderate algal abundances were observed at SW2, SW6 and SW12 with values ranging from 42 cells/l to 84 cells/l. Meanwhile, low algal densities were recorded at three remaining stations (SW8, SW10 and SW11), with average phytoplankton abundances ranging from 1 cell/l to 18 cells/l as shown in **Table 3.2-37**.

1275. *Pediastrum* dominated at SW1 (84 cells/l), followed by *Ulothrix* (34 cells/l), while *Fragilaria* (32 cells/l) was the most abundant taxon at SW2. High mean densities of *Microcystis* were observed SW3 (250 cells/l), SW4 (545 cells/l) and SW5 (140 cells/l), consistently dominating these stations. *Aphanocoapsa* was also recorded at high density at SW4 (328 cells/l), and this taxon dominated at SW9 (199 cells/l), sw10 (3 cells/l) and at SW11 (18 cells/l). Stations SW6 and SW7 were dominated by *Ulothrix* (56 cells/l and 98 cells/l, respectively), while high densities of this taxon were observed at SW1 (34 cells/l) and at SW13 (50 cells/l). Meanwhile*, Melosira* was the most abundant taxon at SW12 and SW13 (18 cells/l and 56 cells/l, respectively) as indicated in **Table 3.2-37**.

1276. The dominance of *Pediastrum, Fragilaria and Melosira,* as well as the occurrence of *Microcystis* at high densities at majority of the surveyed stations are suggestive of eutrophic (nutrient-rich) waters. These taxa are known bioindicators of such condition (Bellinger and Sigee, 2010). *Microcystis* is also known to produce toxin and impart foul smell and unwanted taste in water systems (Bellinger and Sigee, 2010).

Table 3.2-37 Mean (No. of Units/ l) and Relative Mean Density (%) of Algae Recorded at Thirteen (13) Sampling Stations

Taxa	SW-1 Pasig River	SW-2 Laguna Lake	SW-3 Buli River	SW-4 Tunasan River	SW-5 San Pedro River	SW-6 San Cristobal River	SW-7 San Juan River	SW-8 Bgy Bucal River	SW-9 Tadlac (Alligator) Lake	SW-10 Dampalit River	SW-11 Saran River (Bgy Malinta)	SW-12 Molawin River	SW-13 Buot Creek	Overall Mean Density	Relative Mean Density
Bacillariophyta	45	32	27	0	13	2	77	1	0	0	0	18	91	23	13.5
Fragilaria	29	32	23	0	3	0	27	0	0	0	0	0	25	11	6.2
Melosira	0	0	5	0	0	0	39	0	0	0	0	18	56	9	5.2
Navicula	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0.0
Surirella	11	0	0	0	10	2	11	0	0	0	0	0	10	3	2.0
Synedra	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2
Chlorophyta	97	43	0	0	0	60	118	0	0	1	0	17	77	32	18.3
Cladophora	0	0	0	0	0	0	20	0	0	0	0	11	28	5	2.6
Pediastrum	48	10	0	0	0	4	0	0	0	1	0	5	0	5	3.0
Scenedesmus	11	15	0	0	0	0	0	0	0	0	0	0	0	2	1.2
Spirogyra	5	14	0	0	0	0	0	0	0	0	0	0	0	1	0.8
Ulothrix	34	4	0	0	0	56	98	0	0	0	0	0	50	18	10.7
Cyanophyta	0	9	250	873	140	7	12	0	199	3	18	8	17	118	68.2
Aphanocapsa	0	0	0	328	0	0	0	0	199	3	18	8	0	43	24.7
Microcystis	0	0	250	545	140	0	0	0	0	0	0	0	0	72	41.5
Spirulina	0	9		0	0	7	12	0	0	0	0	0	17	3	2.0
Mean Density	142	84	277	873	153	68	207	1	199	4	18	42	186	173	100.0
SD	4	10	23	166	18	11	1	0	37	5	8	14	13		
Number of Taxa	7	6	3	2	3	4	6	2	1	2	1	4	6	13	

Zooplankton

1277. At least fourteen (14) zooplankton taxa representing three (3) animal phyla were recorded at ten (10) surveyed stations combined at the vicinity of the proposed location of PROJECT. Arthropoda was the most abundant phylum representing 46.5% of the total zooplankton, followed by Rotifera with an overall relative density of 38.6%. Relatively lower proportion was recorded for Protozoa comprising 14.9% of the total count. Meanwhile, none was recorded at three remaining stations (SW8, SW9 and SW11). Rotifera had the highest number of zooplankton taxa (8 taxa) followed by Arthropoda (5 taxa), while a single taxon was observed for Protozoa as shown in **Table 3.2-38**.

1278. Moderate zooplankton densities were recorded at SW1 and SW2 with values of 49 inds. /l and 33 inds. /l, respectively. These two (2) stations also had relatively higher number of taxa ranging from 9-10 taxa, compared with that recorded at (8) eight remaining stations. Low zooplankton taxa richness was observed at the rest of the sampling stations with values ranging from 1-5 taxa, as indicated in **Table 3.2-38**.

1279. Copepoda nauplius dominated at SW1 (15 inds. /l), followed by *Filinia* (10 inds. /l). *Copepoda nauplius* and *Brachionus urceolaris* co-dominated at SW2 each having a mean density of 9 inds. /l. Copepoda nauplius dominated at SW12 (4 inds. /l), and Centropyxis at SW13 (5 inds. /l) as shown in **Table 3.2-38**.

1280. Overall composition and mean abundances of zooplankton were low at majority of the surveyed stations except at SW1 and SW2 (**Table 3.2-38**).

1281. The presence of *Filinia* and *Brachionus urceolaris* at moderate densities and the occurrence of protozoan Genus *Centropyxis*, may indicate nutrient-enrichment in some surveyed stations, since these taxa are known bioindicators of such condition (Lampert and Sommers, 2007; Hra, 2011; Marneffe et al., 1998). Sources of organic matter/ nutrients as well as other pollutants may possibly be domestic as well as industrial activities, particularly at sites SW1 and SW2. Low zooplankton taxa richness and mean abundances in majority of the sampling stations can be attributed to moderate to fast water flow in most areas as well as domestic disturbances.

Table 3.2-38 Mean (No. of Units/ l) and Relative Mean Density (%) of Algae Recorded at Thirteen (13) Sampling Stations

Taxa	SW-1 Pasig River	SW-2 Laguna Lake	SW-3 Buli River	SW-4 Tunasan River	SW-5 San Pedro River	SW-6 San Cristobal River	SW-7 San Juan River	SW-8 Bgy Bucal River	SW-9 Tadlac (Alligator) Lake	SW-10 Dampalit River	SW-11 Saran River (Bgy Malinta)	SW-12 Molawin River	SW-13 Buot Creek	Overall Mean Density	Relative Mean Density
Arthropoda	23	16	0	0	0		0	0	3	0	0	4	3	5	46.5
Calanoida copepodite	4	5	0	0	0	0	0	0	1	0	0	0	1	1	9.6
Calanoida female	4	2	0	0	0	0	0	0	0	0	0	0	0	1	6.3
Copepoda Nauplius	15	9	0	0	0	0	0	0	2	0	0	4	2	3	30.4
Isopoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2
Bosmina	5	1	0	0	0	0	0	0	0	0	0	0	0	1	5.8
Protozoa	4	3	1	0	0	0	1	0	1	0	0	1	3	2	14.9
Centropyxis	4	3	1	0	0	0	1	0	1	0	0	1	5	2	14.9
Rotifera	22	15	0	0	0	2	0	0	0	0	0	1	3	4	38.6
Brachionus calyciflorus	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1.7
Brachionus leydigi	0	1	0	0	0	2	0	0	0	0	0	0	0	0	2.9
Brachionus urceolaris	0	9	0	0	0	0	0	0	0	0	0	0	0	1	8.2
Filinia	10	2	0	0	0	0	0	0	0	0	0	0	0	1	10.6
Hexarthra	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1.0
Keratella tropica	5	0	0	0	0	0	0	0	0	0	0	0	0	0	4.6
Lecane	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1.2
Polyarthra	6	3	0	0	0	0	0	0	0	0	0	0	0	1	8.4
Mean Density	49	33	2	0	0	2	1	0	4	0	0	5	8	10	100.0
SD	15	2	1	0	0		1	0	1	0	0	4	2		
Number of Taxa	9	10	3	1	1	1	1	0	4	0	0	5	4	14	

2) Macrobenthos Community

1282. A total of nineteen (19) macrobenthos taxa representing four (4) animal phyla were recorded at thirteen (13) stations combined at the proposed site of the Project, while none was observed at SW3. Arthropoda largely dominated the macrobenthos community comprising 50.4% of the total count, followed by Mollusca with 36.2%. Annelida was recorded at relatively low proportion (13.2%) as shown in **Table 3.2-39**.

1283. Macrobenthos taxa richness was relatively low at surveyed stations, ranging from 1-9 taxa, with relatively higher taxa richness observed at SW1, SW10, SW11 and SW13 (7-9 taxa), compared with that recorded at eight (8) remaining stations (1-4 taxa). High densities of macrobenthos were recorded at SW2, SW8, SW10 (104 to 179 inds. /m2), while moderate densities at SW1, SW9, SW11, SW12 (36 to 76 inds. /m2). Meanwhile low densities were recorded at five (5) remaining stations (1-16 inds. /m2) as presented in **Table 3.2-39**.

1284. Oligochaeta was the most abundant taxon at SW1 (30 inds. /m2), and *Melanoides* at SW2, SW9, SW10 and SW13 (23-95 inds. /m2. Chironomidae of Order Diptera dominated at four (SW7, SW8, SW11, and SW12) of the thirteen (13) surveyed stations. This taxon was recorded at high density at SW8 (178 inds. /m2). Chironomidae was also recorded at high densities at SW9 and SW10 (16 and 44 inds. /m2). Class Hirudinea (leeches) was recorded at moderate density at SW10, as given in **Table 3.2-39**.

Table 3.2-39 Mean (No. of Animals/ m^2) and Relative Mean Density (%) of Macrobenthos at Thirteen (13) Sampling Stations

Taxa	SW-1 Pasig River	SW-2 Laguna Lake	SW-3 Buli River	SW-4 Tunasan River	SW-5 San Pedro River	SW-6 San Cristobal River	SW-7 San Juan River	SW-8 Bgy Bucal River	SW-9 Tadlac (Alligator) Lake	SW-10 Dampalit River	SW-11 Saran River (Bgy Malinta)	SW-12 Molawin River	SW-13 Buot Creek	Total Mean Density	Relative Mean Density
ANNELIDA	30	0	0	4	0	1	1	0	11	11	23	1	6	88	13.2
Hirudinea	0	0	0	0	0	0	0	0	0	10	0	0	4	15	2.2
Oligochaeta	30	0	0	4	0	1	1	0	11	1	23	0	2	72	10.9
Polychaeta	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0.1
Nereididae	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0.1
ARTHROPODA	0	0	0	0	4	0	14	178	16	45	53	7	17	334	50.4
Decapoda (crabs)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Insecta	0	0	0	0	4	0	14	178	16	44	53	7	17	334	50.4
Order Coleoptera	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0.1
Elmidae	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0.1
Order Diptera	0	0	0	0	4	0	14	178	16	44	53	6	1	317	47.8
Chironomidae	0	0	0	0	4	0	14	178	16	44	53	6	1	317	47.7
Tipulidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Order Ephemeroptera	0	0	0	0	0	0	0	0	0	0	0	0	13	13	2.0
Heptageniidae	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0.5
Leptophlebiidae	0	0	0	0	0	0	0	0	0	0	0	0	10	10	1.4
Order Trichoptera	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0.5
Hydropsychidae	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0.5
MOLLUSCA	6	113	0	0	1	0	1	1	25	48	0	1	45	240	36.2
Bivalvia	1	10	0	0	0	0	0	0	0	0	0	0	2	13	2.0
Corbicula	0	10	0	0	0	0	0	0	0	0	0	0	2	13	1.9
Tellinidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Gastropoda	5	102	0	0	1	0	1	1	25	48	0	1	43	227	34.2
Acmaeidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Acmaea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1

Taxa	SW-1 Pasig River	SW-2 Laguna Lake	SW-3 Buli River	SW-4 Tunasan River	SW-5 San Pedro River	SW-6 San Cristobal River	SW-7 San Juan River	SW-8 Bgy Bucal River	SW-9 Tadlac (Alligator) Lake	SW-10 Dampalit River	SW-11 Saran River (Bgy Malinta)	SW-12 Molawin River	SW-13 Buot Creek	Total Mean Density	Relative Mean Density
Ampullaridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Pomacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Physidae	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.2
Thiaridae	4	96	0	0	0	0	1	1	25	48	0	1	43	219	33.0
Melanoides	4	95	0	0	0	0	1	1	23	47	0	1	43	215	32.4
Thiara scabra	1	1	0	0	0	0	0	0	2	0	0	0	0	4	0.6
Viviparidae	0	6	0	0	0	0	0	0	0	0	0	0	0	6	1.0
Viviparus	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0.3
PLATYHELMINTHES	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0.2
Turbellaria	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0.2
Dugesia	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0.2
Mean Density	36	113	0	4	5	1	16	179	52	104	76	9	68	663	100.0
SD	37	143	0	6	2	2	6	69	31	60	24	2	21		
Number of Taxa	8	4	0	2	3	1	4	2	4	9	4	7	9	19	

1285. The dominance of Oligochaeta (**Plate 3.2-9**), Melanoides and Chironomidae (**Plate 3.2-10**) at most surveyed stations and the occurrence of leeches (**Plate 3.2-11**) at few stations are suggestive of polluted conditions. These taxa are known bioindicators of eutrophic, nutrient-rich condition/ poor water quality (Barbour et al., 1999). They frequent areas with high organic matter, since they are known to feed on detritus (organic matter, bacteria and protozoans). Domestic wastes such as solid wastes, and sewage could serve as possible sources of organic matter and nutrients.

Plate 3.2-9 Oligochaeta the Dominant Taxon at WSS1

Plate 3.2-10 Chironomidae (Midge Larvae), the Dominant Taxon at Majority of the Surveyed Stations

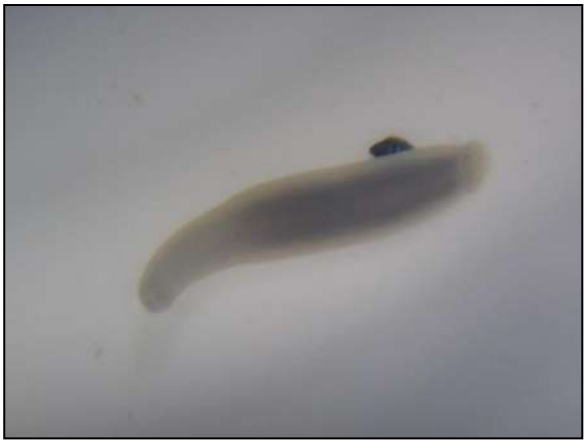


Plate 3.2-11 Hirudinea (Leech) Observed at Moderate Density at WSS10

3) **Fish and Other Aquatic Animals**

1286. Majority of the sampling stations serve as repository for all types of wastes/ garbage and pollutants from domestic and industrial activities. Minor fishing activity was observed at SW2, SW7 and SW9, but fish caught are used for domestic consumption, as shown in **Plate 3.2-12**, **Plate 3.2-13** and **Plate 3.2-14**.

1287. A total of seven (7) aquatic animals comprised of five (5) fish species (tilapia, dalag, hito, kanduli, and janitor fish) and two reptiles (snakes and turtles) were reported by locals to have been caught at five (5) stations as shown in Table 3.2.26. Taxa richness of fish and other aquatic animals was reported highest at SW7 (6 taxa), followed by that recorded at SW8 and SW12 (5 taxa each) (**Table 3.2-40**).

Table 3.2-40 Fish and Other Aquatic Animals Reportedly Caught at Five (5) Stations

Stations	Fish and other aquatic animals
SW2	*Oreochromis niloticus* (tilapia)
SW6	*Hypostomus plecostomus* (janitor fish), *Oreochromis niloticus* (tilapia), *Clarias sp*. (hito), *Channa sp*.(dalag), *turtle* (pawikan)
SW7	*Hypostomus plecostomus* (janitor fish), *Oreochromis niloticus* (tilapia), *Clarias sp*. (hito), *Channa sp*.(dalag), turtle (pawikan), *Arius* (kanduli)
SW9	*Oreochromis niloticus* (tilapia), *Channa sp*.(dalag)
SW12	*Hypostomus plecostomus* (janitor fish), *Oreochromis niloticus* (tilapia), *Channa sp*.(dalag), snake, turtle

Plate 3.2-12 Local Catching Fish at SW2 Using Fish Net

Plate 3.2-13 Catching Fish Using Hook and Line at SW7

Plate 3.2-14 Fisherfolk Catching Fish Using Fish Net at SW9 Tadlak Lake

(2) Biodiversity Values

1288. Phytoplankton communities at SW1, SW2, and SW13 were relatively more diverse (diversity values ranging from 1.61 to 1.66) than that observed at SW7 and SW12 (diversity values of 1.48 and 1.28, respectively). Meanwhile, low diversity values were recorded for phytoplankton communities at the remaining sampling stations (0.34 to 0.67). SW1 and SW2 had more diverse zooplankton communities (2.0 diversity values) compared with that recorded at SW9, SW12 and SW13. Overall diversity of macrobenthos communities were low at most stations except at SW9, SW10 and SW13, where relatively higher index of diversity values was recorded (diversity index values ranged from 1.08 to 1.36) as shown in **Table 3.2-41**.

Table 3.2-41 Shannon's Diversity Index Values of Freshwater Communities at Thirteen (13) Surveyed Stations at the Project Site

Freshwater Communities	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10	SW11	SW12	SW13
Phytoplankton	1.66	1.61	0.37	0.66	0.34	0.67	1.48	0.00	0.00	0.56	0.00	1.28	1.65
Zooplankton	2.03	2.00	0.00	0.00	0.00	0.00	0.00	0.00	1.04	0.00	0.00	0.87	1.15
Macrobenthos	0.48	0.45	0.00	0.00	0.00	0.00	0.46	0.03	1.18	1.08	0.61	0.74	1.36

(3) Stream Visual Assessment for Maricaban Creek

1289. Based on the results of the stream survey, the low-gradient Maricaban Creek is notably affected by the rapidly growing rate of urbanization in Metro Manila. To illustrate, channel flow across the waterway is apparently low, especially from Point 1 to Point 18. Coupled with altered stream channel as a result of built- up concrete structures (i.e., perimeter walls, concrete ledges, bank reinforcements), having reduced channel flow entails less available microhabitat for resident aquatic biota. Moreover, the stream velocity and depth regime is somehow complex, as evidenced by the mixture of slow-deep and slow-shallow areas. Bank stability is good due to the observable bank strengthening components from both banks; however, such impervious surfaces could potentially directly affect the recovery rate of the corresponding groundwater table in the area. Occurrence of concrete surfaces not only permit the entry of terrestrial run-offs, but also eliminates, if not highly reduces the riparian buffer zone. Observed bank vegetative zone was relative good, as depicted in Point 1 to Point 22. Notable riparian species include different varieties of the figs (*Ficus* sp.) along most of the creek margin, which are important food sources for various insect and pollinator species thriving in the area. In terms of water appearance, the creeks possess darkish brown waters with notable strong and distinct unpleasant odor. Sediment deposition was not common for the most part of the creek, except for some portions in Point 24 and Point 25 in which island bars build up around the central portion of the reach. Canopy cover was variable, with relatively good shade availability among Point 8 to Point 23, while sparse vegetation capable of providing food items was low among Point 24 to Point 30. Overall, stream health in Maricaban Creek falls under the poor condition rating.

(4) Stream Visual Assessment for Don Galo Creek

1290. Findings from the visual assessment of the Don Galo Creek showed that the low gradient stream courses through a highly residential area, with characteristic bank fortification structures along the entire surveyed stream channel. Channel flow was relatively good and comparatively higher as opposed to that of Maricaban Creek; in that the volume of water present in the channel reaches the majority of the stream cross-sectional area. Water appearance was also darkish brown in color and has a distinctive pungent odor. Sparse vegetation communities were interspersed along the margins of the creek, as the bank vegetative zone width is reduced as a result of the construction of concrete-enriched stream banks. Canopy cover, in all cases along the reaches of the waterway, was relatively fair and could be attributable to the patchy distribution and dispersed orientation of the vegetation species in the immediate riparian buffer. Vegetation zone width was low, as the houses and road sides fall within 5 m of the left and right stream banks. Despite the low percentage of vegetation cover along the Don Galo Creek, overhanging vegetation may be seen as a vital source of allochthonous food items to existing aquatic biota. In terms of potential sources of pollution affecting the waterway, effluents from residential areas, coupled with domestic wastes and run-offs, appears to be the primary point sources. Overall, the stream health in Don Galo Creek falls under the poor condition rating.

3.2.3.3. Impact Identification, Prediction and Assessment and Mitigation

(1) Pre-construction and Construction Phase

1) Threat to Existence and/or Loss of Species of Important Local and Habitat

1291. The project will have little or minimal impacts on aquatic ecology as almost all stations are already heavily polluted as a result of domestic and industrial activities.

2) Threat to Abundance, Frequency and Distribution

1292. Construction activities along a railway alignment may adversely affect aquatic species, particularly in rivers and streams where individuals of Insect Orders Ephemeroptera (mayflies) and Trichoptera (caddisflies), which are known indicators of good water quality, were observed (such as at WSS 14 or Buot Creek which few kilometers from Calamba Station). Project activities may also have negative impacts on fish communities, particularly reported at several sites (WSS2- Laguna Lake, WSS7- San Cristobal River, WSS8- San Juan River, WSS10- Alligator Lake and WSS13- Maulauen River), where commercially important fishes such as *Oreochromis niloticus* (tilapia), *Channa* (dalag) and *Arius* (kanduli) have been reported. For aquatic species, the adverse effects which would contribute to a decrease in freshwater biota which may be attributed to the Project construction works within the vicinity of rivers and streams include:

- Disruption of water flow in waterways for the construction of drainage structures and earth-moving activities related to project construction (such as excavation and backfilling) may destroy aquatic habitats which serve as shelter, spawning and nursery grounds for aquatic animals such as fishes and macroinvertebrates.
- Increase in turbidity of surface water and disruption of the waterbed by deposition of sediments from soil erosion due to construction works and storm water runoff. Turbidity may clog gills of fishes and affect their respiration and may also result in localized mortality of macroinvertebrates such as larval forms of aquatic insects, annelids (segmented worms) and molluscs (shelled animals), which serve as prey items for fishes and other aquatic animals. This may also impair feeding apparatus of macroinvertebrates. Increased turbidity may also limit light penetration, which may result in decreased primary productivity of phytoplankton and other algae. Consequently, zooplankters which rely on phytoplankton for food may potentially decrease in type and number. If this would persist, an overall decrease in both primary and secondary productivity may occur in the area.

Water pollution from oil/fuel spills of vehicles

1293. Water pollution from domestic sewage effluents of workers may give rise to eutrophication, changes in composition of aquatic fauna (such as increase in abundances of pollution-tolerant aquatic species), and mortality of highly sensitive species of fish and aquatic insects.

Possible illegal fishing of workers

1294. The overall magnitude of the impact decrease in abundances of aquatic organisms during construction is considered low since these are not expected to adversely affect their integrity. These impacts will occur for a short period and aquatic populations will have the capability to recover their numbers once the construction phase ends.

Potential pollution from the dust accumulation

1295. Dust accumulation in freshwater bodies during transport of materials would increase turbidity or levels of suspended particles in water, resulting in decreased light penetration. This would decrease photosynthesis of phytoplankton and benthic algae and consequently decrease diversity of zooplankton and other invertebrates, and fish which rely on them for food. To minimize or prevent this, vehicles carrying construction materials will be covered and speed limits will be implemented.

1296. The main mitigation measures during the construction phase to prevent soil erosion and contamination of water bodies which may directly or indirectly affect aquatic organisms will be the implementation of DOTr's Sedimentation and Erosion Control Plan; Plan for the safe management of hazardous materials and Spill Prevention Program, including emergency response measures in case of accidental spills; and a Waste Management Plan.

1297. Whenever possible, construction activities at the vicinity of water bodies will be carried out during the dry season.

1298. Limit the extent of construction area next to water courses. No occupation of the stream bed or the banks will be allowed, unless there is no other reasonable alternative to carry out the construction work. Stockpiles will be covered to prevent sediment from being washed into nearby rivers and creeks. The construction drainage will be directed to retention basins or grassed filter zones to trap sediments and other contaminants, rather than discharging directly to the water courses. These sediment and contaminant retention structures will be constructed in the areas where habitats of very high or high sensitivity are located along the alignment or in a close location downstream of the effluent discharge point. Domestic wastewater generated in the construction camps will not be allowed to be discharged untreated into natural water courses. The camps will be provided with STP to treat effluents to admissible levels for discharge in the water body. The construction sites will be provided with chemical portable toilets and the waste adequately managed.

(2) Operation Phase

1) Threat to Existence and/or Loss of Species of Important Local and Habitat and threat to Abundance, Frequency and Distribution

1299. During operation phase, negative impacts on aquatic animals could be attributed to spills from washings of trucks and vehicles during normal operation and occasionally due to accidental spills of chemicals and fuel at the depot. Degradation of habitat quality due to storm water discharges and alterations in stream hydrology can degrade habitats ranging up to several hundred meters from railways. Finally, an increase of the local population induced by the railroad could result in an undesirable increase of illegal fishing as well as domestic wastes which may pollute freshwater bodies and adversely affect aquatic organisms.

1300. Regular control and maintenance of drainage structures and retention basins will be conducted to ensure removal of clogged debris or sediments. Domestic wastewater generated at the stations will be treated according to the relevant national legislation and standards. Untreated wastewater will not be allowed to be discharged into natural water courses. In the event that connection of the sewage system at the station to the municipal collector are unfeasible, the station shall be provided with a STP to treat effluents to admissible levels prior to discharge in the water body. The cleaning water generated by the washing of the trucks and vehicles will be treated as well unless it can be discharged under permit issued by the local government unit (municipal/city office or the LLDA/DENR).

1301. Additional measures are as follows:

- Comply with environmental permitting requirements for the storage, transport, handling, and treatment of hazardous material/ wastes and contaminated soil in accordance with RA 6969;
- Strictly implement solid waste/soil management plan, which include minimization of waste/soil generation, segregation, and proper disposal in accordance to RA 9003; Comply with RA 9275 including but not limited to securing of DP; and
- Proper inspection and regular maintenance of drainage system and treatment facility

Table 3.2-42 Summary of Impact Identification, Prediction, Assessment and Mitigation for Water

Environmental Aspect	Environmental Component	Potential Impact	Level of Significance	Prevention/Mitigation/ Enhancement Measures
GENERAL				
Pre-construction, Construction and Operation activities	Water	Contamination of water resources Depletion of water resources	C-	Comply with the relevant laws: • RA 6969: storage, transport, handling, treatment and disposal of hazardous waste • RA 9003: management and disposal of solid wastes • RA 8749: comprehensive air pollution control policy • RA 9275: comprehensive water quality management and for other purpose • PD 856: Sanitation Code of the Philippines
PRE-CONSTRUCTION AND CONSTRUCTION				
• Site preparation, land clearing, removal of vegetation • Excavation • Construction activities	Hydrology	Flooding and inundation by sediment run off, siltation, drainage overflow, clogging	B-	**[Pre-Construction/ Construction]** • Design and install sufficient drainage system including temporary drainage system during construction to accommodate the surface water runoff from the Project and avoid any flooding in the area caused by the project, in consideration to the existing drainage system and flood storage capacity. • Based on the hydrological, geological study and local climate change data from PAGASA, design and install train system insusceptible to flood and related extreme events including temporary construction drainage, SCRP train structure to be above the flood level, installation of drainage pumping system, slope protection, etc. • Based on the result of hydrological study, design and install viaduct piers, tunnels and substations considering the potential impacts on flood levels upstream and downstream of the waterway. • For the underground interconnection section, FTI station will be provided with permanent bund walls. • Coordinate with DPWH and LGUs on the integration of proposed drainage plan to the project area. **[Construction]** • Minimize the removal of vegetation and alteration of topography as much as possible. • Install soil erosion control such as protection of slope and bank silt traps to minimize siltation of waterways as required. • Strictly implement construction plan, operating instructions and solid waste/ soil management plan, which include minimization of waste/ soil generation, segregation, and proper disposal by contractor in accordance to RA 9003. • Regular inspection and prompt maintenance of the drainage system, all installed structures and facilities and improve/ enhance capacity when possible. • FTI station will be provided with permanent bund walls along with water-sealed panels, tempered glass and waterproof iron doors, and drainage pumping stations

Environmental Aspect	Environmental Component	Potential Impact	Level of Significance	Prevention/Mitigation/ Enhancement Measures
				• Applicable dewatering technique may be considered to address this concern such as well point method, educator wells, open sump pumping and deepwell point method. • Conduct of construction activities along the waterways during the drier months of the year or during low flows whenever practicable. • Installation of diversion channels if appropriate
	Hydrogeology	• Depletion of water resource/ competition in water use • Groundwater ingress • Groundwater drawdown	C-	[Pre-Construction/Construction] • A further study is recommended such as hydraulic modelling to estimate the anticipated volume of groundwater inflow, drawdown, hydraulic radius of influence, and rate of groundwater depletion. Additional studies are needed to determine actual depths and extent of these groundwater aquifers and the potential interconnection that would be material information during the construction phase of the project. • A three-dimensional numerical groundwater model should be developed during Detailed Engineering Design (DED) to simulate existing groundwater conditions, proposed tunnel alignment and associated subsurface ancillary infrastructure. The groundwater model shall be used to predict future groundwater conditions and potential impacts related to the project. The groundwater model shall use internationally accepted modeling software. • Establish and operate suitable groundwater control strategies such as pre-drainage or cut-off methods whichever is applicable prior to construction. • Conduct regular monitoring of the ground water level and quality at nearby identified wells to ensure that the project is not causing any depletion of water supply. • A water conservation management plan will be implemented. This will include utilization of recycled water and rainwater. **[Construction]** • Utilize surface water from the local water service provider/s. • Conduct regular monitoring of water consumption. • Implement water conservation program such as use of rain harvested/ recycled water at construction yard/ camp. • Install piezometers to monitor groundwater pressure around the tunnel • Ensure that the underground tunnel is sufficiently supported and lined to prevent failure and ingress of groundwater. • Install dewatering pumps for the underground section and secure necessary discharge permits • Install monitoring wells for observation along the underground tunnel and monitor change of the surrounding ground water levels • If water supply of people relying on groundwater along the underground interconnection section alignment decreases (due to groundwater drawdown), DOTr shall make arrangements to supply affected people with water. • DOTr will coordinate with NWRB regarding tunneling activities and its potential effects on the water table

Environmental Aspect	Environmental Component	Potential Impact	Level of Significance	Prevention/Mitigation/ Enhancement Measures
				• A Dewatering Permit may have to be secured from NWRB prior to tunneling activities.
Earthworks (excavation, backfilling, stockpiling, tunneling/ underground)	Water Quality	Degradation of groundwater quality	C-	**[Pre-Construction/ Construction]** • Plan and implement appropriate construction methods (i.e. excavation, backfilling, stockpiling) based on geological and geotechnical investigations. **[Construction]** • Install siltation/filtration pond at tunnel construction area. • Comply with environmental permitting requirements for the storage, transport, handling, treatment, and disposal of hazardous material/ wastes and contaminated soil in accordance with RA 6969, and solid waste / soil management plan, in accordance to RA 9003.
Earthworks (excavation, backfilling, stockpiling)	Water Quality	• Disturbance on bottom sediment and degradation of surface water • Siltation • Induce of turbidity	B-	**[Pre-Construction]** • Based on the hydrological and geodetic surveys, design bridge piers that will minimize installation within the rivers and select appropriate construction materials to be used. • Minimize the removal of vegetation cover, alternation of topography as much as possible. • Plan and implement construction activities in consideration of waterways, embankment, and weather conditions. • Coordinate with NWRB, DPWH and LGUs for necessary permit. **[Construction]** • Implement construction activities considering waterways, embankment, and weather conditions (designate buffer zones approximately 5 m from each bank of affected waterways, where practicable). • Minimize the removal of vegetation cover, alteration of topography as much as possible. • Install slope to prevent soil erosion and bottom sediment around the bridge piers if necessary. • Place excavated material in temporary staging area with provision for silt traps/ siltation pond to avoid silt draining to waterways, degradation of surface water quality and clogging of waterways, if necessary. • Spoil and building material stockpiles will be provided with physical barriers and/or bunds to minimize silt- laden runoff • Surplus soil from tunneling will be used as backfill; remaining surplus soil after construction will be disposed appropriately in two identified sites within Metro Manila • Conduct regular surface water quality monitoring.
	Freshwater Ecology	Threat to abundance, frequency and distribution of species	C-	
• Discharge of wastewater, from construction	Water Quality	Degradation of surface water quality from wastewater	B-	**[Pre-Construction/ Construction]**

Environmental Aspect	Environmental Component	Potential Impact	Level of Significance	Prevention/Mitigation/ Enhancement Measures
sites/ slurry treatment plant / yards/ camps/ related facilities • Accidental spills of fuels and lubricants from construction vehicles and machineries, as well as other hazardous chemicals like paints and solvents. • Generation and improper handling and disposal of construction, domestic wastes.		discharge, accidental spills and runoff of fuel, paints and solvents to water bodies near the construction sites		• Design and implement the temporary drainage of waste water from construction yard/ slurry treatment facility/ other facilities/ camp, surface water runoff drainage systems to minimize discharge. • Design and install sewage treatment facility and separate non-sewage wastewater for stations and the SCRP Depot in compliance to the Sanitation Code of the Philippines. In addition, the SCRP Depot will have interceptor tank to remove oil and fuel from surface water. • Compliance with RA 9275, secure discharge permit. **[Construction]** • Install wastewater treatment and portable sanitary facilities at the construction sites/yards. Toilets and lavatories to be provided at the construction camps should be at a ratio of 10 people per toilet. The mobile toilets with wastewater treatment system will be provided. • Conduct proper inspection and regular maintenance of construction machineries, equipment, vehicles and wastewater treatment equipment and facilities with appropriate measures to collect potential leak. • Control oil refuelling activities and provide oil bunds in oil storage areas. • Prohibit workers from dumping garbage into drains and canals. • Implement material handling program or a site protection program. • Prior to operation of the batching plant, construct settling/retention ponds with sufficient capacity for treatment of wastewater from washing of equipment such as mixer drums, trucks, and chutes. • Properly maintain settling/retention ponds to ensure compliance with the General Effluent Standards. • Comply with environmental permitting requirements for the storage, transport, handling, and treatment of hazardous material/ wastes and contaminated soil in accordance with RA 6969 and solid waste / soil management plan, which include minimization of waste/soil generation, segregation, and proper disposal including the temporary storage by contractor in accordance with RA 9003. • Conduct of effluent quality monitoring at discharge point. • Temporary installation of adequate hazardous waste facilities as needed.
	Freshwater Ecology	Threat to abundance, frequency and distribution of species	C-	
Generation of hazardous wastes at construction sites	Water Quality	Potential contamination of surface and groundwater	B-	**[Pre-Construction/Construction]** • Contractors will prepare a list of hazardous chemicals to be brought at the site including information on the quantity and hazard classification. • Minimize or avoid long storage of hazardous materials onsite. • Comply with the labelling and storage requirements of hazardous materials/ chemicals, including the provision of MSDS onsite. • Conduct refuelling and equipment servicing only in designated areas with impervious surface. • Temporary installation of adequate hazardous waste facilities and provision of oil and grease traps and other spill containment measures.

Environmental Aspect	Environmental Component	Potential Impact	Level of Significance	Prevention/Mitigation/ Enhancement Measures
				• Collect hazardous materials including used fuel, lubricating oil and contaminated containers for proper disposal.
Spillage of fuel and other hazardous substances			B-	**[Pre-Construction/Construction]** • Contractor to strictly prepare and implement the wastewater and spill management plan. • Store fuel and hazardous substances in paved areas with embankment. If spills or leaks do occur, undertake immediate clean up. • Ensure availability of spill clean-up materials (e.g. absorbent pads, etc.) specifically designed for petroleum products and other hazardous substances where such materials are being stored and used. • Train construction personnel in handling fuels and on spill control procedures. • Ensure all storage containers are in good condition with proper labelling. • Regularly check containers for leakage and undertake necessary repair or replacement. • Equipment maintenance areas shall be provided with drainage leading to an oil-water separator; oil will be regularly skimmed to ensure efficiency. Discharge of contaminated water shall be prohibited. • Store waste oil, used lubricant and other hazardous wastes in tightly sealed containers to avoid contamination of soil and surface water. Transport and off-site disposal of such wastes shall be consistent with national regulations.
Generation of solid waste	Water Quality	Solid wastes may pollute surface waters due to improper handling and disposal		**[Pre-Construction/Construction]** • Comply with environmental permitting requirements for the storage, transport, handling, and treatment of hazardous material/ wastes and contaminated soil in accordance with RA 6969 and solid waste / soil management plan, which include minimization of waste/soil generation, segregation, and proper disposal including the temporary storage by Contractor in accordance with RA 9003. • Provide garbage bins and facilities within the project site for temporary storage of construction waste and domestic solid waste. • Separate solid wastes from hazardous waste and reusable wastes. • Store solid wastes temporarily on-site and secure facilities with weather-proof flooring and roofing. • Ensure that wastes are not haphazardly dumped within the project site and adjacent areas. • Undertake regular collection and disposal of solid wastes to sites approved by local authorities.
OPERATION				
• Operation of passenger trains/facilities, SCRP Depot:	Hydrology / hydrogeology	• Increase of flood intensity/occurrence	C-	• Conduct proper inspection and prompt maintenance of the installed drainage system and improve/ enhance capacity when possible. • Monitor groundwater pressure and levels. • Update tunnel deformation model to determine changes in underground stress regimes.

Environmental Aspect	Environmental Component	Potential Impact	Level of Significance	Prevention/Mitigation/ Enhancement Measures
• Discharge of waste water from passenger facilities and SCRP Depot. • Accidental spills of fuels and lubricants from service vehicles and machineries at the SCRP Depot • Generation and improper handling and disposal of domestic and hazardous wastes.		• Groundwater ingress		• Ensure dewatering pumps are working efficiently. • For the underground interconnection section, stations will be provided with permanent bund walls to mitigate potential flooding impacts to the stations
	Water quality	Degradation of groundwater quality	C-	• Comply with environmental permitting requirements for the storage, transport, handling, treatment and disposal of hazardous material/ wastes and contaminated soil in accordance with RA 6969. • Hygienic toilets will be provided at all stations and facilities. • Wastewater will be treated by a wastewater treatment system at each station before release of effluent into public waterways. • Recycle train washing to reduce volume of wastewater to be discharged daily. • Compliance to RA 9275 including but not limited to securing of discharge permit. • Conduct proper inspection and regular maintenance of drainage system and treatment facility. • Monitor effluent of the wastewater treatment system to ensure compliance with the effluent standards.
	Freshwater ecology	Degradation of surface water quality	B-	
		Threat to abundance, frequency and distribution of species	C-	

Note:
A+/-: Significant positive/negative impact is expected.
B+/-: Moderate positive/negative impact is expected to some extent.
C+/-: Minor positive/negative impact is expected to some extent
D: Extent of impact is unknown

3.3. AIR

3.3.1. Climate and Weather

1302. The climate at the proposed Project area as presented in this report is based on the climate map of the Philippines while the meteorological conditions are described using the meteorological data (1981-2010) from Ninoy Aquino International Airport (NAIA) PAGASA Synoptic Station (**Table 3.3.1**) located at 14°30'25.75" N and 121°00'15.90" E in Pasay City, Metro Manila with an elevation of 21 m.

Table 3.3.1 Meteorological Data Recorded at NAIA PAGASA Synoptic Station (1981-2010)

Month	Rainfall Data		Temperature						Relative Humidity (%)	Wind Direction/velocity	
	Amount (mm)	No. of Rainy Days	Max (°C)	Min (°C)	Mean (°C)	Dry Bulb (°C)	Wet Bulb (°C)	Dew Point (°C)		Wind Direction (16 pt)	Wind Velocity (m/s)
January	6.8	2	30.2	22	26.1	26	22.6	21.2	75	E	3
February	4.2	1	31	22.5	26.7	26.6	22.7	21.1	72	E	3
March	4	1	32.5	23.6	28	27.9	23.4	21.7	68	E	4
April	16	1	34.1	25	29.5	29.4	24.5	22.7	67	ESE	4
May	70.4	10	33.8	25.5	29.7	29.4	25.3	23.9	72	W	3
June	265.2	14	32.5	25.1	28.8	28.5	25.3	24.2	77	W	3
July	316.7	16	31.3	24.6	28	27.7	25.1	24.2	81	W	3
August	418.4	19	30.8	24.6	27.7	27.4	25.1	24.3	83	W	3
September	255.2	16	31	24.6	27.8	27.5	25.2	24.4	83	W	2
October	283.4	14	31.1	24.3	27.7	27.5	24.8	23.8	80	E	2
November	99	8	31.1	23.7	27.4	27.2	24.2	23.1	78	E	2
December	28.6	3	30.2	22.7	26.5	26.3	23.1	21.9	76	E	2
Annual	1,767.8	101	31.6	24.0	27.8	27.6	24.3	23.0	76	E	3

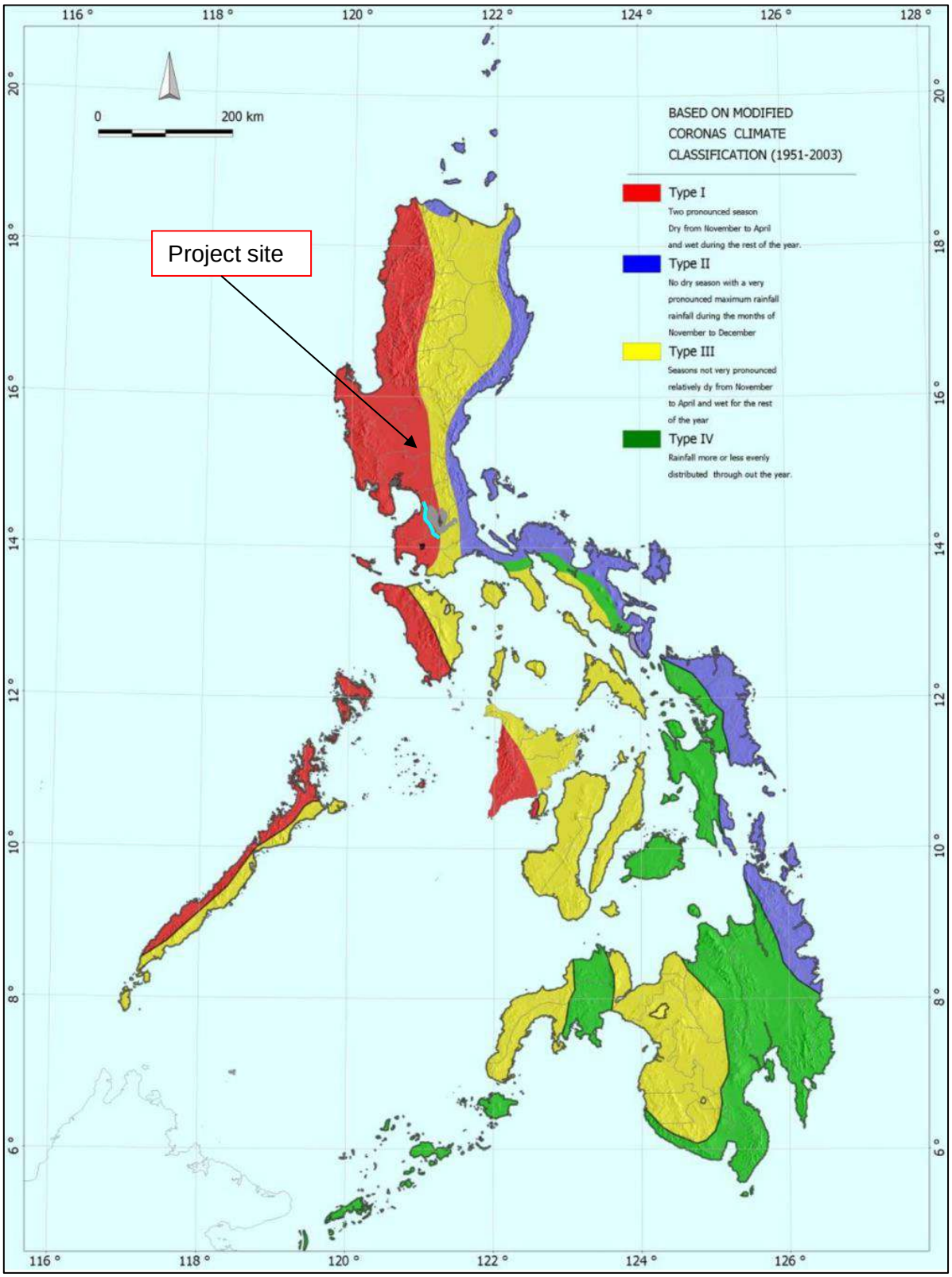
Source: Climatological Normals at NAIA Synoptic Station, PAGASA (1981-2010)

3.3.1.1. Local Climate

1303. Based on the Modified Coronas Climate Classification System, the area that will be traversed by the Project in Metro Manila and Laguna Province fall under Type I climate as indicated in the Climate Map of the Philippines in **Figure 3.3.1**. Type I Climate is characterized by two (2) pronounced seasons, dry season from November to April and wet season from May to October with a maximum rainy period from June to September. Areas under this type of climate are generally exposed to the southwest monsoon during rainy season and receive a fair share of rainfall as brought about by the tropical cyclones occurring during the maximum rainy period.

Table 3.3.2 Climate Classification in the Philippines

Classification	Description
Type I	Dry from November to April and wet during the rest of the year. The highest rainfall is from June to September.
Type II	No dry season with a pronounced rainfall from November to February. March to May has the lowest rainfall.
Type III	Seasons are not very pronounced, relatively dry from November to April, and wet during the rest of the year.
Type IV	Rainfall is more or less evenly distributed throughout the year.



Source: PAGASA

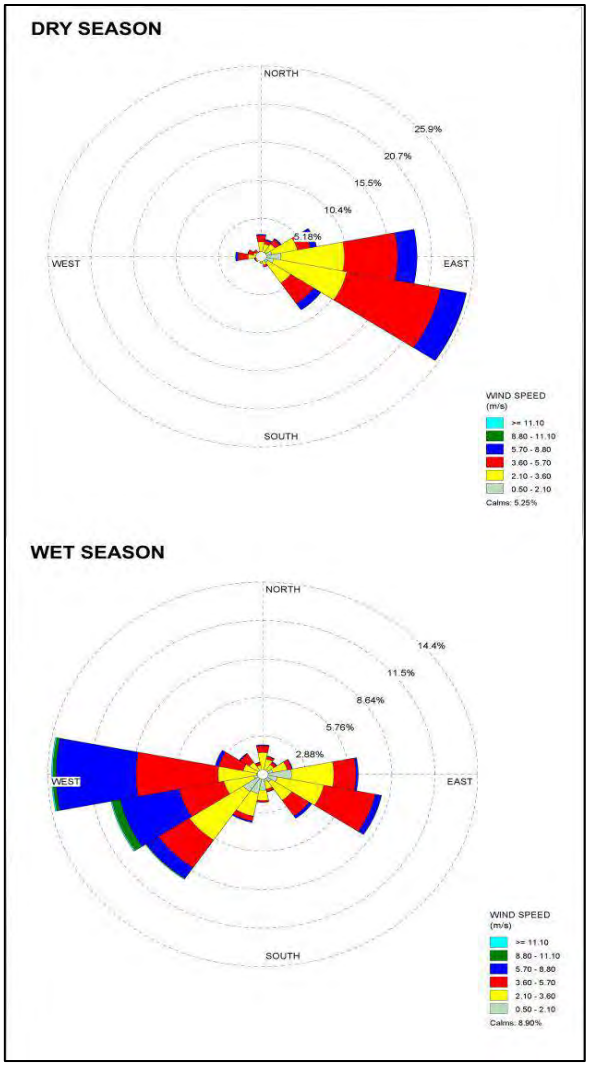
Figure 3.3.1 The Philippine Climate Map

(1) Wind Regime

1304. Based on the meteorological data recorded at NAIA Synoptic Station of PAGASA for the months of November to April covering the period from 2014 to 2019, the prevailing winds at the Project site during dry season were coming from east-southeast which comprised of about 25% of the time. The average hourly wind speed was 3.34 meters per second (m/s), few winds exceeded 11.1 m/s and winds of less than 2.10 m/s occurred from all directions.

1305. Based on the meteorological data recorded at NAIA Synoptic Station of PAGASA for the months of May to October covering the period from 2014 to 2018, the prevailing winds at the Project site during wet season were coming from the west and west-southwest which comprise of about 14% and 10%, respectively. The average hourly wind speed is 3.35 meters per second (m/s), few winds exceeded 11.1 m/s and winds less than 2.10 m/s occur from all directions.

1306. Windrose diagrams for dry and wet seasons based on the data from PAGASA NAIA Station are shown in **Figure 3.3.2**.



Source: AERMET View Version 9.5.0

Figure 3.3.2 Windrose Diagram based from the Data Recorded at PAGASA NAIA Synoptic Station for Dry and Wet Seasons (January 1, 2014 to April 30, 2019)

(2) Relative Humidity

1307. Relative humidity refers to the amount of water vapor in the air, expressed as a percentage of the maximum amount that air could hold at the given temperature. The mean annual relative humidity recorded at PAGASA NAIA Station is 76% (**Table 3.3.1**). The months of July to October are the most humid months. Factors affecting humidity are changes in temperature and atmospheric circulation. The air is said to be saturated when it contains the maximum amount of water vapor at a given temperature. When the temperature of the air falls below the dew point, some of the water vapor contained in the air condenses, then clouds are formed, and precipitation can result in the form of rain.

(3) Rainfall

1308. The monthly average rainfall at the Project area ranges from 4 mm to 418.4 mm, with an annual average of 1,767.8 mm (**Table 3.3.1**). The least number of rainy days occurs during dry season in November to April; while the highest number or rainy days occurs during wet season in May to October. The heaviest precipitation occurred in August at an average rainfall of 418.4 mm.

(4) Temperature

1309. The annual mean average temperature recorded at PAGASA NAIA Station is 27.8 °C with January being the coldest month having an average temperature of 26.1 °C while the month of May is the warmest with an average temperature of 29.7 °C. The highest and lowest temperatures occurred in the months of April and January, respectively. The mean maximum and minimum temperatures were 34.1°C and 22°C, as presented in **Table 3.3.1**.

(5) Frequency of Extreme Events

1310. Climatological extreme values are from the 30-year monthly and annual summaries of temperature, rainfall, and wind speed as presented in **Table 3.3.3**. The recorded annual extreme high and low temperatures were 38.0°C which occurred on June 2, 1991 and 14.6°C on January 1, 1962, respectively. The extreme greatest rainfall was recorded on July 20, 1972 at 472.4 mm while the extreme highest wind was recorded on November 19, 1970 at 56 m/s from westerly direction.

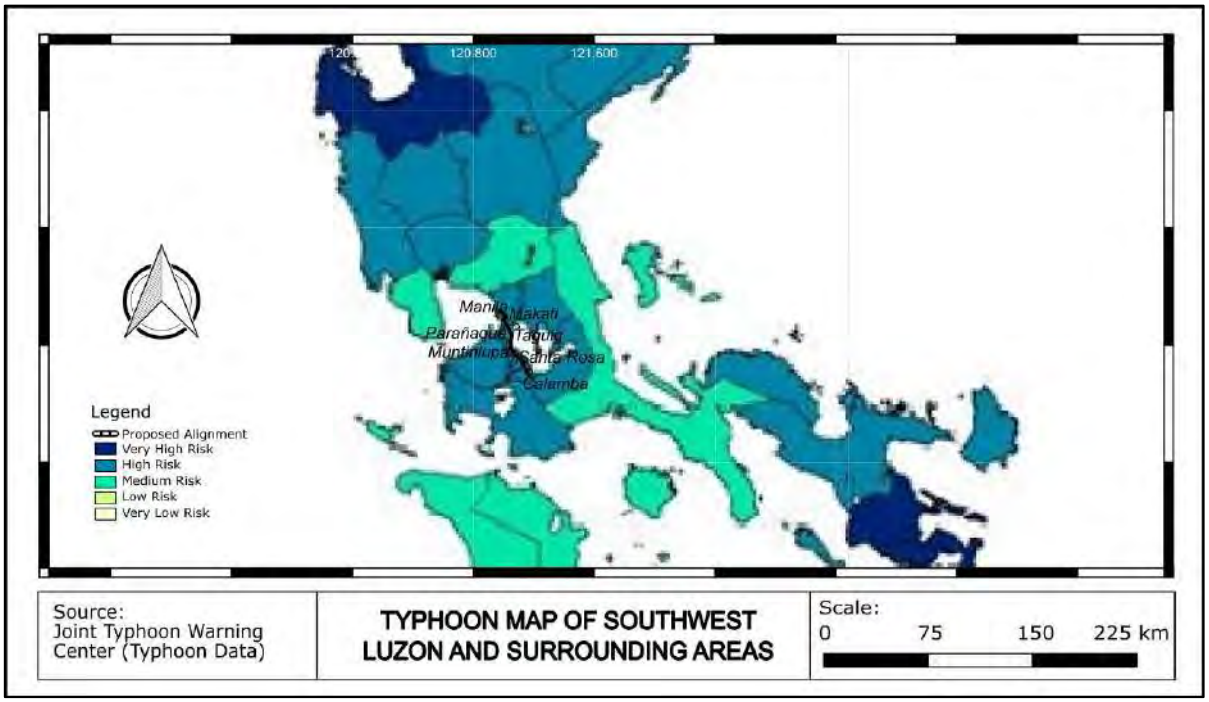
Table 3.3.3 Climatological Extreme Recorded at NAIA Synoptic Station as of 2016

Month	Temperature (°C)				Greatest Daily RF (mm)		Strongest Winds (m/s)		
	High	Date	Low	Date	Amount	Date	Speed	Dir	Date
Jan	35.8	01-07-1989	14.8	01-18-1961	55.3	01-03-1970	20	ENE	01-12-1986
Feb	35.1	02-21-1998	14.6	01-01-1962	16.5	02-27-1950	20	E	02-28-1988
Mar	36.5	03-30-1978	16.0	03-03-1963	36.0	03-07-2011	26	E	03-29-1992
Apr	37.8	04-23-1948	18.7	04-01-1994	63.0	04-04-1992	22	ESE	04-06-1986
May	38.2	05-18-2014	19.1	05-11-1950	229.1	05-27-1960	31	SW	05-22-1976
Jun	38.0	06-02-1991	20.0	06-22-1954	353.8	06-01-1958	36	S	06-29-1964
Jul	36.4	07-26-2016	18.3	07-28-1948	472.4	07-20-1972	36	W	07-08-1986
Aug	35.2	08-29-1989	17.4	08-09-1949	401.8	08-10-1947	30	WSW	08-16-1984
Sep	35.2	09-02-2013	19.1	09-15-1950	228.9	09-08-1963	40	NNW	09-28-2006
Oct	36.0	10-24-1976	18.0	10-23-1981	274.5	10-09-1978	27	W	10-18-1985
Nov	35.8	11-17-1972	17.2	11-26-1949	121.7	11-14-1977	56	W	11-19-1970
Dec	34.2	12-29-1978	16.3	12-18-1955	125.5	12-15-2015	25	NW	12-30-1950
Annual	38.2	05-18-1969	14.6	02-01-1962	472.4	07-20-1972	56	W	11-19-1970

Source: PAGASA, Climatological Extremes at NAIA Synoptic Station as of 2016

(6) Cyclone Frequency

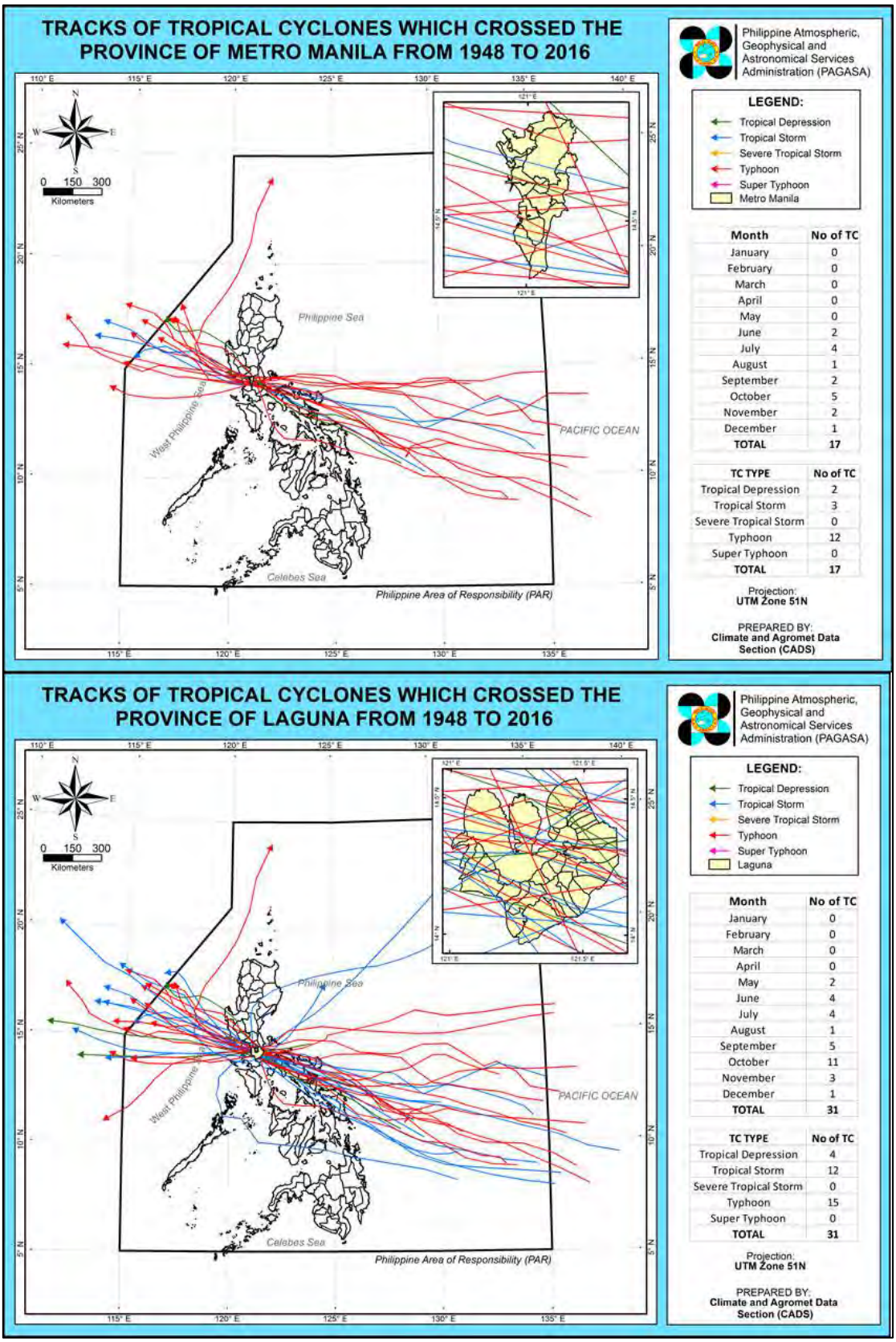
1311. The greatest number of cyclones occurred during the months of June to December. These tropical cyclones were associated with the occurrence of low-pressure areas (LPA) normally originating over the North Western Pacific Ocean within the Philippine Area of Responsibility (PAR) and generally moving northwestward. Tropical cyclones also originate in the South China Sea or at the western part of the country, having unusual motions, and quite rare with 52 occurrences in fifty (50) years (Perez, 2001). PAGASA categorized these cyclones as tropical depressions (TD) with wind speeds up to 63 kph; tropical storm (TS) with wind speeds from 64-117 kph, and tropical typhoon (TY), with wind speeds over 117 kph. As shown in **Figure 3.3.3**, the proposed Project site is within high typhoon risk area.



Source: Manila Observatory, 2005

Figure 3.3.3 Philippine Typhoon Map

1312. From 1948-2016 or a period of 68 years, PAGASA recorded an annual average of 20 tropical cyclones in the PAR with nine of these passed through the Philippine landmasses. Overall, PAGASA tracked 17 tropical cyclones that crossed in Metro Manila while 31 tropical cyclones crossed the Province of Laguna from 1948-2016 as shown in **Figure 3.3.4**. The month of October has the greatest number of tropical cyclones for both Metro Manila and the Province of Laguna.



Source: PAGASA

Figure 3.3.4 Tracks of Tropical Cyclones which Crossed the Province of Metro Manila and Laguna from 1948 to 2016

3.3.1.2. Potential Project Greenhouse Gas Emission

1313. Majority of the greenhouse gas (GHG) emissions that will be generated from the proposed Project are expected to come from activities associated with the construction (fuel/ electricity use for the operation of construction vehicles and equipment), and operation and maintenance (fuel use for maintenance activities). These fuel combustion and electricity consumption activities release three (3) out of seven (7) GHGs, namely: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Majority of these emissions will be CO_2 with very minimal share for CH_4 and N_2O. As such, this report will only focus on CO_2 GHG emissions.

(1) Methodology

1314. The CO_2 were calculated using emission factor-based estimation method. The methodology estimates the CO_2 emissions by multiplying a level of activity data (AD) by an emission factor (EF). Activity data is a quantified measure of activity resulting in emissions during a given period of time (e.g. data on fuel consumption (liters/km) and purchased electricity (kWh reading)) while emission factor is the average emission rate of a given GHG for a given source, relative to units of activity. The general equation which is based on The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard, Revised Edition, World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI), 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National GHG Inventories and 2014 IPCC Assessment Report is shown below.

Equation: GHG Emissions = AD x EF

(2) Results and Analysis

1315. The emissions associated with the Project are categorized into direct and indirect emissions. Direct GHG emissions of Scope 1 are from sources that are owned and/or controlled by the proponent. This is usually applicable during the operational phase (e.g. use of generator set and equipment owned by the proponent). Indirect emissions, on the other hand, are further categorized into Scope 2 and Scope 3. Scope 2 emissions are a consequence of the Project's operations at sources owned and/or controlled by another entity which include purchased electricity consumption. Scope 3 emissions are a consequence of the proponent's activities but to which the proponent has no direct control over which include tailpipe emissions from contracted equipment/ vehicles during construction. In the case of this project, the types of emissions are Scope 2 and Scope 3.

Table 3.3.4 Items to Consider for Each Scope of GHG Emissions

Scope	Construction	Operation
1	1. Stationary combustion Emissions from fuel use of entity-owned/ controlled stationary equipment (e.g. standby genset) 2. Mobile combustion Tailpipe emissions from entity-owned/ controlled vehicles (e.g. service van)	1. Stationary combustion Emissions from fuel use of entity-owned/ controlled stationary equipment (e.g. genset) 2. Mobile combustion Tailpipe emissions from entity-owned/ controlled vehicles (e.g. service van)
2	1. Stationary combustion Emissions from the consumption of purchased electricity for construction works	1. Stationary combustion Emissions from the use of purchased electricity for train, stations and depot operations
3	1. Stationary combustion Emissions from fuel use of contracted construction equipment (e.g. standby genset) 2. Mobile combustion Emissions from transportation of purchase d construction materials/ construction wastes using contracted vehicles (e.g. trucks, pickup)	1. Mobile combustion Emissions from fuel use of contracted vehicles (e.g. service vans)

1) CO_2 Emissions during Construction

1316. In calculating Scope 3 emissions, fuel consumption for the use of construction equipment, service vehicles as well as transport of construction materials were estimated as presented in **Table 3.3.5** and **Table 3.3.6**. Since these construction equipment/vehicles are diesel-powered, the emission factor will be based from the US EPA Emission Factors for Greenhouse Gas Inventories, which was last modified on November 19, 2015. Presented below are the activity data, emission factor as well as the results of the computation. The total CO_2 emissions during construction are estimated at 691.5 MT CO_2/yr for SCRP main alignment section and 17.2522 MT CO_2/yr for the SCRP interconnecting line.

1317. Scope 2 emissions during the construction phase are from the consumption of electricity by construction equipment for the station boxes and tunnel boring machines. For the underground section component, the construction phase Scope 2 emissions of CO_2 is 6.0381 MT CO_2/yr (**Table 3.3.7**).

Table 3.3.5 CO_2 Emissions by Source, SCRP Main Railway (Solis-Calamba)

Emission Sources	No. of Units	Fuel Type	Fuel Consumption (L/100km)[1]	Assumed distance travelled (km/yr)	Fuel Consumption (L/yr)	Emission Factor (kg CO_2/L)[2]	Calculated CO_2 Emission (MT CO_2/yr)
Heavy Equipment	20	Diesel	31.6	5,000	31,600	2.7	85.3
30-tonner Truck	50	Diesel	20.9	15,000	156,750	2.7	423.2
Pick-up	30	Diesel	12.1	12,000	43,560	2.7	117.6
Service Van	20	Diesel	12.1	10,000	24,200	2.7	65.3
Total CO_2 Emission							691.5

Source: 2017 Fuel Consumption Guide, Natural Resources Canada
[2] Source: Emission Factors for Greenhouse Gas Inventories (last modified: 11-19-2015), US EPA

Table 3.3.6 CO_2 Emissions by Source, SCRP Interconnecting Line

Emission Sources	No. of Units	Fuel Type	Fuel Consumption (kL/year)	Emission Factor (kg CO_2/L)[1]	Calculated CO_2 Emission (MT CO_2/yr)
Station Box - Bicutan Station					
20T Crawler crane with clamshell	3	Diesel	373.73	2.7	1.0091
Concrete Pump	1	Diesel	205.77	2.7	0.5556
Excavator	6	Diesel	1,011.42	2.7	2.7308
De-watering pump	1	Diesel	63.99	2.7	0.1728
Concrete Buggy	6	Diesel	88.89	2.7	0.2400
Concrete Vibrator	8	Diesel	110.62	2.7	0.2987
High pressure washer	2	Diesel	27.66	2.7	0.0747
Power trowel	6	Diesel	82.97	2.7	0.2240
Station Box - FTI Station					
20T Crawler crane with clamshell	3	Diesel	373.73	2.7	1.0091
Concrete Pump	1	Diesel	205.77	2.7	0.5556
Excavator	6	Diesel	1,011.42	2.7	2.7308
De-watering pump	1	Diesel	63.99	2.7	0.1728
Concrete Buggy	6	Diesel	88.89	2.7	0.2400
Concrete Vibrator	8	Diesel	110.62	2.7	0.2987

Emission Sources	No. of Units	Fuel Type	Fuel Consumption (kL/year)	Emission Factor (kg CO_2/L)[1]	Calculated CO_2 Emission (MT CO_2/yr)
High pressure washer	2	Diesel	27.66	2.7	0.0747
Power trowel	6	Diesel	82.97	2.7	0.2240
Excavation - Bicutan to FTI					
Concrete Pump	1	Diesel	205.77	2.7	0.5556
Excavator	6	Diesel	1,011.42	2.7	2.7308
De-watering pump	1	Diesel	63.99	2.7	0.1728
Concrete Buggy	6	Diesel	88.89	2.7	0.2400
Concrete Vibrator	8	Diesel	110.62	2.7	0.2987
High pressure washer	2	Diesel	27.66	2.7	0.0747
Power trowel	6	Diesel	82.97	2.7	0.2240
Tunnel Boring - FTI to Senate					
Backfill Grouting Plant	1	Diesel	12.13	2.7	0.0328
25T Locomotive	2	Diesel	647.15	2.7	1.7473
Ventilation Fan	1	Diesel	40.45	2.7	0.1092
20T Excavator	1	Diesel	168.57	2.7	0.4551
Total CO_2 Emission					**17.2522**

[1]Source: Emission Factors for Greenhouse Gas Inventories (last modified: 11-19-2015), US EPA

Table 3.3.7 CO_2 Emissions from Electricity Consumption, SCRP Interconnecting Line

	Consumption (MWh)	No. of Units	Consumption (MWh/year)	Electricity Emission Factor (tCO_2/MWh)	T&D Losses	Calculated CO_2 Emission (MT/yr)
Gantry Crane - Bicutan Station	45.50	1.00	398.5800	0.59	0.20	0.2949
Gantry Crane - FTI Station	45.50	1.00	398.5800	0.59	0.20	0.2949
Tunnel Boring - FTI to Senate						
Tunnel Boring Machine	2.10	1.00	18.3960	0.59	0.20	0.0136
25T Gantry Crane	0.05	1.00	0.3986	0.59	0.20	0.0003
Total CO_2 Emission						**0.6038**

2) CO_2 Emissions during Operation

1318. In calculating Scope 2 emissions, the electricity consumption during SCRP main railway line (Solis-Calamba) operation is estimated at 303.4 million kWh per year (303,419 MWh/yr). The assumption is based on the daily power requirements for the operation of the train, stations and facility depot. GHG Protocol's Purchased Electricity Calculation Tool with emission factor from the GWP values of the 2014 IPCC Fifth Assessment Report was utilized to automatically calculate the total CO_2 emissions. Presented in **Table 3.3.8** are the activity data as well as the results of the computation. The total CO_2 emissions during operation are estimated at 152,4297 MT CO_2/yr.

1319. The Scope 2 emissions for the SCRP interconnecting line are from the consumption of electricity for the stations as well as train operations for both the express and local trains.

The CO_2 emissions were calculated based on an 18-hour daily operation of the underground section. The train electricity consumption calculations were based on a 0.52-hour trip (41 trips per day) and 0.71-hour trip (84 trips per day) for the Express and Local Trains, respectively. Transmission and Distribution losses were assumed to be 0.20 (which is the default factor for the Philippines). The calculated CO_2 emissions during the operations phase for the SCRP interconnecting line is 13.72972 MT CO_2/yr (**Table 3.3.9**).

Table 3.3.8 CO_2 Emission by Railway Operation, SCRP

Emission Sources	Annual Electricity Consumption (MWh)	Calculated CO_2 Emission (MT/yr)
Railway Operation (train, stations and depot)	303,419	152.4297

Table 3.3.9 CO_2 Emission by Railway Operation, Senate-FTI Underground Section

	Consumption (MWh)	No. of Units		Consumption (MWh/year)	Electricity Emission Factor (tCO_2/MWh)	T&D Losses	Calculated CO_2 Emission (MT/yr)
Electricity - Bicutan Station	0.40	18 hours per day		2,628.00	0.59	0.20	1.9447
Electricity - FTI Station	0.40	18 hours per day		2,628.00	0.59	0.20	1.9447
Trains (Express) - Bicutan to FTI	0.23	0.52 hours per trip	41 daily trips	1,750.91	0.59	0.20	1.2957
Trains (Local) - Bicutan to FTI	0.23	0.71 hours per trip	84 daily trips	4,897.94	0.59	0.20	3.6245
Trains (Express) - FTI to Senate	0.23	0.52 hours per trip	41 daily trips	1,750.91	0.59	0.20	1.2957
Trains (Local) - FTI to Senate	0.23	0.71 hours per trip	84 daily trips	4,897.94	0.59	0.20	3.6245
Total CO_2 Emission							13.7297

1320. The total CO_2 emissions by the project is 709.36 MT CO_2/yr during the construction phase and 166.16 MT CO_2/yr during the operations phase.

1321. The Philippines Second National Communication (SNC) on Climate Change has projected 100,402 MT of CO_2 emissions for 2020 for the Energy Sector. Using the projection of SNC, the Project is expected to contribute approximately 0.707% during the construction phase and approximately 0.165% during the operation phase. As presented, the Project will only generate a small amount of CO_2 to the total anthropogenic CO_2 load of the country. If this total load is a measure of responsibility for global warming on an absolute magnitude, the Project is considered to be on the low-end greenhouse gas emitters.

3.3.1.3. Climate Risk/ Climate Change

(1) Climate Change Policy in the Philippines

1322. According to PAGASA, future climate changes in the Philippines are likely in terms of trends in seasonal values of temperature, rainfall and extreme events. Climate data shows an increasing trend in the number of hot days and warm nights but a decreasing trend in the number of cold days and cool nights. Both maximum and minimum temperatures are generally getting warmer. From 1951 to 2010, there was a 0.65°C increase in the mean temperature.

1323. In terms of rainfall, it is becoming more frequent and its intensity is increasing based on trend comparisons of extreme daily rainfall intensity and frequency between 1951-2010 and 1961-1990 mean values. Least number of rainy days per month occurs in November to April; while the highest number or rainy days per month occurs in May to October.

1324. On the average, twenty (20) tropical cyclones visit the PAR with nine (9) of these passing through the Philippine landmasses every year based on 1948-2016 data. The location of the Project is situated on a path where at least one (1) tropical cyclone annually frequents the area.

1325. Relative to this, there is an increasing trend in the annual total cost of damage due to the occurrence of tropical cyclones based on 1970-2012 data. The damage cost during this period amounted to PhP 337.67 Billion in 43 years according to the Office of Civil Defense (OCD). The last five (5) years (2008-2012) of the OCD data indicated an exponential trend which has taken a considerable toll in the economic outlook of the country.

1326. These trends and scenarios, which are further discussed below, indicate that the country will not be spared by the impacts of climate change given its geographical location, archipelagic formation, biophysical characteristics and population distribution. Additionally, even if GHG emissions are drastically reduced, the magnitude of their presence in the atmosphere is irreversible. Stabilizing these GHGs will take time and climate change impacts will continue for the years to come.

1327. In the urgency for local climate action, the Climate Change Act (Republic Act 9729) was passed in 2009 which creates the Climate Change Commission (CCC), mainstreaming climate change into government policy formulations and establishes framework strategies and actions towards adaptation and mitigation. In 2010, the National Framework Strategy on Climate Change (NFSCC) was adopted to serve as reference point to steer national mitigation and adaptation strategies. In line with the NFSCC, the Philippine Strategy on Climate Change Adaptation (PSCCA) was prepared to guide the country's climate change adaptation actions. In 2011, the National Climate Change Action Plan (NCCAP) was prepared which outlines the priority areas for adaptation and mitigation. In 2012, the People's Survival Fund (RA 10174) was passed for financing adaptation programs and projects based on the NFSCC. Other key policies on climate change are presented in Chapter 2.

(2) Change in Local Climate

1) Rainfall

1328. The climate change scenario projected a rainfall decrease and increase in 2020 and 2050 for both Metro Manila and Province of Laguna. Metro Manila in the year 2020 will have an increase of 8.5% for the months of July to August and a decrease of 12.8% to 33.3% for the months of December to May.

1329. For Laguna Province, the year 2020 will have an increase of 2.9% from July to November and a decrease of 20.2 to 31.5% from December to May. Similarly, the 2050

projection shows an increase of 3.7% to 21.3% for the months of July to November and a decrease of 17.3% to 38.5% for the months of December May in Metro Manila while an increase of 0.1 to 6.8% for the months July to February and a decrease of 34.8% for the months of March to May in the Province of Laguna. **Table 3.3.10** and **Table 3.3.11** present the projected monthly average rainfall with climate change scenario for 2006-2035 and the monthly average rainfall with climate change scenario for 2036-2065 in Metro Manila and Laguna. **Figure 3.3.5** and **Figure 3.3.6** show the projected seasonal mean rainfall in 2020 and 2050 in Metro Manila and Laguna Province.

Table 3.3.10 Seasonal Rainfall Change (in %) in 2020 and 2050 under Medium Range Emission Scenario in Metro Manila and Province of Laguna

Province	Observed Baseline (1971-2000) mm				Change in 2020 (2006-2035)				Change in 2050 (2036-2065)			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
Metro Manila	107.5	198.5	1170.2	758.7	-12.8	-33.3	8.5	0.0	-17.3	-38.5	21.3	3.7
Laguna	629.2	386.8	845.0	1066.5	-20.2	-31.5	2.9	2.9	0.1	-34.8	6.8	0.4

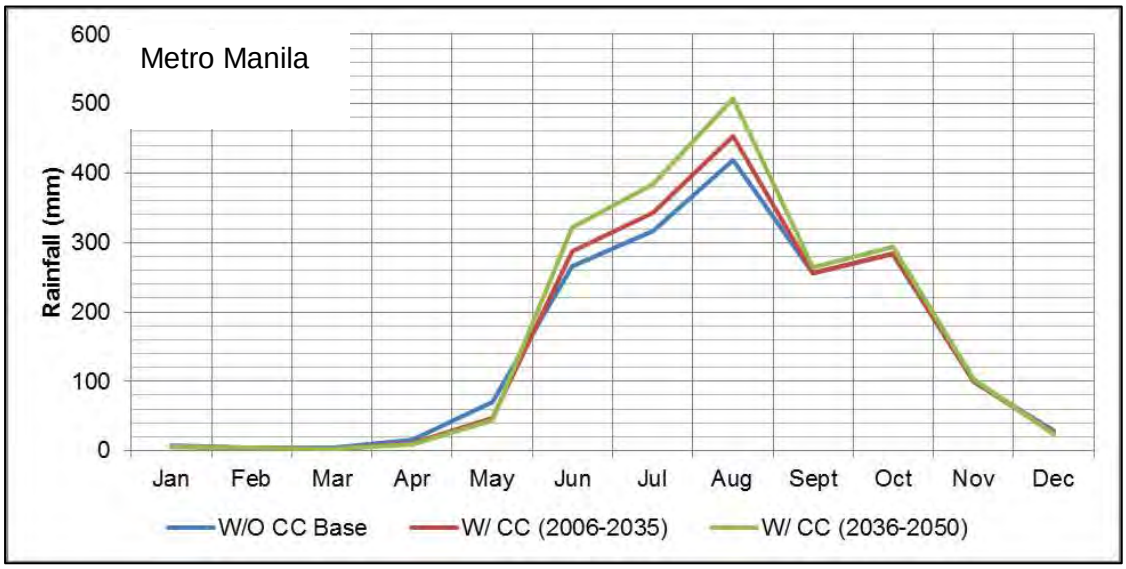
Source: Climate Change in the Philippines, 2011 PAGASA

Table 3.3.11 Projected Seasonal Mean Rainfall in 2020 and 2050 under Medium Range Emission Scenario in Metro Manila and Province of Laguna

	Projected Monthly Average Rainfall (mm)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Baseline/Without Climate Change Scenario (1981-2010)												
Ave	6.80	4.20	4.00	16.00	70.40	265.20	316.70	418.40	255.20	283.40	99.00	28.60
Manila												
With Climate Change Scenario (2006-2035)												
Ave	5.93	3.66	2.67	10.67	46.96	287.74	343.62	453.96	255.20	283.40	99.00	24.94
With Climate Change Scenario (2036-2065)												
Ave	5.62	3.47	2.46	9.84	43.30	321.69	384.16	507.52	264.64	293.89	102.66	23.65
Laguna												
With Climate Change Scenario (2006-2035)												
Ave	5.43	3.35	2.74	10.96	48.22	272.89	325.88	430.53	262.60	291.62	101.87	22.82
With Climate Change Scenario (2036-2065)												
Ave	6.81	4.20	2.61	10.43	45.90	283.23	338.24	446.85	256.22	284.53	99.40	28.63

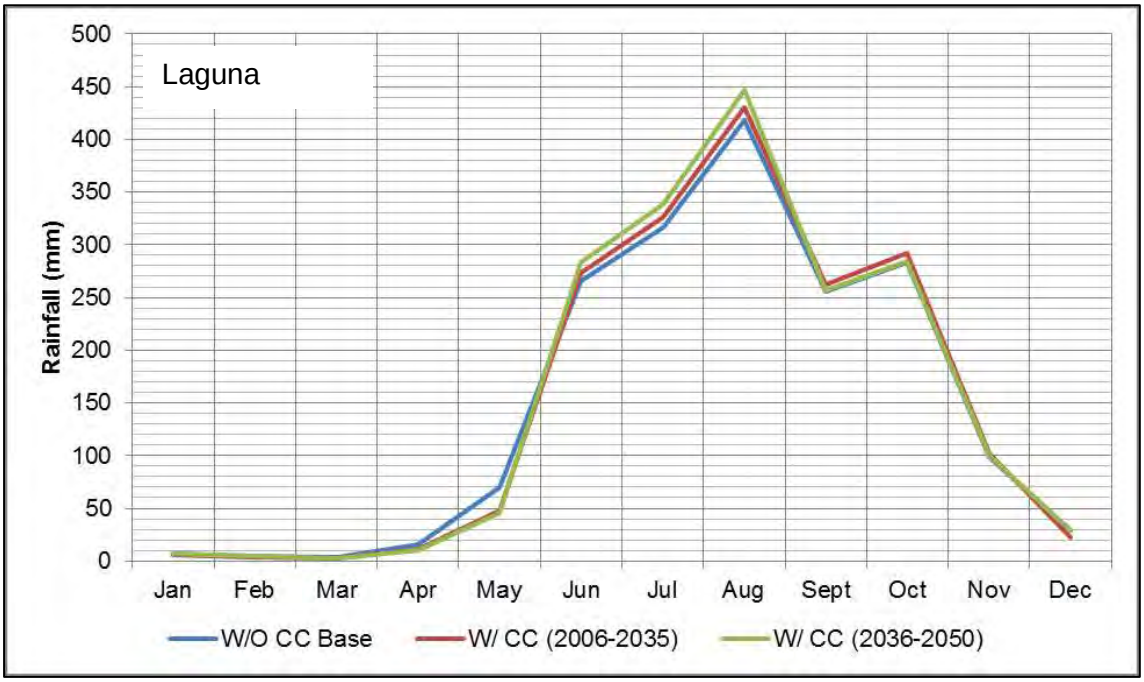
Note: Calculated based on the PAGASA Climate Change in the Philippines, 2011

Source: Climate Change in the Philippines, 2011 PAGASA



Source: Climate Change in the Philippines, 2011 PAGASA

Figure 3.3.5 Projected Seasonal Mean Rainfall in 2020 and 2050 in Metro Manila



Source: Climate Change in the Philippines, 2011 PAGASA

Figure 3.3.6 Projected Seasonal Mean Rainfall in 2020 and 2050 in Laguna Province

2) Temperature

1330. The climate change scenario for the Philippines published by PAGASA in February 2011 indicated that the Provinces of Metro Manila and Laguna where the alignment of the Project will be located will have an increase in temperature in 2020 and 2050. The projected temperature increase in Metro Manila is 0.9 to 1.1°C from the average temperature baseline data in 2020 and an increase of 1.8 to 2.1°C in 2050. Moreover, in the Province of Laguna, the

projected temperature increase is 0.9 to 1.1°C from the average temperature baseline data in 2020 and an increase of 1.8 to 2.1°C in 2050. **Table 3.3.12** and **Table 3.3.13** show the seasonal temperature increase and projected seasonal mean temperature in 2020 and 2050 under medium range emission scenario in Metro Manila and Province of Laguna. **Figure 3.3.7** and **Figure 3.3.8** show the graphical presentation of the monthly average temperature change from 2006 to 2035 and from 2036 to 2050, respectively.

Table 3.3.12 Seasonal Temperature Increase (in ºC) in 2020 and 2050 under Medium Range Emission Scenario in Metro Manila and Province of Laguna

Province	Observed Baseline (1971-2000)				Change in 2020 (2006-2035)				Change in 2050 (2036-2065)			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
Metro Manila	26.1	28.8	28.0	27.4	1.0	1.1	0.9	1.0	2.0	2.1	1.8	1.9
Laguna	25.0	27.5	27.5	26.7	0.9	1.1	1.0	0.9	1.8	2.1	1.9	1.9

Source: Climate Change in the Philippines, 2011 PAGASA

Table 3.3.13 Projected Seasonal Mean Temperature in 2020 and 2050 under Medium Range Emission Scenario in Metro Manila and Province of Laguna

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Baseline/Without Climate Change Scenario (1997-2010)												
Max	30.2	31	32.5	34.1	33.8	32.5	31.3	30.8	31	31.1	31.1	30.2
Min	22	22.5	23.6	25	25.5	25.1	24.6	24.6	24.6	24.3	23.7	22.7
Ave	26.1	26.7	28	29.5	29.7	28.8	28	27.7	27.8	27.7	27.4	26.5
With Climate Change Scenario (2006-2035)												
Metro Manila												
Max	31.2	32	33.6	35.2	34.9	33.4	32.2	31.7	32	32.1	32.1	31.2
Min	23	23.5	24.7	26.1	26.6	26	25.5	25.5	25.6	25.3	24.7	23.7
Ave	27.1	27.7	29.1	30.6	30.8	29.7	28.9	28.6	28.8	28.7	28.4	27.5
Laguna												
Max	31.1	31.9	33.6	35.2	34.9	33.5	32.3	31.8	31.9	32	32	31.1
Min	22.9	23.4	24.7	26.1	26.6	26.1	25.6	25.6	25.5	25.2	24.6	23.6
Ave	27	27.6	29.1	30.6	30.8	29.8	29	28.7	28.7	28.6	28.3	27.4
With Climate Change Scenario (2006-2065)												
Metro Manila												
Max	32.2	33	34.6	36.2	35.9	34.3	33.1	32.6	32.9	33	33	32.2
Min	24	24.5	25.7	27.1	27.6	26.9	26.4	26.4	26.5	26.2	25.6	24.7
Ave	28.1	28.7	30.1	31.6	31.8	30.6	29.8	29.5	29.7	29.6	29.3	28.5
Laguna												
Max	32	32.8	34.6	36.2	35.9	34.4	33.2	32.7	32.9	33	33	32
Min	23.8	24.3	25.7	27.1	27.6	27	26.5	26.5	26.5	26.2	25.6	24.5
Ave	27.9	28.5	30.1	31.6	31.8	30.7	29.9	29.6	29.7	29.6	29.3	28.3

Source: Climate Change in the Philippines, 2011 PAGASA

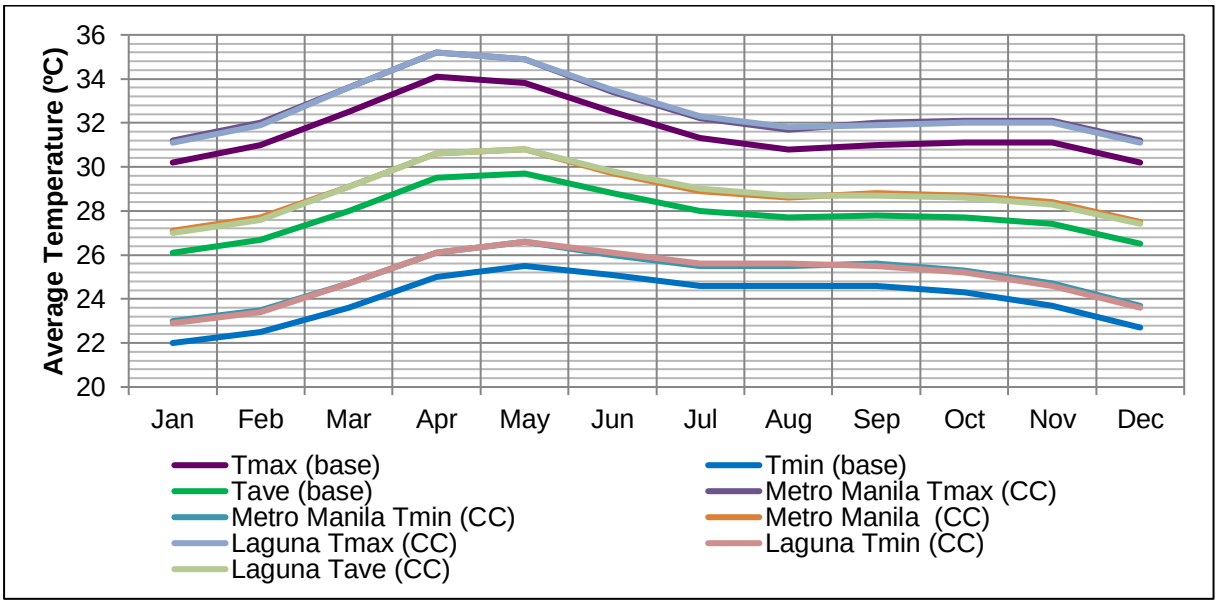


Figure 3.3.7 Change in Monthly Average Temperature for the Period of 2006-2035

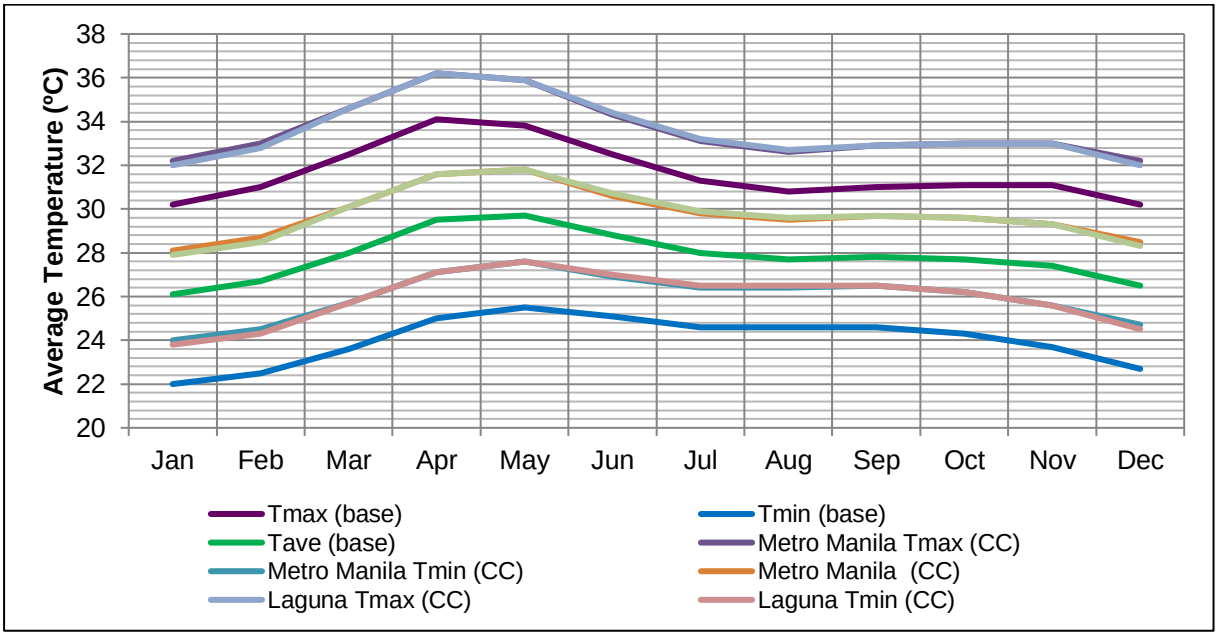


Figure 3.3.8 Change in Monthly Average Temperature for the Period of 2036-2065

3) Frequency of Extreme Events

1331. Based from the climate change scenario for the Philippines as published by PAGASA in February 2011, Metro Manila will have 1,176 days with maximum temperature of >35°C during the 2006-2035 period and 2,118 days during the 2036-2050 period; 6,445 dry days during the 2006-2035 period and 6,382 dry days during the 2036-2050 period; and 12 days with rainfall >200 mm during the 2006-2035 period and 13 days during the 2036-2050 period. Data are presented in **Table 3.3.14**.

1332. Moreover, the Province of Laguna will have 8,010 days with maximum temperature of >35°C during the 2006-2035 period and 8,016 days during the 2036-2050 period; 8,226 dry

days during the 2006-2035 period and 6,081 dry days during the 2036-2050 period; and 14 days with rainfall >200 mm during the 2006-2035 period and 9 days during the 2036-2050 period.

Table 3.3.14 Frequency of Extreme Events in 2020 and 2050 under Medium Range Emission Scenario

Province	No. of Days w/ T_{max} >35ºC			No. of Dry Days			No. of Days w/ Rainfall >200mm		
	OBS (1971-2000)	2020	2050	OBS	2020	2050	OBS	2020	2050
Metro Manila*	299	1176	2118	7380	6445	6382	12	12	13
Laguna**	928	8010	8016	8226	6081	6049	6	14	9

Note: * Using values of Port Area, ** Using values of Ambulong

Source: Climate Change in the Philippines, 2011 PAGASA

3.3.1.4. Impact Identification, Prediction and Assessment, and Mitigation

(1) Pre-construction and Construction Phase

1) Local Climate Effects on Project

1333. During construction, more extreme variations in local climate have the potential to affect the schedule of construction works, potentially delaying the progress of construction.

1334. The changes in the rainfall pattern and potential for local temperature extremes were included in the design criteria of the Project. These include increasing the capacity of drainage at the stations to cope with predicted rainfall. Material selection and technologies to be used in the project have taken into consideration the effects of predicted climate extremes.

1335. Passenger facilities incorporate energy efficient technologies (use of LED lights, energy efficient air conditioning system, etc.) to minimize the CO_2 contributions as far as possible.

1336. Exposure to extreme local climate conditions may have negative effects on the worker's health and compromise their safety and productivity. Health and safety specifications included in Contractor's requirements require work policies, proper work clothing, equipment safety features, etc. to minimize health effects and work hazards for the workers.

2) Project Effects on Greenhouse Gas Emissions

1337. The project will remove significant numbers of trees that have grown up on the line. Trees are absorbers and temporary stores of CO_2.

1338. The Philippines SNC on Climate Change has projected the country's Energy Sector will emit 100,402 MT of $CO_2$for 2020. The construction of the Project is expected to contribute an approximately 0.707% of the total Philippine Energy Sector CO_2emission, which is a small contribution to the total anthropogenic CO_2load of the country. As discussed in Section 3.3.1.2(2), the estimated total CO_2emission during construction will be 709.36 MT CO_2/year.

1339. In order to minimize unnecessary CO_2 generation from construction activities, the following measures will be implemented:

- Vegetation removal will be limited to the Project ROW only, the remaining part of the PNR ROW will not be cut. Vegetation removal will be compensated by replanting of

seedlings at a rate of 50 seedlings per tree removed, in reforestation projects. Opportunities will be taken to plant trees at the depot and on station plaza.

- Implement regular inspection and preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standard; and
- Use electric or fuel-efficient equipment, machineries and vehicles and maximize its operation if possible.

3) Impact of Climate Change on the Project

1340. The Philippines is subject to Global Climate Change. This will increase the likelihood and severity of extreme events as well as increased rainfall in the rainy season and higher maximum temperatures.

1341. During construction extreme weather events could lead to increased negative impacts on soil erosion, mudflow and landslides as well as flash flooding. In addition, changes to groundwater levels may affect tunnel sections.

1342. The Project is generally at high risk to the effects of climate change based on the AWARE climate risk screening report (ADB, 2018) for the project. It determined the level of climate risk of the proposed Project to flooding, landslide, typhoons, precipitation increase, temperature increase, and precipitation decrease. Among the climate risk topics analyzed, precipitation increase registered at medium level while temperature increase, and precipitation decrease registered at low level. The rest, including flooding, landslide and typhoons are identified to cause high risk to the proposed Project. The following are taken from the AWARE Climate Risk Screening Report.

High Risk

1343. The level of climate risk for the Project due to flooding, landslides and typhoons is high. Among the geographical factors considered are proximity to waterbodies, topography, land use characteristics (including land use in upstream catchment areas), design and maintenance level of drainage infrastructure, and vulnerability of exposed assets. Flooding may cause overflow of drainage systems and restrictions/disruption during construction phase. Relative to flooding, many cities/ municipalities are prone to liquefaction. In terms of increase in frequency and severity of typhoons, the potential impacts are restrictions/ disruption of railway construction.

Medium Risk

1344. The level of climate risk for the Project due to increase in precipitation is medium. The designs of certain Project components have been slightly modified to cope with its potential impacts. Intense rainfall would potentially cause damage to embankment and earthwork due to soil erosion, landslides and flooding. Extended rain periods would potentially cause slower drainage, soil erosion of infrastructure assets as well as disruption in construction. During pre-construction phase, design consideration will be based on the results of the geohazard assessment and geotechnical investigation to prevent or minimize slope failure.

Low Risk

1345. The level of climate risk for the Project due to increasing temperature, resulting to longer periods of warm temperature/drought as well as warm days and nights, is low. It is further characterized by high temperature and heat waves, sudden temperature changes and intense sunlight. High temperature and heat waves would potentially cause overheating of construction equipment and service vehicles and cause heat stress to workers. In order to mitigate this, construction activities will be adjusted as needed.

1346. The following design mitigations reduce the climate change impacts on the project to acceptable levels.

- The viaduct design is chosen to avoid all potential flood levels.
- Structural design takes into account dead load, live load (solar light panel weight is included on roof top, although not specified), Wind load, earthquake load, soil and water pressure (against underground structures), thermal load at the same time as per National Structural Code of the Philippines (NSCP) 2015
- Improved drainage capacity at stations using a 15-year flood return basis.
- Freeboard levels of ground floor entrances using a 100-year flood return basis.
- Emergency Response Plan to deal with extreme events.

(2) Operation Phase

1) Local Climate Effects on the Project

1347. As previously discussed, the changes in the rainfall pattern and local temperature have been included in the design criteria of the Project based on the PAGASA projection for 2020 and 2050. However, the possibility of extreme events will still require that there are procedures in place to inspect and repair in the aftermath of typhoon or flood.

1348. Establishment of buffer zones/vegetated areas will be made more difficult by periods of drought and irrigation will be required for 1-2 years during establishment.

1349. The following design mitigations reduce the climate change impacts to acceptable levels.

- Landscape maintenance plan to include irrigation of tree planting and replacement of losses.
- Operator to develop Emergency Response Plan to deal with extreme events including evacuation, closure, inspection and repair.

2) Contribution of the Project on Greenhouse Gas Emissions

1350. Global passenger and freight activity are increasing as economies grow. In the Philippines, majority of existing transport systems are conventional buses, passenger cars, taxis, and jeepneys that heavily rely on petroleum, which supplies 95% of the total energy used by world transport. In 2010, the transport sector accounted for 27% of final energy use and 6.7 $GtCO_2$ direct emissions based on IPCC's Fifth Assessment Report (AR5). With the increasing need for transport activities, baseline CO_2 emissions are projected to approximately double by 2050 if not mitigated.

1351. The Project can be considered to be on the low-end greenhouse gas emitters based on its estimated CO_2 contribution. However, necessary measures will be enforced to further minimize its possible impact. In addition, essential enhancement will be implemented to lessen impact of climate change to the Project.

1352. Relative to this, the project itself is a climate mitigation measure as it intends to reduce GHG emissions by realizing a “modal shift” from conventional commuter transport systems to passenger railway systems. In addition, “electrification” of passenger railway systems will reduce GHG emissions.

1353. In comparison with other transport modes, collective modes of transport, such as the one promoted by the project, use less energy and generate proportionately less GHG emissions per passenger kilometer travelled.

1354. Figures from the European Environment Agency (2014) provide the following averages for Europe in grams CO_2 per passenger-kilometer g CO_2/pkm)[1]: two-wheeler at 80.73 g CO_2/pkm; Buses and coaches at 55.77 g CO_2/pkm; passenger cars at 107.22 g CO_2/pkm; road (average) at 101.61 g/pkm; and rail at 28.39 g/pkm.

1355. Based on 2,392,544 average daily passengers, the Project’s GHG emissions per passenger kilometer travelled will have 2.33 g CO_2/pkm. If most future train users are currently using buses and coaches, the GHG emissions reduced per person per kilometer travelled is 53.44 g CO_2/pkm.

1356. Furthermore, mass transit systems provide more capacity at less marginal cost. The reduced CO_2 emissions represent only one of benefit of the improved mass transit system. Majority of the benefits for the populace and the economy are due to substantially improved accessibility, job opportunities and air quality.

1357. Measures to enhance the Project contribution to climate change are as follows:

- Provision of incentives and information dissemination activities to encourage commuters to use rail transit and its benefits over other modes of transport (Modal Shift);
- Energy/water conservation program such as use energy efficient products (i.e. LED lights);
- Planting of trees in open areas at the depot, around buildings, station plaza and car parks to attenuate heat effects and reduce air conditioning requirements.

3) Impact of Climate Change to the Project

1358. As described in the pre-construction and construction phase, precipitation increase registered at medium level while temperature increase and precipitation decrease registered at low level, and flooding, landslide and typhoons, are identified to cause high risk to the proposed project. Flooding, landslides and typhoons will cause damage to catenary as well as restrictions/ disruption of railway operation. Increase in precipitation would potentially cause damage to embankment due to landslides and flooding. Extended rain periods would potentially cause slower drainage and disruption in operations. Increase in temperature and heat would potentially cause overheating of infrastructure and rolling stock equipment; while, sudden temperature changes and intense sunlight would cause tension/overheating of track buckling and signaling problems. Decrease in precipitation is characterized by droughts, which has potential impact to earthworks desiccation.

1359. Mitigation measures and enhancement to address the impact of the Project to climate change are as follows:

[1] https://www.eea.europa.eu/data-and-maps/indicators/energy-efficiency-and-specific-co2-emissions/energy-efficiency-and-specific-co2-9

- Station design has included a lightweight membrane roof and open mesh sides to the station. This has the benefit of allowing natural lighting (reducing artificial lighting) and natural air conditioning;
- Drainage capacity is upgraded in the design to meet climate change induced future requirements;
- Regular inspection and proper maintenance of railway systems and facilities, and equipment and machinery;
- Design of railway system using design factors that take into account the predicted climate changes; and
- Ensure the Operator of the railway establishes and implements an Emergency Response Plan and post extreme event inspection plans.

3.3.2. Air Quality

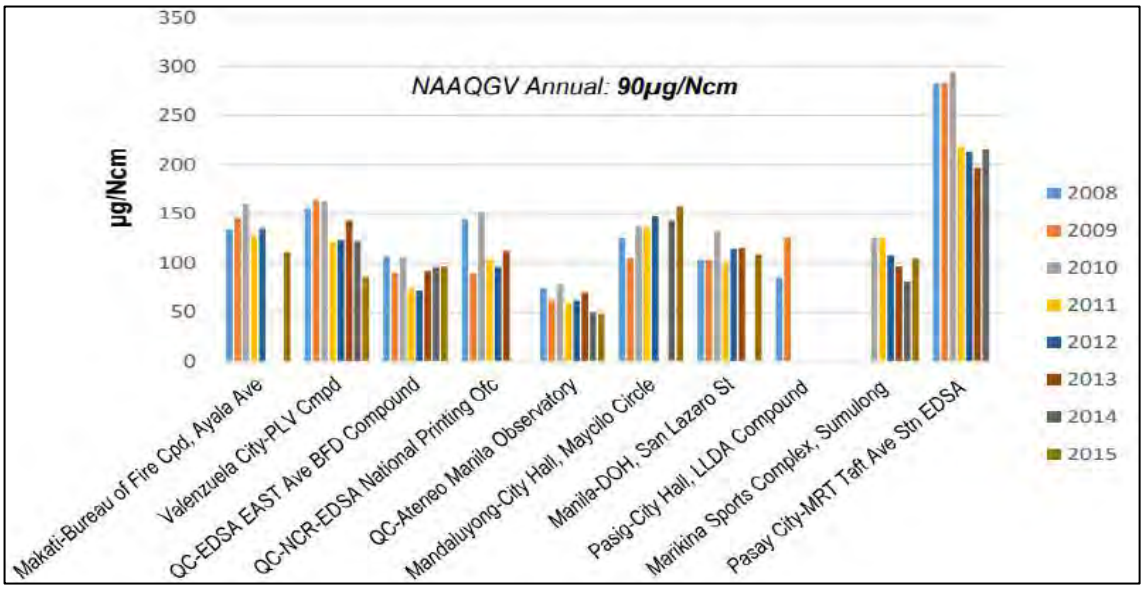
3.3.2.1. Ambient Air Quality

1360. Ambient Air Quality as defined in RA 8749 is the general amount of pollution present in a broad area and refers to the atmosphere's average purity as distinguished from discharge measurements taken at the source of pollution. In order to monitor the ambient air quality of the country, EMB regional monitoring stations routinely take measurements of criteria air pollutants, namely: Total Suspended Particulates (TSP), Particulate Matter up to 10 microns (PM_{10}), Particulate Matter up to 2.5 microns ($PM_{2.5}$), Lead (Pb), Sulfur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Ozone (O_3) and Carbon Monoxide (CO).

1361. The National Air Quality Status Report for 2008-2015 of EMB showed that the average annual TSP values recorded in all monitoring stations in the National Capital Region (NCR) exceeded the National Ambient Air Quality Guideline Values (NAAQGV) except in the Ateneo Station. **Figure 3.3.9** shows the annual TSP trends in NCR from 2008 to 2015.

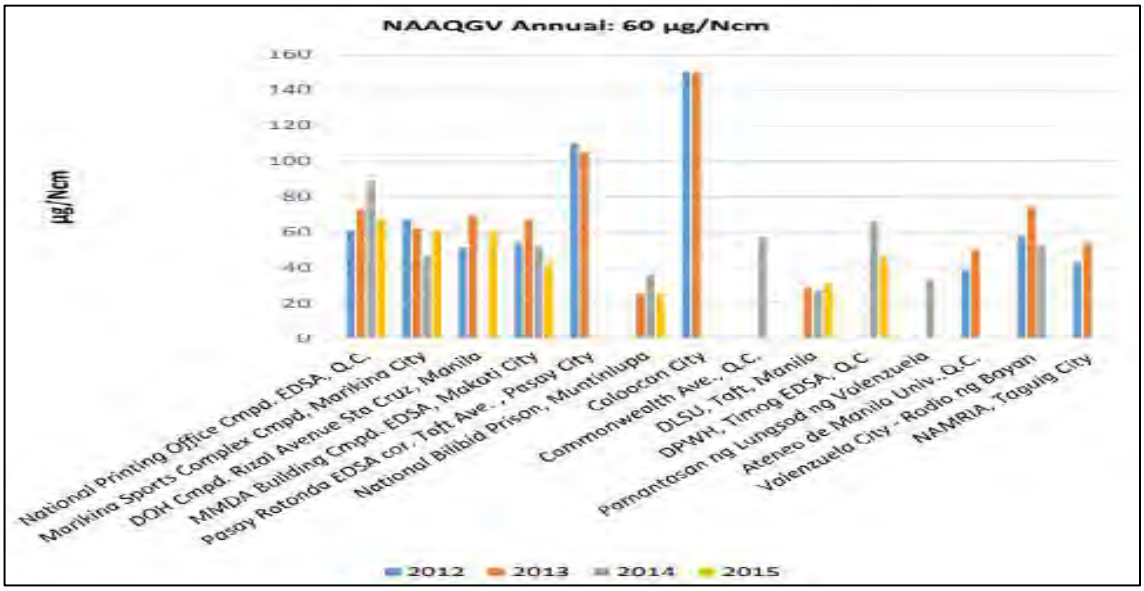
1362. The PM_{10} levels in NCR were also monitored by the EMB. **Figure 3.3.10** shows the PM_{10} levels in the NCR during the period 2012-2015. It is notable that there were fewer stations that registered measurements exceeding the guideline PM_{10} value of 60 µg/NCM in 2012 and 2014. The majority of stations, however, had measurements that exceeded the guideline value in 2013.

1363. The exceedances in levels of TSP and PM_{10} in the NAAQGV of the DENR show the poor or deteriorating quality of air in NCR.



Source: https://emb.gov.ph/wp-content/uploads/2015/09/1-Air-Quality-1.8-National-Air-Quality-Status-Report-2008-2015.pdf (Date retrieved: April 10, 2018)

Figure 3.3.9 TSP Annual Mean Values in NCR, 2008-2015



Source: https://emb.gov.ph/wp-content/uploads/2015/09/1-Air-Quality-1.8-National-Air-Quality-Status-Report-2008-2015.pdf (Date retrieved: April 10, 2018)

Figure 3.3.10 PM10 Annual Levels in the National Capital Region 2012-2015

(1) Field Survey

1364. The ambient air quality monitoring for SCRP main railway line (Solis to Calamba) was conducted between January 18 – February 8, 2018 and March 12 - April 30, 2019 for the dry season and between June 22 - July 15, 2018 for the wet season at eight (8) stations during EIA, and on March 11-14, 2019 and April 29-30, 2019 at four (4) stations during its detailed design phase as presented in **Table 3.3.15** and shown in **Figure 3.3.11**.

1365. The monitoring was conducted to measure the ground level concentrations (GLCs) of TSP, PM_{10}, $PM_{2.5}$, Pb, SO_2, NO_2 for a 24-hour averaging time and O_3 and CO for 1-hour averaging time at the pre-established sampling stations along the SC alignment. The monitoring was conducted in accordance to the standard methods of the DENR as prescribed in its AO 2000-81, the Implementing Rules and Regulations (IRR) of the Philippine Clean Act of 1999.

1366. Ambient air quality monitoring for the SCRP interconnecting line was conducted between 10 to 27 July 2017 for the wet season and 27 March to 5 May 2017 for the dry season. Additional monitoring was also conducted on 20 to 23 June 2019 (**Figure 3.3.11**) for TSP, PM_{10}, SO_2, and NO_2 for 24-hour and 1-hour averaging times.

1367. The collected samples were brought to DENR accredited laboratories for analysis. Temperature, wind direction and other relevant parameters which describe the weather conditions in the area were also recorded at each station during sampling.

Table 3.3.15 Date and Time of Air Quality Sampling Per Station

Sampling Station		Description	Coordinates	Date of Sampling	
				Dry Season	Wet Season
AAQ1	PNR – Solis	Adjacent to Bliss residential area, approximately 150 meters from PNR Solis station	14°37'42.17" N; 120°58'32.88" E	Jan 20-21, 2018	Jun 22-23, 2018
AAQ2	PNR - Sta. Mesa	Near Barangay 630 barangay hall approximately 100 meters from PUP main gate	14°35'54.27" N; 121°00'46.14" E	Jan 21-22, 2018	Jun 23-24, 2018
AAQ3	PNR Buendia	Buendia Flyover corner Osmeña Highway and South Superhighway	14°33'29" N; 121°00'27" E	Jan 18-19, 2018	Jul 14-15, 2018
AAQ4	PNR - FTI	Along East Service Road, approximately 70m from FTI station entrance and 30 m south of Bagong Lipunan Condominium	14°30'24.86" N; 121°02'07.64" E	Feb 7-8, 2018	Jul 10-11, 2018
AAQ5	PNR – Sucat	Near residential and Sucat Thermal PP	14°27'8.01" N; 121°03'03.04" E	Feb 20-21, 2018	Jul 11-12, 2018
AAQ6	PNR – Binan	Basketball Court near new PNR Biñan Station, 200 m from San Vicente Ferrer Parish Church	14°19'52.11" N; 121°04'51.08" E	Jan 23-24, 2018	Jul 12-13, 2018
AAQ7	PNR – Calamba	Basketball Court near PNR Calamba Station, 200 m from Maranatha Christian Academy	14°12'26.05" N; 121°09'28.13" E	Jan 24-25, 2018	Jun 26-27, 2018
AAQ8	Paciano Rizal Elementary School	Paciano Rizal Elementary School Bay, Laguna	14°08'57.04" N; 121°16'5.08" E	Jan 25-26, 2018	Jun 25-26, 2018
DD AAQ1	Elias Street	5 m north of Basketball Court; Residential area	14°37'16.00" N; 120°59'16.00" E	Apr 29-30, 2019	-
DD AAQ2	Banlic Depot Site	20 m south of Iglesia Ni Cristo Church	14°13'30.86" N; 121°09'46.36" E	Mar 11-12, 2019	-
DD AAQ3	Calamba Station	Residential area along J.P. Rizal St., Calamba	14°12'33.95" N; 121°09'31.40" E	Mar 13-14, 2019	-
DD AAQ4	Calamba	At the back of Halang Elementary School, beside Master Restaurant	14°11'53.29" N; 121°09'35.56" E	Mar 12-13, 2019	-
A13	FTI Station PNR Station	FTI PNR Station near SLEX and East Service Road	14° 30' 24.84" N 121° 2' 7.21" E	Mar 30-31, 2017	Jul 18-19, 2017
AN1	Senate Station	Sitio Fort Bonifacio Health Center (Near National Nutrition Council)	14° 31' 46.390" N 121° 1' 28.470" E	-	Jun 20-21, 2019
AN3	Bicutan Station	Dr. Arcadio Santos National Highschool, Barangay San Martin De Porres, Paranaque City	14° 29' 40.050" N 121° 2' 34.630" E	-	Jun 22-23 2019

Figure 3.3.11 Ambient Air Quality Sampling Station

(2) Standards Applied

1368. The results of ambient air quality monitoring for the project were compared to the NAAQGV and NAAQS of the DENR set forth in DAO 2000-81 or the National Ambient Air Quality Guideline for Criteria Pollutants of the Philippine Clean Air Act of 1999 and, DAO 2013-13 or Provisional National Ambient Air Quality Guideline Values for $PM_{2.5}$ as presented in **Table 3.3.16**. DENR has no relevant standard for Pb measured at 24-hour averaging time.

Table 3.3.16 Relevant Guideline Values and Standards for Ambient Air Quality

Parameter	NAAQGV (DAO 2000-81)		NAAQS (DAO 2000-81)	
	Averaging Time	Concentrations (µg/NCM) (1)	Averaging Time	Concentrations (µg/NCM) (1)
TSP	24 Hours	230	1 Hour	300
PM_{10}	24 Hours	150	1 Hour	200
$PM_{2.5}$	24 Hours	50 (2)	-	-
Lead (Pb)	24 Hours	1.5 (3 mos.); 1.0 (annual)	30 Minutes	20
Sulfur dioxide (SO_2)	24 Hours	180	1 Hour	340
Nitrogen dioxide (NO_2)	24 Hours	150	1 Hour	260
Ozone (O_3)	1 Hour	140	-	-
Carbon monoxide (CO)	1 Hour	35,000	-	-

Sources:
(1) National Ambient Air Quality Guideline for Criteria Pollutants of the Philippine Clean Air Act of 1999
(2) DENR Administrative Order No. 2013-13

(3) Results and Analysis

1369. There is a general shift in the prevailing wind direction during wet season, which mostly come from the southerly direction, while during the dry season, winds mostly come from the northerly direction. Highest wind speed was recorded at stations AAQ1 and AAQ4. The range of average wind speeds recorded was narrower during the dry season. Average temperature recorded were almost similar. Relative humidity was higher in all stations during the wet season. Barometric pressure recorded were almost similar. **Table 3.3.17** shows the summary of weather conditions during ambient air quality sampling.

1370. Most stations have higher levels of TSP, although these levels did not exceed the NAAQGV in all stations. PM_{10} and $PM_{2.5}$ concentrations increased in four (4) stations and decreased in the remaining four (4) stations during wet and dry seasons. Pb and NO_2 concentrations increased in most stations, while most SO_2 concentrations decreased during wet and dry seasons monitoring. Majority of the parameters were conformant to the NAAQGV limits except for some stations and for TSP and $PM_{2.5}$. Ozone was not detected in any stations during the wet season.

1371. Meteorological conditions may affect the amount of suspended particulates in a given area. Higher relative humidity during wet season may cause particles of larger diameter to agglomerate, become heavier, and settle down. On the other hand, the measured warmer temperatures and lower ambient pressures may induce upward-moving air and entrains smaller, lightweight particulates like $PM_{2.5}$, and keep them suspended for a longer period of time. Higher maximum winds also result to more suspended particulates and transport them to farther areas. This is significant, especially if there are nearby sources of dust like open dirt spaces, and activities like vehicles passing near the stations.

1372. Increase in humidity in the atmosphere, along with cloud cover, reduces the amount of solar radiation reaching the earth's surface, and may cause slower degradation of chemical pollutants like NO_2 and SO_2, increasing their concentrations. Higher humidity may also induce thermal inversion, keeping chemical pollutants at low elevations.

1373. **Table 3.3.17** summarizes the results of ambient air quality monitoring for the Project during dry and wet seasons. The results of monitoring by sampling station per parameter are discussed below.

Table 3.3.17 Weather Conditions during Wet and Dry Seasons

Parameter	Season	Sampling Stations												
		AAQ1	AAQ2	AAQ3	AAQ4	AAQ5	AAQ6	AAQ7	AAQ8	DD AAQ1	DD AAQ2	DD AAQ3	DD AAQ4	A13*
Prevailing Wind Direction	Dry	ENE	NE	ENE	N	ENE	NE	ENE	NE	ESE	NE	NE	E	SE and NW
	Wet	N	SW	W	SW	SW	SW	E	N / ENE / E / SE	-	-	-	-	NE and SW
Highest Wind Speed, m/s	Dry	5.81	4.47	5.81	4.92	6.71	4.02	3.58	5.36	6.26	4.02	4.02	5.36	-
	Wet	7.6	6.1	3.1	7.6	6.3	5.4	4	4.9	-	-	-	-	-
Ave. Wind Speed, m/s	Dry	2.53	2.47	3.33	3.09	3.63	2.52	2.63	2.5	4.18	3.44	2.16	2.68	0 to 1.8
	Wet	2.8	1.9	1.9	4	2.4	1.8	1.1	1	-	-	-	-	0.4 to 1.6
Calm Winds, %	Dry	20	0	0	4	0	0	0	0	0	0	0	0	-
	Wet	0	0	0	0	0	0	0	0	-	-	-	-	-
Ave. Temp, °C	Dry	27.8	28.3	27.4	25	29.2	27.1	26.6	26.1	30.56	27.48	27.00	27.24	-
	Wet	28	27.5	27.6	27.8	26.7	27	27.4	26.6	-	-	-	-	-
Ave. Barometric Pressure, inHg	Dry	29.8	29.81	29.87	29.82	29.85	29.78	29.78	29.79	29.84	29.88	29.94	29.92	-
	Wet	29.82	29.83	29.7	29.69	29.73	29.6	29.81	29.8	-	-	-	-	-
Ave. Relative Humidity, %	Dry	76	79	79	81	70	78	80	80	59.44	72.16	69	72.88	-
	Wet	93	85	85	94	95	87	89	92	-	-	-	-	-

Notes: (-) not sampled

Sources: Ambient Air Monitoring, GEOSPHERE Technologies 2019; * Delta Tierra Consultants, Inc., 2017

1) Results by Sampling Stations

1374. The results of monitoring for each station are briefly described below.

Station AAQ1 (PNR Solis)

1375. During dry season monitoring, the prevailing winds were coming from east-northeast, with an average wind speed of 2.53 m/s and average temperature of 27.8^{0}C. The barometric pressure was 29.80 inHg and relative humidity was 76%. The ground level concentrations (GLCs) of TSP, PM_{10}, $PM_{2.5}$, Pb, SO_2 and NO_2 did not exceed the NAAQGV; while levels of CO and O_3 were not detected.

1376. During wet season monitoring, the prevailing winds were coming from the north with an average wind speed of 2.8 m/s. The average temperature was 28.0^{0}C, while the average values for barometric pressure and relative humidity were 29.82 inHg and 93%, respectively. The concentration levels of TSP, PM_{10}, $PM_{2.5}$, Pb, SO_2 and NO_2 did not exceed the NAAQGV. The concentration of O_3 was not detected; while the CO concentration did not exceed the NAAQGV.

Station AAQ2 (PNR Sta. Mesa)

1377. During dry season monitoring, the prevailing winds were coming from northeast direction, with average wind speed of 2.47 m/s. Average temperature was 28.3^{0}C, while barometric pressure was 29.81 inHg and relative humidity at 79%. The GLCs of all parameters did not exceed the NAAQGV except for $PM_{2.}5$; while level of CO was not detected.

1378. During wet season monitoring, the prevailing winds were coming from the southwest, with average wind speed of 1.9 m/s. Average temperature was 27.5^{0}C, while the average barometric pressure was 29.83 inHg and relative humidity at 85%. The GLCs of all parameters in station AAQ2 (PNR Sta. Mesa) did not exceed the NAAQGV. Both O_3 and CO were not detected in this station.

Station AAQ3 (PNR Buendia)

1379. During dry season monitoring, the prevailing winds were coming from east-northeast, with average wind speed of 3.33 m/s. Average temperature was 27.4^{0}C, while barometric pressure was 29.87 inHg and relative humidity at 79%. Most of the parameters did not exceed the NAAQGV except for TSP and PM_{10}. CO was not detected in this station.

1380. During wet season monitoring, the prevailing winds were coming from the west at an average wind speed of 1.9 m/s. the average temperature was 27.6^{o}C, while the barometric pressure was 29.70 inHg and relative humidity at 85%. All parameters did not exceed the NAAQGV. Levels of Pb, CO and O_3 were not detected in this station.

Station AAQ4 (PNR FTI)

1381. During dry season monitoring, the prevailing winds were coming from the north, with average wind speed of 3.09 m/s. Average temperature was 25.0^{0}C, while barometric pressure was 29.82 inHg and relative humidity at 81%. The concentration levels of TSP, PM_{10}, $PM_{2.5}$, NO_2 and Pb did not exceed the NAAQGV while SO_2, Pb, CO and O_3 were not detected.

1382. During wet season monitoring, the prevailing winds were coming from the southwest, with average wind speed of 4.0 m/s. Average temperature was 27.8^{0}C, while barometric pressure was 29.69 inHg and relative humidity at 94 %. The concentration levels of TSP, PM_{10}, $PM_{2.5,}$ SO_2, $NO_{2,}$ Pb and CO did not exceed the NAAQGV while O_3 was not detected.

Station AAQ5 (PNR Sucat)

1383. During dry season monitoring, the prevailing winds were coming from the east-northeast, with average wind speed of 3.63 m/s. Average temperature was 29.2^{0}C, while barometric pressure was 29.85 inHg and relative humidity at 70%. The concentration levels of TSP, PM_{10}, $PM_{2.5,}$ NO_2, CO and O_3 did not exceed the NAAQGV. SO_2 and Pb were not detected in this station.

1384. During wet season monitoring, the prevailing winds came from the southwest, with average wind speed of 2.4 m/s. Average temperature was 26.7^{0}C, while barometric pressure was 29.73 inHg and relative humidity at 95%. All parameters did not exceed the NAAQGV. Pb, CO and O_3 were not detected in this station.

Station AAQ6 (PNR Biñan)

1385. During dry season monitoring, the prevailing winds were coming from the northeast, with average wind speed of 2.52 m/s. Average temperature was 27.1^{0}C, while barometric pressure was 29.78 inHg and relative humidity at 78%. The concentration levels of all parameters did not exceed the NAAQGV. CO was not detected in this station.

1386. During wet season monitoring, the prevailing winds were coming from the southwest, with average wind speed of 1.8 m/s. Average temperature was 27.0^{0}C, while the barometric pressure was 29.60 inHg and relative humidity at 87%. All parameters did not exceed the NAAQGV, while SO_2, Pb, O_3 and CO were not detected.

Station AAQ7 (PNR Calamba)

1387. During dry season monitoring, the prevailing winds were coming from the east-northeast, with average wind speed of 2.63 m/s. Average temperature was 26.6^{0}C, while barometric pressure was 29.78 inHg and relative humidity at 80%. Concentration levels of TSP, PM_{10}, $PM_{2.5}$, SO_2, and NO_2 did not exceed the NAAQGV while Pb, CO and O_3 were not detected in this station.

1388. During wet season monitoring, the prevailing winds were coming from the east, with average wind speed of 1.1 m/s. The average temperature was 27.4^{0}C, while barometric pressure was 29.81 inHg and relative humidity at 89%. Almost all parameters did not exceed the NAAQGV, except for $PM_{2.5}$. Both O_3 and CO were not detected in this station.

Station AAQ8 (Paciano Rizal Elementary School)

1389. During dry season monitoring, the prevailing winds were coming from the northeast direction, with average winds speeds at 2.50 m/s. Average temperature was 26.1^{0}C, while barometric pressure was 29.79 inHg and relative humidity at 80%. Concentration levels of TSP, PM_{10}, $PM_{2.5}$, SO_2, and NO_2 in this station did not exceed the NAAQGV. Pb, CO and O_3 were not detected in this station.

1390. During wet season monitoring, the prevailing winds were coming from the north, east-northeast, east and southeast directions, with average wind speed of 1.0 m/s. Average temperature was 26.6^{0}C, while barometric pressure was 29.80 inHg and relative humidity at 92%. All parameters did not exceed the NAAQGV. Both O_3 and CO were not detected in this station.

Station DD AAQ1 (Elias Street)

1391. During monitoring on April 29-30, 2019, the prevailing winds were coming from the east-northeast, with average wind speed of 4.18 m/s at an average temperature of 30.56^{0}C.

The average barometric pressure was recorded at 29.84 inHg with average relative humidity of 59.44%. All parameters did not exceed the NAAQGV. O_3 was not detected in this station.

Station DD AAQ2 (Banlic Depot Site)

1392. During monitoring on March 11-12, 2019, the prevailing winds were coming from the northeast, with an average wind speed of 3.44 m/s at an average temperature of 27.48 ^{0}C. The average barometric pressure was 29.88 inHg with average relative humidity of 72.16%. Concentrations of TSP, $PM_{10,}$ SO_2 and NO_2 did not exceed the NAAQGV while $PM_{2.5}$ exceeded the NAAQGV. Pb, CO and O_3 were not detected in this station.

Station DD AAQ3 (Calamba Station)

1393. During monitoring on March 13-14, 2019, the prevailing winds were coming from the northeast, with average wind speed of 2.16 m/s. The average temperature was 27 ^{0}C while the average barometric pressure was 29.94 inHg with average relative humidity of 69%. The concentration levels of PM_{10}, $PM_{2.5}$, SO_2, and NO_2 did not exceed the NAAQGV while TSP exceeded the NAAQGV. Minimal concentration of Pb was detected while CO and O_3 were not detected in this station.

Station DD AAQ4 (Calamba)

1394. During monitoring on March 12-13, 2019, the prevailing winds were coming from the east, with average wind speed of 2.68 m/s. The average recorded temperature, barometric pressure, and relative humidity was 27.24ºC, 29.92 inHg, and 72.88%, respectively. All parameters measured in this station did not exceed the NAAQGV. Levels of CO and O_3 were not detected in this station.

Station A13 (FTI)

1395. During the dry season monitoring, the prevailing winds were from the SE and NW directions, with wind speeds ranging from 0 to 1.8 m/s. During the wet season, winds were generally to the northeast and southwest directions with wind speeds ranging from 0.4 m/s to 1.6 m/s. The concentrations of TSP and SO_2 were higher during the wet season than the dry season, while concentrations of PM_{10} and NO_2 were lower. Concentrations of criteria pollutants were within the DAO 2000-81 NAAQGV.

Station AN1 (Senate)

1396. SO_2 was below the detection limit. All parameters were within the DAO 2000-81 NAAQGV and NAAQS.

Station AN3 (Bicutan)

1397. All parameters were within the DAO 2000-81 NAAQGV and NAAQS.

Table 3.3.18 Ambient Air Quality Results during Wet and Dry Seasons

Para-meter	Unit	Sampling Stations														NAAQGV (µg/NCM)
		AAQ1	AAQ2	AAQ3	AAQ4	AAQ5	AAQ6	AAQ7	AAQ8	DD AAQ1	DD AAQ2	DD AAQ3	DD AAQ4	A13	AN1	AN3	
TSP, ug/NCM	Dry	59.47	107.28	276.54	137.06	130.39	37.31	56.96	52.59	58.08	84.02	230.59	179.44	204.3	--	--	230
	Wet	63.38	57.51	196.43	163.27	206.38	95.63	77.52	26.92	--	--	--	--	209.7	58	54	
PM_{10}, ug/NCM	Dry	51.91	84.74	272.1	90.43	50.68	27.29	23.86	26.87	36.96	81.27	81.80	56.44	81.4	--	--	150
	Wet	61.01	53.60	84.52	84.36	105.98	62.73	59.57	21.32	--	--	--	--	34.8	47	47	
$PM_{2.5}$, ug/NCM	Dry	43.59	80.3	35.99	36.39	20.41	20.62	10.17	10.59		76.67	28.08	34.75	--	--	--	50
	Wet	25.81	24.51	28.28	49.33	35.05	19.32	51.65	20.27	--	--	--	--	--	--	--	
SO_2, ug/NCM	Dry	6.06	7.65	62.79	ND	ND	57.3	10.98	6.2	33.39	2.50	1.68	13.09	ND	--	--	180
	Wet	5.49	1.82	11.56	11.80	4.86	ND	3.04	4.25	--	--	--	--	--	ND	3.0	
NO_2 ug/NCM	Dry	15.56	7.02	0.34	52.98	3.28	12.3	2.9	3.05	19.69	11.47	4.72	9.87	37.2	--	--	150
	Wet	45.77	42.87	11.88	24.14	55.61	29.27	2.56	1.28	--	--	--	--	27.3	6.1	10	
Pb, ug/NCM	Dry	0.0024	0.0025	0.0007	ND	ND	0.0008	ND	ND	*	ND	0.0027	0.0025	ND	--	--	-
	Wet	0.0068	0.0025	ND	0.0059	ND	ND	0.0011	0.0046	--	--	--	--	2.0	--	--	
CO, ug/NCM	Dry	ND	ND	ND	ND	113.09	ND	ND	ND	1.14	ND	ND	ND	--	--	--	35,000
	Wet	1.14	ND	ND	1.14	ND	ND	ND	ND	--	--	--	--	--	--	--	
O_3, ug/NCM	Dry	ND	1.14	1.14	ND	0.05	1.14	ND	ND	ND	ND	ND	ND	ND	--	--	140
	Wet	ND	ND	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	

Notes:
ND means less than method detection limit (MDL);
Cells shaded in red indicate exceedances to the National Ambient Air Quality Guideline Values (NAAQGV) (DAO 2000-81)
µg/NCM denotes microgram per normal cubic meter as per the nomenclature in NAAQGV. Sample concentrations are corrected to 25ºC and 1 atmosphere pressure.

Table 3.3.19 Ambient Air Quality Results for 1-Hour Monitoring, Wet Season

Station ID	Location	TSP (µg/NCM)	PM_{10} (µg/NCM)	NO_2 (µg/NCM)	SO_2 (µg/NCM)
AN1	Sitio Fort Bonifacio Health Center (Near National Nutrition Council)	25	19	17	16
AN3	Dr. Arcadio Santos National Highschool, Barangay San Martin De Porres, Paranaque City	32	25	20	23
DAO 2000-81 NAAQS (µg/NCM)		**300**	**200**	**260**	**340**

2) Results by Parameters

1398. Results of analysis for each parameter are presented in graphs showing the pollutant concentrations in the 15 sampling stations and comparing the results against relevant NAAQGV and NAAQS.

Total Suspended Particulates (TSP)

1399. **Figure 3.3.12** shows concentrations of TSP 15 sampling stations. As shown, concentration levels of TSP exceeded the NAAQGV of 230 ug/NCM in stations AAQ3 (PNR Buendia) and DD AAQ3 (Calamba Station) measured at 276.54 ug/NCM and 230.59 ug/NCM, respectively. TSP levels in all other stations did not exceed the NAAQGV.

1400. During dry season monitoring, the highest concentration of TSP was measured in **AAQ3** (PNR Buendia) at 276.54 µg/NCM and the lowest was recorded in station AAQ6 (PNR Biñan) at 37.31 ug/NCM. During wet season monitoring, TSP levels in all stations did not exceed the NAAQGV. The highest concentration of TSP during the wet season was recorded in station A13 (FTI) at 209.7 µg/NCM. The lowest concentration was recorded in station AAQ8 (Paciano Rizal Elementary School) at 26.92 µg/NCM.

1401. **Figure 3.3.13** presents the results of the 1-hour ambient air quality monitoring in Stations AN1 and AN3. The 1-hour TSP in the two stations were 25 µg/NCM and 32 µg/NCM, respectively. Both stations were within the DAO 2000-81 NAAQS (300 µg/NCM).

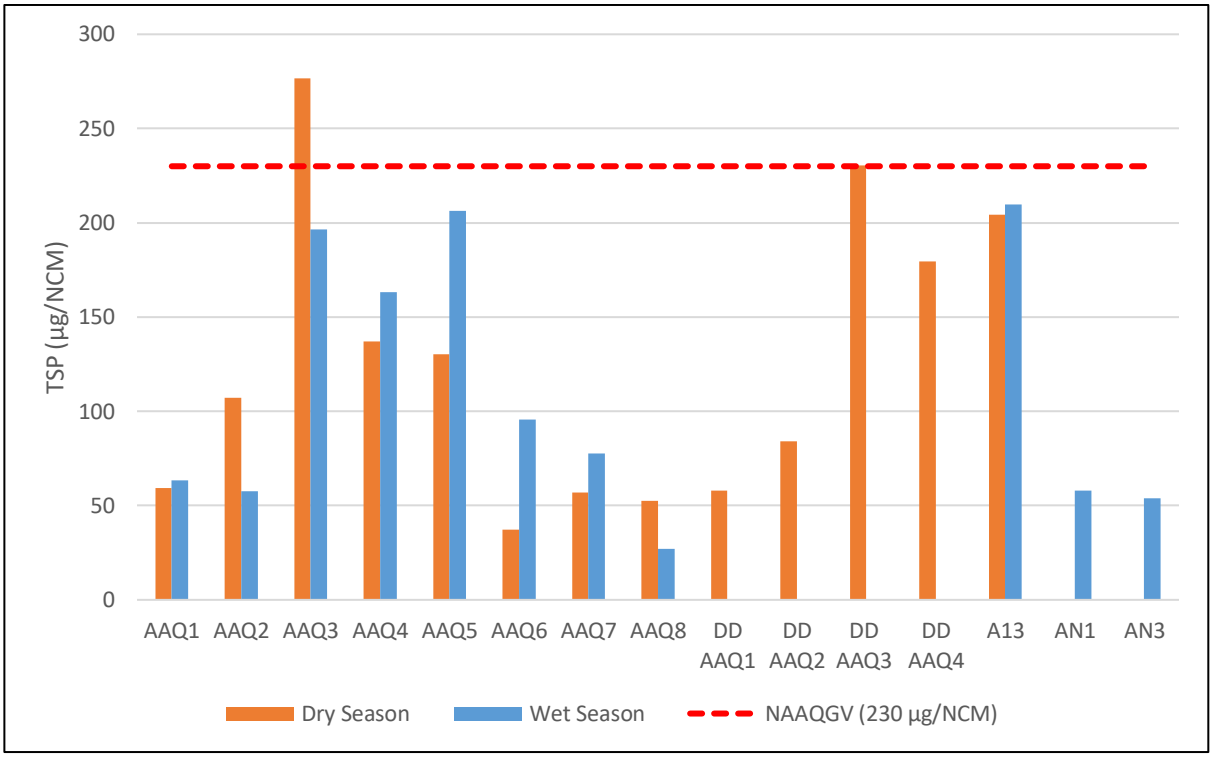


Figure 3.3.12 TSP Concentrations (µg/NCM), 24-Hour Averaging

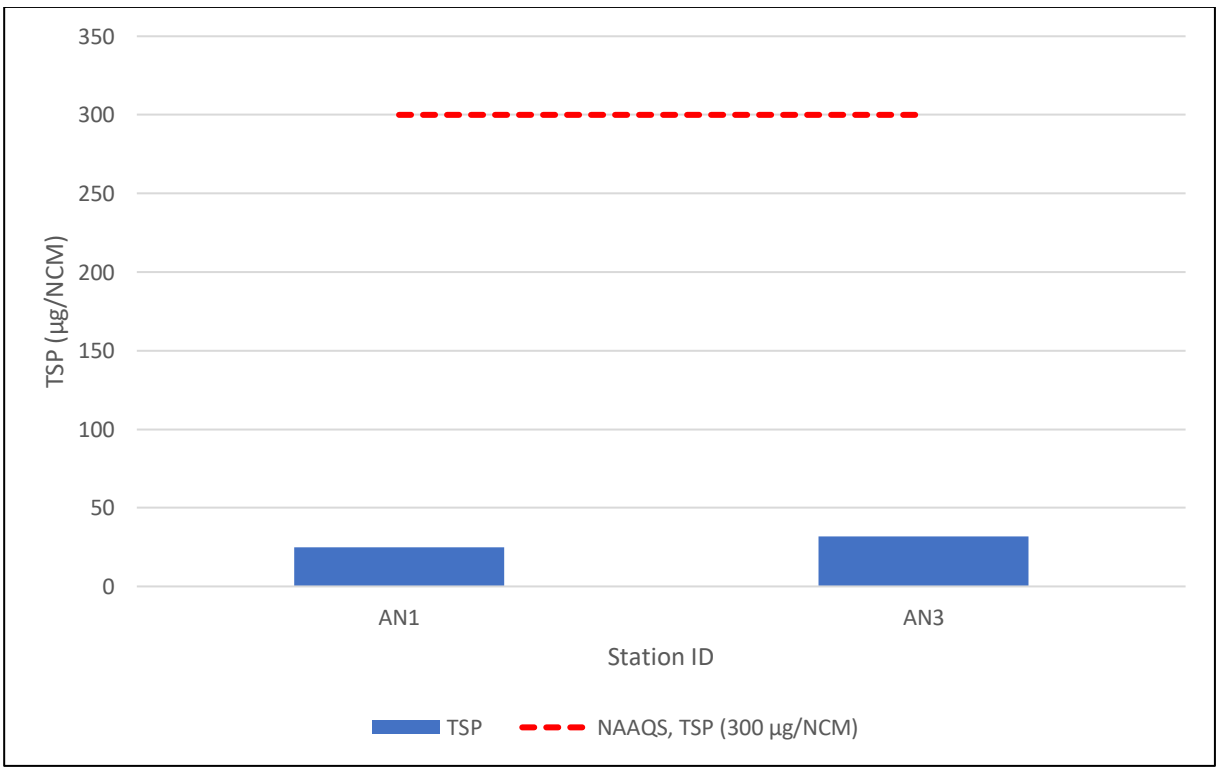


Figure 3.3.13 TSP Concentrations (µg/NCM), 1-Hour Averaging

Particulate Matter up to 10 microns (PM_{10})

1402. **Figure 3.3.14** shows the PM_{10} concentrations in the 15 sampling stations. As shown, PM_{10} level in station AAQ3 (PNR Buendia) measured at 272.1 ug/NCM exceeded the NAAQGV of 230 µg/NCM during dry season. Levels of PM_{10} in all other stations during dry and wet seasons monitoring did not exceed the NAAQGV.

1403. During dry season monitoring, the highest concentration of PM_{10} was recorded in AAQ3 (PNR Buendia) while the lowest was recorded in station AAQ7 (PNR Calamba) at 23.86 µg/ NCM. During wet season monitoring, the highest concentration of PM_{10} was recorded in AAQ5 (PNR Sucat) at 105.98 µg/NCM while the lowest concentration was recorded in station AAQ8 (Paciano Rizal Elementary School) at 21.32 µg/ NCM.

1404. The 1-hour PM_{10} concentrations in Stations AN1 and AN3 were 19 µg/NCM and 25 µg/NCM, respectively. Both stations are within the DAO 2000-81 NAAQS (**Figure 3.3.15**).

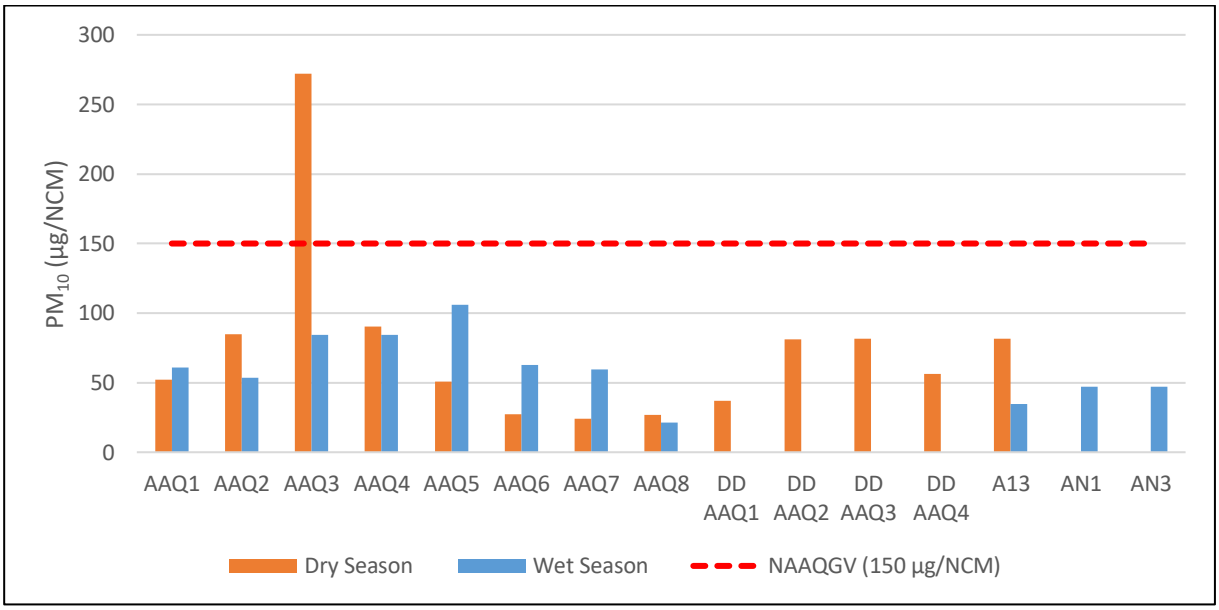


Figure 3.3.14 PM10 Concentrations (µg/NCM), 24-Hour Averaging

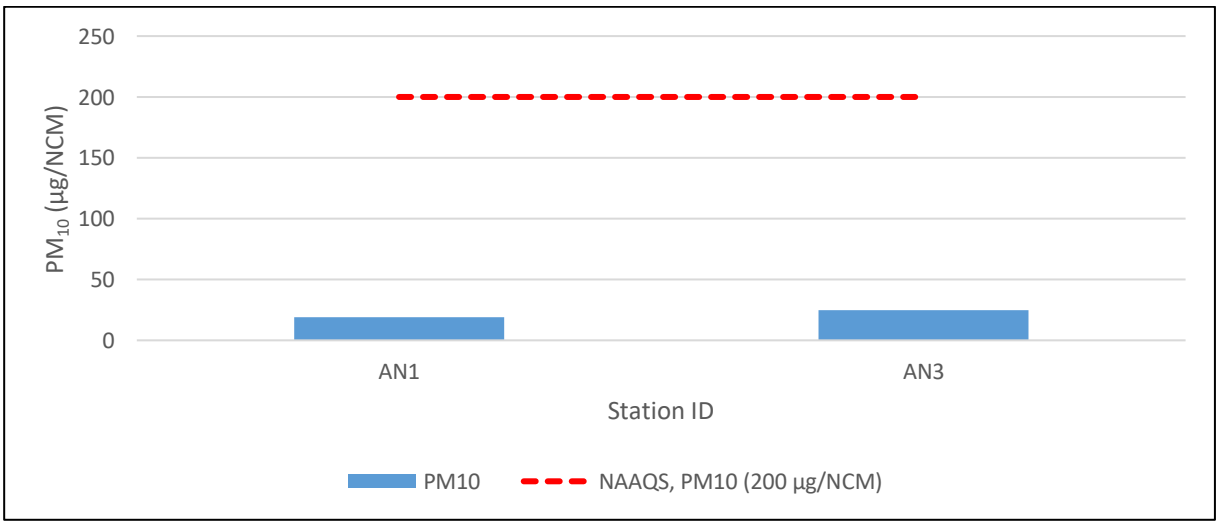


Figure 3.3.15 PM_{10} Concentrations (µg/NCM), 1-Hour Averaging

Particulate Matter up to 2.5 microns ($PM_{2.5}$)

1405. **Figure 3.3.16** shows the graphical presentation of the concentration levels of $PM_{2.5}$ in eleven (11) sampling stations. As shown, concentration of $PM_{2.5}$ in stations AAQ2 (PNR Sta. Mesa) during dry season, AAQ7 (PNR Calamba) during wet season, and DD AAQ2 (Banlic Depot Site) during dry season exceeded the NAAQGV of 50 µg/NCM. Levels of $PM_{2.5}$ in all other stations for both dry and wet seasons monitoring did not exceed the NAAQGV.

1406. During dry season monitoring, the highest concentration of $PM_{2.5}$ was measured in station AAQ2 at 80.3 µg/NCM while the lowest was recorded in station AAQ7 (PNR Calamba) at 10.17 µg/ NCM. During wet season monitoring, the highest concentration of $PM_{2.5}$ was recorded in AAQ7 at 51.65 µg/ NCM, while the lowest was recorded in station AAQ6 (PNR Biñan) at 19.32 µg/ NCM.

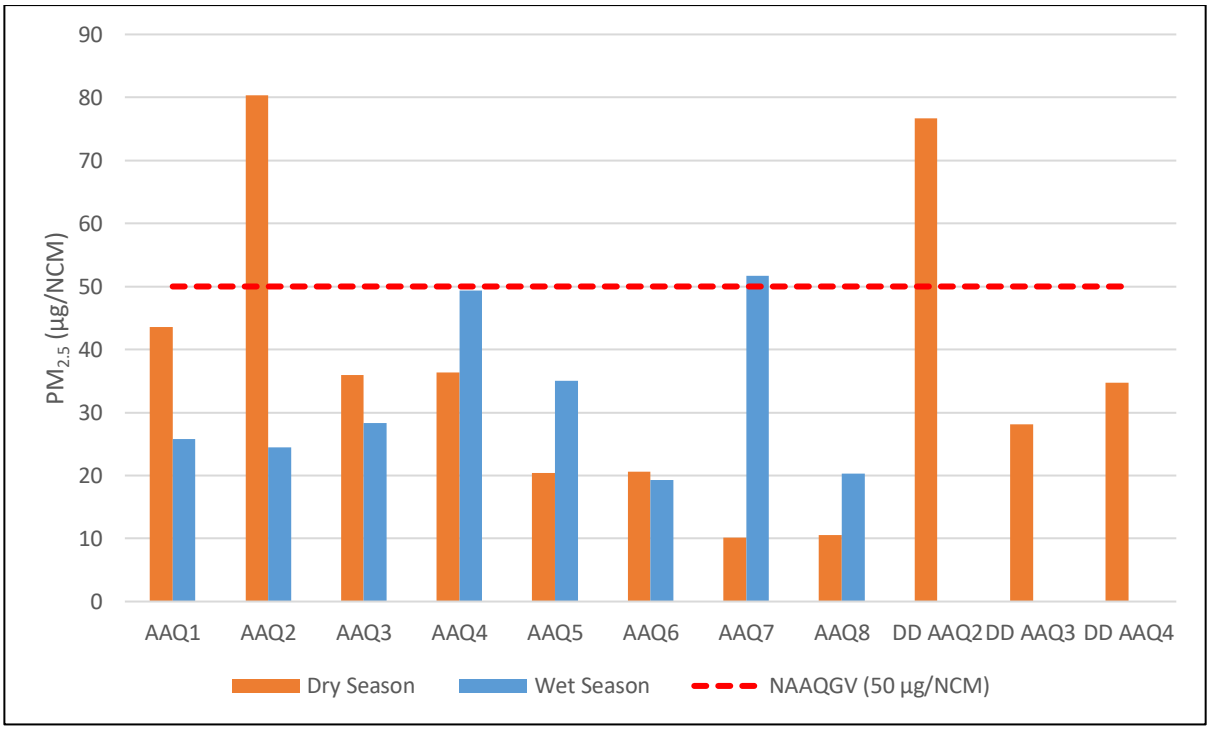


Figure 3.3.16 $PM_{2.5}$ Concentrations (µg/NCM), 24-Hour Averaging

Sulfur Dioxide (SO_2)

1407. **Figure 3.3.17** shows the graphical presentation of the concentration levels of SO_2 in 15 sampling stations. As shown, the concentration levels of SO_2 in sampling stations did not exceed the NAAQGV of 180 µg/NCM.

1408. During dry season monitoring, the highest SO_2 concentration was recorded in station AAQ3 (PNR Buendia) at 62.79 µg/NCM. SO_2 was not detected in stations AAQ4, AAQ5, and A13. During wet season monitoring, the highest concentration of SO_2 was recorded in station AAQ4 (PNR FTI) at 11.80 µg/NCM, while the concentration of SO_2 in Stations AAQ6 (PNR Sta. Mesa), AN1 (Sitio Fort Bonifacio Health Center), and AN3 (Dr. Arcadio Santos National Highschool) was not detected.

1409. The 1-hour SO_2 concentrations in Stations AN1 and AN3 were 16 µg/NCM and 23 µg/NCM, respectively. These values are within the DAO 2000-81 NAAQS (340 µg/NCM) (**Figure 3.3.18**).

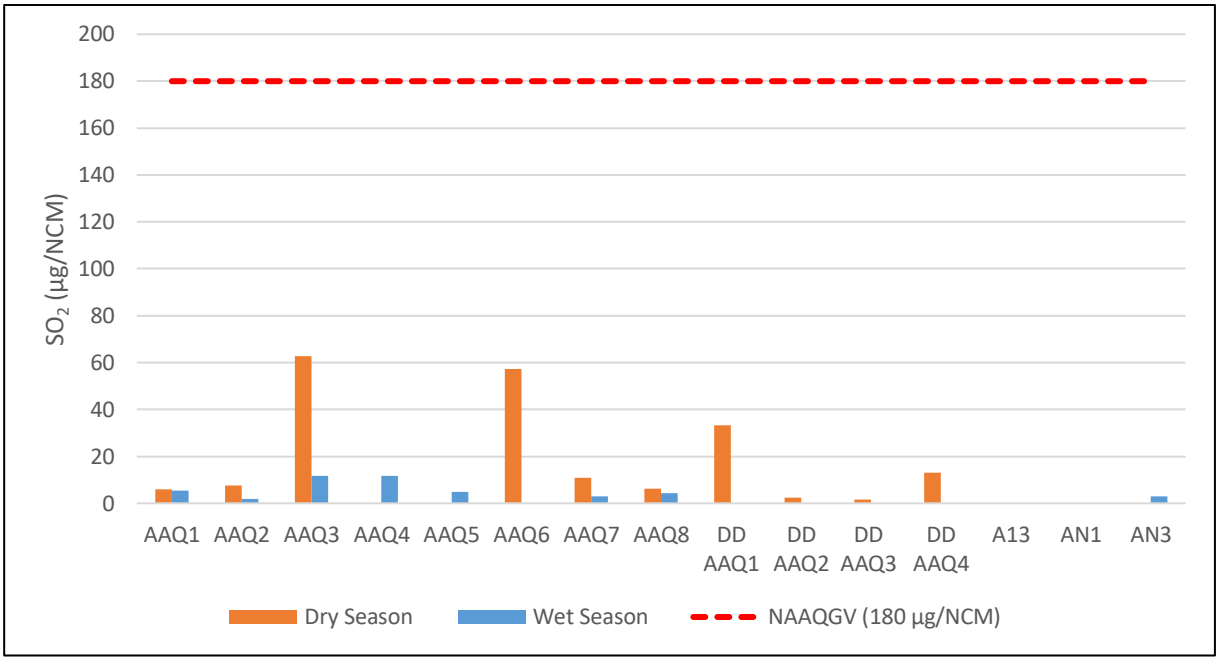


Figure 3.3.17 SO_2 Concentrations (µg/NCM), 24-Hour Averaging

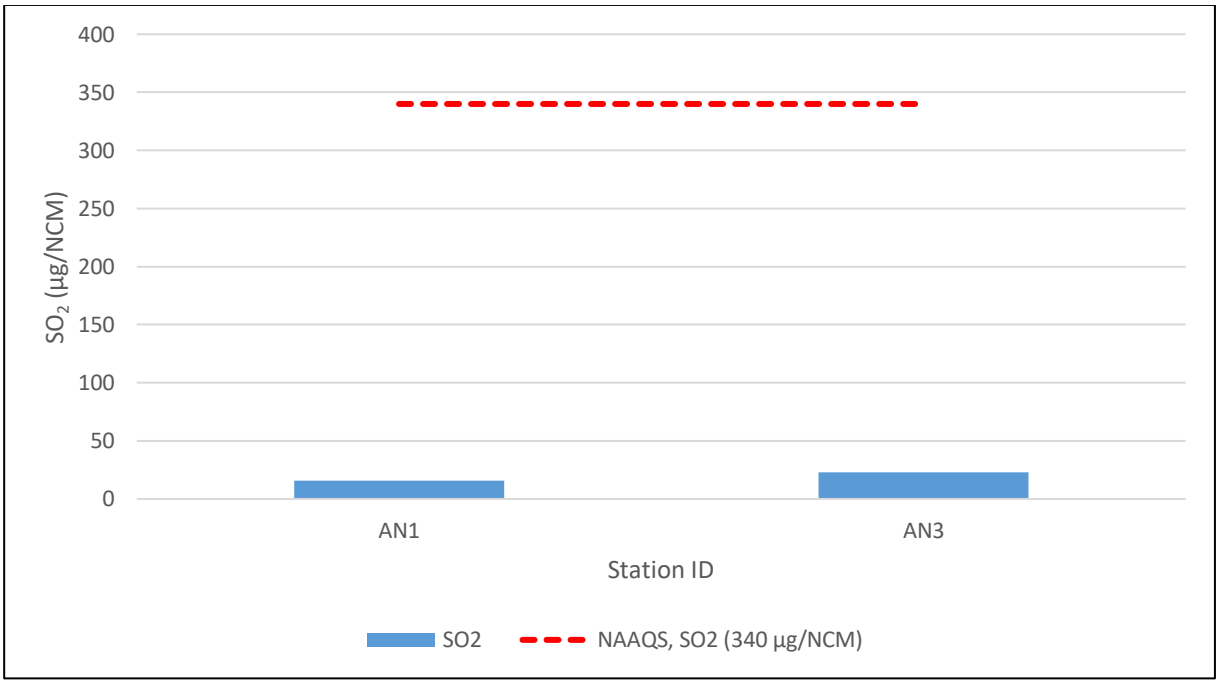


Figure 3.3.18 SO_2 Concentrations (µg/NCM), 1-Hour Averaging

Nitrogen Dioxide (NO_2)

1410. **Figure 3.3.19** shows the graphical presentation of the concentration levels of NO_2 in 15 sampling stations. As shown, concentration levels of NO_2 in all sampling stations did not exceed the NAAQGV.

1411. During dry season monitoring, the highest concentration of NO_2 was recorded in station AAQ4 (PNR FTI) at 52.98 µg/NCM while the lowest concentration was recorded in station AAQ3 (PNR Buendia) at 0.34 µg/NCM. During wet season monitoring, the highest concentration was recorded in station AAQ5 (PNR Sucat) at 55.61 µg/NCM while the lowest concentration was recorded in station AAQ8 (Paciano Rizal Elementary School) at 1.28 µg/NCM.

1412. The 1-hour NO_2 concentrations in Stations AN1 and AN3 were 17 µg/NCM and 20 µg/NCM, respectively (**Figure 3.3.20**). These are within the DAO 2000-81 NAAQS (260 µg/NCM).

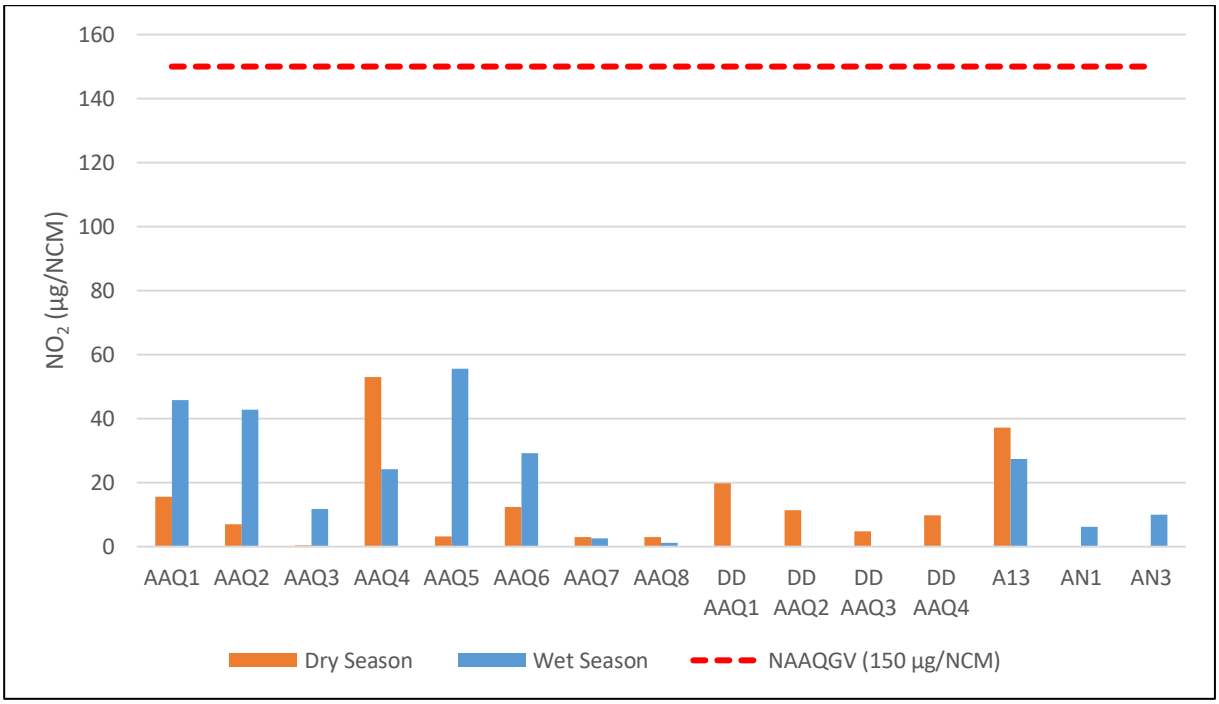


Figure 3.3.19 NO_2 Concentrations (µg/NCM), 24-Hour Averaging

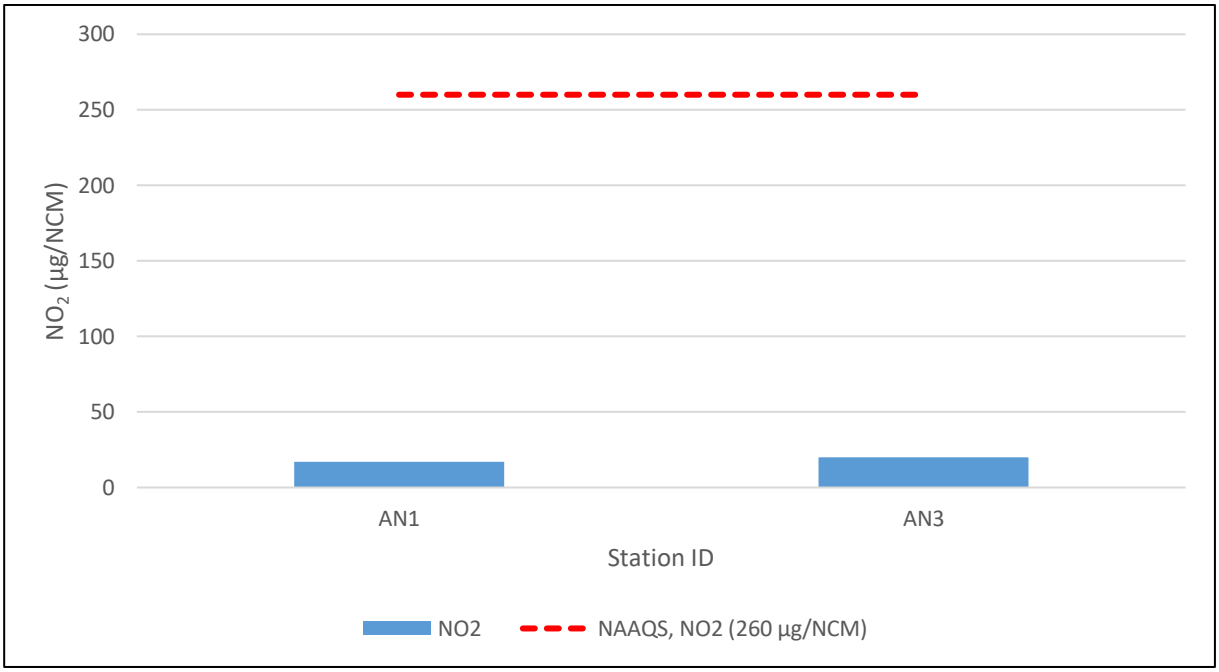


Figure 3.3.20 NO_2 Concentrations (µg/NCM), 1-Hour Averaging

Lead (Pb)

1413. **Figure 3.3.21** shows the graphical presentation of the concentration levels of Pb in 13 sampling stations. During dry season monitoring, the highest Pb concentration was recorded in AAQ2 (PNR Sta. Mesa) at 0.0025 µg/NCM while during wet season monitoring, the highest Pb concentration was recorded in Station A13 at 2 µg/NCM. NAAQGV has no 24-hour guideline value for Pb. Pb was not also detected in seven stations during dry season monitoring and at three stations during wet season.

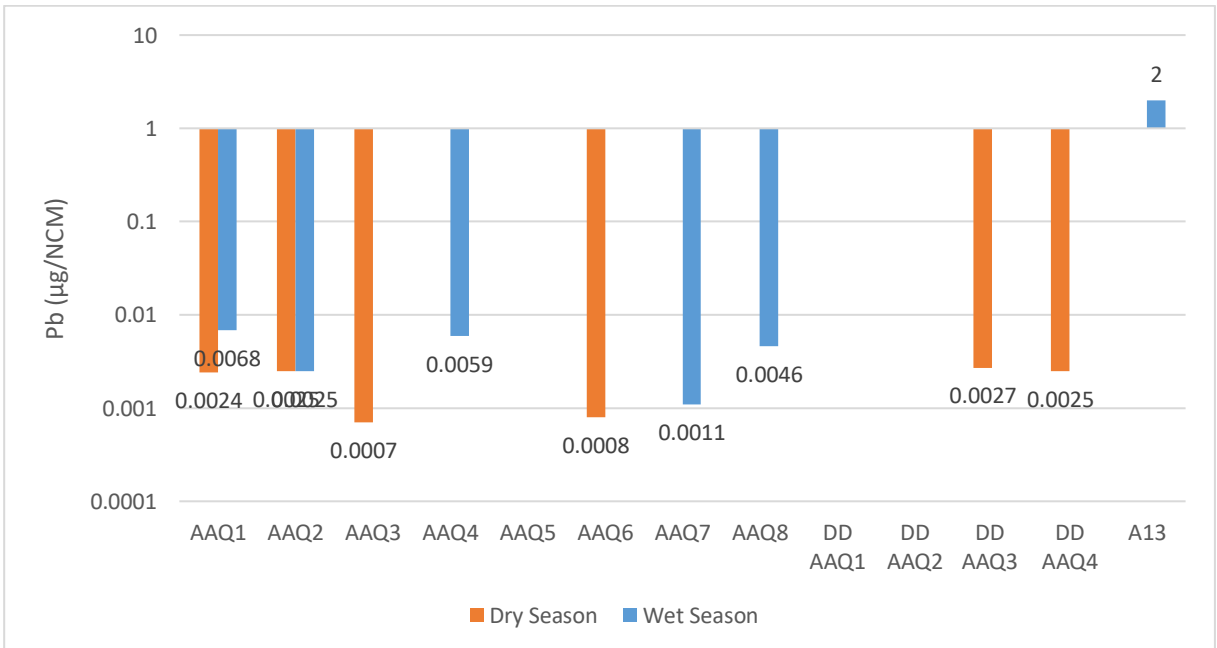


Figure 3.3.21 Pb Concentrations (µg/NCM), 24-hour averaging

Carbon Monoxide (CO)

1414. **Figure 3.3.22** shows the graphical presentation of the concentration levels of CO in twelve (12) sampling stations. As shown, concentration levels of CO in all stations did not exceed the NAAQGV.

1415. During dry season monitoring, CO was not detected in all stations, except for stations AAQ5 (PNR Sucat) at 113.09 µg/NCM and DD AAQ1 (Elias Street) at 1.14 µg/NCM. During wet season monitoring, CO was detected in minute concentrations at stations AAQ1 (PNR Solis) and AAQ4 (PNR FTI) at 1.14 µg/NCM each.

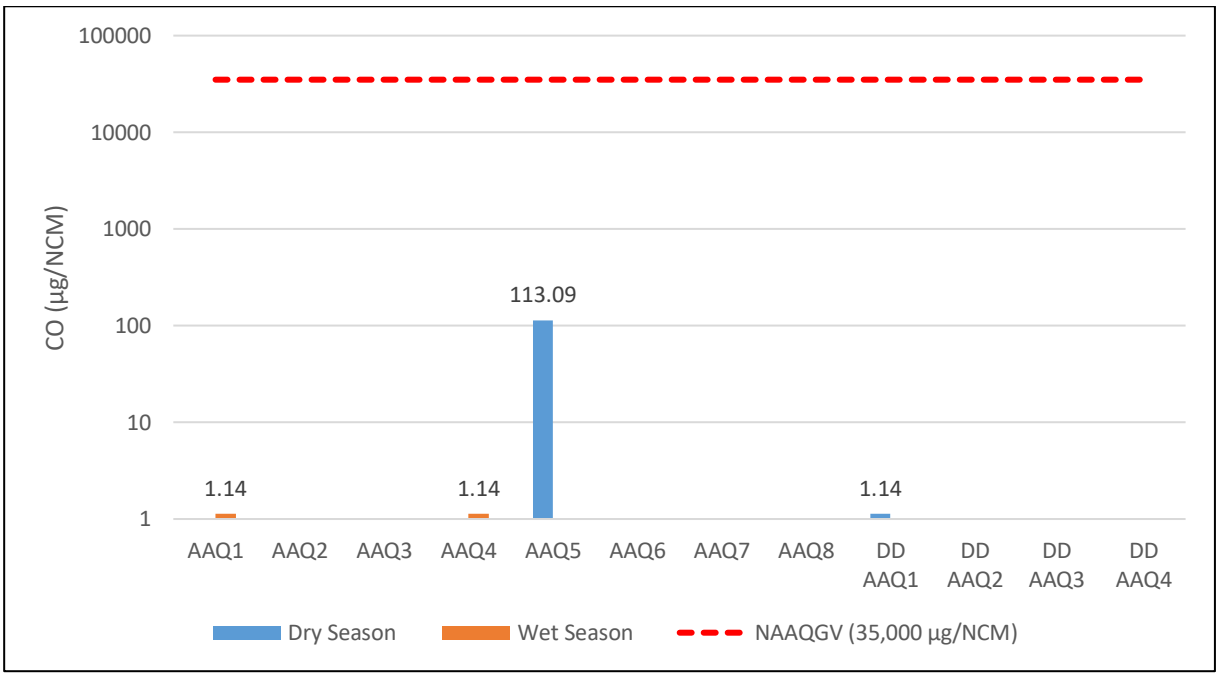


Figure 3.3.22 Concentration Levels of CO (µg/NCM) at Twelve (12) Sampling Stations

Ozone (O_3)

1416. **Figure 3.3.23** shows the graphical presentation of the concentration levels of O_3 in 13 sampling stations. As shown, concentration levels of O_3 in all sampling stations did not exceed the NAAQGV of 140 µg/NCM.

1417. During dry season monitoring, O_3 was detected in minute concentrations at stations AAQ2 (PNR Sta. Mesa), AAQ3 (PNR Buendia), AAQ5 (PNR Sucat) and AAQ6 (PNR Biñan). During wet season monitoring, O_3 was not detected in all stations.

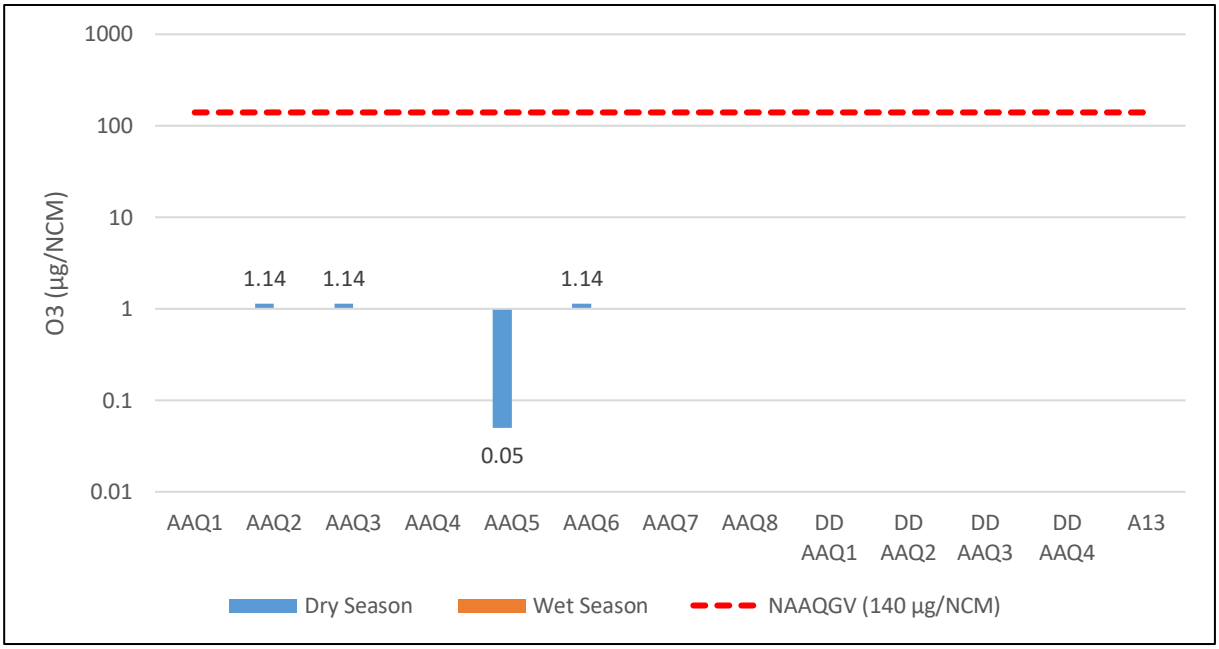


Figure 3.3.23 O_3 Concentrations (µg/NCM), 1-hour averaging

3.3.2.2. Impact Identification, Prediction and Assessment, and Mitigation

(1) Pre-construction and Construction Phase

1) Potential impact, Prediction and Assessment

1418. Fine particles can come from various sources including power plants, motor vehicles, airplanes, residential wood burning, forest fires, agricultural burning, volcanic eruptions and dust storms. Anthropogenic produced air pollution comes mainly from combustion of fossil fuels and the secondary reactions and from fuel impurities contributes CO, NOx, SO_2 and SO_3, particulates (carbon) and unburnt Hydrocarbons.

1419. During the construction and operation of the railway the objective is that there is no significant increase in these levels at neighboring communities. The most sensitive receptors for air pollution are children, pregnant women and any person with pre-existing respiratory or cardiopulmonary conditions. Also, people who have to make physical effort under polluted conditions such as laborers, tricycle drivers. In general, potentially sensitive receptors are schools, nurseries, hospital, maternity centers and residential areas.

1420. Due to the complexity of the movement of airborne pollutants and dispersal effects, all nearby communities are considered to be the receptor of air quality changes. The nearby communities are judged to have moderate sensitivity to changes in air quality caused by the project because current levels are generally lower than the National Ambient Air Quality Guideline Values. Specific highly sensitive receptors (such as child care facilities, care homes) have not been identified as air quality impacts will be worst at the station site both during construction and operation and therefore adequately represent the neighborhood. Those stations will NAAQ limit exceedance (PNR Sta. Mesa (AAQ2) Dry Season $PM_{2.5}$; PNR Buendia (AAQ3) Dry Season TSP; PNR Calamba (AAQ7) Wet Season $PM_{2.5}$; Banlic Depot Site (AAQ2) Dry Season $PM_{2.5}$; Calamba Station (AAQ3) Dry Season TSP.) are considered high sensitivity.

1421. Agricultural land close to major earthmoving operations such as the depot or new batching plants (subject to Contractor decision) are judged to be moderately sensitive due to the sensitivity of crops and time of year of sensitivity varying throughout the growing season.

1422. The major sources of impacts on current air quality by the project in the construction phases are from Exhaust emission and dust.

Exhaust emission

1423. Exhaust are mainly emission from 1) stationary point sources (Generators, stationary working vehicles); 2) moving vehicles (vehicles and construction equipment) or stand-alone generators,

1424. Many emissions will be intermittent based on operating periods and the combination of equipment to be used at any one time. The maximum construction vehicles working on piling at any one time is estimated to be 13, consisting of, piling rig, backhoe, generator (2), crane (2), dump truck, mixing plant, slurry pump, de-sanding machine, concrete mixer truck (2), bar bending machine. The location of emission sources will also change as the construction activity progresses along the alignment with piling operations likely to take 3 months to complete at any viaduct location. Two - three piling sites will be worked on at the same time at 40 m intervals, meaning that 80-120m sections will be exposed to the additional airborne emissions for up to three months. Station construction will take considerably longer but use similar amounts of machines.

1425. Correctly maintained modern construction machinery (vehicles and generators) will add very little to emissions particularly in the particulates type PM10 which represents incompletely burnt fuel and is sign of poor maintenance. The magnitude of change to the existing situation caused by the project vehicles and generators will be negligible to low and the overall impact significance minor. In those stations that already exceed the NAAQ limits when station construction is taking place close to the boundary may experience a little higher magnitude of change of low-moderate. However other changes such as reduction of local traffic in the area due to closing off previous through routes may compensate. These sites will be closely monitored by the proponents Environmental Unit and additional actions by the contractor required such as locating machines further away from the boundary and, no idling rules implemented for trucks.

Dust Generation

1426. Dust is likely to have greater impact on air quality. All construction activities have the potential to generate dust. About half of typical soil dust particles are greater than 10 μm in size. Dust particles greater than 10 μm settle out quickly, however <10 μm (PM_{10}) may remain airborne for weeks. Any increase of impacts from dust will be detected in the PM_{10} measurements. Construction activities generate dust from 1) excavated soil, or on vehicle tires carried by trucks on public roads; 2) earthworks construction at the depot, and other cut and fill activities where large amounts of soil is excavated, tipped, spread or removed.; 4) demolition dust from site clearance including the demolition of existing structures along the ROW, and 5) dust from topsoil stripping including the removal of topsoil at the depot site and topsoil along the length of the ROW.

1427. Weather also plays an important factor for dust generation. Stronger winds and dry condition will increase the transfer of dust, whereas damp or wet conditions will reduce the impact.

1428. Transportation of excavated materials and establishment of the material will involve use of heavy machinery like wheel loaders, dumpers and trucks. This activity will result in dust generation from wheeled traffic. However, this activity will only be short term around the pile sites (3 months) and medium term around the stations (< 12 months) and long term around

the depot (over 1 year). Dust is relatively easy to control around piling and station sites as the soil is excavated as a slurry and water for dust suppression is easily available. Dust generation at the depot during filling and moving is more difficult to control and the volumes of spoil moved are large.

1429. The magnitude of the impact associated with the emission of dust during construction activities on the basis of above factors is predicted to be medium magnitude in the worst case with respect to station and piling sites without mitigation at certain times of year and high magnitude with respect to the depot sites to close by receptors for all times of the year outside of rainy season.

1430. There are a few receptors around the depot, various housing clusters could be affected by nuisance dust and crops could be affected at sensitive times of their growth.

1431. The mitigations are expected to reduce the impact significance of dust blow to low in most cases but in the depot sites due to the large scale of spoil movements certain weather conditions may make moderately significant dust pollution inevitable over short periods. If the contractor cannot cease operations during these periods, receptors affected will be informed and present measures offered to lessen its impact. The mitigations provided below are expected to reduce the impact significance of emissions and dust blow to low during the construction phase.

2) Mitigation Measures

1432. The proposed mitigating measures to minimize exhaust emissions are as follows:

- Conduct prompt inspection and regular maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standards;
- Control vehicle movement maintaining the speed limit within the construction site to <10kph and minimize vehicle transport by maximizing the use of site generated materials
- Install board-ups or fence at the construction area not less than 2 meters high.
- Conduct regular maintenance of vehicles and equipment to ensure emissions comply with standards.
- Prohibit burning of waste materials. Unauthorized burning of construction materials and wastes shall be subject to penalties for the Contractor.
- Make daily visual checks of exhaust “smoke” and take corrective actions on all vehicles and generators.
- Monitor air quality at identified nearby sensitive receptors monthly before, during and after operations and evaluate effectiveness of the air pollution reduction measures provided.

1433. The proposed mitigating measures to minimize dust generation are as follows;

- Adjust construction activities in consideration to weather system, identifying periods of high winds and drought that aggravated dust transport and avoiding these periods for major earth moving activities.;
- Control vehicle movement maintaining the speed limit within the construction site to <10kph and minimize vehicle transport by maximizing the use of site generated materials
- Conduct regular cleaning and clearing of construction access / sites surfaces of spoils and debris from construction equipment and vehicles and wetting of ground soil in the construction site when necessary. Stock pile and trucks loaded with spoils will be covered.

- Implement materials handling or a site protection and rehabilitation program.
- Conduct water sprinkling in areas prone to dust emission such as at soil excavation areas or stockpile of aggregates and under the elevated stations.
- Require contractor to wash wheels of vehicles before leaving the construction area particularly at the depot and transition areas to avoid mud tracking on roads that cause dust emission later on.
- Keep site and nearby roads clean of mud.
- Install board-ups or fence at the construction area not less than 2 meters high.
- Require materials delivery trucks to cover materials.
- In case of accidental spill of materials during transport, the contractor will be required to immediately clean-up spilled materials.
- Keep excavated soil and stockpiles moist, covered, or graded to prevent dust blow. Long term piles should be seeded with a stabilizing groundcover.
- Make daily inspections on site to identify dust producing operation and take corrective actions.

1434. Air quality will be monitored at the identified baseline sampling points including nearby sensitive receptors (residential, school and hospital areas) at regular intervals and if required by the proponents monitoring team. The Grievance Redress Mechanism will provide a way to monitor the effectiveness of dust control.

(2) Operation Phase

1) Potential impact, Prediction and Assessment

1435. As an electrically powered railway the operation of the train service will not generate any increased emissions locally. The increase in local emissions will come from indirect effects particularly the traffic attracted to the station areas. Traffic conditions along main access roads are likely to be significantly different to the existing situation and the change is permanent and ongoing.

1436. As such the potential impacts on air quality during the operation phase of the Project are dust and vehicle emissions around stations, especially from highly polluting vehicles, public service vehicles, queued traffic and stop start traffic conditions. Public service vehicles in the Philippines generally have high emissions currently and may contribute to a poor working environment for people around drop off points. Certain covered/ semi covered areas of the stations (ground level) may collect dust and fumes and make the air quality very poor particularly for staff and vendors located there.

1437. The impact of new traffic on air quality around the stations is likely to raise air emissions and lower air quality. At the stations already exceeding national ambient air quality levels for PM2.5 (PNR Sta. Mesa (AAQ2) during dry season, PNR Calamba (AAQ7) during wet season and Banlic Depot Site (DD AAQ2) during dry season), and TSP (PNR Buendia (AAQ3) and Calamba Station (DD AAQ3) during dry season); the impact significance is predicted to be high. Over the short to medium term, enforcement of existing emissions laws and gradual improvement of emissions quality of vehicles will reduce the impact. In the long-term reordering of streets and transport orientated development (separate project) will have a positive effect.

1438. The magnitude of the impact on staff working at ground level is judged to be potentially high at any site already exceeding national limits and would require further monitoring to understand. Air quality monitoring at the station sites will continue during operation.

1439. The working depot is not expected to have any negative effects on air quality. Some hazardous materials will be produced by the maintenance operations and will be dealt with under the Waste Management Plan. Most machinery is electrically powered, and the shunting locomotive will be electric powered. A diesel-powered emergency locomotive is required to retrieve a failed EMU or in the event of major power failure. The vehicle will only get very minor use.

1440. Impact significance on air quality around stations is predicted to reduce to moderate over time. Plazas to manage traffic are being constructed in parallel with the project. Over the medium to long term air quality should see further improvement from replacement of aging public service vehicles with modern less polluting vehicles or technologies and road widening and new roads will reduce queuing, stop start and other polluting side effects. Over the long term the impact of the stations will likely decrease further.

2) Mitigation Measures

1441. The proposed mitigation and enhancement measures to address these possible impacts are as follows;

- Monitor air quality at vicinity of the proposed stations and evaluate effectiveness of any air pollution reduction measures provided. Monitor actions on complaints, if any, based on Grievance Redress Mechanism.
- Select appropriate operation and maintenance equipment that are fuel efficient to reduce emission;
- Conduct regular inspection and maintenance of heavy equipment, machineries, facilities and service vehicles and facilities such as generator etc. to meet the DENR Emission Standard;
- Regular cleaning and clearing of road from spoils and debris and wetting of ground in the periphery of the depot when necessary;
- Comply with environmental permitting requirements for the storage, transport, handling, and treatment of hazardous material/ wastes and contaminated soil in accordance with RA 6969 at depot area, and provide appropriate PPE for the concerned personnel; and
- Control service vehicle movement by maintaining the speed limit to <10kph within the depot area.

3.3.3. Noise

3.3.3.1. Ambient Noise Level

1442. The measurement of the ambient noise levels is a requirement of the Philippine Environmental Impact Statement System as part of the overall baseline characterization of the existing environmental quality before the project is implemented. The gathered noise level data set provides the basis for the assessment of potential risk from the project, identify direct and indirect impacts on the environment, and allow the design of appropriate mitigation and monitoring measures to assure that significant environmental impacts are avoided or managed.

1443. Increase in population density and increase in road networks are two conditions that go along with development and urbanization. Noise levels will also reflect the general conditions of urban areas. Generally, higher noise levels are expected in urban areas as compared to rural areas.

1444. As of the 2010 data of Philippine Statistics Authority, 100% of Metro Manila and 71.9% of Laguna are urban areas. It is then expected that the noise levels within the vicinity of the proposed Project, traversing from Solis, Manila to Calamba, Laguna, will reflect the general conditions of urban areas, namely, dense population and moderate to heavy traffic conditions.

1445. For example, in a survey conducted by DPWH in May 2000, reported in Metro Manila Road Pavement Rehabilitation Project by JICA, noise levels obtained at Kalayaan Avenue Intersection of the C-5 road in Metro Manila were reported to range from 75 - 77 dBA, higher than the DENR Standard of 75 dBA for commercial areas fronting 4-lane or wider roads. The same report also indicated that 80% of road users who were interviewed said the noise levels were worse than before.

1446. A paper by Fajardo presented at the International Association for Impact Assessment (IAIA) 2007 conference reports that noise levels in some parts of Metro Manila exceeded the DENR Standard for Class B category facing 4-lane or wider roads as presented in **Table 3.3.20**.

Table 3.3.20 Noise Levels in Taft Avenue, Quezon Avenue and EDSA

Study Area	Noise Ranges, dBA	DENR Standard (Class B facing 4-lane or wider roads), Daytime
Taft Avenue, Manila	75 - 79	75
Quezon Avenue	75 - 80	75
EDSA (Camp Crame)	86 - 89	75

Source: Fajardo, Belinda, "A Study on Individual Perceptions of Road Traffic Noise" 2007

1447. The Environmental Impact Assessment Report for Laguna Section of Cavite-Laguna Expressway (CALAx) Project showed the noise levels at the three (3) stations located within Laguna exceeded the NPCC standards for Class B category 75 % of the sampling periods, with noise ranging from 49.6 dBA to 70.6 dBA.

(1) Field Survey

1448. Noise levels were measured at fifteen (15) monitoring stations during dry and wet seasons in 2018 for the EIA Study and additional four (4) stations during dry season in 2019 for the detailed design phase of the SCRP main railway alignment (Solis to Calamba). Noise level measurements were done during morning (5:00 AM to 9:00 AM), daytime (9:00 AM to 6:00 PM), evening (6:00 to 10:00 PM) and nighttime (10:00 PM to 5:00AM) using an Extech® Model No. SDL600 and Extech® Model No. SL355. Noise levels were recorded manually and the median of the seven highest noise level readings was determined and compared with the NPCC standards for noise in general areas (NPCC MC No. 1980-002).

1449. On the other hand, for noise levels recorded at 1-second interval for a period of one-hour, the equivalent energy level (LAeq) was computed using the formula below.

$$LA_{eq} = 10 \times log_{10}\{(10^{L_{AE1}/10} + 10^{L_{AE2}/10} + \cdots E^{L_{AEi}/10})/n\}$$

$$where: L_{AEi} = sound\ level\ at\ i^{th}\ interval$$
$$n = number\ of\ samples$$

1450. The computed LAeq was then compared with the guidelines for community noise of the World Bank Group's Environment, Health and Safety Guidelines (WBG EHS Guidelines 2007).

1451. **Table 3.3.21** presents the description of the sampling stations for noise level monitoring and the corresponding receptor according to the applied guidelines. **Figure 3.3.24** shows the location of the ambient noise sampling stations.

Table 3.3.21 Description of Noise Sampling Stations

Station ID	Station	Description	NPCC Area Class	Receptors[1]
N01	PNR – Solis 14°37'42.17" N 120°58'32.88" E	Adjacent to BLISS residential area, approximately 150m from PNR Solis station and 25m north of Gregoria de Jesus Elementary School	AA	RIE
N02	PNR - Sta. Mesa 14°35'54" N 121°00'46" E	Near Brgy. 630 barangay hall approximately 100m from PUP main gate	AA	RIE
N03	PNR Old Paco Station 14°34'46.79" N 120°59'59.27" E	Near PNR Paco at Brgy. 815 residential area, approx. 250m west of Concordia College and 250m southeast of Manuel Roxas High School	A	RIE
N04	PNR Buendia 14°33'29" N 121°00'27" E	Buendia Flyover corner Osmeña Highway and South Superhighway. Adjacent areas occupied by business establishments	B*	IC
N05	PNR FTI 14°30'24.86" N 121°02'07.64" E	Along East Service Road, approximately 70m from FTI station entrance and 30m south of Bagong Lipunan Condominium	B*	IC
N06	PNR Sucat 14°27'08" N 121°03'03" E	Approx. 20m east of Escalades South Metro residences, and 40m west of Purok II residential area. Near Sucat Thermal Power Plant.	A	RIE
N07	PNR Alabang 14°25'02.12" N 121°02'51.78" E	Residential area near PNR Alabang Station, approx. 150m northwest of West Bay College and 120m west of St. Peter's School	A	RIE
N08	Divine Mercy Memorial Chapel 14°22'14.9" N 121°03'01.1" E	Front of Divine Mercy Memorial Chapel, about 90m south of Sikatville RMT Tunasan residential area	AA**	RIE
N09	Biñan Community Hospital 14°20'12.7" N 121°04'28.6" E	Parking area in front of the Emergency Section of Biñan Community Hospital	AA	RIE
N10	PNR Biñan 14°19'52" N 121°04'51" E	Basketball Court near new PNR Biñan Station, 100m northeast of San Vicente Ferrer Parish Church	AA	RIE
N11	Cabuyao Central School 14°16'35.7" N 121°07'35.2" E	Front of Sergio Osmeña St. about 25m across Cabuyao Central School. The station is adjacent to residential area of Poblacion II.	AA	RIE
N12	PNR Calamba 14°12'26.1" N 121°09'28.7" E	Vacant lot near PNR Calamba Station, 20m west of Criscor Homes, 200m northwest of Maranatha Christian Academy	A	RIE
N13	Tiyani Elementary School 14°10'44.1" N 121°11'58.5" E	Approx. 20m north of Tiyani Elementary School	AA	RIE
N14	Los Baños Municipal Health Center 14°10'52.8" N 121°13'34.7" E	Approx. 10m south of Los Baños Municipal Health Center, adjacent to a 2-way Manila East Road	AA**	RIE
N15	Paciano Rizal Elementary School 14°08'57" N 121°16'05" E	Approx. 60m south of Paciano Rizal Elementary School in Bay, Laguna	AA	RIE

Station ID	Station	Description	NPCC Area Class	Receptors[1]
DD N01	Elias Street 14°37'16.00" N; 120°59'16.00" E	5 m north of basketball court; Residential area	A	RIE
DD N02	Banlic Depot Site 14°13'30.86" N; 121°09'46.36" E	20 m south of Iglesia Ni Cristo Church	AA	RIE
DD N03	Calamba Station 14°12'33.95" N 121°09'31.40" E	Beside King of Heaven Funeral Services, along J.P. Rizal St., Calamba	AA	RIE
DD N04	Calamba 14°11'53.29" N 121°09'35.56" E	At the back of Halang Elementary School, beside Master Restaurant	AA	RIE

Notes: *Areas directly fronting or facing wider than four-lane road. NPCC MC 1980-002 Standards for Noise in General Areas +10 dBA correction factor is applied in these stations.
**Areas directly fronting or facing a four-lane road. NPCC MC 1980-002 Standards for Noise in General Areas +5 dBA correction factor is applied in these stations.
[1]RIE – Residential; Institutional; Educational; IC – Industrial; Commercial

Figure 3.3.24 Ambient Noise Sampling Station

(2) Criteria applied for assessment of ambient noise quality

1452. The measured ambient noise levels were compared to the Environmental Quality Standards for Noise in General Areas of NPCC Memorandum Circular No. 002 series of 1980 and WBG EHS Guideline for Community Noise (2007).

(3) Results and Analysis

1453. The results of noise level monitoring which was conducted in accordance to the requirements of NPCC MC No. 1980-002 were above the standard values of the Environmental Quality Standards for Noise in General Areas of NPCC, for both the dry and wet seasons.

1454. For dry season monitoring, the lowest noise level recorded at 54.0 dBA was measured in DD N01 (Elias Street; 14°37'16.00" N; 120°59'16.00" E) during nighttime while the highest noise level recorded at 85.5 dBA was measured in the same station during evening. For wet season monitoring, the lowest noise level recorded at 56.1 dBA was measured in Station N10 (PNR Biñan; 14°19'52" N; 121°04'51" E) during nighttime, while the highest noise level recorded at 89.5 dBA was measured in Station N08 (Divine Mercy Memorial Chapel; 14°22'14.9" N; 121°03'01.1" E) during morning. The summary of results of the noise level monitoring conducted at the Project alignment is shown in **Table 3.3.22**.

1455. Moreover, the results of noise level monitoring, which was conducted in accordance to the WBG EHS Guidelines for Community Noise (2007), showed that the ambient noise levels measured in all stations exceeded the guideline values.

1456. For dry season monitoring, the lowest noise level recorded at 55.2 dBA was measured in Station DD N02 (Banlic Depot Site; 14°13'30.86" N; 121°09'46.36"E) during nighttime while the highest noise level recorded at 77.2 dBA was measured in Station N04 (PNR Buendia; 14°33'29" N; 121°00'27" E) during daytime. For wet season monitoring, the lowest noise level recorded at 56.3 dBA was measured in Station N10 (Biñan; 14°19'52" N; 121°04'51" E) during nighttime, while the highest noise level recorded at 99 dBA was measured in Station N05 (PNR FTI; 14°30'24.86" N; 121°02'07.64" E) during daytime. The noise levels obtained were characteristic of urban areas near roads or streets and with relatively dense population.

1457. The most common sources of noise were vehicles passing near the monitoring station, and the activities and voices of people nearby. The results of the noise level monitoring as compared with the WBG EHS Guidelines is presented in **Table 3.3.23**.

1458. The succeeding Tables compare the noise measurements to the NPCC Standards and WBG EHS Noise Values. All measured morning, daytime, evening, and nighttime ambient noise levels exceed the NPCC Standards in all monitoring stations. All measured noise values, expressed in two time slices- daytime and nighttime, exceeds the WBG EHS Noise Values.

Table 3.3.22 Results of Noise Level Monitoring (Dry and Wet Seasons) as Compared with NPCC Standards

Sta, No.	Dry Season			Wet Season			NPCC Standard			Exceed Standard?
	Date	Time	Noise Level	Date	Time	Noise Level	Area Class	Period	Noise Level	Y/N
N01	Jan 21, 2018	0648H	76.9	June 23, 2018	0515H	65.0	AA	Morning	45 dBA	Y
	Jan21, 2018	1258H	63.7	June 23, 2018	1030H	63.8		Daytime	50 dBA	Y
	Jan 20, 2018	1858H	66.4	June 22, 2018	2130H	75.3		Evening	45 dBA	Y
	Jan 21, 2018	2258H	58.8	June 23, 2018	0400H	60.8		Nighttime	40 dBA	Y
N02	Jan 22, 2018	0704H	72.0	June 24, 2018	0648H	71.8	AA	Morning	45 dBA	Y
	Jan 22, 2018	1338H	72.1	June 24, 2018	1348H	71.5		Daytime	50 dBA	Y
	Jan 21, 2018	1858H	75.6	June 23, 2018	2050H	61.5		Evening	45 dBA	Y
	Jan 21, 2018	2247H	68.1	June 24, 2018	0227H	64.9		Nighttime	40 dBA	Y
N03	Feb 3, 2018	0634H	70.2	July 15, 2018	0823H	69.2	A	Morning	50 dBA	Y
	Feb 2, 2018	1655H	71.8	July 14, 2018	1759H	70.4		Daytime	55 dBA	Y
	Feb 2, 2018	1823H	78.0	July 14, 2018	2041H	71.6		Evening	50 dBA	Y
	Feb 2, 2018	2208H	67.7	July 14, 2018	2200H	72.1		Nighttime	45 dBA	Y
N04	Jan 19, 2018	0704H	84.2	July 15, 2018	0644H	78.5	B*	Morning	70 dBA	Y
	Jan 19, 2018	1301H	80.4	July 14, 2018	1115H	83.1		Daytime	75 dBA	Y
	Jan 18, 2018	1900H	76.4	July 14, 2018	1824H	85.5		Evening	70 dBA	Y
	Jan 18, 2018	2303H	75.1	July 15, 2018	0108H	76.9		Nighttime	65 dBA	Y
N05	Feb 8, 2018	0720H	78.0	July 11, 2018	0743H	79.0	B*	Morning	70 dBA	Y
	Feb 8, 2018	1300H	76.2	July 10, 2018	1647H	78.3		Daytime	75 dBA	Y
	Feb 8, 2018	1909H	76.6	July 10, 2018	1852H	87.0		Evening	70 dBA	Y
	Feb 7, 2018	2319H	77.8	July 11, 2018	0155H	79.2		Nighttime	65 dBA	Y
N06	Feb 21, 2018	0654H	60.3	July 12, 2018	0605H	70.4	A	Morning	50 dBA	Y
	Feb 21, 2018	1110H	70.3	July 11, 2018	1725H	74.8		Daytime	55 dBA	Y
	Feb 20, 2018	1825H	78.4	July 11, 2018	1955H	66.1		Evening	50 dBA	Y
	Feb 20, 2018	2305H	64.2	July 12, 2018	0440H	65.5		Nighttime	45 dBA	Y
N07	Mar 23, 2018	0637H	78.8	July 16, 2018	0752H	78.9	A	Morning	50 dBA	Y
	Mar 24, 2018	1203H	66.6	July 13, 2018	1702H	68.6		Daytime	55 dBA	Y
	Mar 24, 2018	1946H	72.2	July 07, 2018	2037H	71.3		Evening	50 dBA	Y

Sta, No.	Dry Season			Wet Season			NPCC Standard			Exceed Standard?
	Date	Time	Noise Level	Date	Time	Noise Level	Area Class	Period	Noise Level	Y/N
	Mar 25, 2018	0100H	59.0	July 07, 2018	2208H	61.7		Nighttime	45 dBA	Y
N08	Mar 23, 2018	0749H	77.1	July 07, 2018	0609H	89.5	AA**	Morning	50 dBA	Y
	Mar 8, 2018	1650H	71.0	July 06, 2018	1106H	87.4		Daytime	55 dBA	Y
	Mar 8, 2018	1830H	65.2	July 06, 2018	2140H	86.3		Evening	50 dBA	Y
	Mar 25, 2018	0215H	61.8	July 12, 2018	0215H	79.5		Nighttime	45 dBA	Y
N09	Mar 24, 2018	0755H	69.3	July 16, 2018	0752H	70.4	AA	Morning	45 dBA	Y
	Mar 8, 2018	1512H	61.9	July 13, 2018	1515H	65.3		Daytime	50 dBA	Y
	Mar 8, 2018	2007H	73.1	July 13, 2018	2140H	61.2		Evening	45 dBA	Y
	Mar 24, 2018	0353H	69.9	July 13, 2018	2245H	57.6		Nighttime	40 dBA	Y
N10	Jan 24, 2018	0738H	66.4	July 13, 2018	0612H	69.0	AA	Morning	45 dBA	Y
	Jan 23, 2018	1259H	61.7	July 13, 2018	1008H	59.3		Daytime	50 dBA	Y
	Jan 23, 2018	1858H	62.0	July 12, 2018	1920H	69.1		Evening	45 dBA	Y
	Jan 23, 2018	2308H	64.5	July 12, 2018	2255H	56.1		Nighttime	40 dBA	Y
N11	Mar 24, 2018	0630H	69.5	July 06, 2018	0754H	69.2	AA	Morning	45 dBA	Y
	Mar 8, 2018	1035H	78.5	July 06, 2018	0926H	79.3		Daytime	50 dBA	Y
	Mar 23, 2018	1800H	63.0	July 06, 2018	2003H	62.1		Evening	45 dBA	Y
	Mar 23, 2018	2315H	77.3	July 06, 2018	2355H	64.0		Nighttime	40 dBA	Y
N12	Jan 25, 2018	0657H	70.7	June 27, 2018	0600H	79.8	A	Morning	50 dBA	Y
	Jan 25, 2018	1248H	66.4	June 27, 2018	1430H	81.1		Daytime	55 dBA	Y
	Jan 24, 2018	1908H	73.8	June 26, 2018	1910H	75.9		Evening	50 dBA	Y
	Jan 25, 2018	2247H	64.3	June 27, 2018	0115H	59.3		Nighttime	45 dBA	Y
N13	Mar 8, 2018	0750H	72.5	July 06, 2018	0535H	72.6	AA	Morning	45 dBA	Y
	Feb 22, 2018	1614H	71.8	June 28, 2018	1015H	70.8		Daytime	50 dBA	Y
	Feb 22, 2018	1954H	73.4	July 06, 2018	1810H	80.2		Evening	45 dBA	Y
	Mar 8, 2018	2208H	74.2	June 26, 2018	2322H	62.0		Nighttime	40 dBA	Y
N14	Mar 8, 2018	0520H	81.2	June 26, 2018	0504H	77.3	AA**	Morning	50 dBA	Y
	Feb 22, 2018	1054H	61.7	June 27, 2018	1150H	73.2		Daytime	55 dBA	Y
	Feb 22, 2018	1825H	74.8	June 26, 2018	2040H	78.0		Evening	50 dBA	Y

Sta, No.	Dry Season			Wet Season			NPCC Standard			Exceed Standard?
	Date	Time	Noise Level	Date	Time	Noise Level	Area Class	Period	Noise Level	Y/N
	Mar 8, 2018	0349H	74.5	June 26, 2018	1004H	72.3		Nighttime	45 dBA	Y
N15	Jan 26, 2018	0655H	63.8	June 26, 2018	0740H	74.2	AA	Morning	45 dBA	Y
	Jan 26, 2018	1254H	67.8	June 25, 2018	1430H	66.1		Daytime	50 dBA	Y
	Jan 25, 2018	1834H	74.6	June 25, 2018	1900H	63.5		Evening	45 dBA	Y
	Jan 25, 2018	2255H	65.0	June 26, 2018	0130H	65.3		Nighttime	40 dBA	Y
DD N01	Apr 30, 2019	0807H	61.1	-	-	-	A	Morning	50 dBA	Y
	Apr 30, 2019	1630H	69.8	-	-	-		Daytime	55 dBA	Y
	Apr 29, 2019	2050H	85.5	-	-	-		Evening	50 dBA	Y
	Apr 30, 2019	0205H	54.0	-	-	-		Nighttime	45 dBA	Y
DD N02	Mar 12, 2019	0605H	55.6	-	-	-	AA	Morning	45 dBA	Y
	Mar 12, 2019	1025H	64.3	-	-	-		Daytime	50 dBA	Y
	Mar 11, 2019	2115H	81.7	-	-	-		Evening	45 dBA	Y
	Mar 12, 2019	0320H	63.2	-	-	-		Nighttime	40 dBA	Y
DD N03	Mar 14, 2019	0615H	78.7	-	-	-	A	Morning	50 dBA	Y
	Mar 14, 2019	1302H	74.2	-	-	-		Daytime	55 dBA	Y
	Mar 13, 2019	2150H	79.5	-	-	-		Evening	50 dBA	Y
	Mar 14, 2019	0300H	77.3	-	-	-		Nighttime	45 dBA	Y
DD N04	Mar 13, 2019	0615H	75.0	-	-	-	AA	Morning	45 dBA	Y
	Mar 13, 2019	1550H	75.0	-	-	-		Daytime	50 dBA	Y
	Mar 12, 2019	1910H	75.8	-	-	-		Evening	45 dBA	Y
	Mar 13, 2019	0020H	62.5	-	-	-		Nighttime	40 dBA	Y

Notes: *Areas directly fronting or facing wider than four-lane road. NPCC MC 1980-002 Standards for Noise in General Areas +10 dBA correction factor is applied in these stations.
**Areas directly fronting or facing a four-lane road. NPCC MC 1980-002 Standards for Noise in General Areas +5 dBA correction factor is applied in these stations.

Table 3.3.23 Results of Noise Level Monitoring (Dry and Wet Seasons) and WBG EHS Guidelines (2007)

Station Number	Dry Season			Wet Season			WBG EHS Guidelines			Exceed Standard? Y/N
	Date	Time	Noise Level (dBA)	Date	Time	Noise Level (dBA)	Receptors	Period	Noise Level (dBA)	
N01	Jan 21, 2018	1304H-1404H	57.9	June 23, 2018	1021H-1121H	66.5	RIE	Daytime	55	Y

Station Number	Dry Season			Wet Season			WBG EHS Guidelines			Exceed Standard? Y/N
	Date	Time	Noise Level (dBA)	Date	Time	Noise Level (dBA)	Receptors	Period	Noise Level (dBA)	
	Jan 20-21, 2018	2304H-0004H	60.1	June 23, 2018	0352H-0452H	64.5		Nighttime	45	Y
N02	Jan 22, 2018	1343H-1443H	66.3	June 24, 2018	1335H-1435H	83.6	RIE	Daytime	55	Y
	Jan 21-22, 2018	2303H-0003H	68.4	June 24, 2018	0210H-0310H	65.4		Nighttime	45	Y
N03	Feb 2, 2018	1700H-1800H	69.4	July 14, 2018	1650H-1750H	86.1	RIE	Daytime	55	Y
	Feb 2, 2018	2214H-2314H	68.3	July 14, 2018	2210H-2310H	73.1		Nighttime	45	Y
N04	Jan 19, 2018	1306H-1406H	77.2	July 14, 2018	1110H-1210H	96.0	IC	Daytime	70	Y
	Jan 18-19, 2018	2309H-0009H	76.5	July 15, 2018	0100H-0200H	85.1		Nighttime	70	Y
N05	Feb 8, 2018	1305H-1405H	75.7	July 10, 2018	1640H-1740H	99.0	IC	Daytime	70	Y
	Feb 7-8, 2018	2325H-0025H	75.0	July 11, 2018	0150H-0250H	77.6		Nighttime	70	Y
N06	Feb 21, 2018	1115H-1215H	75.0	July 11, 2018	1715H-1815H	80.7	RIE	Daytime	55	Y
	Feb 20-21, 2018	2310H-0010H	69.3	July 12, 2018	0433H-0533H	64.5		Nighttime	45	Y
N07	Mar 24, 2018	1210H-1310H	67.3	July 13, 2018	1702H-1802H	97.1	RIE	Daytime	55	Y
	Mar 25, 2018	0105H-0205H	63.5	July 7, 2018	2212H-2312H	70.5		Nighttime	45	Y
N08	Mar 8, 2018	1655H-1755H	61.7	July 6, 20188	1056H-1156H	82.8	RIE	Daytime	55	Y
	Mar 25, 2018	0220H-0320H	62.9	July 7, 2018	0120H-0220H	78.9		Nighttime	45	Y
N09	Mar 8, 2018	1518H-1618H	68.0	July 13, 2018	1504H-1604H	69.3	RIE	Daytime	55	Y
	Mar 25, 2018	0358H-0458H	68.0	July 13, 2018	2235H-2335H	61.6		Nighttime	45	Y
N10	Jan 23, 2018	1304H-1404H	64.1	July 13, 2018	1000H-1100H	58.5	RIE	Daytime	55	Y
	Jan 23-24, 2018	2314H-0014H	63.8	July 12, 2018	2240H-2340H	56.3		Nighttime	45	Y
N11	Mar 8, 2018	1041H-1141H	71.5	July 6, 2018	0920H-1020H	93.4	RIE	Daytime	55	Y
	Mar 23-24, 2018	2320H-0020H	65.0	July 6-7, 2018	2349H-0049H	72.5		Nighttime	45	Y
N12	Jan 25, 2018	1253H-1353H	64.3	June 27, 2018	1426H-1526H	74.8	RIE	Daytime	55	Y
	Jan 24, 2018	2253H-2353H	63.4	June 27, 2018	0111H-0211H	63.0		Nighttime	45	Y
N13	Feb 22, 2018	1620H-1720H	70.3	June 28, 2018	1002H-1102H	70.0	RIE	Daytime	55	Y
	Mar 8, 2018	2214H-2314H	58.3	June 28-29, 2018	2310H-0010H	80.4		Nighttime	45	Y
N14	Feb 22, 2018	1100H-1200H	71.2	June 27, 2018	1145H-1245H	71.4	RIE	Daytime	55	Y
	Mar 8, 2018	0355H-0455H	72.7	June 26, 2018	2200H-2300H	82.9		Nighttime	45	Y
N15	Jan 26, 2018	1300H-1400H	67.8	June 25, 2018	1424H-1524H	83.6	RIE	Daytime	55	Y
	Jan 25-26, 2018	2300H-000H	61.6	June 25, 2018	0121H-0221H	62.8		Nighttime	45	Y
DD N01	Apr 30, 2019	1012H-1112H	63.2	-	-	-	RIE	Daytime	55	Y
	Apr 29, 2019	2200H-2300H	70.6	-	-	-		Nighttime	45	Y
DD N02	Mar 13, 2019	1030H-1130H	56.9	-	-	-	RIE	Daytime	55	Y
	Mar 12, 2019	0318H-0418H	55.2	-	-	-		Nighttime	45	Y
DD N03	Mar 13, 2019	1302H-1402H	71.9	-	-	-	RIE	Daytime	55	Y
	Mar 14, 2019	0104H-0204H	64.8	-	-	-		Nighttime	45	Y
DD N04	Mar 13, 2019	1550H-1650H	69.9	-	-	-	RIE	Daytime	55	Y
	Mar 12, 2019	2205H-2305H	57.1	-	-	-		Nighttime	45	Y

Notes: RIE – Residential; Institutional; Educational; IC – Industrial; Commercial
Noise impacts should not exceed the levels of the guideline value or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

1) Geographical Variation of Measured Ambient Noise Levels

N01 – PNR Solis

1459. Station N01 is located within 25 meters of Gregoria de Jesus Elementary School, and therefore categorized under Class AA according to NPCC classification. Noise levels measured for all periods during morning/evening, daytime and nighttime were higher than the NPCC noise standards of 45 dBA, 50 dBA and 40 dBA, respectively. Station N01 is classified under Residential, Institutional and Educational receptors based in the WBG EHS Guidelines. Noise levels measured during daytime and nighttime were higher than the WBG EHS Guideline values of 55 dBA and 45 dBA, respectively. Noise sources during measurements include birds chirping, woman sweeping of dried leaves, motorcycle passing by the nearby road, people talking, airplane passing by the area, frogs croaking, dogs barking and rooster cackling.

N02 – PNR Sta. Mesa

1460. Station N02 is located within 100 meters of Polytechnic University of the Philippines (PUP), and therefore was categorized as a Class AA area according to NPCC classification. Noise levels measured for all periods during morning/evening, daytime and nighttime were higher than the NPCC noise standards of 45 dBA, 50 dBA and 40 dBA, respectively**.** Station N02 is classified under Residential, Institutional and Educational receptors based in the WBG EHS Guidelines. Noise levels measured during daytime and nighttime periods were higher than the WBG EHS Guideline values of 55 dBA and 45 dBA, respectively. Noise sources include vehicles passing nearby, people talking nearby, train passing, clucking of chickens, dogs barking, birds chirping and cars passing by nearby road.

N03 - PNR Old Paco Station

1461. Station N03 is located in a residential area at Brgy. 815 and, therefore, categorized under Class A area according to NPCC classification. Noise levels measured in all periods during morning/evening, daytime and nighttime were higher than the NPCC standards of 50 dBA, 55 dBA and 45 dBA, respectively**.** Station N03 is classified under Residential, Institutional and Educational receptors based in the WBG EHS Guidelines. Noise levels measured during daytime and nighttime periods were higher than the WBG EHS Guideline values of 55 dBA and 45 dBA, respectively. Sources of noise include vehicles passing, people talking, train passing, public paging announcement, radio of the store owner near the station, birds chirping, chicken clucking and dogs barking.

N04 - PNR Buendia

1462. Station N04 is located in a commercial area and, therefore, was categorized under Class B area according to NPCC classification. It is also located adjacent to Buendia Flyover corner Osmeña Highway and South Superhighway, which qualifies for a correction factor of +10 dBA on the measured noise levels. Nonetheless, noise levels measured for all periods during morning/evening, daytime and nighttime were higher than the NPCC standards of 70 dBA, 75 dBA and 65 dBA, respectively. Station N04 is classified under Industrial and Commercial receptors based in the WBG EHS Guidelines. Noise levels measured during daytime and nighttime were higher than the WBG EHS Guideline values of 70 dBA for both periods. Major sources of noise include the vehicles and trains passing near the station.

N05 - PNR FTI

1463. Station N05 is located in a commercial area and, therefore categorized under Class B according to NPCC classification. It is also located adjacent to the east service road where

the Metro Manila Skyway converges with the South Luzon Expressway, which qualifies for a correction factor of +10 dBA on the measured noise levels. Nonetheless, noise levels measured for all periods during morning/evening, daytime and nighttime were higher than the NPCC standards of 70 dBA, 75 dBA and 65 dBA, respectively. Station N05 is classified under Industrial and Commercial receptors based in the WBG EHS Guidelines. Noise levels measured during daytime and nighttime were higher than the WBG EHS Guideline values of 70 dBA for both periods. Major noise sources during measurements include vehicles passing by the nearby road, trains passing and people talking.

N06 - PNR Sucat

1464. Station N06 is located in a residential area at Purok 4 and Escalades South Metro residences and, therefore categorized under Class A according to NPCC classification. Noise levels measured for all monitoring periods during morning/evening, daytime and nighttime were higher than the NPCC standards of 50 dBA, 55 dBA and 45 dBA, respectively. Station N06 is classified under Residential, Institutional and Educational receptors based in the WBG EHS Guidelines. Noise levels measured during daytime and nighttime were higher than the WBG EHS Guideline values of 55 dBA and 45 dBA, respectively. Sources of noise during measurements include people talking, train passing, vehicles passing the nearby highway, airplane passing and dogs barking.

N07 - PNR Alabang

1465. Station N07 is located in a residential area near PNR Alabang Station and, therefore categorized under Class A area according to NPCC classification. Noise levels measured for all monitoring periods were higher than the NPCC standards of 50 dBA, 55 dBA and 45 dBA, respectively. Station N07 is classified under Residential, Institutional and Educational receptors based in the WBG EHS Guidelines. Noise levels measured during daytime and nighttime periods were higher than WBG EHS Guideline values of 55 dBA and 45 dBA, respectively. Sources of noise include vehicles and tricycles passing near the station, people talking, vendor's sound system near the station and train passing nearby.

N08 - Divine Mercy Memorial Chapel

1466. Station N08 is located in front of Divine Mercy Memorial Chapel and, therefore categorized under Class AA area according to NPCC classification. It is also located adjacent to a 4-lane street, which qualifies for a correction factor of + 5 dBA on measured noise levels. Nonetheless, noise levels measured for all periods during morning/evening, daytime and nighttime were higher than the NPCC standards of 50 dBA, 55 and 45 dBA, respectively. Station N08 is classified under Residential, Institutional and Educational receptors based in the WBG EHS Guidelines. Noise levels measured during daytime and nighttime periods were higher than the WBG EHS Guideline values of 55 dBA and 45 dBA, respectively. Sources of noise during measurements include buses, jeepneys and light vehicles passing nearby, car horns blowing and siren from funeral convoy.

N09 - Biñan Community Hospital

1467. Station N09 is located adjacent to the Biñan Community Hospital and, therefore categorized under Class AA area according to NPCC classification. Noise levels measured for all periods during morning/evening, daytime and nighttime were higher than the NPCC standards of 45 dBA, 50 dBA and 40 dBA, respectively. Station N09 is classified under Residential, Institutional and Educational receptors based in the WBG EHS Guidelines. Noise levels measured during daytime and nighttime periods were higher than the WBG EHS Guideline values of 55 dBA and 45 dBA, respectively. Noise sources during measurements include tricycles passing near the station, vehicles coming in and going out

of the hospital, people talking, ongoing building construction nearby, train passing, megaphone from PNR station, train horn blowing; and idling vehicles.

N10 - PNR Biñan

1468. Station N10 is located within 100 meters of San Vicente Ferrer Parish Church and, therefore categorized under Class AA area according to NPCC classification. Noise levels measured for all periods during morning/evening, daytime and nighttime were higher than the NPCC standards of 45 dBA, 50 dBA and 40 dBA respectively. Station N10 is classified under Residential, Institutional and Educational receptors based in the WBG EHS Guidelines. Noise levels measured during daytime and nighttime periods were higher than the WBG EHS Guideline values of 55 dBA and 45 dBA, respectively. Sources of noise during measurements include people playing basketball inside the court, train and vehicles passing, dogs barking, birds chirping and people talking nearby.

N11 - Cabuyao Central School

1469. Station N11 is located across Cabuyao Central School and, therefore categorized under Class AA area according to NPCC classification. Noise levels measured for all periods during morning/evening, daytime and nighttime were higher than the NPCC standards of 45 dBA, 50 dBA and 40 dBA respectively. Station N11 is classified under Residential, Institutional and Educational receptors based in the WBG EHS Guidelines. Noise levels measured during daytime and nighttime periods were higher than the WBG EHS Guideline values of 55 dBA and 45 dBA, respectively. Noise sources during measurements include children talking and playing nearby, birds and nocturnal insects chirping, tricycles coming in and going out of the school, students shouting and vehicles passing the road fronting the school.

N12 - PNR Calamba

1470. Station N12 is located near Criscor Homes residential area and, therefore categorized under Class A area according to NPCC classification. Noise levels measured for all periods during morning/evening, daytime and nighttime were higher than the NPCC standards of 50 dBA, 55 dBA and 45 dBA, respectively. Station N12 is classified under Residential, Institutional and Educational receptors based in the WBG EHS Guidelines. Noise levels measured during daytime and nighttime periods were higher than the WBG EHS Guideline values of 55 dBA and 45 dBA, respectively. Noise sources during measurements include people talking nearby, vehicles and tricycles passing the nearby road and nocturnal insects chirping.

N13 - Tiyani Elementary School

1471. Station N13 is located within 100 meters of Tiyani Elementary School and, therefore categorized under Class AA area according to NPCC classification. Noise levels measured for all periods during morning/evening, daytime and nighttime were higher than NPCC standards of 45 dBA, 50 dBA and 40 dBA, respectively. Station N13 is classified under Residential, Institutional and Educational receptors based in the WBG EHS Guidelines. Noise levels measured during daytime and nighttime periods were higher than the WBG EHS Guideline values of 55 dBA and 45 dBA, respectively. Noise sources during measurements include birds and nocturnal insects chirping, dogs barking, chicken clucking, children talking nearby, tricycles and motorcycles passing, dogs barking, and a TV playing nearby.

N14 - Los Baños Municipal Health Center

1472. Station N14 is located near Los Baños Municipal Health Center and, therefore categorized under Class AA area according to NPCC classification. It is also located

adjacent to a 4-lane street, which qualifies for a correction factor of + 5 dBA on measured noise levels. Nonetheless, noise levels measured for all periods during morning/evening, daytime and nighttime were higher than the NPCC standards of 50 dBA, 55 dBA and 45 dBA, respectively. Station N014 is classified under Residential, Institutional and Educational receptors based in the WBG EHS Guidelines. Noise levels measured during daytime and nighttime periods were higher than WBG EHS Guideline values of 55 dBA and 45 dBA, respectively. Sources of noise during measurements include vehicles passing nearby, vehicles coming in and going out of the parking area and vehicle engine starting up.

N15 - Paciano Rizal Elementary School

1473. Station N15 is located within 100 meters of Paciano Rizal Elementary School and, therefore categorized under Class AA area according to NPCC classification. Noise levels measured for all periods during morning/evening, daytime and nighttime were higher than the NPCC standards pf 45 dBA, 50 dBA and 40 dBA, respectively. Station N15 is classified under Residential, Institutional and Educational receptors based in the WBG EHS Guidelines. Noise levels measured during daytime and nighttime periods were higher than the WBG EHS Guideline values of 55 dBA and 45 dBA, respectively. Noise sources during measurements include vehicles passing nearby, noise from classroom activities, metal works in operation nearby and videoke playing nearby.

DD N01– Elias Street

1474. Station DD N01 is in a residential area and therefore categorized under Class A area according to NPCC classification. Noise levels measured for all periods during morning/evening, daytime and nighttime were higher than the NPCC standards of 50 dBA, 55 dBA and 45 dBA, respectively. Station DD N01 is classified under Residential, Institutional and Educational receptors based in the WBG EHS Guidelines. Noise levels measured during daytime and nighttime periods were higher than the WBG EHS Guideline values of 55 dBA and 45 dBA, respectively. Noise sources during measurements include children playing nearby, motor pump operating, dogs barking, and rooster cackling.

DD N02– Banlic Depot Site

1475. Station DD N02 is located at 20 meters south of Iglesia Ni Cristo Church, and therefore categorized under Class AA area according to NPCC classification. Noise levels measured for all periods during morning/evening, daytime and nighttime were higher than the NPCC standards of 45 dBA, 50 dBA and 40 dBA, respectively. Station DD N02 was classified under Residential, Institutional and Educational receptors based in the WBG EHS Guidelines. Noise levels measured during daytime and nighttime periods were higher than the WBG EHS Guideline values of 55 dBA and 45 dBA, respectively. Noise sources during measurements include birds chirping, people talking nearby, dogs barking, and tricycles and motorcycles passing nearby.

DD N03 – Calamba Station

1476. Station DD N03 is located within the residential area and beside King of Heaven Funeral Services, along J.P. Rizal St., Calamba which therefore, categorized under Class A area according to NPCC classification. Noise levels measured for all periods during morning/evening, daytime and nighttime were higher than NPCC standards 50 dBA, 55 dBA and 45 dBA, respectively. Station DD N03 is classified under Residential, Institutional and Educational receptors based in the WBG EHS Guidelines. Noise levels measured during daytime and nighttime periods were higher than the WBG EHS Guideline values of 55 dBA and 45 dBA, respectively. Noise sources during measurements include trucks, tricycles, motorcycles and other light vehicles passing nearby.

DD N04 – Calamba

1477. Station DD N04 is located at the back of Halang Elementary School, beside Master Restaurant, and categorized under Class AA area according to NPCC classification. Noise levels measured for all periods during morning/evening, daytime and nighttime were higher than the NPCC standards of 45 dBA, 50 dBA and 40 dBA, respectively. Station DD N04 is categorized under Residential, Institutional and Educational receptors based in the WBG EHS Guidelines. Noise levels measured during daytime and nighttime periods were higher than the WBG EHS Guideline values of 55 dBA and 45 dBA, respectively. Noise sources during measurements include tricycles, motorcycles and other light vehicles passing the nearby road, and noise from live band.

Seasonal Variation of Measured Noise Levels

1478. There are no clear seasonal trends in the measured noise levels across the project area. **Figure 3.3.25** to **Figure 3.3.30** present the measured dry and wet season noise levels for each time slice and land use type.

2) Results by Monitoring Period

a. Compliance with NPCC MC 1980-002

Noise Levels During Morning

1479. As shown in **Figure 3.3.25**, noise levels in all stations exceeded the NPCC standards during morning period During dry season monitoring, the highest noise level of 84.2 dBA was measured at station N04 in PNR Buendia while the lowest noise level of 55.6 dBA was measured at station DD N02 in Banlic Depot Site. During wet season monitoring, the highest noise level of 89.5 dBA was measured at station N08 in Divine Mercy Memorial Chapel while the lowest noise level of 65.0 dBA was measured at station N01 in PNR Solis Station. The morning period covers the time between 5:00 AM to 9:00 AM.

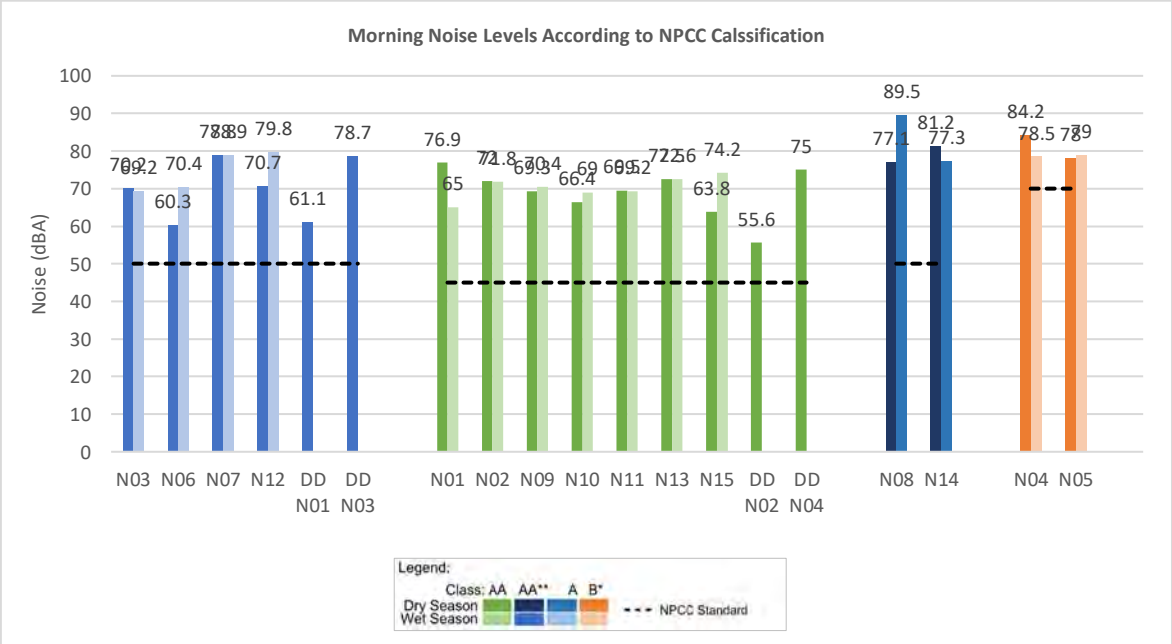


Figure 3.3.25 Morning Ambient Noise Levels According to NPCC MC 1980-002 Classification

Noise Levels During Daytime

1480. As shown in **Figure 3.3.26**, noise levels in all stations exceeded the NPCC standards during the daytime period During dry season monitoring, the highest noise level of 80.4 dBA was measured at station N04 in PNR Buendia while the lowest noise level of 61.7 dBA was measured at station N10 in PNR Biñan and N14 in Los Baños Municipal Health Center. During wet season monitoring, the highest noise level of 87.4 dBA was measured at station N08 in Divine Mercy Memorial Chapel while the lowest noise level of 59.3 dBA was measured at station N10 in PNR Biñan Station. The daytime period covers the time between 9:00 AM to 6:00 PM.

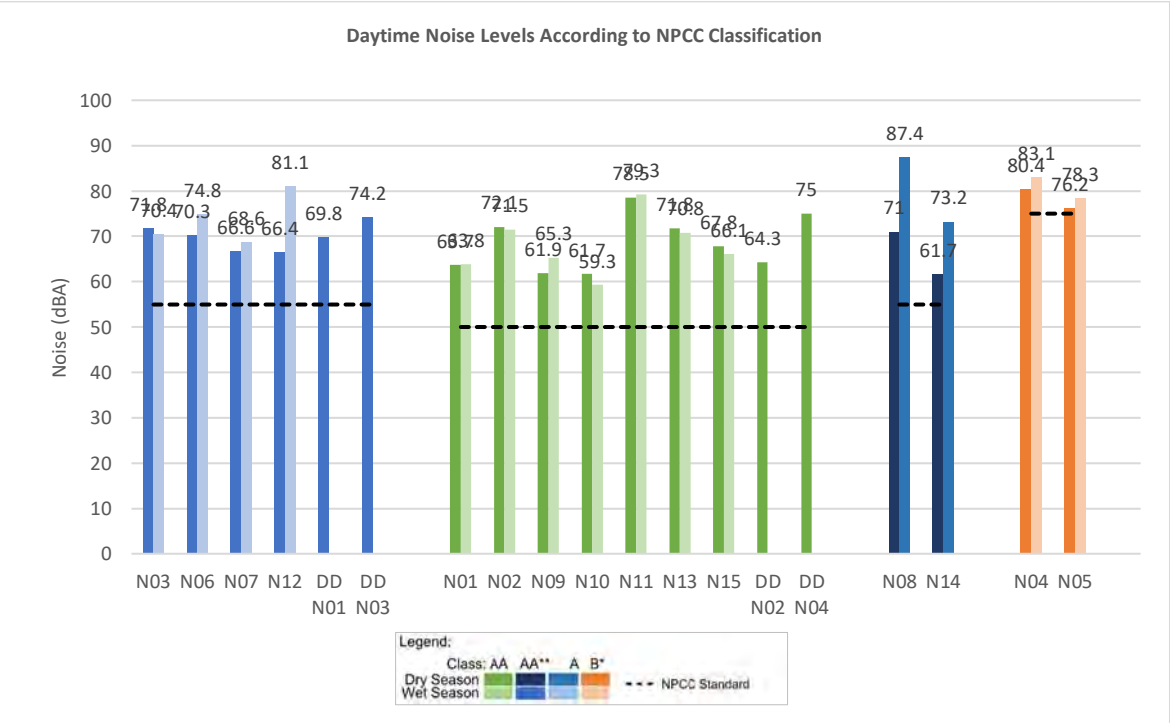


Figure 3.3.26 Daytime Ambient Noise Levels According to NPCC MC 1980-002 Classification

Noise Levels during Evening

1481. As shown in **Figure 3.3.27**, noise levels in all stations exceeded the NPCC standards during the evening period During dry season monitoring, the highest noise level of 85.5 dBA was measured at station DD N01 in Elias Street while the lowest noise level of 62.0 dBA was measured at station N10 in PNR Biñan. During wet season monitoring, the highest noise level of 87.0 dBA was measured at station N05 in PNR FTI Station while the lowest noise level of 61.2 dBA was measured at station N09 in Biñan Community Hospital. The evening period covers the time between 6:00 PM to 10:00 PM.

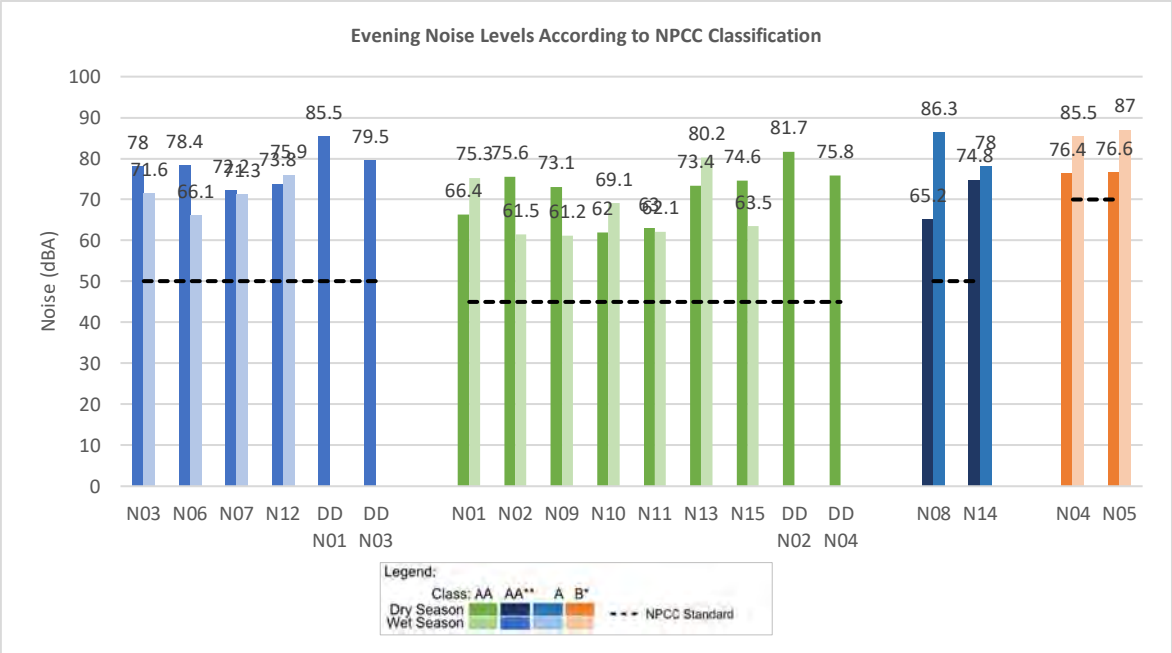


Figure 3.3.27 Evening Ambient Noise Levels According to NPCC MC 1980-002 Classification

Noise Levels during Nighttime

1482. As shown in **Figure 3.3.28**, noise levels in all stations exceeded the NPCC standards during the nighttime period During dry season monitoring, the highest noise level of 77.8 dBA was measured at station N05 in PNR FTI while the lowest noise level of 54 dBA was measured at station DD N01 in Elias Street. During wet season monitoring, the highest noise level of 79.5 dBA was measured at station N08 in Divine Mercy Memorial Chapel while the lowest noise level of 56.1 dBA was measured at station N10 in PNR Biñan. The nighttime period covers the time between 10:00 PM to 5:00 AM.

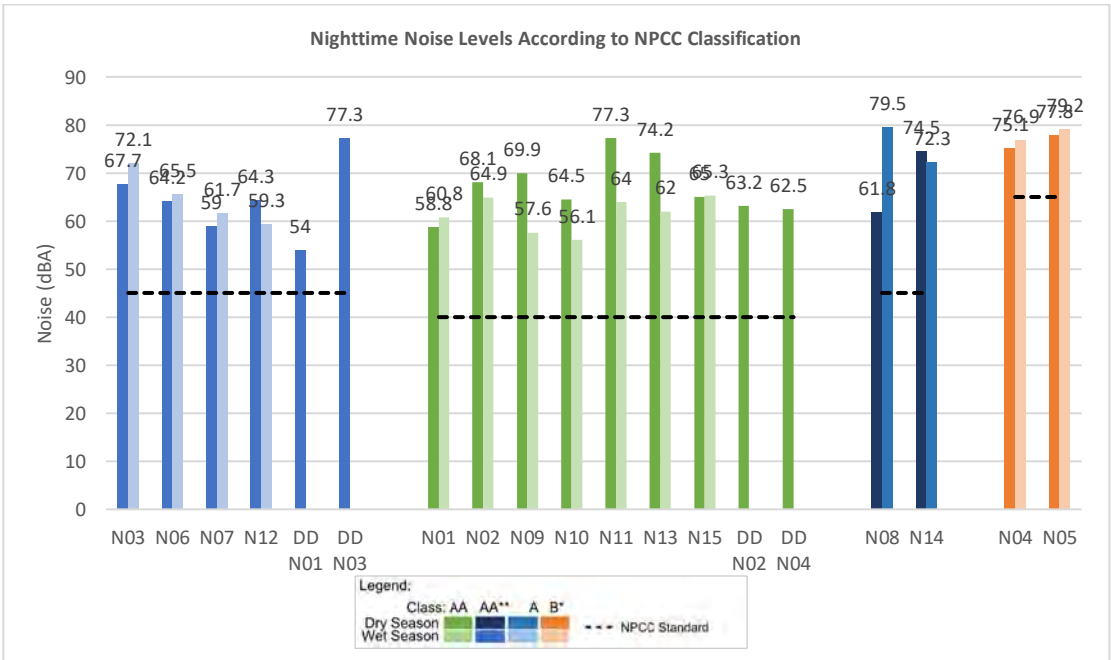


Figure 3.3.28 Nighttime Ambient Noise Levels According to NPCC MC 1980-002 Classification

b. Compliance with the WBG EHS Guidelines for Noise, 2007

Noise Levels During Daytime

1483. The noise levels in all stations classified as Residential, Institutional and Educational receptors exceeded the WBG EHS Guideline value of 55 dBA during daytime, while the noise levels in two (2) stations classified as Industrial/Commercial receptors also exceeded the WBG EHS Guideline value of 70 dBA during daytime. The daytime period as set by WBG covers the time from 7:00 AM to 10:00 PM.

1484. During dry season monitoring, the highest noise level of 77.2 dBA was measured at station N04 in PNR Buendia Station while the lowest noise level of 56.9 dBA was measured at station DD N02 in Banlic Depot Site. During wet season monitoring, the highest noise level of 99.0 dBA was measured at station N05 in PNR FTI Station while the lowest noise level of 58.5 dBA was measured at station N10 in PNR Biñan Station.

1485. It was noted that for both seasons, stations N06 in PNR Sucat, N11 in Cabuyao Central School, N13 in Tiyani Elementary School and N14 in Los Baños Municipal Health Center exceeded the WBG EHS Guideline value for Industrial and Commercial receptors, even though these are classified as Residential, Institutional and Educational receptors (see **Figure 3.3.29**).

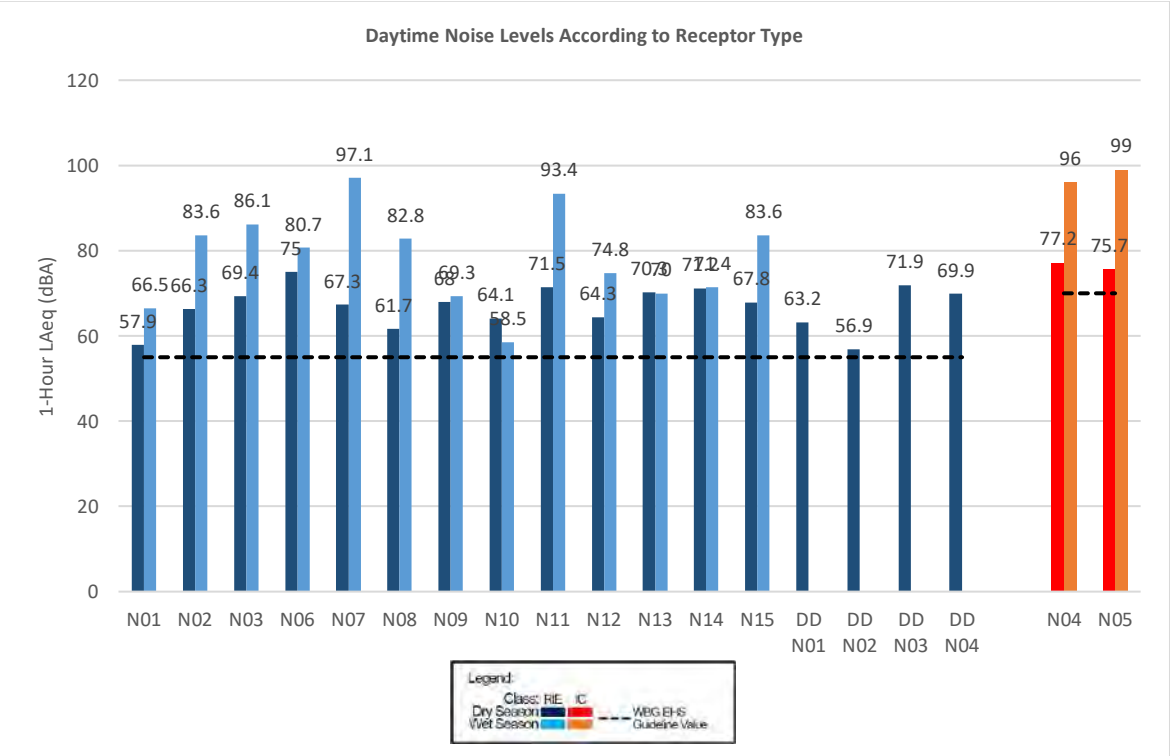


Figure 3.3.29 Daytime Ambient Noise Levels According to WBG EHS Guidelines for Noise

Noise Levels During Nighttime

1486. The noise levels in all stations classified as Residential, Institutional and Educational receptors exceeded the WBG EHS Guideline value of 45 dBA for nighttime, while the noise levels in two (2) stations categorized as Industrial/Commercial also exceeded the WBG EHS Guideline Value of 70 dBA for nighttime. The nighttime period as set by WBG covers the time between 10:00 PM to 7:00 AM.

1487. During dry season monitoring, the highest noise level of 76.5 dBA was measured at station N04 in PNR Buendia Station while the lowest noise level of 55.2 dBA was measured at station DD N02 in Banlic Depot Site. During wet season monitoring, the highest noise level of 85.1 dBA was measured at station N04 in PNR Buendia Station while the lowest noise level of 56.3 dBA was measured at station N10 in PNR Biñan Station.

1488. It was noted that for both seasons, station N14 in Los Baños Municipal Health Center exceeded the WBG EHS Guideline value for Industrial and Commercial receptors, even though it is classified under Residential, Institutional and Educational receptors (see **Figure 3.3.30**).

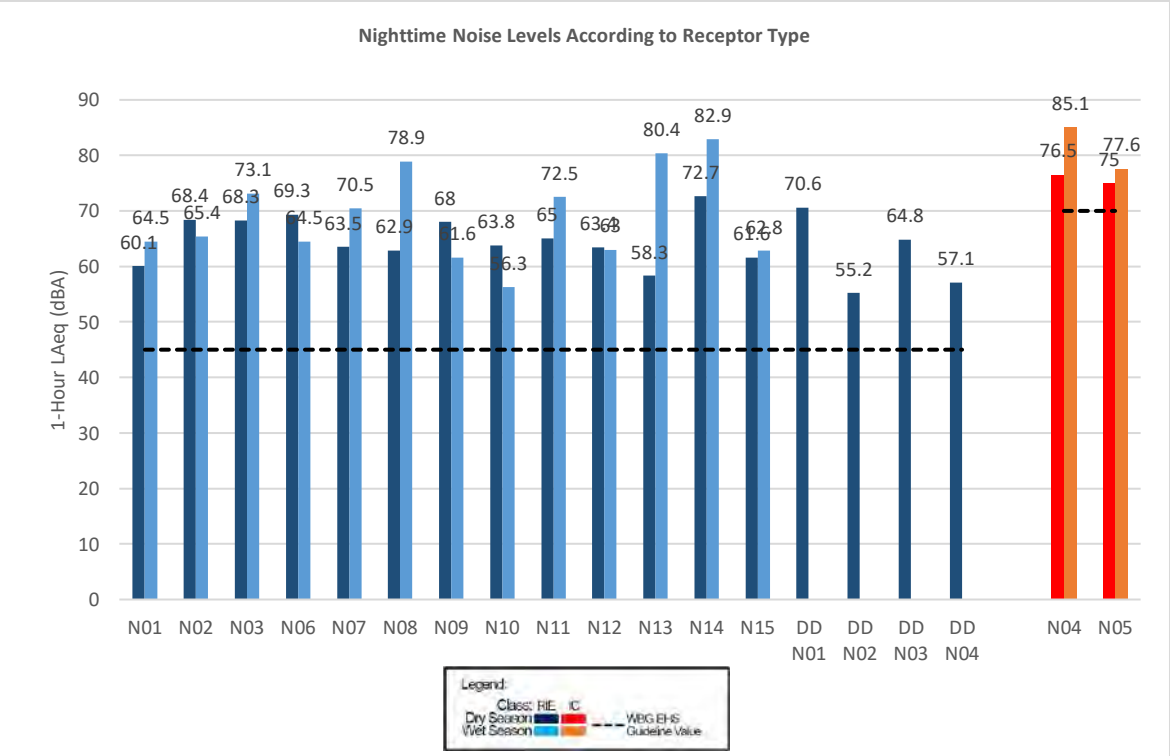


Figure 3.3.30 Nighttime Ambient Noise Levels According to WBG EHS Guidelines for Noise

3.3.3.2. Existing Noise Levels for Transit Noise Assessment

1489. The ambient noise measurements along the Blumentritt-Calamba section[2] was adequate to characterize the baseline ambient noise levels in compliance with requirements of the Philippine EIS System and to conclude the project area in general does not meet the noise standards for all time slices – morning, day, evening, and nighttime.

1490. However, with an average measurement density of 1 for every 4 kms railway length with the widest distances between two (2) measurement points reaching 7-8 kms apart (see **Figure 3.3.31** to **Figure 3.3.32)**, the 2018 wet season and 2019 dry season additional noise measurements were necessary to provide adequate baseline for the assessment of transit noise impacts particularly if there is a need to identify noise mitigation measures and design and install noise barriers. The selected sites for the wet season 2018 and dry season 2019 noise measurements generally[3] coincided with or near existing and proposed metro stations where the train operating speeds are slowest and correspondingly

[2] N01-N11, DD N02, DD N03, and DD N04
[3] 8 measurements were taken from PNR stations

lower operational noise levels. Further, ambient noise levels in the proposed station locations are relatively higher as they are located along major thoroughfares intersections of major roads like the Paco-Sta. Mesa Road, South Luzon Expressway, Manila South Road. As the ambient noise increases, the noise levels of the trains that will result to a 3dB(A) also increases as by the laws logarithm, a doubling of the noise level will increase the total noise level by 3dB(A). Confining the noise measurements along the major thoroughfares running parallel to the project's railway alignment or along the first layer of receivers along these major thoroughfares may lead to the underestimation of the noise impacts from the project.

1491. Additional 41 noise measurements were conducted between September 8-October 4, 2019 within 1-3 blocks away from the project's RoW to capture the potential impacts from an elevated linear noise source on areas that are not fully exposed to road noise but have direct line of sight to the project noise. These sites are also exposed to noise reflections from intervening buildings in contrast to baseline noise measurements which were done immediately along the project alignment. All noise measurements are within the noise assessment screening distance of 114 meters as provided by the U.S. Federal Highway Administration (FHWA) for rail projects with intervening buildings.

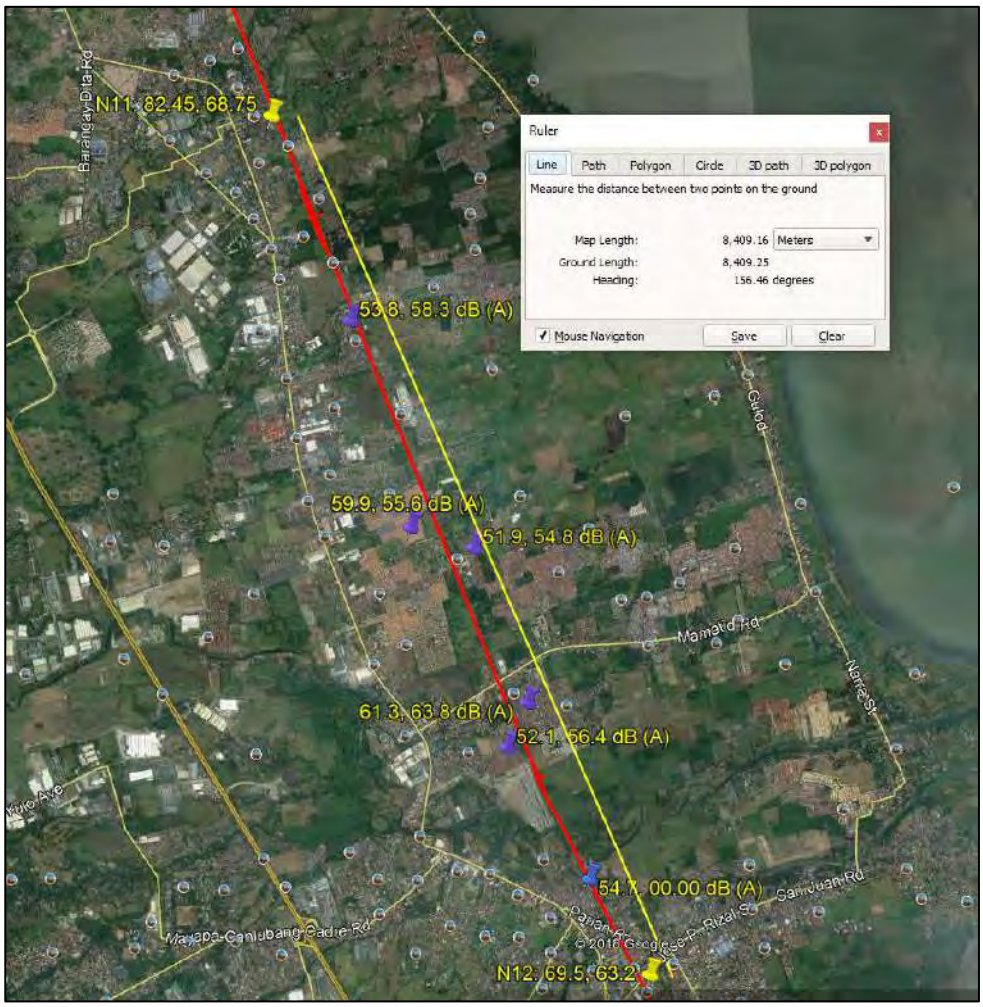


Figure 3.3.31 Distance Between Noise Measurement Locations N11 and N12 is about 8.4 kms

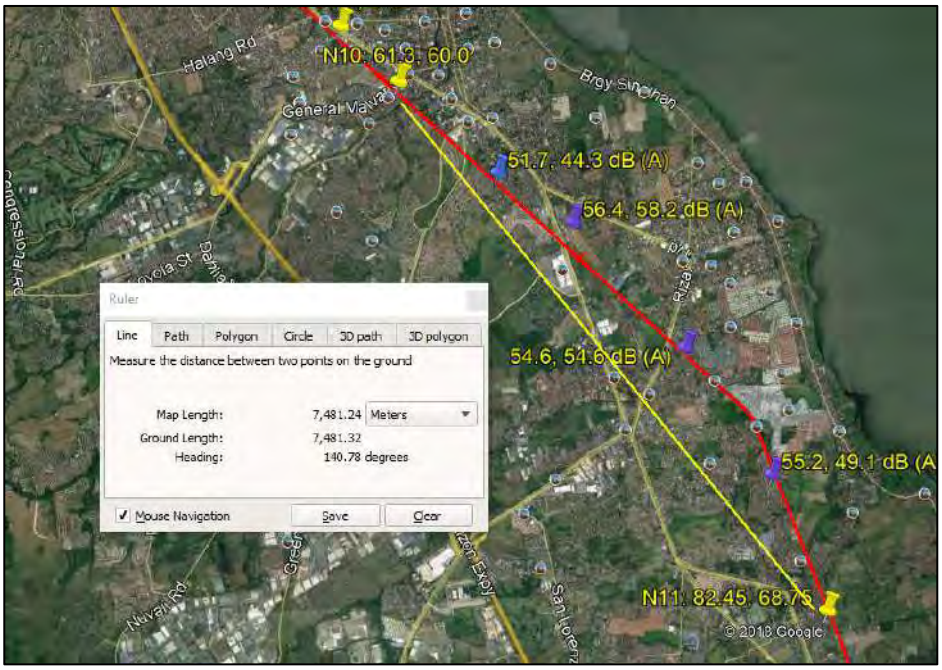


Figure 3.3.32 The distance between Noise Measurement Locations N10 and N11 is about 7.5 kms.

1492. The additional 41 short-term, 30-minute noise measurements were made between September 8-October 4, 2019. The microphone height was set at 1.5m above the ground. To the extent possible, the microphones were located at least 7.5 meters from a reflecting surface as required in the ANSI/ASA S12.9-2013 Part 3. However, the narrow streets with less than 7.5 meters formation widths prohibited the implementation of this requirement and instead, the microphones were positioned 1 m to 2 m away from the surface. Another consideration for the site selection is the safety of the team and the equipment. Nighttime measurements were not possible on the same location as the daytime measurements as the team were partly harassed by the locals and had no recourse but to abandon the activity.

1493. The noise descriptor that was adopted in the study is the one-hour A-weighted equivalent sound level [Leq(h)]. The 30-minute measurement duration was assumed to be "able to represent the one-hour Leq with a shorter-term measurement to reduce time and cost for the measurement study, but without sacrificing accuracy" as provided the FHWA guidelines.

1494. For the additional ambient noise measurements, 2 integrating sound level meters including microphone and preamplifier capable of 1-minute sampling intervals were used. These meters are the Extech Sound Meter Model SL 400 and a generic SL 5868P[4]. Each measurement is comprised of 30 records of 1-minute Leq at repeating intervals to allow the identification and removal of unrepresentative events like dog barking, motorcycle acceleration, and helicopter and ambulance pass byes. The sound meters were calibrated before and after the measurements using a Reed Instruments R8090 (SC-05) Sound Level Calibrator.

1495. The locations of the additional noise measurements and day and nighttime results are provided in the succeeding table and figures. The additional measurements, being located 1-3 blocks away from the project alignment yielded noise levels that are, on the average, 17.6 dB(A) and 12.7 dB(A) lower than the seasonal daytime and nighttime

[4] Complies with IEC 651.2 and ANSI 1.4.2

measurements along the project railway alignment. These figures were derived by comparing the 2 nearest measurements to the earlier seasonal noise measurements as illustrated in the succeeding Figures. The remarks column provides qualification why no measurements were made during nighttime or factors that lead to unexpected noise levels.

Table 3.3.24 Additional Noise Measurement Results

No.	Location	Coordinates		Average Noise		Dominant Source of Noise	Remarks
		Latitude	Longitude	Day	Night		
1	Ilang-Ilang St., Calamba Laguna	N 14º 11' 47"	E 121º 09' 40"	65.6	50.0	Motorcycle, Cars, Dog, Tricycle	
2	Near Villa Carpio Subdivision, Calamba, Laguna	N 14º 12' 53.74"	E 121º 09' 10.56"	54.7	No Data	Construction Site, Dog, People	Slum Area, unsafe during nighttime
3	San Cristobal Garden Homes, Sta. Rosa, Laguna	N 14º 13' 32"	E 121º 08' 46"	52.1	56.4	Motorcycle, Cars	Videoke playing, Playing Basketball during nighttime
4	Villa Palao Subd., Calamba Laguna	N 14º 13' 45"	E 121º 08' 52"	61.3	63.8	Motorcycle, Cars, People, Jeepney, People	playing basketball
5	San Isidro Homes, Cabuyao, Laguna	N 14º 41' 30"	E 121º 08' 36"	52.0	54.8	Motorcycle, People	
6	Birmingham Village, Sta. Rosa, Laguna	N 14º 14' 36"	E 121º 08' 17"	59.9	55.6	Motorcycle, Cars, People	
7	Katapatan Homes, Cabuyao, Laguna (Beside Pamantasan ng Cabuyao)	N 14º 15' 36"	E 121º 07' 59"	53.8	58.3	Motorcycle, Cars, People	ongoing house construction; playing basketball
8	Marysville Academy, Santa Rosa, Laguna	N 14º 17' 26"	E 121º 07' 14"	55.3	49.1	Cars, Motorcycle, Dog, Train	
9	Don Jose Zavalla Subd., Santa Rosa, Laguna	N 14º 18' 13"	E 121º 06' 41"	54.6	54.6	Dog, Motorcycle	
10	Howard Village, Tagapo, Santa Rosa, Laguna	N 14º 18' 59.7"	E 121º 05' 57.71"	56.4	58.2		
11	Near Platero - G. Sigue Road, Biñan, Laguna	N 14º 19' 18"	E 121º 05' 29"	51.7	44.3	Motorcycle, Dog	
12	Parking Area, Pacita Complex, San Pedro, Laguna	N 14º 20' 48"	E 121º 03' 43"	60.3	56.1	Cars, Tricycle, Motorcycle	
13	Jasmin cor. Crismore Ave., San Pedro Laguna	N 14º 21' 23"	E 121º 21' 23"	64.4	55.5	Cars, Tricycle, Motorcycle	
14	Ricarte St., San Pedro Laguna	N 14º 21' 54"	E 121º 03' 15"	55.0	51.4	Motorcycle, Jeepney, Cars	

No.	Location	Coordinates		Average Noise		Dominant Source of Noise	Remarks
		Latitude	Longitude	Day	Night		
15	E. Rodriguez Jr. Ave., Brgy. Tunasan, Muntinlupa City (Infront of Brgy. Hall)	N 14º 22' 37"	E 121º 02' 54"	69.0	59.4	Cars, Tricycle, Motorcycle, Jeepney, Truck	
16	St. John St., JPA Subd., Tunasan, Muntinlupa City	N 14º 23' 07"	E 121º 02' 46"	56.3	47.9	Cars, Motorcycle, Dog	
17	San Francisco St., Brgy. Putatan, Muntinlupa City	N 14º 23' 31"	E 121º 02' 48"	58.3	No Data	Motorcycle, People	Videoke playing; unsafe
18	The Church of Jesus Christ the Latter of Saint, Muntinlupa City	N 14º 24' 18.1"	E 121º 02' 49.72"	68.4	65.2	Cars, Tricycle, Motorcycle, Jeepney, Truck	
19	near Arevalo St., Parañaque City	N 14º 25' 45"	E 121º 02' 56"	54.7	58.0	Train, Motorcycle, People	
20	Espeleta St., Muntinlupa City	N 14º 26' 31"	E 121º 03' 06"	65.	No Data	Train, Motorcycle, People, fun fair	unsafe and too noisy due to fun fair
21	Lakefront Drive, Sucat, Parañaque City	N 14º 27' 54"	E 121º 03' 00"	58.5	61.1	Cars, Tricycle, Motorcycle	
22	Arthuro Drive, Mañalac Industrial Estate, Brgy. Bagumbayan, Taguig City	N 14º 28' 16.58"	E 121º 03' 9.28"	61.9	61.5	Cars, Motorcycle, Tricycle, Truck, Train	
23	1st Ave., Mañalac Industrial Estate, Brgy. Bagumbayan, Taguig City	N 14º 28' 38"	E 121º 03' 05"	66.0	72.0	Truck, Cars, Tricycle, Motorcycle	
24	Eric Oil Gas Station, East Service Road, Taguig City	N 14º 28' 58"	E 121º 02' 43"	74.8	73.1	Trucks, Cars, Motorcycle, Tricycle, Jeepney	Siren
25	7th Day Adventist Marian Road, Bicutan, Taguig City	N 14º 29' 45"	E 121º 2' 36"	59.6	62.1	Tricycle, Motorcycle, Cars, Truck	
26	Caltex Gas Station (Near C5 Extension), Parañaque City	N 14º 30' 33"	E 121º 01' 57"	67.8	65.6	Trucks, Cars, Motorcycle, Tricycle, Jeepney	
27	Rosal St., East Service Road, Taguig City	N 14º 30' 59.39"	E 121º 01' 54.76"	64.5	58.2	Airplane, Motorcycle, people, Dog	Ambulance
28	AFPOVI Phase III Subd., East Service Road, Taguig City	N 14º 31' 22.16"	E 121º 01' 38.22"	73.3	69.4	Cars, Truck, Jeepney, Train	Helicopter, Train passing

No.	Location	Coordinates		Average Noise		Dominant Source of Noise	Remarks
		Latitude	Longitude	Day	Night		
29	Magallanes Village, Lapu-Lapu St., Makati City	N 14º 32' 0.81"	E 121º 1' 8.16"	59.0	56.9	Cars, Motorcycle	
30	Don Bosco, Chino Roces Ave., Makati City	N 14º 32' 54.23"	E 121º 00' 55.57"	63.9	55.2	Cars, Motorcycle	
31	Sagrada Familya cor Amatista, Manila	N 14º 34' 09"	E 121º 00' 13"	58.4	54.9	Cars, Motorcycle, Tricycle, Truck	
32	4th St., Sta. Ana, Manila	N 14º 34' 35"	E 121º 0' 1"	61.4	58.8	Cars, Motorcycle, People, Dog	
33	Kahilom St., Manila	N 14º 34' 58"	E 121º 00' 19"	59.5	55.0	Cars, jeepney, motorcycle, people	
34	St. Luis Compound, Pandacan Manila	N 14º 35' 18"	E 121º 00' 16"	64.9	61.8	Cars, Motorcycle, Trucks	
35	Beata, Pandacan, Manila	N 14º 35' 27"	E 121º 0' 31"	67.0	64.6	Jeepney, Cars, Truck, Motorcycle, Train	
36	Oasis Condominium, Sta. Mesa Manila	N 14º 35' 46"	E 121º 00' 43"	60.6	59.9	Cars, Tricycle, Motorcycle, Train	Train Passing
37	Hippodromo St., Sta. Mesa, Manila	N 14º 36' 2"	E 121º 00' 31"	64.4	58.1	Cars, Tricycle, Motorcycle	
38	Visayan cor. Domingo Santiago St, Sampaloc, Manila	N 14º 36' 19"	E 121º 00' 16"	64.4	62.3	Cars, Motorcycle, People	motorcycle revolution
39	Sobriedad cor. V. Cruz, Sampaloc, Manila	N 14º 36' 30"	E 121º 59' 54"	69.8	60.8	Trucks, Cars, Motorcycle, Tricycle, Jeepney	
40	R. Cristobal St., Sampaloc, Manila	N 14º 37' 2"	E 121º 59' 26"	55.3	57.9	Cars, Motorcycle, People	
41	Vertex Road (Near SM San Lazaro), Manila	N 14º 37' 13"	E 121º 59' 08"	64.7	55.3	Cars, Motorcycle, Tricycle	engine running

Figure 3.3.33 Locations and Noise Level Measurements, Yellow Pin N02 for 2018 Wet Season and 2019 Dry Season Periods while Purple Pins are the Additional Noise Measurements conducted in Sept-Oct. 2019. Note the Drop in Noise Levels with Respect to Distance from the Project Alignment and the Shielding Effect of Intervening Buildings.

Figure 3.3.34 Locations and Noise Level Measurements, Yellow Pin N03 for 2018 Wet Season and 2019 Dry Season Periods while Purple Pins are the Additional Noise Measurements conducted in Sept-Oct. 2019. Note the Drop in Noise Levels with Respect to Distance and from the Project Alignment and the Shielding Effect of Intervening Buildings.

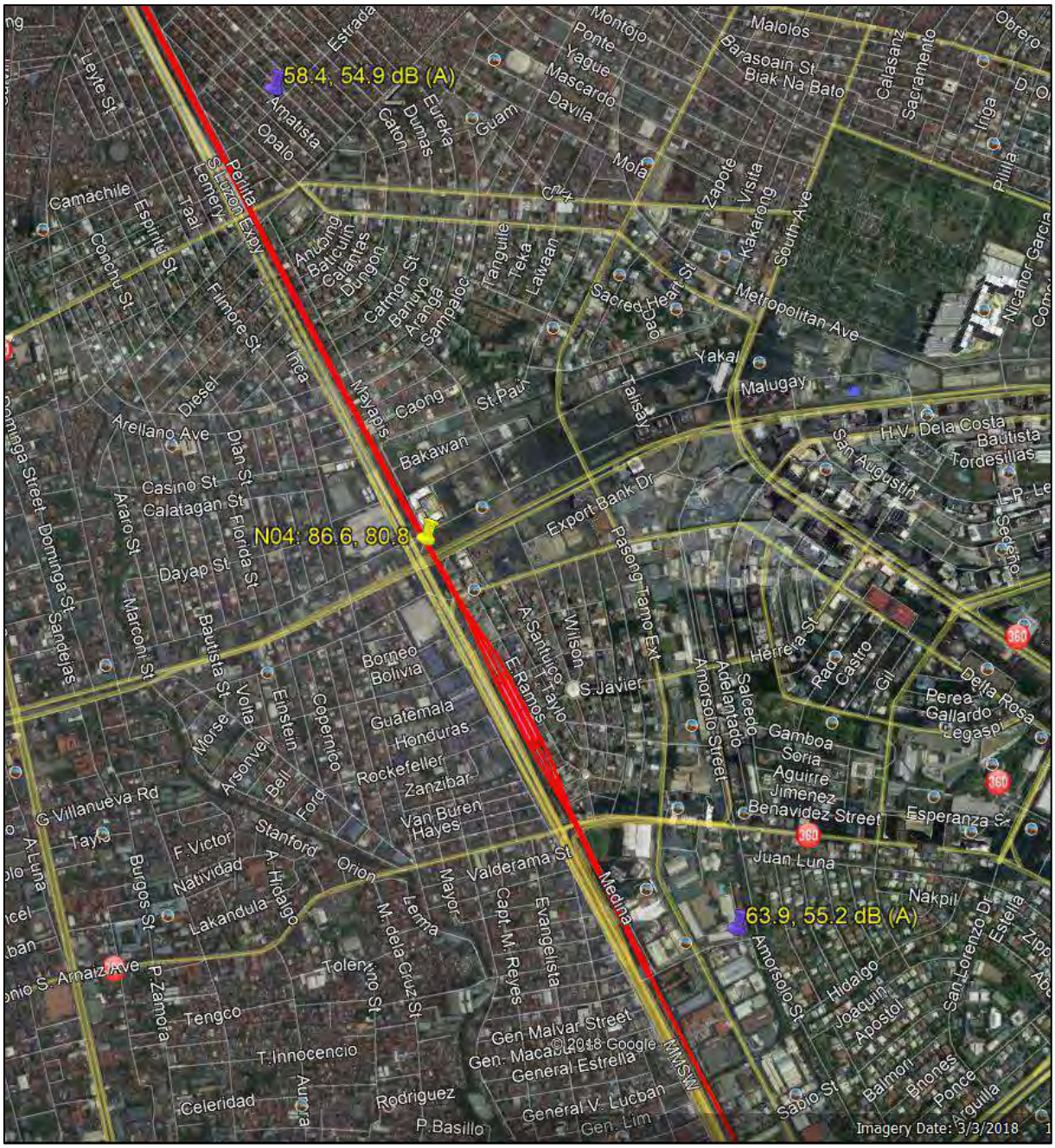
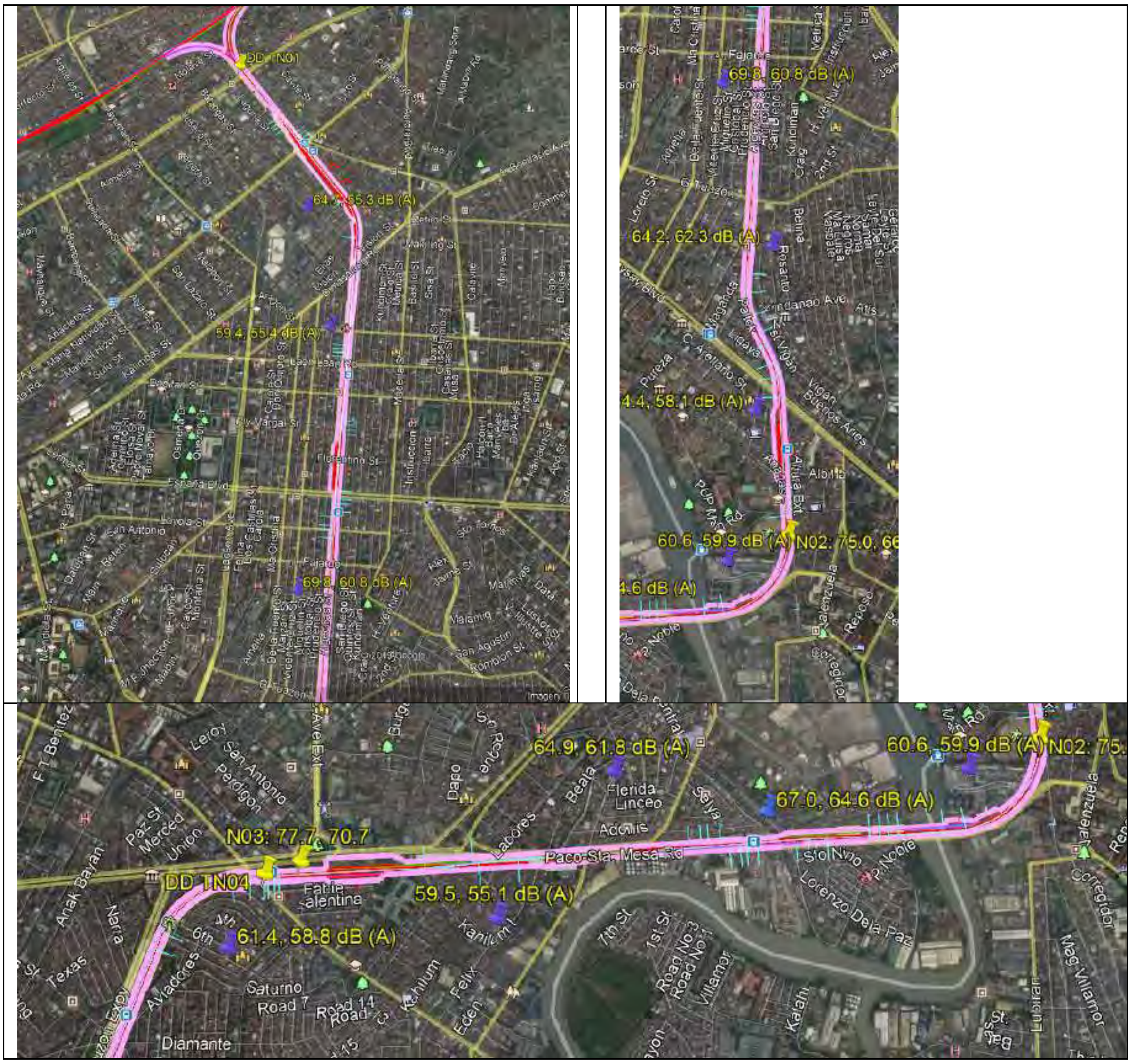


Figure 3.3.35 Locations and Noise Level Measurements, Yellow Pin N04 for 2018 Wet Season and 2019 Dry Season Periods while Purple Pins are the Additional Noise Measurements conducted in Sept-Oct. 2019. Note the Drop in Noise Levels with Respect to Distance from the Project Alignment and the Shielding Effect of Intervening Buildings.


DD TN01
69.8, 60.8 dB (A)
64.2, 62.3 dB (A)
59.4, 55.4 dB (A)
60.6, 59.9 dB (A)
N02: 75.0, 66
64.9, 61.8 dB (A)
67.0, 64.6 dB (A)
N03: 77.7, 70.7
DD TN04
59.5, 55.1 dB (A)
61.4, 58.8 dB (A)
Paco-Sta. Mesa Rd
Diamante
Saturno


58.9, 56.9 dB (A)
73.3, 69.4 dB (A)
64.5, 58.7 dB (A)


67.8, 65.5 dB (A)
DD_TN05
N05; 87.3, 76.3
59.6, 62.1 dB (A)


N05; 87.3, 76.3
59.6, 62.1 dB (A)
74.8, 73.2 dB (A)
65.9, 71.6 dB (A)
64.9, 61.5 dB (A)
58.5, 61.1 dB (A)
N06; 77.8, 66.9
64.7, 00.0 dB (A)
54.7, 57.9 dB (A)
DD_TN06


N07, 82.2, 67
65.2, 68.4 dB (A)
58.3, 00.0 dB (A)
56.2, 47.9 dB (A)
68.9, 59.4 dB (A)
DD TN07
N08, 72.2, 70.9
55.0, 51.4 dB (A)
64.3, 55.5 dB (A)
56.1, 60.3 dB (A)
N09, 68.6, 64.8
DD TN08
N10, 61.3, 60.0
51.7, 44.3 dB (A)
DD TN09
1, 82.45, 68.75
53.8, 58.3 dB (A)
59.9, 55.6 dB (A)
51.9, 54.8 dB (A)
63.8, 61.3 dB (A)
60.8, 00.0 dB (A)
52.1, 56.4 dB (A)
DD TN10
54.7, 00.00 dB (A)
DD NT 11


55.2, 49.1 dB (A)
DD TN09
Manila S Rd
63.8, 61.3 dB (A)
60.8, 00.0 dB (A
2.1, 56.4 dB (A)
54.7, 00.00 dB (
Calamba - Tagaytay Rd
San Vicente Ferrer Rd
© 2019 Google

Figure 3.3.36 Collage of Google Earth Images Showing the Locations and Noise Measurements for Day and Nighttime Time Slices used in the Noise Impact Assessment

3.3.3.3. Impact Identification, Prediction and Assessment, and Mitigation

1496. A comprehensive study[5] was carried out to assess noise impacts from the proposed Project. The detailed Noise and Vibration Analysis Report is provided in **Annex 3-5**. Key findings are summarized in this section.

(1) Pre-construction and Construction Phase

1) Assessment Criteria for Construction Noise

1497. The Philippines has no noise standards or criteria to guide the assessment of construction noise. A general compliance requirement to ambient noise standards are required from all projects, however, limited guide is provided when the existing noise levels exceeds the noise standards. The Philippine Government allows increases in the existing baseline noise levels like the FTA and IFC-EHS regulation and guidelines. The Philippine noise control regulation prohibits noise levels greater that the ambient noise standards of 55, 50, and 45 dB(A) during the day (9am-6PM), morning/evening (6PM-10PM), and night time (10PM-6AM), respectively, but allows 5 dB(A) and 10 dB(A) increase over the ambient standards for areas along a 4-lane road or more, respectively. In contrast, the IFC EHS

[5] A first assessment was conducted from January to May 2018 as part of the Feasibility Study. The study was refined and revised from October 2018 to demonstrate compliance of the project with ADB's Safeguard Policy Statement (2009). An update was made in December 2019 based on more detailed design particularly the railway's alignment, station location, design speed curves, and schedule of operation including the merging of subway at the Sucat Station. Assessment results are provided in Annex 3-5.

Guideline referred in the ADB SPS 2009 puts a limit to the allowable the maximum increase over the baseline of 3 d(BA).

1498. There are also no standard criteria developed by the FTA to assess the construction noise impacts from transit projects and instead a set of guidelines for "reasonable criteria for assessment" is used if there are no applicable state or local criteria applicable. The general guide is quoted below and adopted in the assessment of construction noise in addition to the ADB SPS 2009 requirements.

> "*Project construction noise criteria should take into account the existing noise environment, the absolute noise levels during construction activities, the duration of the construction, and the adjacent land use*."

1499. The succeeding Figures and Table present the FTA assessment criteria for different land uses. The assessment criteria are unlike Philippine national standards and the IFC-EHS that provide directly proportional limits to the project noise regardless of the existing noise levels. The Philippine ambient noise standards provide limits based on land uses but ambivalent on the allowable project noise when the existing noise levels already exceeds the standards. The IFC-EHS addresses the limitation of the national standards by providing ambient noise limits for different land uses, and if existing levels are already higher, allows a maximum increase in background levels of 3 dB(A). As previously mentioned, a 3 dB(A) increase results when the project noise equals the existing noise level for example, a 60 dB(A) noise level produced by an activity will result to a 3 dB(A) increase on an environment with the same noise level. Unlike the IFC-EHS, the FTA criteria varies accordingly with the changing existing noise level, i.e. it allows projects to exceed the 3 dB(A)[6] increase where the existing levels are lower than 55 dB(A)[7] and progressively decreases as the existing noise becomes louder. The FTA criteria allows increases higher than 3 dB(A) provided the total noise level at the receptor is within 55 dB(A). To illustrate, a project emitting 53 dB(A) in an environment with an existing noise of 45 dB(A) will result to a 53.6 dB(A) or 8 dB(A) higher and still be considered to cause no impact. In contrast, an area with an existing noise level of 55 dB(A) can only allow projects to emit the same level to ensure no impacts are generated. As the community becomes noisy, the allowable noise increase to avoid impacts is lower and at an existing noise level of 60 dB(A), a project is allowed to generate about 57 dB(A) or a total of 61.8 dB(A) or 1.8 dB(A) increase to have no impacts.

1500. Another notable difference between the FTA and the IFC EHS noise assessment is former's use of Ldn noise metric to characterize impacts in residential areas. Ldn is a single, A-weighted decibel value that accounts for total sound energy from all sound sources over 24 hours and is expressed in the unit, dBA. Events between 10 p.m. and 7 a.m. are increased by 10 dB to account for people's greater nighttime sensitivity to noise. The succeeding Figures and Table presents the FTA noise assessment criteria adopted in evaluation of construction noise.

[6] It should be noted that a 3 dB(A) change is barely perceptible, a 5dB(A) change is clearly perceptible, whole a 10 dB(A) change is considered double as loud or half as loud

[7] Expressed in Ldn for residential land uses or Leq(h) for highly noise sensitive, non-residential land uses

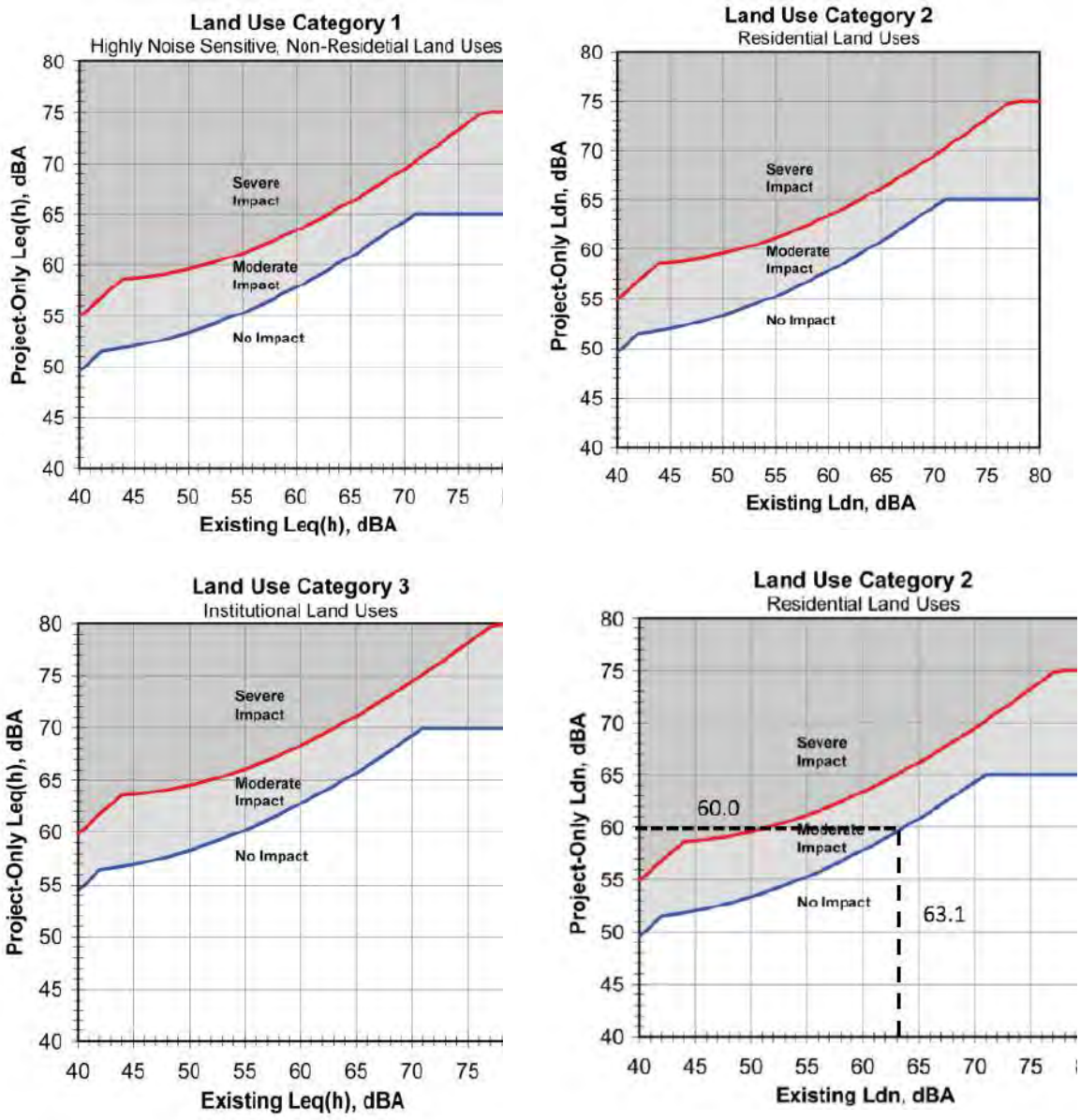


Figure 3.3.37 FTA Noise Impact Criteria

Table 3.3.25 Noise Levels Defining Impact for Transit Projects

Existing Noise Exposure, dBA	Project Noise Impact Exposure, dBA					
	Category 1 (Leq(1hr)) or 2 (Ldn) Sites			Category 3 Sites (Leq(1hr))		
Leq(1hr) or Ldn	No Impact	Moderate Impact	Severe Impact	No Impact	Moderate Impact	Severe Impact
<43	< Ambient+10	Ambient +10 to 15	> Ambient+15	< Ambient+15	Ambient +15 to 20	> Ambient+20
43	<52	52-58	>58	<57	57-63	>63
44	<52	52-58	>58	<57	57-63	>63
45	<52	52-58	>58	<57	57-63	>63
46	<53	53-59	>59	<58	58-64	>64
47	<53	53-59	>59	<58	58-64	>64
48	<53	53-59	>59	<58	58-64	>64
49	<54	54-59	>59	<59	59-64	>64
50	<54	54-59	>59	<59	59-64	>64

Existing Noise Exposure, dBA	Project Noise Impact Exposure, dBA					
	Category 1 (Leq(1hr)) or 2 (Ldn) Sites			Category 3 Sites (Leq(1hr))		
Leq(1hr) or Ldn	No Impact	Moderate Impact	Severe Impact	No Impact	Moderate Impact	Severe Impact
51	<54	54-60	>60	<59	59-65	>65
52	<55	55-60	>60	<60	60-65	>65
53	<55	55-60	>60	<60	60-65	>65
54	<55	55-61	>61	<60	60-66	>66
55	<56	56-61	>61	<61	61-66	>66
56	<56	56-62	>62	<61	61-67	>67
57	<57	57-62	>62	<62	62-67	>67
58	<57	57-62	>62	<62	62-67	>67
59	<58	58-63	>63	<63	63-68	>68
60	<58	58-63	>63	<63	63-68	>68
61	<59	59-64	>64	<64	64-69	>69
62	<59	59-64	>64	<64	64-69	>69
63	<60	60-65	>65	<65	65-70	>70
64	<61	61-65	>65	<66	66-70	>70
65	<61	61-66	>66	<66	66-71	>71
66	<62	62-67	>67	<67	67-72	>72
67	<63	63-67	>67	<68	68-72	>72
68	<63	63-68	>68	<68	68-73	>73
69	<64	64-69	>69	<69	69-74	>74
70	<65	65-69	>69	<70	70-74	>74
71	<66	66-70	>70	<71	71-75	>75
72	<66	66-71	>71	<71	71-76	>76
73	<66	66-71	>71	<71	71-76	>76
74	<66	66-72	>72	<71	71-77	>77
75	<66	66-73	>73	<71	71-78	>78
76	<66	66-74	>74	<71	71-79	>79
77	<66	66-74	>74	<71	71-79	>79
>77	<66	66-75	>75	<71	71-80	>80

Source: FTA (2019). Transit Noise and Vibration Manual

Table 3.3.26 Land Use Categories and Metrics for Transit Noise Impact Criteria

Land Use Category	Land Use Type	Noise Metric, dBA	Description of Land Use Category
1	High Sensitivity	Outdoor Leq(1hr)	Land where quiet is an essential element of its intended purpose. Example land uses include preserved land for serenity and quiet, outdoor amphitheaters and concert pavilions, and national historic landmarks with considerable outdoor use. Recording studios and concert halls are also included in this category.
2	Residential	Outdoor Ldn	This category is applicable to all residential land use and buildings where people normally sleep, such as hotels and hospitals.
3	Institutional	Outdoor Leq(1hr)	This category is applicable to institutional land uses with primarily daytime and evening use. Examples include schools, libraries, theaters, and churches where it is important to avoid interference with such activities as speech, meditation, and concentration on reading material. Places for meditation or study associated with cemeteries, monuments, museums, campgrounds, and recreational facilities are also included in this category.

2) Assessment Area

1501. In the assessment of construction noise, the Dimasalang and Piyo Margal section (est. 2+760 – 3+580 kms) was selected to represent a typical project section due to the presence of residential buildings that are located immediately outside the ROW and the lack of cohesive and single land use surrounding the railway tracks and instead hospitals, schools, and government offices are nestled in the middle of residential and commercial blocks. The locations of the sensitive receivers with respect to the project alignment areas provided on the succeeding Figure.

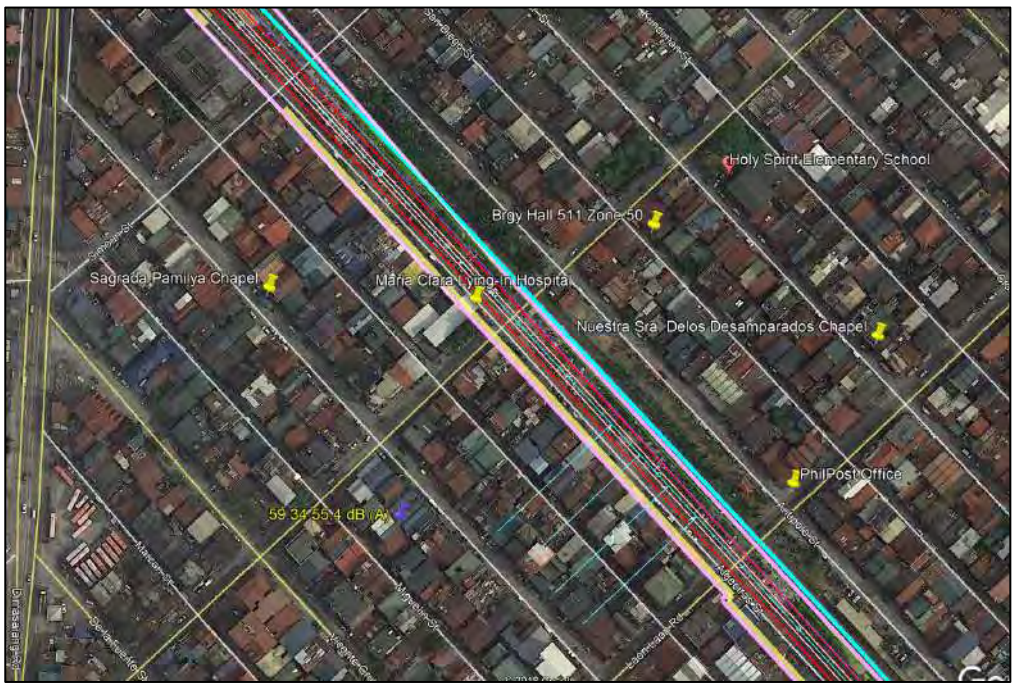


Figure 3.3.38 Selected Project Section for Construction Noise Assessment

1502. The measured day and nighttime equivalent noise levels (Leq) along the selected section, are 59.4 and 55.4 dB(A), respectively. The computed Ldn is 63.1 using the following equation: (It should be noted that the Ldn is not a measured value but was derived from 1-hour Leq measurements for day and nighttime)

$$Ldn = \frac{10\log(\text{energy sum of daytime, hourly Leqs} + (10 * \text{energy sum of nighttime, hourly Leq}))}{\text{Time period (hrs)}}$$

1503. For the assessment of construction noise, the following criteria were used, again based on the FTA.

Table 3.3.27 Noise Levels Defining the Construction Noise Impacts

Existing Noise Exposure, dBA	Project Noise Impact Exposure, dBA					
	Category 1 (Leq(1hr)) or 2 (Ldn) Sites			Category 3 Sites (Leq(1hr))		
	No Impact	Moderate Impact	Severe Impact	No Impact	Moderate Impact	Severe Impact
55 dBA Leq, n	<56	56-61	>61	<61	61-66	>66
59 dBA Leq, d	<58	58-63	>63	<63	63-68	>68
63 Ldn	<60	60-68	>68	NA	NA	NA

3) Assessment Findings

1504. The assessment of construction individually covered piling, footing, and piers construction, the erection of box girder segment, cast-in-place box girder, station building, and depot construction. Impact equipment were identified, and acoustical and sound power levels (Lw, dB(A)) were taken from the FTA Roadway Construction Noise Model User Guide and BS 5228-1:2009. Key findings are as follows:

- A 3-m temporary barrier made of wood or metal confining the active construction area is enough to reduce construction noise to Ldn 60 dB(A) during footing construction activities resulting to no residual impacts.
- The same wall can reduce impacts during in-situ piling from moderate to no impact except for the houses located along the ROW that may be exposed to moderate impacts.
- Pier construction will generate the most severe noise impacts particularly in the construction of the pier heads where the noise sources are elevated and higher than the noise wall.
- The launching of box girder which mainly utilizes cranes and girder erectors is anticipated to generate no significant impact.
- Station building construction is not anticipated to generate significant impact.

1505. The succeeding Figures show the Ldn contour maps and summary result tables of predicted noise levels with- and without the 3-m noise walls.

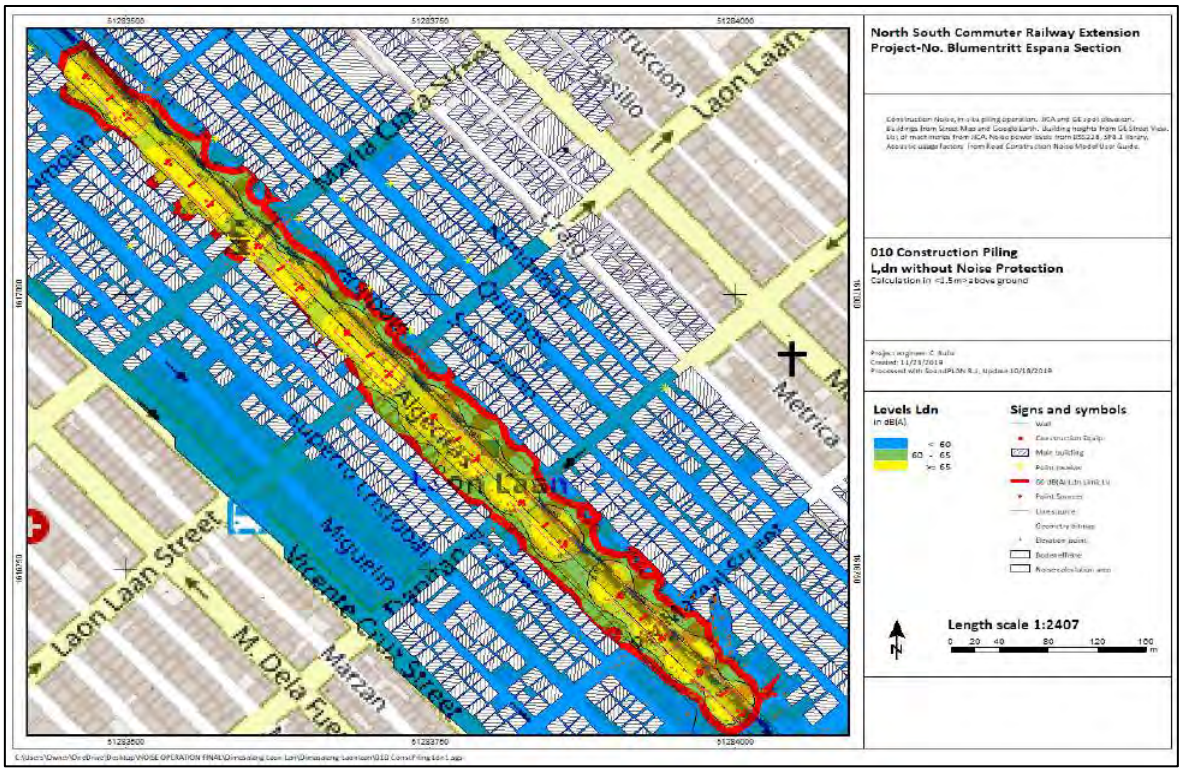


Figure 3.3.39 Predicted Noise Contours during Piling Activity Showing Ldn 60 dB(A) Limit Line

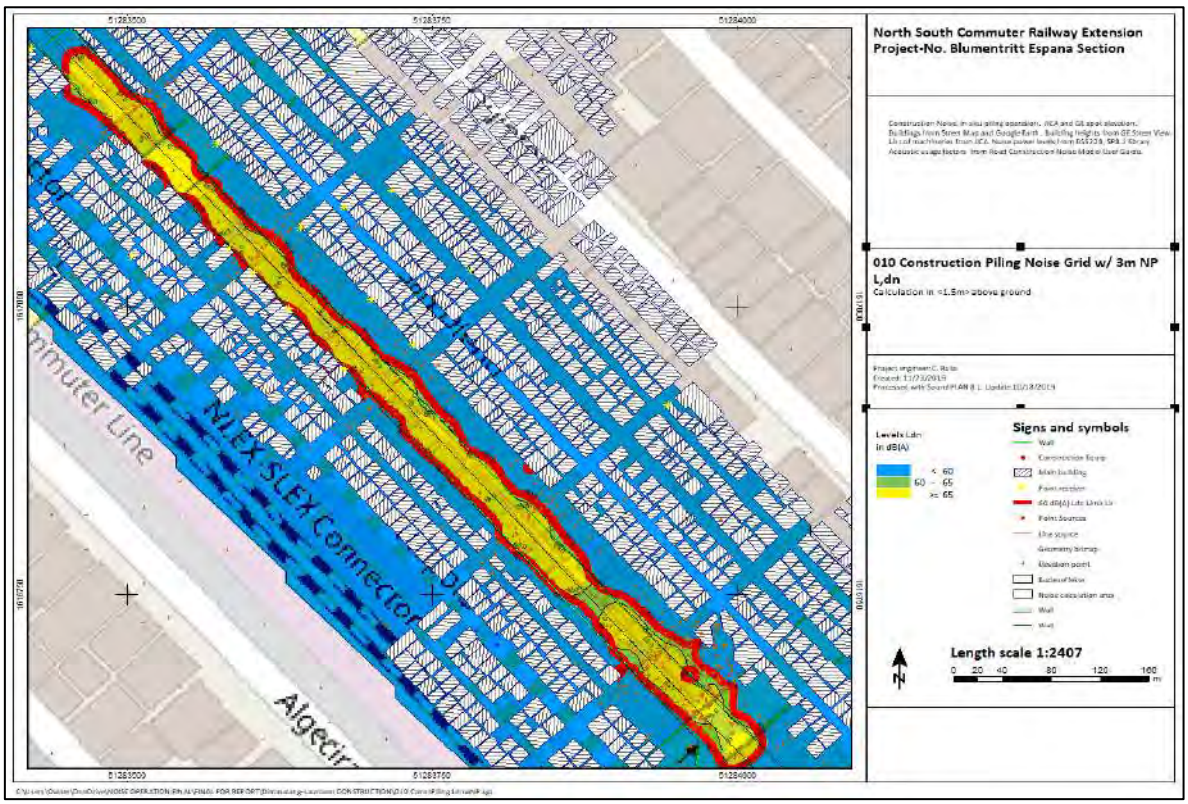


Figure 3.3.40 Predicted Noise Contours during Piling Activity with 3-M Noise Wall Showing the No Impact Ldn 60 dB(A) Limit Line

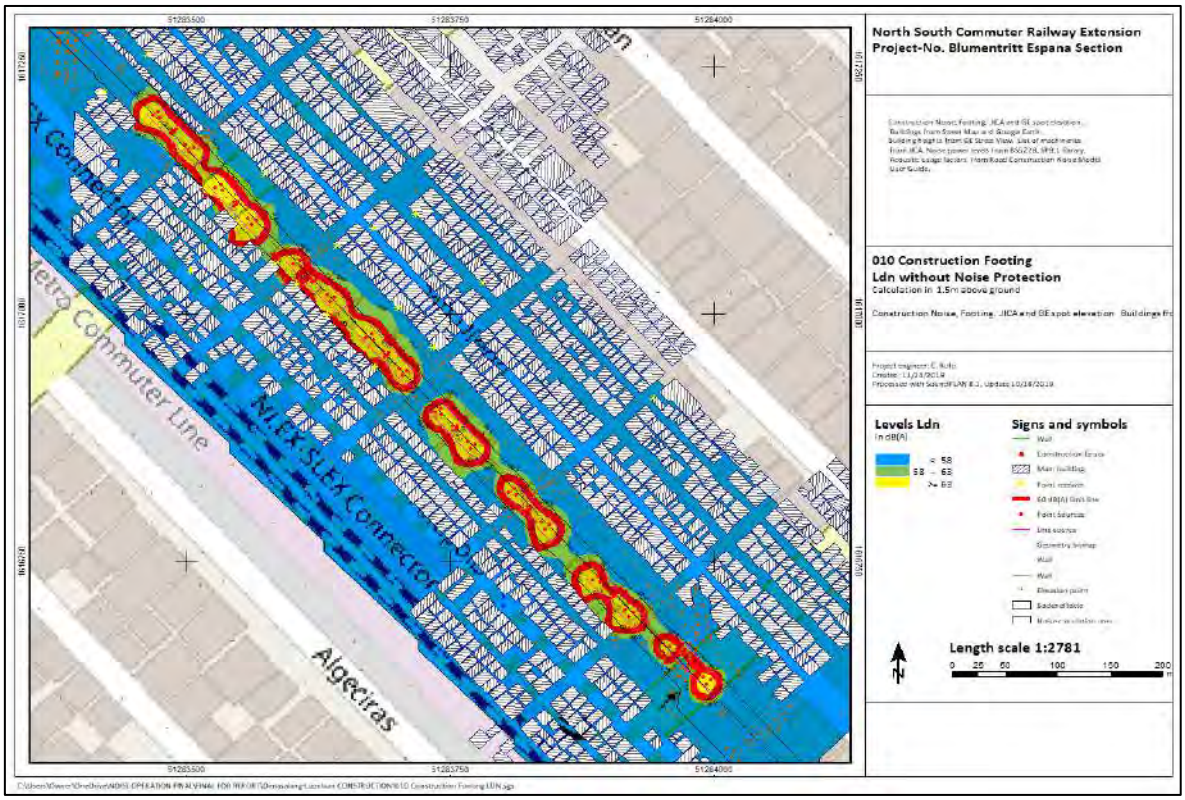


Figure 3.3.41 Predicted Noise Contours during Footing Construction, Ldn in dB(A)

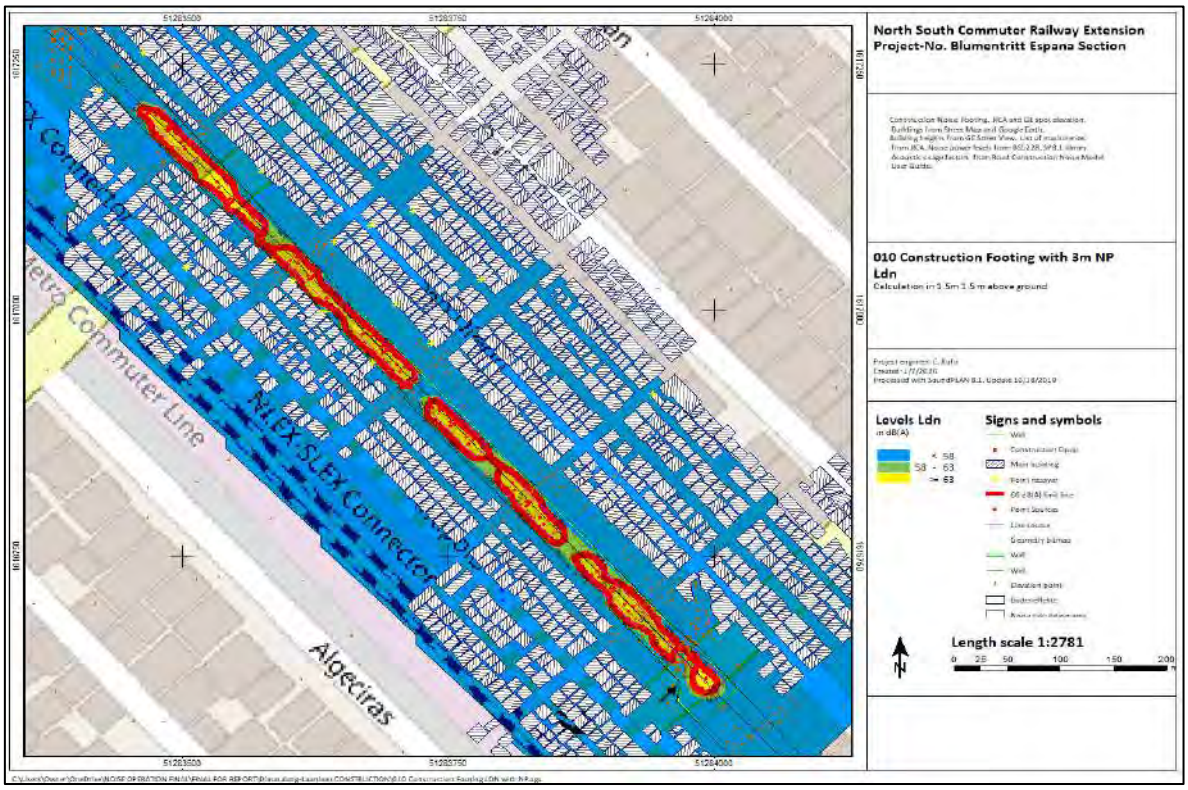


Figure 3.3.42 Predicted Noise Contours during Footing Construction, Ldn in dB(A) with 3-m Noise Wall

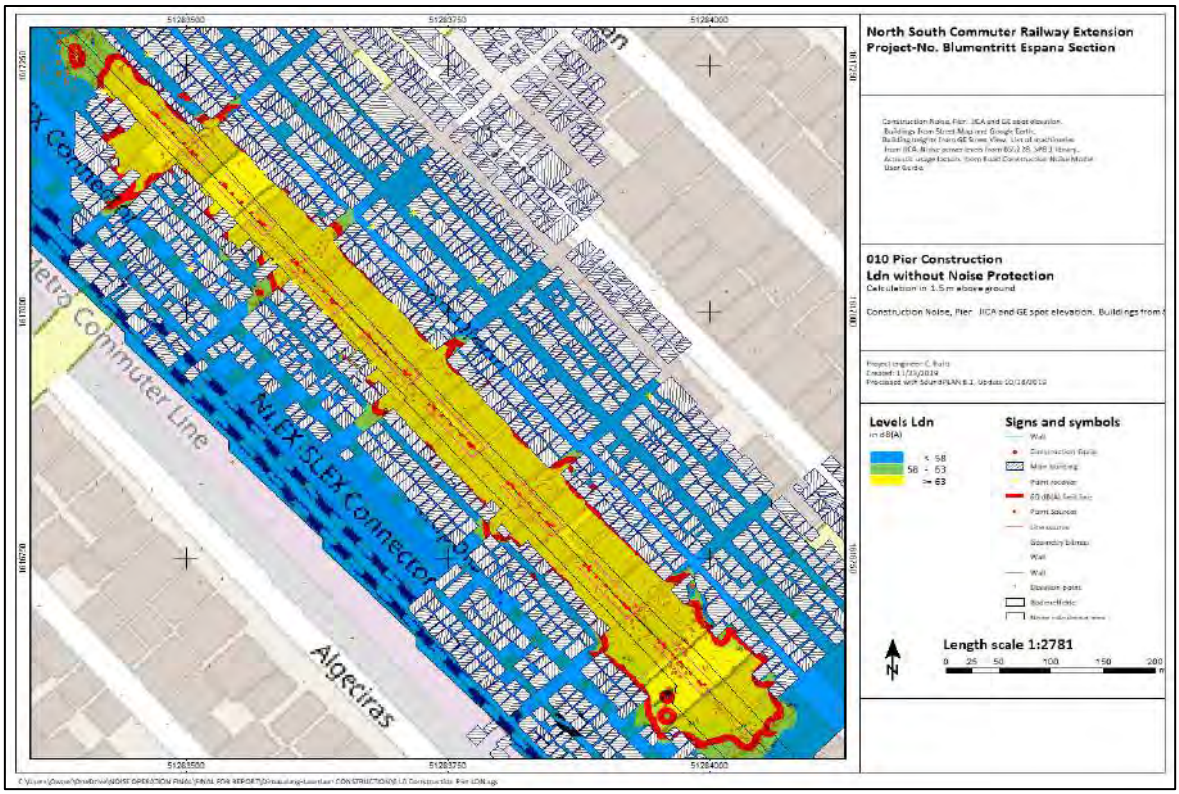


Figure 3.3.43 Predicted Noise Contours during Pier Construction, Ldn in dB(A)

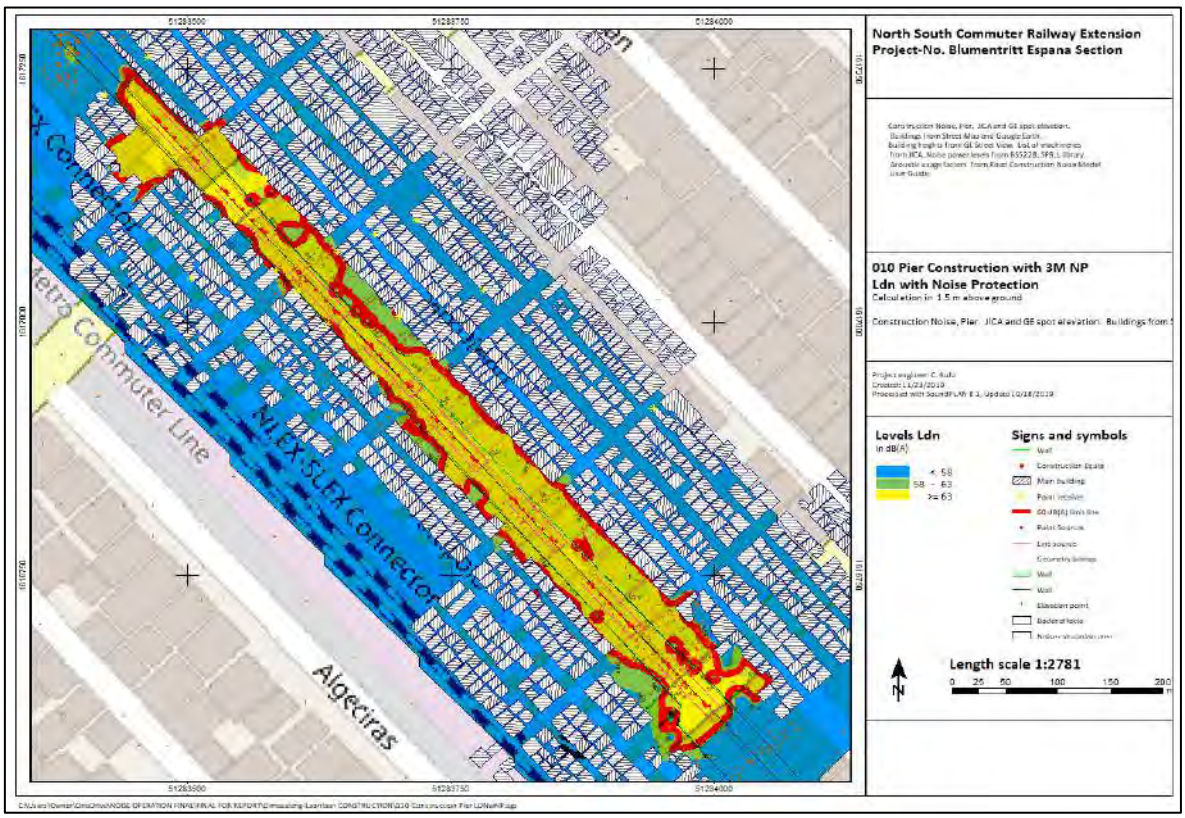


Figure 3.3.44 Predicted Noise Contours during Pier Construction with 3-m Noise Wall, Ldn in dB(A)

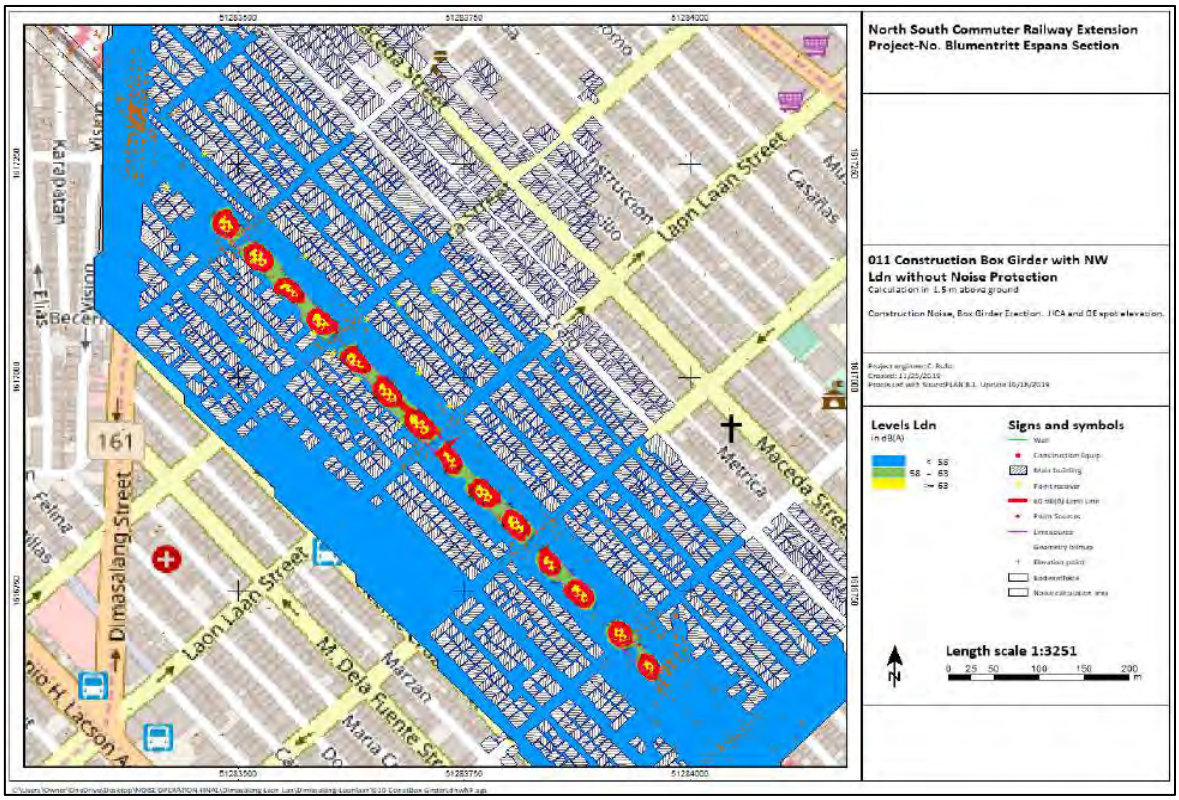


Figure 3.3.45 Predicted Noise Contours during Erection of Box Girder with 3M Noise Wall, Showing Ldn 60 dB(A) Limit Line

Table 3.3.28 Noise Assessment Construction Phase, Piling Activity

LU Cat	Floor	Receiver Name	Sensitive?	Existing Noise Level			Piling Operations Without Noise Wall			Impact			Piling Operations With Noise Wall			Impacts		
				Ldn	Leq,d	Leq,n	Ldn	Leq,d	Leq,n	Ldn	Leq,d	Leq,n	Ldn	Leq,d	Leq,n	Ldn	Leq,d	Leq,n
2	GF	Algeciras 1	N	63.1	59.4	55.4	63	56.6	56.6	Moderate			62.6	56.2	56.2	Moderate		
2	1.FL	Algeciras 1	N	63.1	59.4	55.4	63.3	56.9	56.9	Moderate			66.1	59.7	59.7	Moderate		
2	GF	Algeciras 13	N	63.1	59.4	55.4	67	60.6	60.6	Moderate			58.9	52.5	52.5	No		
2	GF	Algeciras 14	N	63.1	59.4	55.4	65	58.6	58.6	Moderate			57.4	51	51	No		
2	1.FL	Algeciras 14	N	63.1	59.4	55.4	65.8	59.3	59.3	Moderate			63.2	56.8	56.8	Moderate		
2	2.FL	Algeciras 14	N	63.1	59.4	55.4	66	59.5	59.5	Moderate			66	59.5	59.5	Moderate		
2	GF	Antipolo1	N	63.1	59.4	55.4	52.2	45.8	45.8	No			51.4	45	45	No		
2	1.FL	Antipolo1	N	63.1	59.4	55.4	53.4	47	47	No			53	46.6	46.6	No		
2	GF	Antipolo 2	N	63.1	59.4	55.4	59.1	52.6	52.6	No			57.9	51.5	51.5	No		
2	1.FL	Antipolo 2	N	63.1	59.4	55.4	60.1	53.6	53.6	Moderate			57.9	51.5	51.5	No		
2	GF	Antipolo 10	N	63.1	59.4	55.4	58.9	52.5	52.5	No			57	50.6	50.6	No		
2	1.FL	Antipolo 10	N	63.1	59.4	55.4	59.9	53.5	53.5	No			57.6	51.2	51.2	No		
2	2.FL	Antipolo 10	N	63.1	59.4	55.4	60.9	54.4	54.4	Moderate			58.4	52	52	No		
2	GF	Antipolo 11	N	63.1	59.4	55.4	58	51.6	51.6	No			57.3	50.9	50.9	No		
2	1.FL	Antipolo 11	N	63.1	59.4	55.4	58.6	52.2	52.2	No			57.9	51.5	51.5	No		
3	GF	Bgy Hall 50 Zone 50	Y	63.1	59.4	55.4	51.3	44.9	44.9		No	No	49.9	43.4	43.4		No	No
2	GF	Dimasalang Cor Algeciras	Y	63.1	59.4	55.4	53.5	47.1	47.1	No			51.6	45.2	45.2	No		
2	1.FL	Dimasalang Cor Algeciras	Y	63.1	59.4	55.4	55.3	48.8	48.8	No			55	48.6	48.6	No		
2	2.FL	Dimasalang Cor Algeciras	Y	63.1	59.4	55.4	56.1	49.7	49.7	No			55.7	49.3	49.3	No		
2	3.FL	Dimasalang Cor Algeciras	Y	63.1	59.4	55.4	55.6	49.2	49.2	No			55.4	49	49	No		
3	GF	Holy Spirit E/S	Y	63.1	59.4	55.4	47.4	40.9	40.9		No	No	46.4	40	40		No	No
3	1.FL	Holy Spirit E/S	Y	63.1	59.4	55.4	49.7	43.3	43.3		No	No	48.5	42.1	42.1		No	No
3	GF	Maria Clara Lying Inn Hospital	Y	63.1	59.4	55.4	62.5	56.1	56.1		No	No	59.8	53.4	53.4		No	No
3	1.FL	Maria Clara Lying Inn Hospital	Y	63.1	59.4	55.4	63.5	57	57		No	No	61.5	55.1	55.1		No	No
3	GF	Nuestra Sr. delos Desamparados Chapel	Y	63.1	59.4	55.4	45.1	38.7	38.7		No	No	44.1	37.7	37.7		No	No
3	1.FL	Nuestra Sr. delos Desamparados Chapel	Y	63.1	59.4	55.4	47.7	41.2	41.2		No	No	46.2	39.8	39.8		No	No
3	GF	PhilPost Office	Y	63.1	59.4	55.4	58.4	52	52		No	No	57.7	51.3	51.3		No	No
3	1.FL	PhilPost Office	Y	63.1	59.4	55.4	58.9	52.5	52.5		No	No	58.4	52	52		No	No
3	GF	Sagrada Familia Chapel	Y	63.1	59.4	55.4	44.6	38.2	38.2		No	No	42.8	36.4	36.4		No	No
3	1.FL	Sagrada Familia Chapel	Y	63.1	59.4	55.4	47.6	41.2	41.2		No	No	46.2	39.8	39.8		No	No
3	GF	Untal Clinic	Y	63.1	59.4	55.4	45.7	39.3	39.3		No	No	46.2	39.8	39.8		No	No
3	1.FL	Untal Clinic	Y	63.1	59.4	55.4	46.9	40.5	40.5		No	No	46.9	40.5	40.5		No	No

Table 3.3.29 Noise Assessment Pier Construction Activity, dB(A)

LU Cat	Floor	Receiver Name	Sensitive?	Existing Noise Level			Pier Operations Without Noise Wall			Impact			Pier Operations With Noise Wall			Impacts		
				Ldn	Leq,d	Leq,n	Ldn	Leq,d	Leq,n	Ldn	Leq,d	Leq,n	Ldn	Leq,d	Leq,n	Ldn	Leq,d	Leq,n
2	GF	Algeciras 1	N	63.1	59.4	55.4	70.8	64.4	64.4	Severe			64.5	58.1	58.1	Moderate		
2	1.FL	Algeciras 1	N	63.1	59.4	55.4	73.8	67.4	67.4	Severe			74.1	67.7	67.7	Severe		
2	GF	Algeciras 13	N	63.1	59.4	55.4	75.8	69.4	69.4	Severe			58.4	52	52	No		
2	GF	Algeciras 14	N	63.1	59.4	55.4	71.2	64.8	64.8	Severe			57.3	50.9	50.9	No		
2	1.FL	Algeciras 14	N	63.1	59.4	55.4	71.8	65.4	65.4	Severe			70	63.6	63.6	Severe		
2	2.FL	Algeciras 14	N	63.1	59.4	55.4	72.1	65.7	65.7	Severe			73	66.6	66.6	Severe		
2	GF	Antipolo1	N	63.1	59.4	55.4	51.5	45.1	45.1	No			51.6	45.2	45.2	No		
2	1.FL	Antipolo1	N	63.1	59.4	55.4	54.2	47.8	47.8	No			54.9	48.5	48.5	No		
2	GF	Antipolo 2	N	63.1	59.4	55.4	69.6	63.2	63.2	Severe			64.7	58.3	58.3	Moderate		
2	1.FL	Antipolo 2	N	63.1	59.4	55.4	70	63.6	63.6	Severe			68	61.6	61.6	Severe		
2	GF	Antipolo 10	N	63.1	59.4	55.4	69.6	63.1	63.1	Severe			58.8	52.4	52.4	No		
2	1.FL	Antipolo 10	N	63.1	59.4	55.4	69.5	63.1	63.1	Severe			62.4	56	56	Moderate		
2	2.FL	Antipolo 10	N	63.1	59.4	55.4	69.5	63.1	63.1	Severe			65.9	59.5	59.5	Severe		
2	GF	Antipolo 11	N	63.1	59.4	55.4	66.8	60.4	60.4	Severe			59.5	53.1	53.1	No		
2	1.FL	Antipolo 11	N	63.1	59.4	55.4	67.5	61.1	61.1	Severe			62.8	56.3	56.3	Moderate		
3	GF	Bgy Hall 50 Zone 50	Y	63.1	59.4	55.4	53.3	46.9	46.9				53.2	46.8	46.8			
2	GF	Dimasalang Cor Algeciras	Y	63.1	59.4	55.4	48.6	42.2	42.2	No			49.4	43	43	No		
2	1.FL	Dimasalang Cor Algeciras	Y	63.1	59.4	55.4	52.9	46.5	46.5	No			51.6	45.2	45.2	No		
2	2.FL	Dimasalang Cor Algeciras	Y	63.1	59.4	55.4	45.8	39.4	39.4	No			46.7	40.3	40.3	No		
2	3.FL	Dimasalang Cor Algeciras	Y	63.1	59.4	55.4	48.1	41.7	41.7	No			48.2	41.8	41.8	No		
3	GF	Maria Clara Lying Inn Hospital	Y	63.1	59.4	55.4	67.1	60.7	60.7		Moderate	Moderate	59.7	53.3	53.3		No	No
3	1.FL	Maria Clara Lying Inn Hospital	Y	63.1	59.4	55.4	69.1	62.7	62.7		Moderate	Severe	63.7	57.3	57.3		Moderate	Moderate
3	GF	Nuestra Sr. delos Desamparados Chapel	Y	63.1	59.4	55.4	48.1	41.7	41.7		No	No	49.8	43.4	43.4		No	No
3	1.FL	Nuestra Sr. delos Desamparados Chapel	Y	63.1	59.4	55.4	49.2	42.7	42.7		No	No	50.5	44.1	44.1		No	No
3	GF	PhilPost Office	Y	63.1	59.4	55.4	44.7	38.3	38.3		No	No	46.5	40	40		No	No
3	1.FL	PhilPost Office	Y	63.1	59.4	55.4	45.6	39.2	39.2		No	No	47.5	41.1	41.1		No	No
3	GF	Sagrada Familia Chapel	Y	63.1	59.4	55.4	63.7	57.2	57.2		Moderate	Moderate	57.7	51.3	51.3		No	No
3	1.FL	Sagrada Familia Chapel	Y	63.1	59.4	55.4	63.8	57.3	57.3		Moderate	Moderate	63.9	57.5	57.5		No	Moderate
3	GF	Untal Clinic	Y	63.1	59.4	55.4	64.2	57.8	57.8		Moderate	Moderate	65.2	58.8	58.8		Moderate	Moderate
3	1.FL	Untal Clinic	Y	63.1	59.4	55.4	64.3	57.9	57.9		Moderate	Moderate	64.6	58.2	58.2		Moderate	Moderate

Table 3.3.30 Noise Assessment Footing Construction Activity, dB(A)

LU Cat	Floor	Receiver Name	Sensitive?	Existing Noise Level			Footing Construction Without Noise Wall			Impact			Footing Construction With Noise Wall			Impacts		
				Ldn	Leq,d	Leq,n	Ldn	Leq,d	Leq,n	Ldn	Leq,d	Leq,n	Ldn	Leq,d	Leq,n	Ldn	Leq,d	Leq,n
2	GF	Algeciras 1	N	63.1	59.4	55.4	59.9	53.4	53.4	No			40	33.6	33.6	No		
2	1.FL	Algeciras 1	N	63.1	59.4	55.4	60.3	53.8	53.8	Moderate			41.5	35.1	35.1	No		
2	GF	Algeciras 13	N	63.1	59.4	55.4	62.1	55.7	55.7	Moderate			39.5	33.1	33.1	No		
2	GF	Algeciras 14	N	63.1	59.4	55.4	57.7	51.3	51.3	No			40.4	34	34	No		
2	1.FL	Algeciras 14	N	63.1	59.4	55.4	59	52.6	52.6	No			41.2	34.8	34.8	No		
2	2.FL	Algeciras 14	N	63.1	59.4	55.4	59	52.6	52.6	No			43.1	36.7	36.7	No		
2	GF	Antipolo1	N	63.1	59.4	55.4	38.8	32.4	32.4	No			36.5	30.1	30.1	No		
2	1.FL	Antipolo1	N	63.1	59.4	55.4	41.4	34.9	34.9	No			37.2	30.8	30.8	No		
2	GF	Antipolo 2	N	63.1	59.4	55.4	55.6	49.2	49.2	No			40.9	34.5	34.5	No		
2	1.FL	Antipolo 2	N	63.1	59.4	55.4	55.6	49.2	49.2	No			43	36.6	36.6	No		
2	GF	Antipolo 10	N	63.1	59.4	55.4	55.1	48.7	48.7	No			39	32.6	32.6	No		
2	1.FL	Antipolo 10	N	63.1	59.4	55.4	55.3	48.9	48.9	No			40.1	33.7	33.7	No		
2	2.FL	Antipolo 10	N	63.1	59.4	55.4	55.4	49	49	No			41.9	35.4	35.4	No		
2	GF	Antipolo 11	N	63.1	59.4	55.4	53.7	47.3	47.3	No			39.4	33	33	No		
2	1.FL	Antipolo 11	N	63.1	59.4	55.4	54.9	48.5	48.5	No			40.5	34.1	34.1	No		
3	GF	Bgy Hall 50 Zone 50	Y	63.1	59.4	55.4	39.4	33	33		No	No	34.6	28.2	28.2		No	No
2	GF	Dimasalang Cor Algeciras	Y	63.1	59.4	55.4	51.4	45	45	No			33.9	27.5	27.5	No		
2	1.FL	Dimasalang Cor Algeciras	Y	63.1	59.4	55.4	51.5	45.1	45.1	No			36.4	30	30	No		
2	2.FL	Dimasalang Cor Algeciras	Y	63.1	59.4	55.4	51.9	45.5	45.5	No			40.5	34	34	No		
2	3.FL	Dimasalang Cor Algeciras	Y	63.1	59.4	55.4	52	45.6	45.6	No			47.1	40.7	40.7	No		
3	GF	Holy Spirit E/S	Y	63.1	59.4	55.4	35.1	28.7	28.7		No	No	31.9	25.5	25.5		No	No
3	1.FL	Holy Spirit E/S	Y	63.1	59.4	55.4	39.6	33.2	33.2		No	No	33.8	27.4	27.4		No	No
3	GF	Maria Clara Lying Inn Hospital	Y	63.1	59.4	55.4	60.4	54	54		Moderate	No	39.7	33.3	33.3		No	No
3	1.FL	Maria Clara Lying Inn Hospital	Y	63.1	59.4	55.4	60.3	53.9	53.9		Moderate	No	40.1	33.7	33.7		No	No
3	GF	Nuestra Sr. delos Desamparados Chapel	Y	63.1	59.4	55.4	32.8	26.4	26.4		No	No	30.5	24.1	24.1		No	No
3	1.FL	Nuestra Sr. delos Desamparados Chapel	Y	63.1	59.4	55.4	35	28.6	28.6		No	No	31	24.6	24.6		No	No
3	GF	PhilPost Office	Y	63.1	59.4	55.4	54.3	47.9	47.9		No	No	39.6	33.2	33.2		No	No
3	1.FL	PhilPost Office	Y	63.1	59.4	55.4	54.7	48.3	48.3		No	No	40.7	34.3	34.3		No	No
3	GF	Sagrada Familia Chapel	Y	63.1	59.4	55.4	34.2	27.8	27.8		No	No	33.1	26.7	26.7		No	No
3	1.FL	Sagrada Familia Chapel	Y	63.1	59.4	55.4	35.6	29.1	29.1		No	No	33.6	27.2	27.2		No	No
3	GF	Untal Clinic		63.1	59.4	55.4	30.7	24.3	24.3		No	No	29.9	23.4	23.4		No	No
3	1.FL	Untal Clinic		63.1	59.4	55.4	31.8	25.3	25.3		No	No	30.1	23.7	23.7		No	No

Table 3.3.31 Noise Assessment Box Girder Construction Activity, dB(A)

LU Cat	Floor	Receiver Name	Sensitive?	Existing Noise Level			Box Girder Construction Without Noise Wall			Impact			Box Girder Construction With Noise Wall			Impacts		
				Ldn	Leq,d	Leq,n	Ldn	Leq,d	Leq,n	Ldn	Leq,d	Leq,n	Ldn	Leq,d	Leq,n	Ldn	Leq,d	Leq,n
2	GF	Algeciras 1	N	63.1	59.4	55.4	54.3	47.9	47.9	No			44.8	38.4	38.4	No		
2	1.FL	Algeciras 1	N	63.1	59.4	55.4	56.2	49.8	49.8	No			47.3	40.9	40.9	No		
2	GF	Algeciras 13	N	63.1	59.4	55.4	56.9	50.5	50.5	No			43.6	37.2	37.2	No		
2	GF	Algeciras 14	N	63.1	59.4	55.4	56.5	50.1	50.1	No			46.3	39.9	39.9	No		
2	1.FL	Algeciras 14	N	63.1	59.4	55.4	57.8	51.4	51.4	No			47.9	41.5	41.5	No		
2	2.FL	Algeciras 14	N	63.1	59.4	55.4	58.8	52.4	52.4	No			50.4	44	44	No		
2	GF	Antipolo1	N	63.1	59.4	55.4	42.8	36.4	36.4	No			40.8	34.4	34.4	No		
2	1.FL	Antipolo1	N	63.1	59.4	55.4	43.7	37.3	37.3	No			41.7	35.2	35.2	No		
2	GF	Antipolo 2	N	63.1	59.4	55.4	52.5	46.1	46.1	No			45.9	39.5	39.5	No		
2	1.FL	Antipolo 2	N	63.1	59.4	55.4	53.1	46.7	46.7	No			46.7	40.3	40.3	No		
2	GF	Antipolo 10	N	63.1	59.4	55.4	52.5	46.1	46.1	No			45.1	38.7	38.7	No		
2	1.FL	Antipolo 10	N	63.1	59.4	55.4	53.4	47	47	No			45.8	39.4	39.4	No		
2	2.FL	Antipolo 10	N	63.1	59.4	55.4	54.2	47.8	47.8	No			46.5	40.1	40.1	No		
2	GF	Antipolo 11	N	63.1	59.4	55.4	51.6	45.2	45.2	No			45	38.6	38.6	No		
2	1.FL	Antipolo 11	N	63.1	59.4	55.4	52.4	46	46	No			45.6	39.2	39.2	No		
3	GF	Bgy Hall 50 Zone 50	Y	63.1	59.4	55.4	44.3	37.9	37.9		No	No	38.3	31.8	31.8		No	No
2	GF	Dimasalang Cor Algeciras	Y	63.1	59.4	55.4	43	36.6	36.6	No			39.4	32.9	32.9	No		
2	1.FL	Dimasalang Cor Algeciras	Y	63.1	59.4	55.4	44.7	38.3	38.3	No			41.7	35.3	35.3	No		
2	2.FL	Dimasalang Cor Algeciras	Y	63.1	59.4	55.4	45.3	38.9	38.9	No			43.3	36.9	36.9	No		
2	3.FL	Dimasalang Cor Algeciras	Y	63.1	59.4	55.4	45.3	38.9	38.9	No			45.7	39.2	39.2	No		
3	GF	Holy Spirit E/S	Y	63.1	59.4	55.4	40.6	34.2	34.2		No	No	35.2	28.8	28.8		No	No
3	1.FL	Holy Spirit E/S	Y	63.1	59.4	55.4	42.5	36.1	36.1		No	No	36.8	30.4	30.4		No	No
3	GF	Maria Clara Lying Inn Hospital	Y	63.1	59.4	55.4	58.1	51.7	51.7		No	No	47.7	41.3	41.3		No	No
3	1.FL	Maria Clara Lying Inn Hospital	Y	63.1	59.4	55.4	59.5	53.1	53.1		No	No	48.4	42	42		No	No
3	GF	Nuestra Sr. delos Desamparados Chapel	Y	63.1	59.4	55.4	38.6	32.2	32.2		No	No	34.6	28.2	28.2		No	No
3	1.FL	Nuestra Sr. delos Desamparados Chapel	Y	63.1	59.4	55.4	40.9	34.5	34.5		No	No	35.8	29.4	29.4		No	No
3	GF	PhilPost Office	Y	63.1	59.4	55.4	51.9	45.5	45.5		No	No	45.6	39.1	39.1		No	No
3	1.FL	PhilPost Office	Y	63.1	59.4	55.4	53	46.5	46.5		No	No	46.2	39.8	39.8		No	No
3	GF	Sagrada Familia Chapel	Y	63.1	59.4	55.4	36.2	29.8	29.8		No	No	34	27.6	27.6		No	No
3	1.FL	Sagrada Familia Chapel	Y	63.1	59.4	55.4	39.6	33.2	33.2		No	No	36.2	29.8	29.8		No	No
3	GF	Untal Clinic		63.1	59.4	55.4	35.4	29	29		No	No	32.5	26.1	26.1		No	No
	1.FL	Untal Clinic		63.1	59.4	55.4	37.2	30.8	30.8		No	No	33.5	27.1	27.1		No	No

LU Cat	Floor	Receiver Name	Sensitive?	Existing Noise Level			Footing Construction Without Noise Wall			Impact			Footing Construction Without Noise Wall			Impacts		
				Ldn	Leq,d	Leq,n	Ldn	Leq,d	Leq,n	Ldn	Leq,d	Leq,n	Ldn	Leq,d	Leq,n	Ldn	Leq,d	Leq,n
2	GF	Algeciras 1	N	63.1	59.4	55.4	59.9	53.4	53.4	No			40	33.6	33.6	No		
2	1.FL	Algeciras 1	N	63.1	59.4	55.4	60.3	53.8	53.8	Moderate			41.5	35.1	35.1	No		
2	GF	Algeciras 13	N	63.1	59.4	55.4	62.1	55.7	55.7	Moderate			39.5	33.1	33.1	No		
2	GF	Algeciras 14	N	63.1	59.4	55.4	57.7	51.3	51.3	No			40.4	34	34	No		
2	1.FL	Algeciras 14	N	63.1	59.4	55.4	59	52.6	52.6	No			41.2	34.8	34.8	No		
2	2.FL	Algeciras 14	N	63.1	59.4	55.4	59	52.6	52.6	No			43.1	36.7	36.7	No		
2	GF	Antipolo1	N	63.1	59.4	55.4	38.8	32.4	32.4	No			36.5	30.1	30.1	No		
2	1.FL	Antipolo1	N	63.1	59.4	55.4	41.4	34.9	34.9	No			37.2	30.8	30.8	No		
2	GF	Antipolo 2	N	63.1	59.4	55.4	55.6	49.2	49.2	No			40.9	34.5	34.5	No		
2	1.FL	Antipolo 2	N	63.1	59.4	55.4	55.6	49.2	49.2	No			43	36.6	36.6	No		
2	GF	Antipolo 10	N	63.1	59.4	55.4	55.1	48.7	48.7	No			39	32.6	32.6	No		
2	1.FL	Antipolo 10	N	63.1	59.4	55.4	55.3	48.9	48.9	No			40.1	33.7	33.7	No		
2	2.FL	Antipolo 10	N	63.1	59.4	55.4	55.4	49	49	No			41.9	35.4	35.4	No		
2	GF	Antipolo 11	N	63.1	59.4	55.4	53.7	47.3	47.3	No			39.4	33	33	No		
2	1.FL	Antipolo 11	N	63.1	59.4	55.4	54.9	48.5	48.5	No			40.5	34.1	34.1	No		
3	GF	Bgy Hall 50 Zone 50	Y	63.1	59.4	55.4	39.4	33	33		No	No	34.6	28.2	28.2		No	No
2	GF	Dimasalang Cor Algeciras	Y	63.1	59.4	55.4	51.4	45	45	No			33.9	27.5	27.5	No		
2	1.FL	Dimasalang Cor Algeciras	Y	63.1	59.4	55.4	51.5	45.1	45.1	No			36.4	30	30	No		
2	2.FL	Dimasalang Cor Algeciras	Y	63.1	59.4	55.4	51.9	45.5	45.5	No			40.5	34	34	No		
2	3.FL	Dimasalang Cor Algeciras	Y	63.1	59.4	55.4	52	45.6	45.6	No			47.1	40.7	40.7	No		
3	GF	Holy Spirit E/S	Y	63.1	59.4	55.4	35.1	28.7	28.7		No	No	31.9	25.5	25.5		No	No
3	1.FL	Holy Spirit E/S	Y	63.1	59.4	55.4	39.6	33.2	33.2		No	No	33.8	27.4	27.4		No	No
3	GF	Maria Clara Lying Inn Hospital	Y	63.1	59.4	55.4	60.4	54	54		Moderate	No	39.7	33.3	33.3		No	No
3	1.FL	Maria Clara Lying Inn Hospital	Y	63.1	59.4	55.4	60.3	53.9	53.9		Moderate	No	40.1	33.7	33.7		No	No
3	GF	Nuestra Sr. delos Desamparados Chapel	Y	63.1	59.4	55.4	32.8	26.4	26.4		No	No	30.5	24.1	24.1		No	No
3	1.FL	Nuestra Sr. delos Desamparados Chapel	Y	63.1	59.4	55.4	35	28.6	28.6		No	No	31	24.6	24.6		No	No
3	GF	PhilPost Office	Y	63.1	59.4	55.4	54.3	47.9	47.9		No	No	39.6	33.2	33.2		No	No
3	1.FL	PhilPost Office	Y	63.1	59.4	55.4	54.7	48.3	48.3		No	No	40.7	34.3	34.3		No	No
3	GF	Sagrada Familia Chapel	Y	63.1	59.4	55.4	34.2	27.8	27.8		No	No	33.1	26.7	26.7		No	No
3	1.FL	Sagrada Familia Chapel	Y	63.1	59.4	55.4	35.6	29.1	29.1		No	No	33.6	27.2	27.2		No	No
3	GF	Untal Clinic		63.1	59.4	55.4	30.7	24.3	24.3		No	No	29.9	23.4	23.4		No	No

(2) Additional Construction Noise Assessment for Senate-FTI Underground Section

1506. An additional noise impact assessment has been carried out for the 4.866 km underground section of the SCRP interconnecting line. Since this section is underground the noise impacts from construction activities in this section will be different than those of viaduct section. The construction impacts will be mostly associated with noise generated from the cut and cover activities at FTI station. Since this is underground section, operational noise impacts are not anticipated. The summary of the assessment is presented herewith.

1507. **Methodology and Analysis**: The construction noise assessment was performed following the US FTA manual and sided by SoundPlan 8.1 Noise Model. **Table 3.3.32** presents the list of construction equipment, reference noise levels, and acoustic usage factor during cut and cover operations for establishment of the FTI station. This activity is expected to generate significant noise levels compared to other activities like TBM operation wherein most of the noise generation equipment and activities will take place underground.

1508. This assessment also considered the relocation of the first row of structures along the East Service Road at the United Hills Village and United Paranaque Village as depicted in **Figure 3.3.47.** In addition to the residential houses that are nearest to the station construction, two sensitive receptors were identified, and these are: Iglesia ni Kristo located at the end of Malugay Road, and Our Lady of Fatima Chapel also along Malugay Street. Existing noise levels were measured long several points on the Link Line alignment as provided in **Figure 3.3.46,** where in the impact of the airport operation can be observed. To allow for conservative estimate of noise impacts, the lowest set of existing noise measurements were utilized for the assessment at 59.6 dB(A) and 62.1 dB(A) during day and nighttime periods. Building dimension, locations, and heights were taken from Open Street Map and Google Earth and its streetviews. Elevation data were also taken from Google Earth which was deemed suitable given the flat terrain of the link line section. Annual average relative humidity and temperature data were taken from the PAGASA as provided in the baseline chapter of the environmental impact assessment report.

1509. To mitigate the noise during the cut and cover operation in the construction of the FTI terminal, several noise wall heights located within the right-of-way was evaluated. The assessment indicated that in general, a 290m long, 3m high perimeter wall will be adequate to reduce the impacts within 3 dB(A) as required in the IFC-EHS guideline. The location of the perimeter noise wall starts at 14º30'12.74N 121º2'14.30E and 14º30'4.39N, 121º2'18.87E and presented in **Figure 3.3.54 and Figure 3.3.55**.

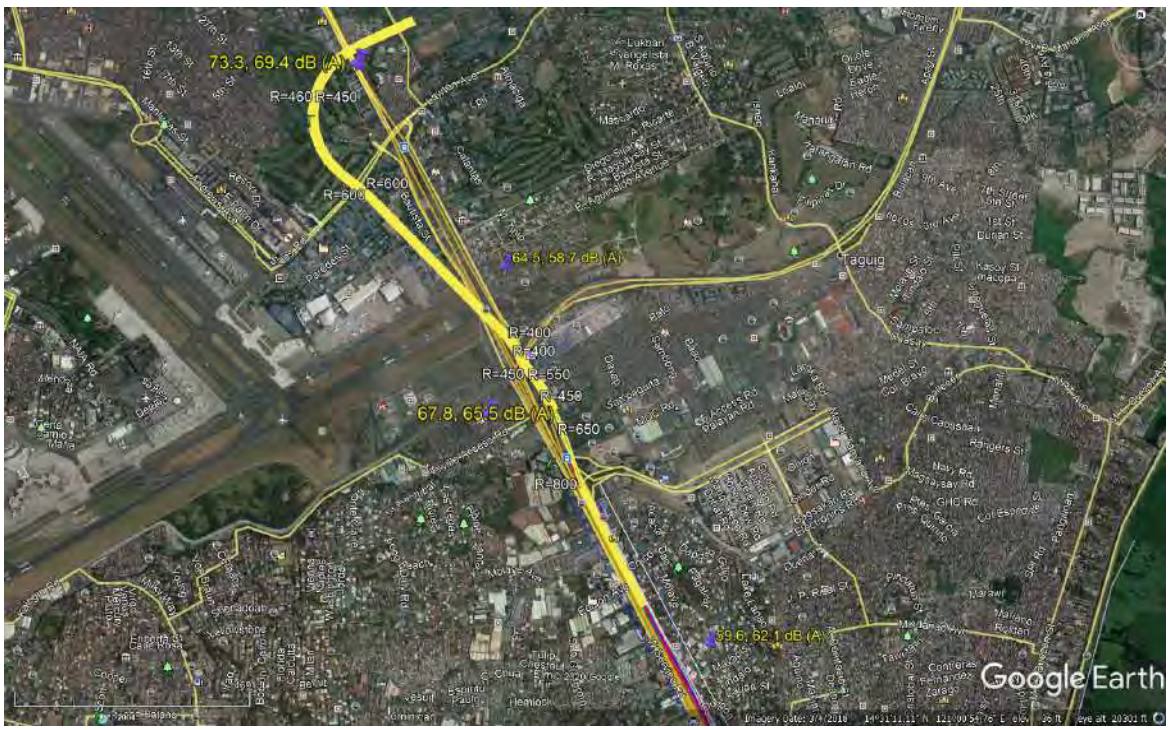


Figure 3.3.46 Day and night time noise measurements along and near the proposed Senate to FTI underground section

1510. Figure 3.3.48 to Figure 3.3.53 present the noise contour map while Table 3.3.33 presents the noise impacts at the selected receptors. Unmitigated noise impacts during construction will exceed the allowable 3dB(A) noise increase in 7 of the 10 selected receptors. Constructing a noise wall on the eastern boundary as provided in Figure 3.3.54 was selected for impact assessment. Installing a 3-m perimeter temporary wall will decrease this to 3 receptors, and a 4-m wall will provide 100% protection from noise impacts. A 3-m perimeter wall is deemed adequate, considering the exceedances are less than 0.6 dB(A).

Figure 3.3.47 Affected Structures During Cut and Cover Activities for the Construction of the FTI Station

Table 3.3.32 Equipment to be used during the cut and cover operations for the FTI Station construction

No.	Description	Quantity	Acoustical Usage Factor, %	Sound Power Level, Lw dB(A)
1	20T crane with clamshell	3	40	82.6
2	Concrete Pump	1	40	109
3	Excavator	6	40	62.2
4	De-watering Pump	1	50	72.2
5	Concrete Vibrator	8	50	80
6	High pressure washer	2	50	78
7	Gantry Crane	1	40	88.8
8	Hand Tools (air power tools)		40	79

Table 3.3.33 Baseline noise, Noise impact and mitigation using 3m and 4m Noise Wall

Floor	Name	Usage	Existing Noise		Without Noise Wall		Difference		With 3-meter Noise Wa		Difference		Exceeds 3dB(A)?		With 4-meter Noise Wall		Exceeds 3dB(A)?	
			Day	Night	Leq,d	Leq,n			Leq,d	Leq,n					Leq,d	Leq,n		
			dB(A)		dB(A)				dB(A)				Day	Night	dB(A)		Day	Night
G	Building 21662	RES	59.6	62.1	64.3	64.3	6.0	4.2	60	60	3.2	2.1	Y	N	57.8	57.8	N	N
F2	Building 21670	RES	59.6	62.1	63.7	63.7	5.5	3.9	58.4	58.4	2.5	1.5	N	N	56.1	56.1	N	N
G	Building 21670	RES	59.6	62.1	64.3	64.3	6.0	4.2	60.6	60.6	3.5	2.3	Y	N	59.3	59.3	N	N
F2	Building 21670	RES	59.6	62.1	64.1	64.1	5.8	4.1	59.9	59.9	3.2	2.0	Y	N	57.9	57.9	N	N
G	Building 21925	RES	59.6	62.1	62.1	62.1	4.4	3.0	57.5	57.5	2.1	1.3	N	N	55.5	55.5	N	N
F2	Building 21925	RES	59.6	62.1	62.7	62.7	4.8	3.3	59	59	2.7	1.7	N	N	57.6	57.6	N	N
G	Iglesia Ni Cristo	REL	59.6	62.1	45.6	45.6	0.2	0.1	43.9	43.9	0.1	0.1	N	N	43.2	43.2	N	N
F2	Iglesia Ni Cristo	REL	59.6	62.1	48.3	48.3	0.3	0.2	47.3	47.3	0.2	0.1	N	N	45.7	45.7	N	N
G	Our Lady of Fatima Chapel	REL	59.6	62.1	61.6	61.6	4.1	2.8	56.3	56.3	1.7	1.0	N	N	54.1	54.1	N	N
F2	Our Lady of Fatima Chapel	REL	59.6	62.1	62.3	62.3	4.6	3.1	58.4	58.4	2.5	1.5	N	N	56.8	56.8	N	N

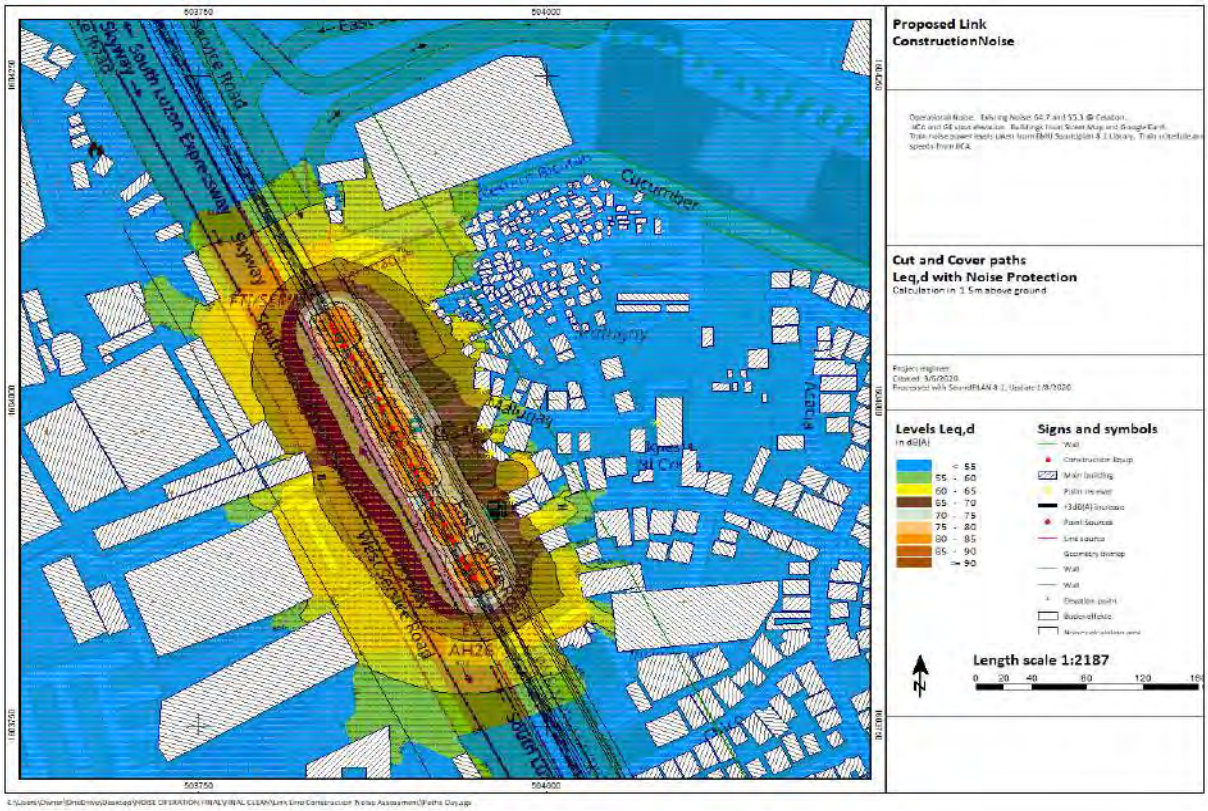


Figure 3.3.48 Predicted Noise Contour Map, Daytime, without Noise Wall

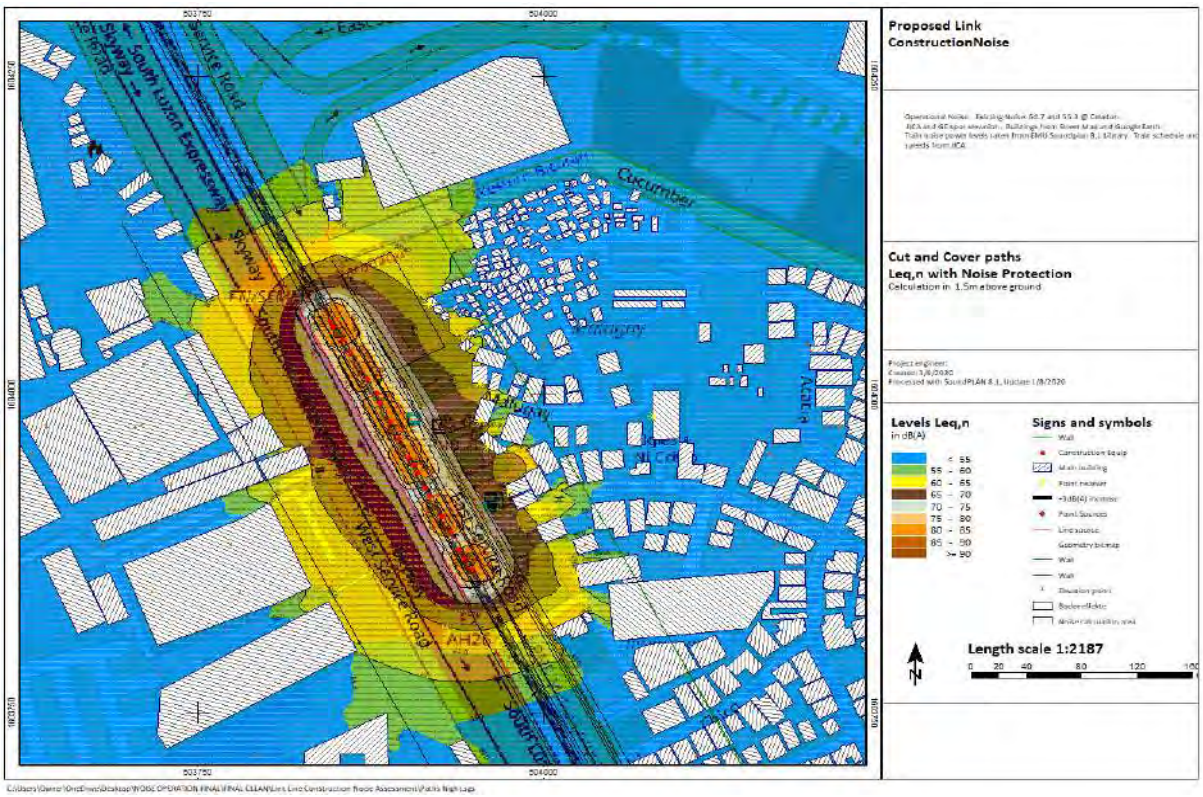


Figure 3.3.49 Predicted Noise Contour Map, Nighttime, without Noise Wall

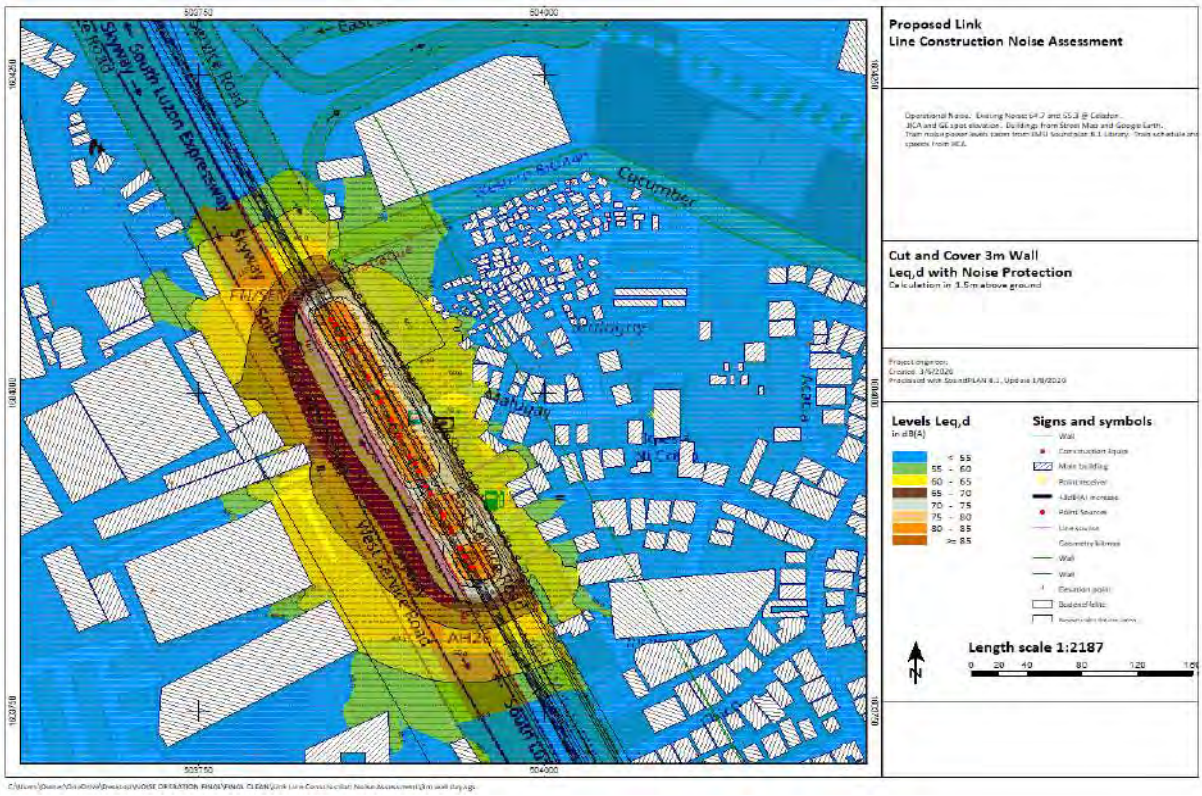


Figure 3.3.50 Predicted Noise Contour Map, Daytime, with 3M Noise Wall

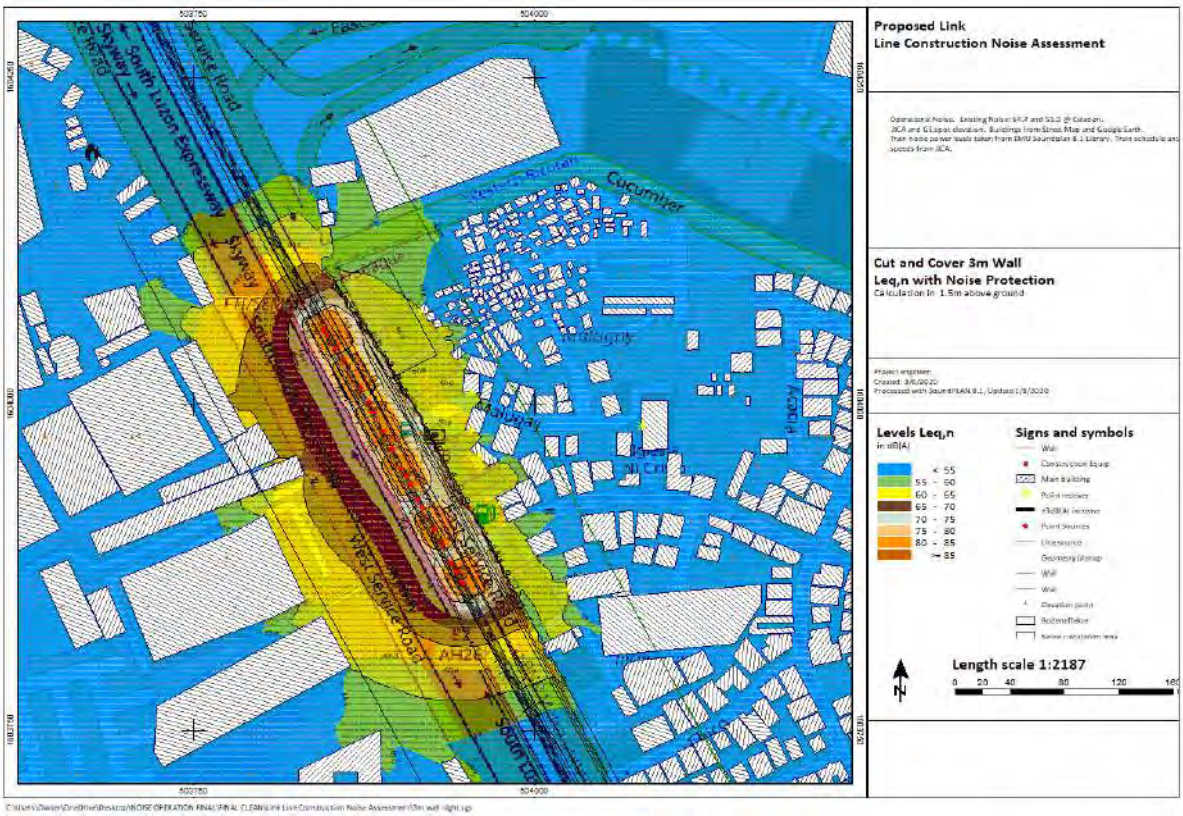


Figure 3.3.51 Predicted Noise Contour Map, Nighttime, with 3M Noise Wall

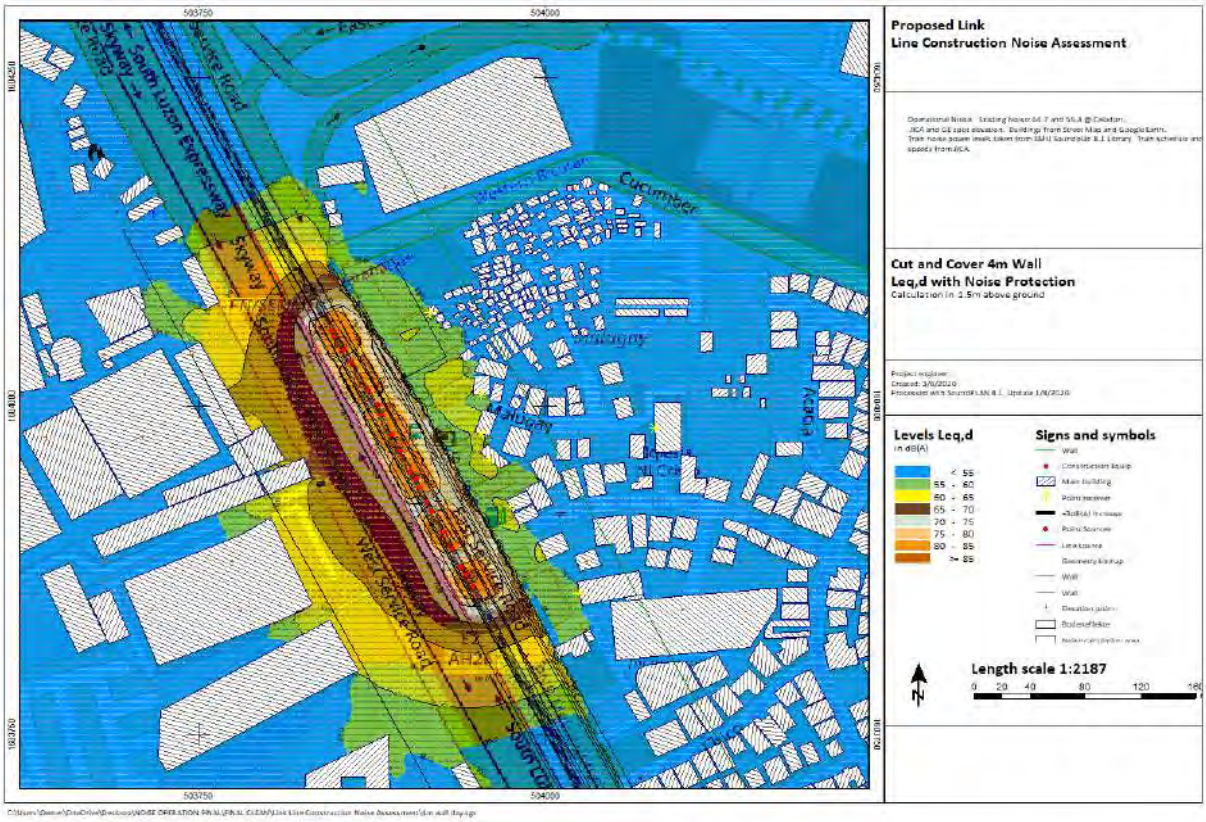


Figure 3.3.52 Predicted Noise Contour Map, Daytime, with 3M Noise Wall

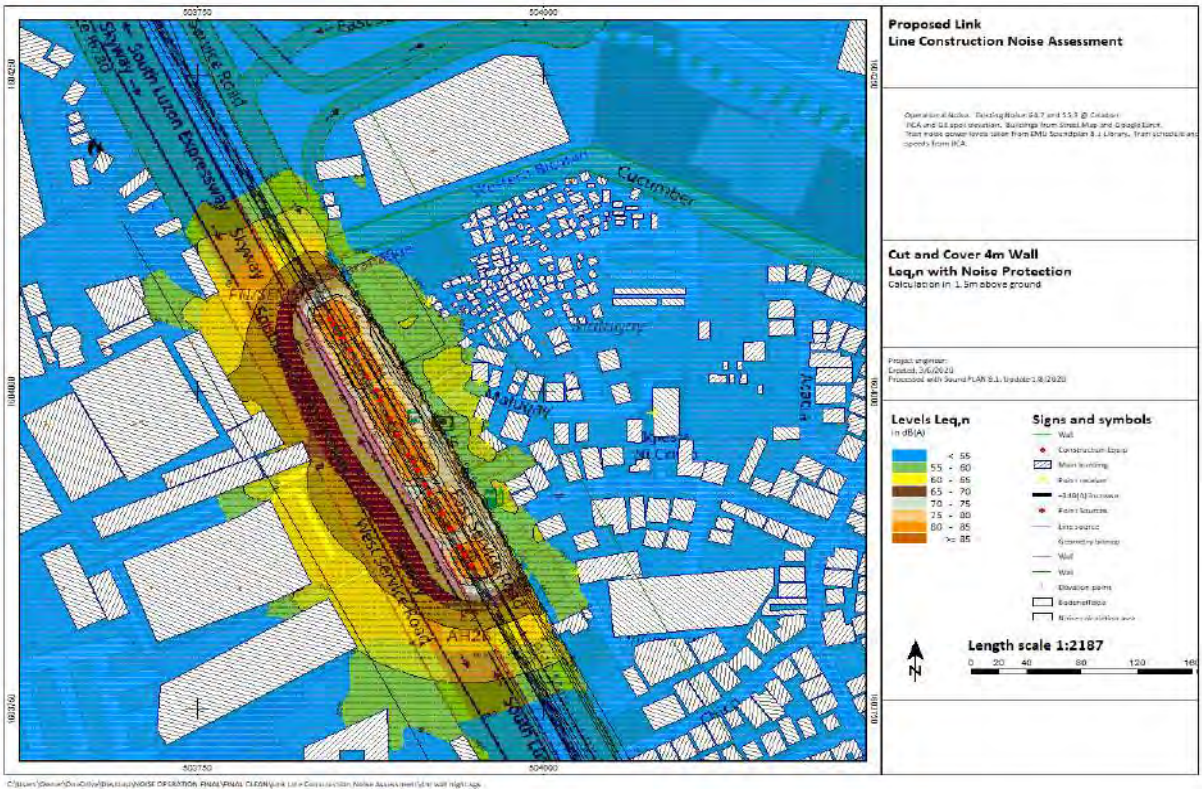


Figure 3.3.53 Predicted Noise Contour Map, Nighttime, with 3M Noise Wall

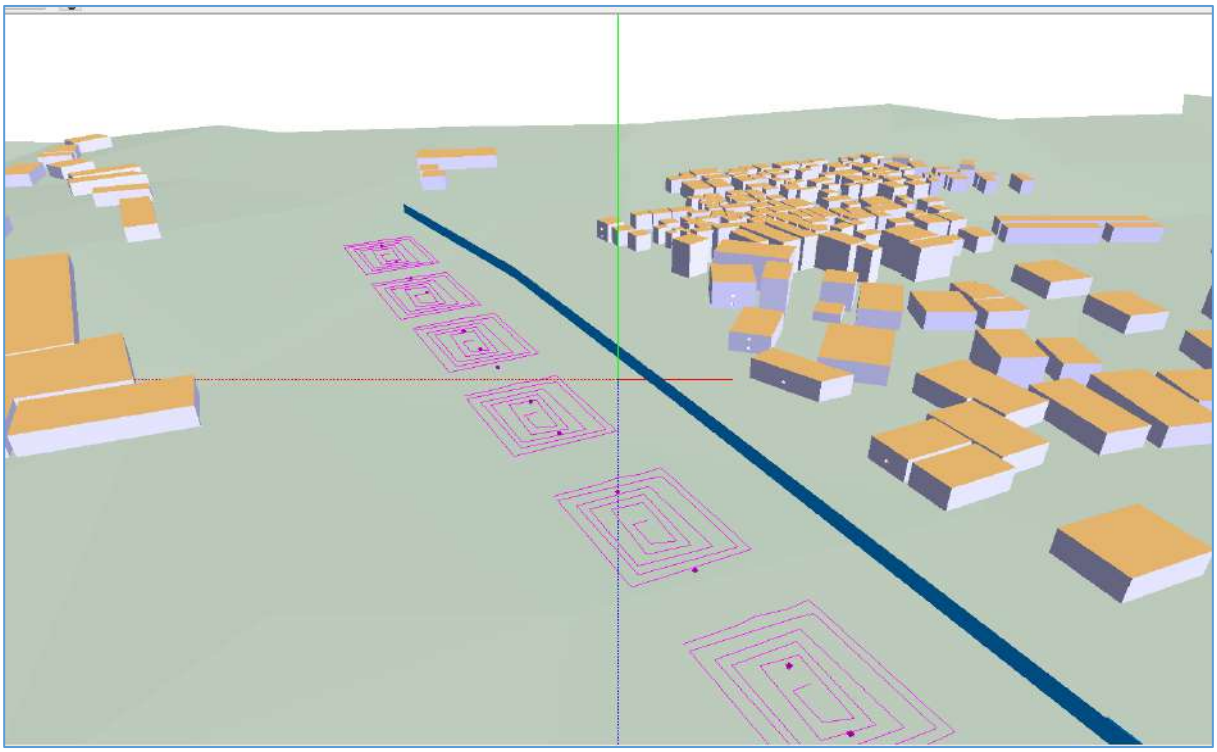


Figure 3.3.54 Recommended Location of the 290m Noise Wall

Figure 3.3.55 Recommended Location Superimposed in Google Earth

1511. **Findings**: The construction noise assessment focused on the cut and cover construction method in the establishment of the FTI Station. The United Hills Village and United Paranaque Village were identified as the sensitive areas. Representative residential structures along the East Service Road first row of houses after resettlement were selected as sensitive receptors and in addition two places of worship. Unmitigated noise impacts during construction will exceed the allowable 3dB(A) noise increase in 7 or the 10 receptors. Constructing a temporary noise wall on the eastern boundary of then project is adequate to mitigate noise impacts. Installing a 3-m perimeter temporary wall will decrease this to 3 receptors, and a 4-m wall will provide 100% protection from noise impacts. A 3-m perimeter wall is deemed adequate, considering the exceedances are less than 0.6 dB(A).

1) Mitigation Measures during Pre-Construction and Construction Phase

1512. Elevated noise levels during construction is inevitable and even after mitigation residual noise may still cause moderate impacts despite of feasible and reasonable measures as shown in the assessment. In addition to the 3-m noise protection walls, the following noise control/mitigation measures will be implemented during the project construction:[8]

a. Before construction:

- Position storage and other large equipment to function as noise barriers
- Identify haul roads that minimizes noise impacts
- Consider traffic re-routing
- Maximize the use of existing structures like fences, walls, and other structures as noise barriers.

b. During Construction

- Sequence the construction operation: i) Schedule noisy activities at the same time since the combined noise levels may not be significantly higher that noise levels from individual equipment operation; ii) Install temporary noise barriers in the early stages of project construction
- Use of alternative construction methods: i) Do not use pile driving. Only vibration, hydraulic insertion, or auger drill techniques shall be applied; ii) use of electric compressors which is quieter than gasoline or diesel-fed compressors.
- Contract Specifications to include: i) Construction noise criteria limits as follows: Lmax in sensitive areas (residences, institutions, and hotels) <85dB(A) daytime and evening, and <80 dB(A) during nighttime; <140 dB(A) at any time; ii) Training for contractors to be administered by the construction supervision consultant on project specific noise requirement, project personnel in-charge with noise management, equipment noise level specifications, and personal protective equipment
- Source Mitigation: i) use of less noisy equipment; ii) installation of mufflers on all internal combustion engines; iii) installation of noise shields to particular equipment; iv) dampeners through equipment modification; v) installation of aprons or curtains using absorptive mats; vi) enclosures; and vii) Equipment operating training
- Consultations with affected community: Public involvement regarding noise impact and its mitigation is required under project during the noise assessment process and discuss the effectiveness of the mitigation measures. The need for coordination with the local officials to protect future development on areas identified to be exposed to elevated noises during construction and operation is an important input

8 Adapted from the FHWA Construction Noise Handbook https://www.fhwa.dot.gov/Environment/noise/construction_noise/handbook/handbook07.cfm

in the town and land use planning. The local government units can also assist in the dissemination of information to residents.

- For cut and cover activities for underground FTI station area, install a 290m long 3-m high peripheral wall around construction area mainly on the eastern boundary of area around FTI station.

(3) Operation Phase

1513. Depending on the routes, speeds, and designated stops, there are four types of trains that will be operated under the proposed project; i) Limited Express ii) Commuter Express, iii) Commuter, and iv) Subway/Underground. The major noises associated with the operation of the trains include the following: steel wheels rolling on steel rails (wheel/rail noise), electric motor propulsion, and aerodynamic from the train noise, wheel, region, and pantograph. For this study, the aerodynamic noise was only applied to the Limited Express. The US Federal Transit Administration's (FTA) as detailed in the Transit Noise and Vibration Impact Assessment manual[9] provided guidance for projects with conventional train speeds below 144 kph (90 mph). This protocol was adopted using the SoundPlan 8.1 noise model.

1) Assessment Methodology

1514. This section describes the methodology for assessing the potential impact from the proposed commuter railway project.

Train Noise and Operation Schedule

1515. For the proposed trains, the SoundPlan 8.1 reference noise levels for high speed electric multiple unit train were adopted. **Table 3.3.34** and **Table 3.3.35** present the input values for the noise model from SoundPlan 8.1 and commuter train operation schedule as provided by the JICA design team.

Table 3.3.34 FTA/Federal Railroad Administration Input Values for Noise Model

Detail	Commuter and Underground	Express Commuter (EC)	Limited Express (LE)
Reference SEL at 15m			
Propulsion, dB(A)	86	86	86
Wheel Rail, dB(A)	91	91	91
Aerodynamic dB(A) 2/	0	0	89
Speed Coefficient, K for Power Units	0	0	0
Speed Coefficient, K for Rail Cars	20	20	20
Reference heights Wheel-Rail (m)	1	1	1
Train Speed (km/h)	43-97 (max 109)	43-97 (max 117)	43-117 (max 117)
Number of Propulsion	4	4	4
Number of Cars per train	8	8	8
Total Length (m)	152 (8 x 19)	152 (8x19)	152 (8x19)

[9] https://www.transit.dot.gov/research-innovation/transit-noise-and-vibration-impact-assessment-manual-report-0123

Table 3.3.35 Commuter Train Operation Schedule

Details		Operating Years			
		2023-2025	2025-2035	2035-2040	2040-Onwards
NSCR to Alabang					
	Limited Express (NSCR to Alabang)				
	Northbound Train/Daytime (7AM to 10PM)	15	15	15	30
	Northbound Train/Nighttime (10PM to 7AM)	6	6	6	11
	Southbound Train/Daytime (7Am to 10PM)	15	15	15	30
	Southbound (10Pm to 7AM)	6	6	6	11
Express Commuter (NSCR to Calamba)					
	Northbound Train/Daytime (7AM to 10PM)	47	47	47	47
	Northbound Train/Nighttime (10PM to 7AM)	12	12	12	12
	Southbound Train/Daytime (7Am to 10PM)	48	48	48	48
	Southbound (10Pm to 7AM)	14	14	14	14
Commuter (NSCR to Calamba)					
	Northbound Train/Daytime (7AM to 10PM)	55	117	122	131
	Northbound Train/Nighttime (10PM to 7AM)	16	24	27	32
	Southbound Train/Daytime (7Am to 10PM)	55	115	122	133
	Southbound (10Pm to 7AM)	14	23	24	31
Commuter (Tutuban-Blumentritt)					
	Northbound Train/Daytime (7AM to 10PM)	15	15	30	30
	Northbound Train/Nighttime (10PM to 7AM)	6	6	12	12
	Southbound Train/Daytime (7Am to 10PM)	15	15	30	30
	Southbound (10Pm to 7AM)	6	6	12	12
Commuter Underground					
	(Bicutan-Sucat)/(Sucat-Calamba)				
	Northbound Train/Daytime (7AM to 10PM)		90/75		
	Northbound Train/Nighttime (10PM to 7AM)		36/30		
	Southbound Train/Daytime (7Am to 10PM)		90/75		
	Southbound (10Pm to 7AM)		36/30		
	Bicutan-Calamba				
	Northbound Train/Daytime (7AM to 10PM)			105	120
	Northbound Train/Nighttime (10PM to 7AM)			30	30
	Southbound Train/Daytime (7Am to 10PM)			105	120
	Southbound (10Pm to 7AM)			30	30

Source: JICA, August 2019

Train Speeds

1516. North and south bound trains speed curves provided by JICA were adopted in this assessment. Samples of the speed curves are provided in the succeeding collage of Figures. Each curve in between the stations was divided into increments of 20 kph intervals until the peak speeds were reached. Acceleration and decelerations from the stations were estimated with an assumed sustained minimum speed of 10 kph within the station. For the underground train, the Commuter Train speed and scheduled terminal stops were adopted from Bicutan to Calamba.

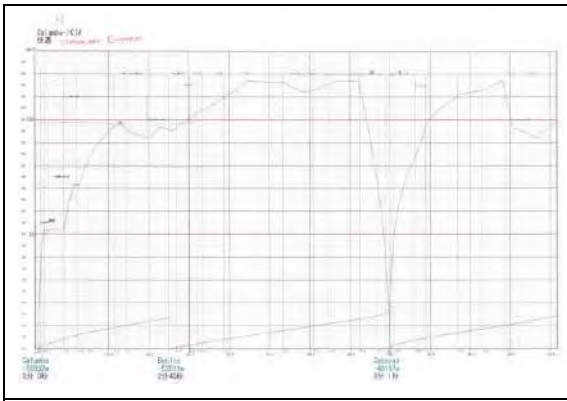
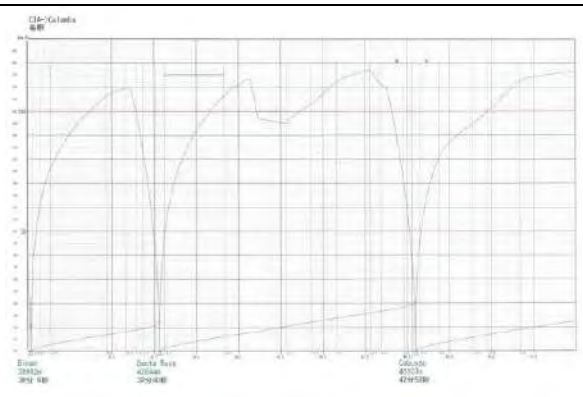
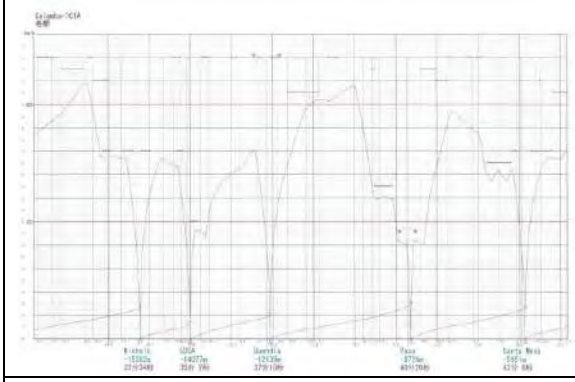
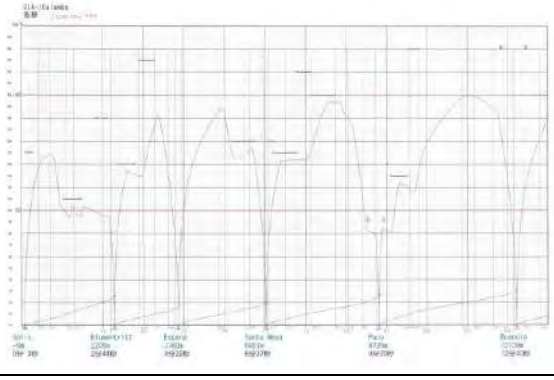
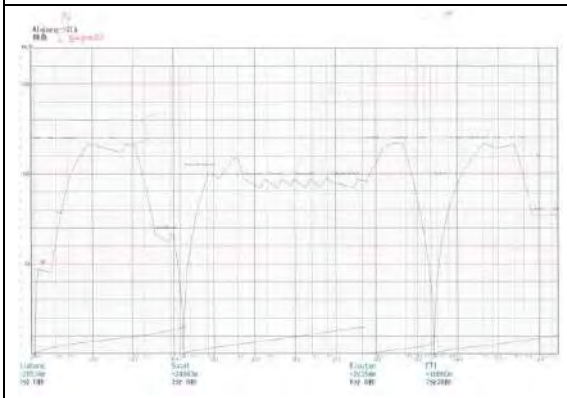
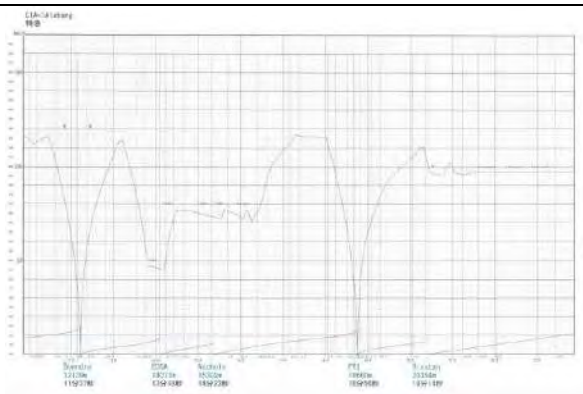
		
Northbound Commuter Express Speed Curve		Southbound Commuter Express Speed Curve
		
Northbound Commuter Express Speed Curve		Southbound Commuter Express Speed Curve
		
Northbound Limited Express Speed Curve		Southbound Limited Express Speed Curve

Figure 3.3.56 Predicted Collage of Figures Showing Speed Curves of Selected North and Southbound Trains

Ground Elevation and Digital Ground Model

1517. The topographic survey prepared during the detailed engineering design stage in defining the vertical profile of the railway was used in noise assessment. This data included ground survey and light detection and ranging (LIDAR) data integrated by the engineering design team to make a survey composite with detailed information within a 50m railway corridor. **Figure 3.3.57** and **Figure 3.3.58** depict the ground elevation used and digital ground model computed using the SoundPlan 8.1.

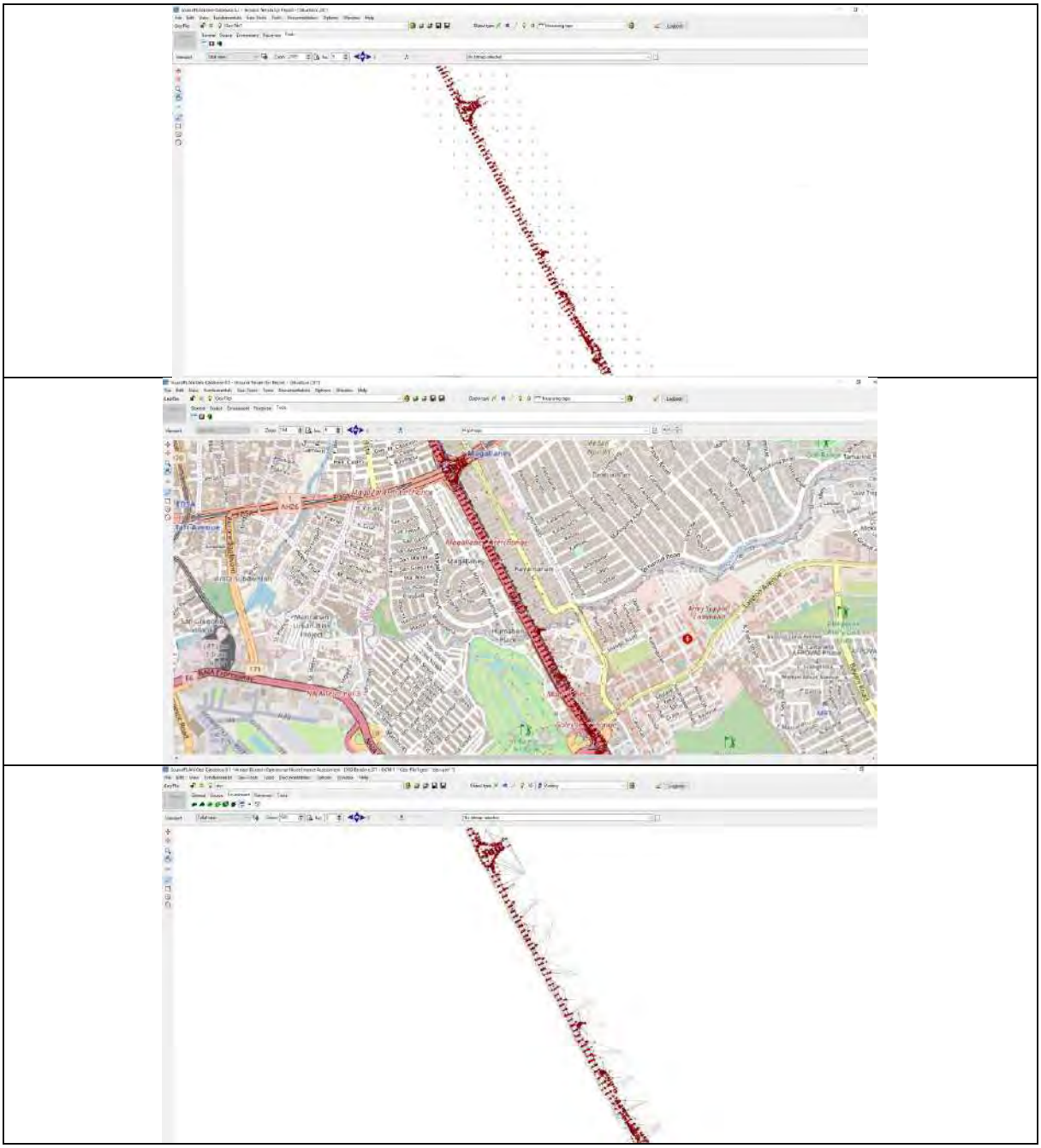


Figure 3.3.57 Elevation data and digital ground model (triangles) for the EDSA-FTI Section

Rail Elevation

1518. The rail elevation from the engineering vertical profiles were used to establish the absolute and relative height of the railway every 20 meters.

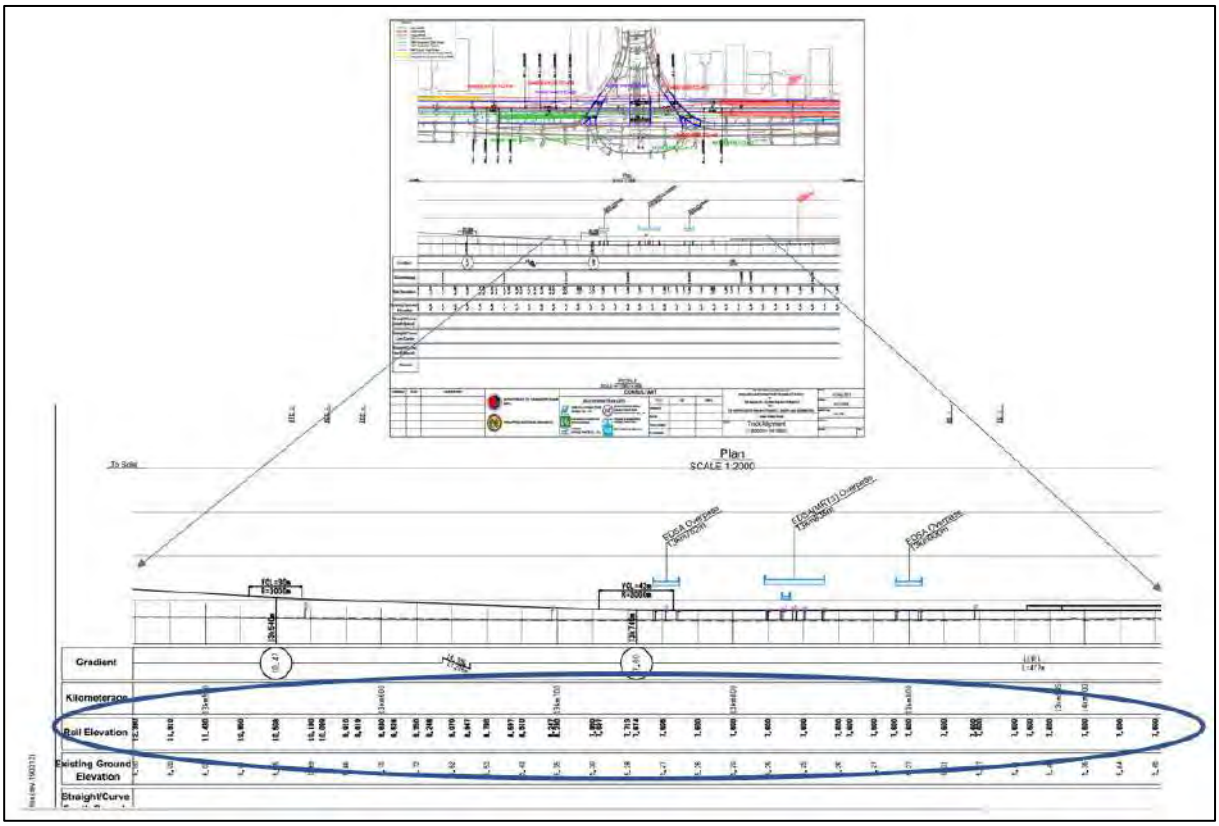


Figure 3.3.58 Rail elevation data taken from the detailed engineering design

Building Location and Heights

1519. Building locations were taken from OpenStreet and Google Maps while the building heights were extrapolated from the number of floors as observed from the Google Earth Street View and published photographs.

Sensitive Receptors

1520. A total of 185 receptors were identified from Blumentritt to Calamba within the 114m screening distance from both sides of the alignment of which 21% are residential villages and subdivisions, 14% are residential condominium and apartments, 22% are schools, 20 % and places of worship, 5% are hospitals, and 17% commercial establishment, and 1% are open parks.

Noise Model

1521. Using SoundPlan 8.1, the calculation options that were selected for this project provided a balance between accuracy of noise assessment and time to complete the computation. As mentioned earlier, in addition to the FTA/FRA-HSGT (2005) standards that were applied, the following options were adopted:

- Assessment: Day, Night, Ldn
- Emission time slices: 7h-22h, 22h-7h
- Reflection order: 2
- Maximum Search Radius: 1,200 km
- Maximum reflection distance: 100m
- Grid noise map spacing: 10m

2) Assessment Findings and Mitigating Measures

1522. The summary of the single point noise calculations on the identified sensitive receptors with noise walls are provided in the succeeding **Table 3.3.36**. The key findings and recommendations are presented in the following paragraphs.

1523. Uncontrolled (i.e. without mitigation measures) operational noise will exceed the 3dBA threshold and where the Limited Express operates the exceedance will occur within 2023-2025

1524. In general, a 1-m noise wall on both sides along the entire stretch is effective to control the operational noise until the anticipated operational schedule in 2035-2040 with the exception of three (3) sections (measuring 887m length) all in Makati City where the commercial speeds of the Limited Express and Commuter Express are running at its peak and tall buildings are located within the 114-m screening distance. Taller noise protection walls will be needed to protect the buildings' inhabitants. These sections are:

- Between model points 71 and 68, SLEX-Arnaiz Model Section, with chainage 10+464 to 10+743, north bound, where a composite noise protection wall is needed having a vertical element of 3.0 m, and on top are two elements of 0.25 m and slope of 45^0. This noise wall is necessary to protect the future residents of the SMDC 36-storey condominium which is currently under construction along Zobel Roxas Avenue. At this section, the LE, CE, and C north bound train speeds will all reach almost 100 km/hr emitting day and night time noise levels (LmE[10] at 15 meters) of 63.6 and 60.6 dB(A) Leq and exceeds the measured noise levels of 61.4 and 57.9 dB(A), respectively.

- Between modeling points 181 and 171, north bound, Arnaiz-Bicutan Model Section, with chainage 12+557 to 12+970, north bound where a similar noise protection wall is required. This will protect the residents and occupants of the cluster or tall buildings that includes the 7-storey Don Bosco School, 21-storey Laureano di Trevi towers, 14-storey City Land Pasong Tamo, and 26-storey Avida Towers San Lorenzo Towers where the measured noise level is 58.2 dB(A) during the nighttime. At this section, the LE, CE, and C north and southbound trains will be running at 75-80 kph on their entries and exits to and from the Buendia Station In this section, the northbound track will generate 61.9 dB(A) and 58.7 while the south bound track will reach 62.4 and 59.3 dB(A).

- Between model points 17 – 20, southbound, Arnaiz-Bicutan Model Section, with chainage 13+093 to 13+288, where a similar wall will be required to protect the residents of the 13-storey South Star Plaza Condominium where the measured noise level is 63.9 and 58.2 dB(A) for the day and nighttime. In front of this building the LE, CE, and C trains run at speeds of 100, 80, and 80 kph, respectively.

1525. A cluster of highrise buildings at the corner of Buendia and South Luzon Expressway was subjected to a more detailed assessment to determine the need for a similar noise protection wall. **Figure 3.3.59** depicts the façade noise map at the beginning of the operation year 2023-2025. The assessment concludes that even with the 3-m composite noise protection wall, some of the building floors in the Laureano di Trevi Towers and Citiland will experience moderate impacts i.e. increase in noise greater than3-5 dB(A) and these are the 12th floors, and 12-13th and 17th-20th, respectively. For those buildings, the first thing to do is to make these floors as permanent long term monitoring points during operation. The

[10] LmE is the emission level at 50' distance (15 m) from the railroad track (FTA/FRA). The E stands for noise emission average over 1-hr and is equivalent to Leq(1hr). The FTA/FRA do use LmE value and instead use SEL – sound exposure level (all compressed into 1 second) at 50'. Therefore, the difference between LmE and the SEL is 10*log(3600) = 35.6 dB

exceedances are expected to occur in the planning period 2025-2035. Additional noise protection measures such as increasing the height of wall or replacing windows for those apartments where noise levels are anticipated to exceed the 3dB(a) threshold are also considered.

1526. Even with higher (4meter) with longer elements (2 meters total) the noise levels are beyond 3 dB(A). In such situation the cost of mitigation measures out weights the benefits (in the US it is about USD 50,000 for each structure is allowed). If the monitoring results indicates increasing ambient noise levels by 2025, then this will effectively increase the allowable 3 dB(A) and no mitigation maybe needed. Other measures such as Louvers on the patio door and windows may be used but this will need careful design as the wind speeds will be stronger at these floors and particularly during typhoons these will be become risky projectiles. Overall, the impacts are moderate and the ADB SPS 2009 specifically provides avoiding significant adverse impacts. As we are talking of a small impact, instead of allowable 3 dB(A) it will be 4 dB(A), even the equipment calibration error alone already allows +- 1dB(A), therefore the project complies with SPS requirements.

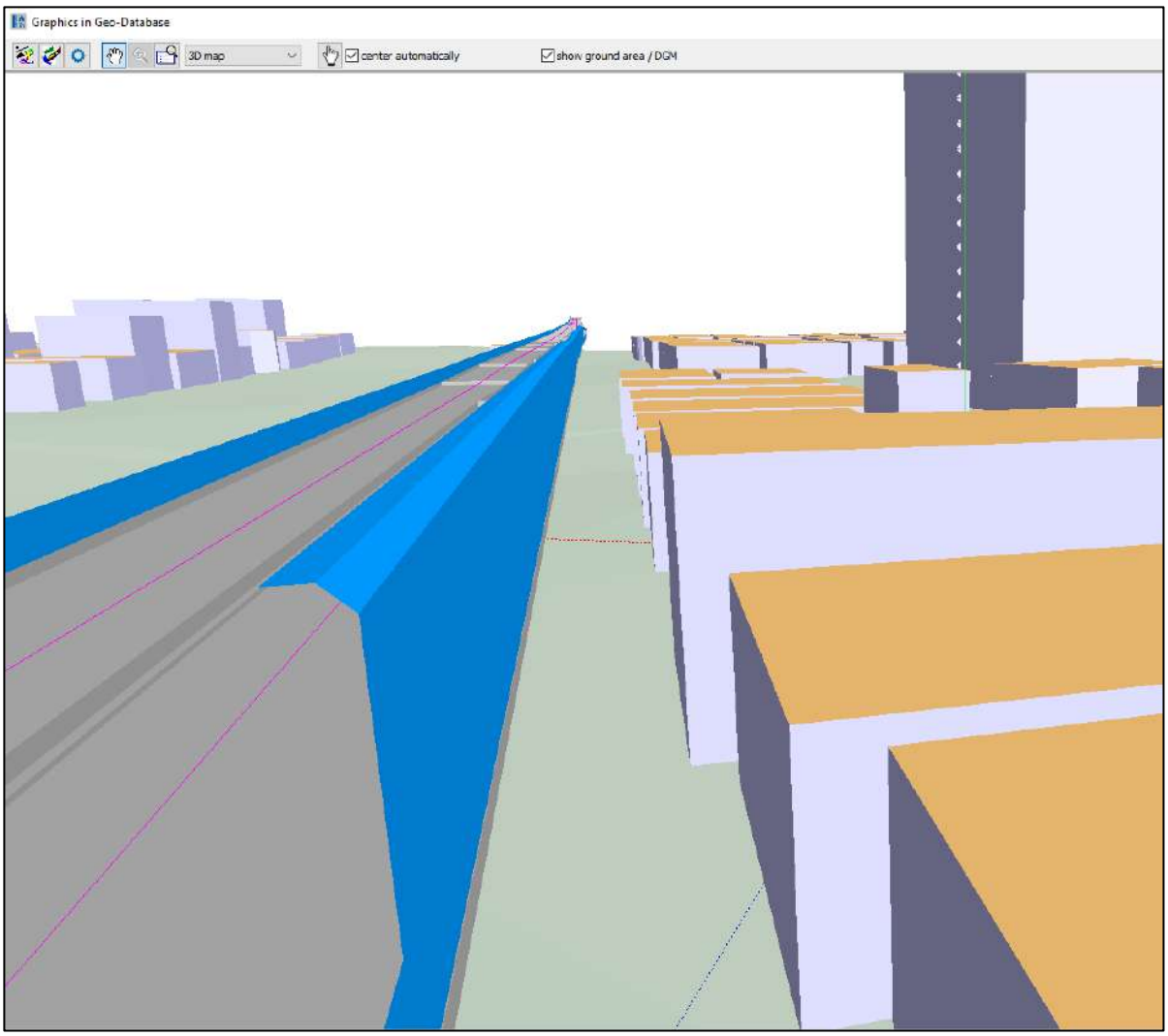


Figure 3.3.59 3-D Model of the Noise Protection Wall Recommended at Chainage 10+464 to 10+743 Northbound. At the right will be the SMDC 36-Storey Condominium

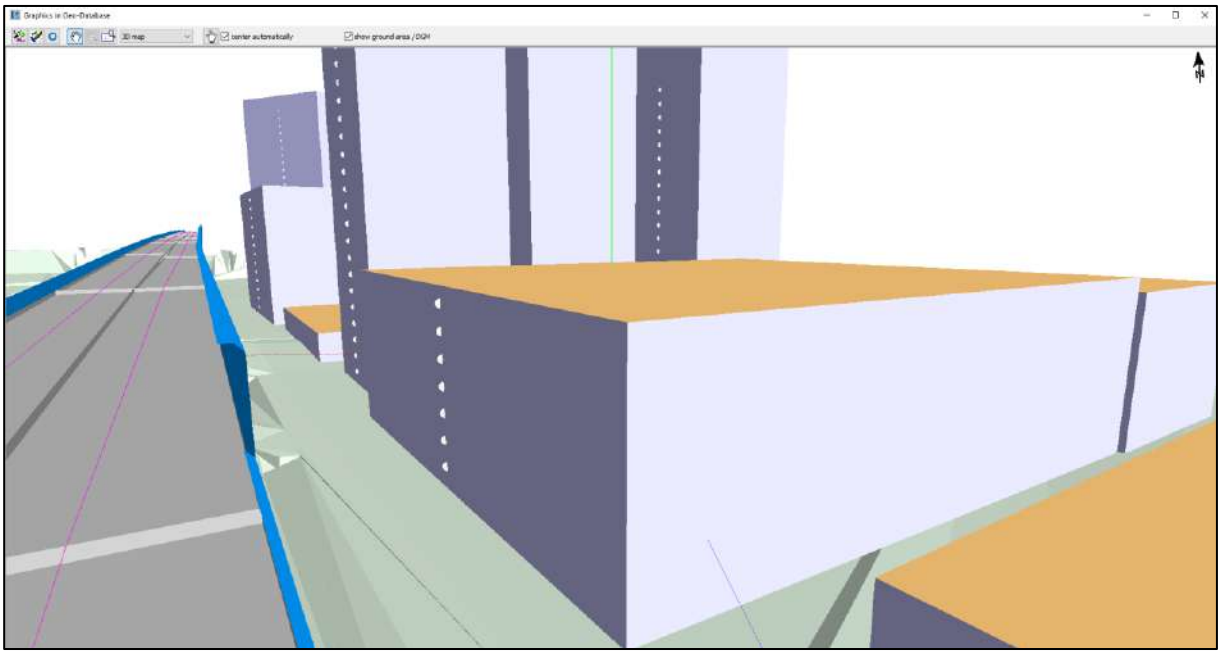


Figure 3.3.60 3-D Model of the Noise Protection Wall Recommended at Chainage 12+557 to 12+970, for the Don Bosco School, Laureano di Trevi Towers, City Land Pasong Tamo, and Avida Towers San Lorenzo Towers

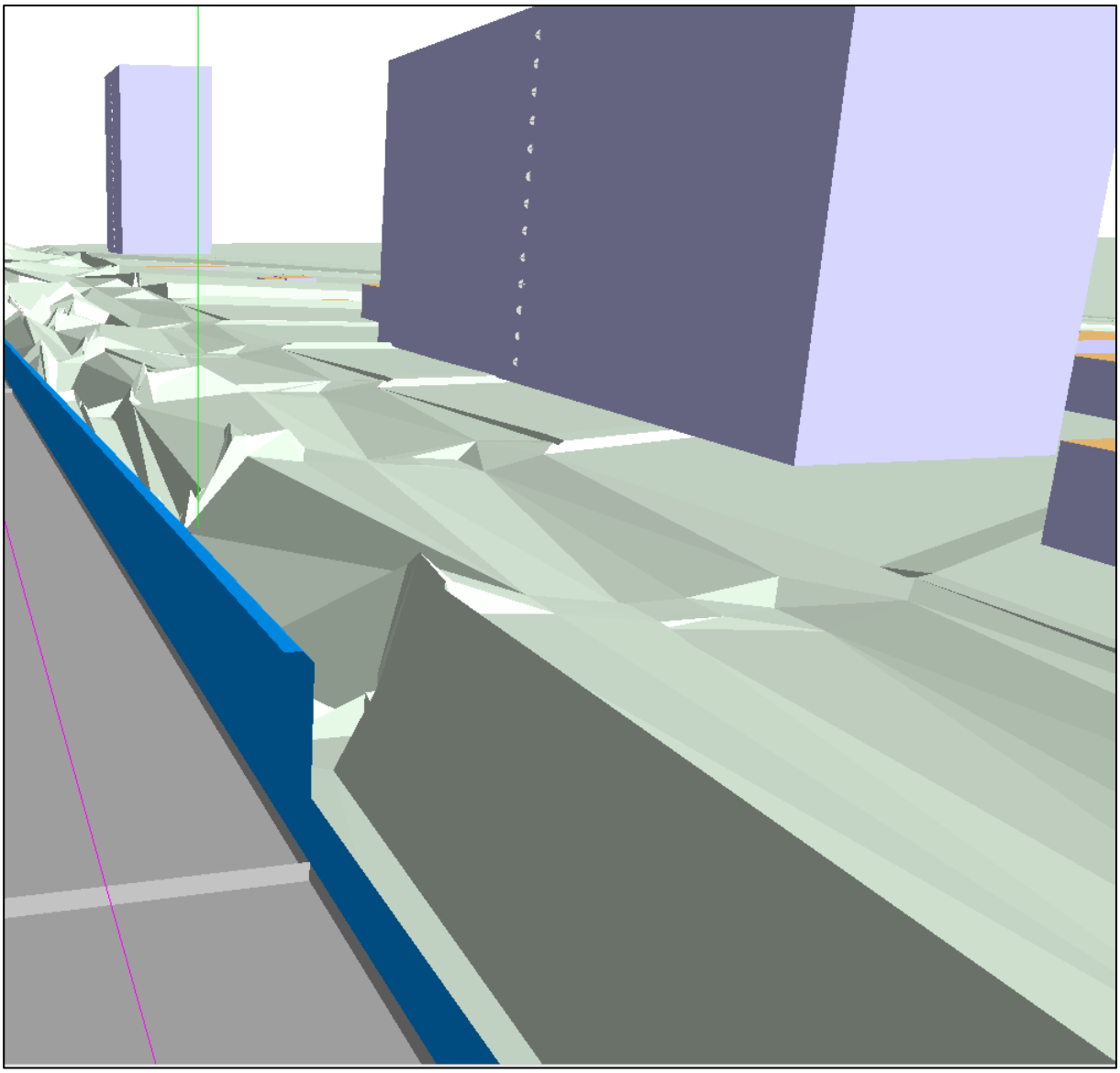


Figure 3.3.61 3-D Model of the Noise Protection Wall Recommended at Chainage 13+093 to 13+288, for the South Star Plaza Condominium. Note the rough terrain is the digital ground model for the elevated highway

Figure 3.3.62 Façade Noise Map of the Cluster of Buildings at the Corner of Buendia and South Luzon Expressway Approaching the Buendia Station to the left

Table 3.3.36 Summary of Single Point Noise Calculation for the Predicted Noise Level at the Sensitive Areas

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
1	1	Celadon 1	PR	1+420	47.1	64.7	55.3	51.7	48.7	52.8	49.5	52.8	49.5
1	2	Celadon 1	PR	1+420	47.1	64.7	55.3	52.5	49.5	53.7	50.3	53.7	50.3
1	3	Celadon 1	PR	1+420	47.1	64.7	55.3	53.1	50.2	54.6	51.1	54.6	51.1
2	1	Celadon 2	PR	1+433	45.94	64.7	55.3	51.1	48.1	52.2	48.8	52.2	48.8
2	2	Celadon 2	PR	1+433	45.94	64.7	55.3	51.9	48.9	53.1	49.7	53.1	49.7
2	3	Celadon 2	PR	1+433	45.94	64.7	55.3	52.6	49.6	54	50.5	54	50.5
3	1	Celadon 3	PR	1+461	43.43	64.7	55.3	49.8	46.8	51.1	47.7	51.1	47.7
4	1	Celadon 4	PR	1+500	34.33	64.7	55.3	41.2	38.3	41.2	38.3	41.2	38.3
4	2	Celadon 4	PR	1+500	34.33	64.7	55.3	49.3	46.3	50.7	47.3	50.7	47.3
4	3	Celadon 4	PR	1+500	34.33	64.7	55.3	50.3	47.4	52.1	48.5	52.1	48.5
5	1	Celadon 5	PR	1+510	24.37	64.7	55.3	45.8	42.8	47	43.6	47	43.6
5	2	Celadon 5	PR	1+510	24.37	64.7	55.3	46.8	43.8	48	44.7	48	44.7
6	3	Celadon 5	PR	1+510	24.37	64.7	55.3	47.8	44.8	49.2	45.8	49.2	45.8
6	1	Celadon 6	PR	1+535	14.68	64.7	55.3	45.2	42.2	46.2	42.9	46.2	42.9
6	2	Celadon 6	PR	1+535	14.68	64.7	55.3	46.1	43.1	47.1	43.8	47.1	43.8
6	3	Celadon 6	PR	1+535	14.68	64.7	55.3	46.5	43.5	47.7	44.4	47.7	44.4
7	1	Karapatan cor ROW	SCR	1+643	43.34	64.7	55.3	47.8	44.8	48.2	45.1	48.2	45.1
7	2	Karapatan cor ROW	SCR	1+643	43.34	64.7	55.3	48.8	45.8	49.1	46	49.1	46
8	1	Elias cor ROW	SCR	1+649	24.65	64.7	55.3	43.8	40.8	45.3	41.8	45.3	41.8
9	1	Karapatan St cor ROW	SCR	1+686	46.91	64.7	55.3	46.7	43.7	47.3	44.1	47.3	44.1
9	2	Karapatan St cor ROW	SCR	1+686	46.91	64.7	55.3	48.8	45.9	49.3	46.2	49.3	46.2
10	1	Edge of PNR ROW	SCR	1+723	37.78	64.7	55.3	46.3	43.3	47	43.8	47	43.8
10	2	Edge of PNR ROW	SCR	1+723	37.78	64.7	55.3	48.1	45.1	48.7	45.5	48.7	45.5
11	1	Vision cor Dimasalang	SCR	1+788	21.29	64.7	55.3	44	41	45.4	42	45.4	42

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
11	2	Vision cor Dimasalang	SCR	1+788	21.29	64.7	55.3	44.9	41.9	46.4	42.9	46.4	42.9
12	1	Antipolo cor Calamba Mid Blk	SCR	1+865	40.16	64.7	55.3	45	42	45.4	42.3	45.4	42.3
12	2	Antipolo cor Calamba Mid Blk	SCR	1+865	40.16	64.7	55.3	47.1	44.1	47.5	44.4	47.5	44.4
13	1	Untal Clinic 1	HSP	1+865	15.52	64.7	55.3	42.8	39.8	44.1	40.7	44.1	40.7
13	2	Untal Clinic 1	HSP	1+865	15.52	64.7	55.3	43.6	40.7	45	41.6	45	41.6
13	3	Untal Clinic 1	HSP	1+865	15.52	64.7	55.3	44.1	41.1	45.6	42.2	45.6	42.2
14	1	Simon cor Antipolo	SCR	1+888	73.7	64.7	55.3	40.8	37.8	41.7	38.4	41.7	38.4
14	2	Simon cor Antipolo	SCR	1+888	73.7	64.7	55.3	42.2	39.2	43	39.8	43	39.8
15	1	Antipolo1	SCR	2+845	40.15	59.4	55.4	44.9	41.9	45.6	41.8	46.1	42.5
15	2	Antipolo1	SCR	2+845	40.15	59.4	55.4	45	41.9	45.7	41.9	46.2	42.6
16	1	Dimasalang Cor Algeciras	SCR	2+845	15.53	59.4	55.4	46.9	43.8	47.7	43.9	48.2	44.6
16	2	Dimasalang Cor Algeciras	SCR	2+845	15.53	59.4	55.4	47.1	44	47.9	44.1	48.4	44.8
16	3	Dimasalang Cor Algeciras	SCR	2+845	15.53	59.4	55.4	47.4	44.3	48.2	44.4	48.7	45.1
17	1	Sagrada Familia Chapel	REL	3+034	77.8	59.4	55.4	45.8	42.7	46.8	43	47.3	43.7
17	2	Sagrada Familia Chapel	REL	3+034	77.8	59.4	55.4	46.9	43.8	47.8	43.9	48.2	44.7
18	1	Antipolo 2	SCR	3+009	40.64	59.4	55.4	45.5	42.5	46.4	42.6	46.9	43.3
18	2	Antipolo 2	SCR	3+009	40.64	59.4	55.4	45.3	42.3	46.2	42.3	46.6	43.1
19	1	Maria Clara Lying Inn Hospital	HSP	3+083	12.68	59.4	55.4	47.3	44.3	48.2	44.3	48.6	45.1
19	2	Maria Clara Lying Inn Hospital	HSP	3+083	12.68	59.4	55.4	47.5	44.5	48.4	44.6	48.9	45.3
20	1	Nuestra Sr. delos Desamparados Chapel	REL	3+083	12.68	59.4	55.4	48.1	45.1	49.1	45.3	49.6	46
21	1	Antipolo 11	SCR	3+109	42.2	59.4	55.4	47.5	44.5	48.8	44.9	49.2	45.7
21	2	Antipolo 11	SCR	3+109	42.2	59.4	55.4	48.5	45.5	49.7	45.8	50.1	46.6
22	1	Algeciras 1	SCR	3+112	12.27	59.4	55.4	48.7	45.7	49.8	45.9	50.2	46.7
22	2	Algeciras 1	SCR	3+112	12.27	59.4	55.4	48.8	45.8	49.8	46	50.3	46.7
23	1	Bgy Hall 50 Zone 50	COM	3+120	80.51	59.4	55.4	48.3	45.3	49.2	45.3	49.6	46.1

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
24	1	Holy Spirit E/S	SCH	3+135	119.54	59.4	55.4	41.2	38.2	42	38.1	42.4	38.9
24	2	Holy Spirit E/S	SCH	3+135	119.54	59.4	55.4	49.8	46.8	50.3	46.4	50.7	47.2
25	1	Algeciras 13	SCR	3+155	11.59	59.4	55.4	49	46	50.1	46.2	50.5	47
25	1	Algeciras 14	SCR	3+224	12.84	59.4	55.4	48.9	45.9	50	46.2	50.5	46.9
26	1	Antipolo 10	SCR	3+194	43.54	59.4	55.4	46.8	43.8	47.9	44.1	48.4	44.8
26	2	Antipolo 10	SCR	3+194	43.54	59.4	55.4	47	44	48.2	44.3	48.6	45.1
26	3	Antipolo 10	SCR	3+194	43.54	59.4	55.4	48.2	45.1	49.3	45.4	49.7	46.2
27	1	Algeciras 14	SCR	3+224	12.84	59.4	55.4	49.1	46.1	50.3	46.4	50.7	47.2
27	2	Algeciras 14	SCR	3+224	12.84	59.4	55.4	48.6	45.6	49.6	45.8	50.1	46.5
28	1	Nuestra Sr. delos Desamparados Chapel	REL	3+230	120.65	59.4	55.4	41	38	41.8	37.9	42.2	38.7
29	1	PhilPost Office	COM	3+230	120.65	59.4	55.4	44.1	41.1	44.6	40.7	45	41.5
29	2	PhilPost Office	COM	3+246	41.92	59.4	55.4	47.5	44.5	48.7	44.8	49.1	45.6
30	1	Sagrada Familia Chapel	REL	3+246	41.92	59.4	55.4	47.7	44.7	49	45.1	49.4	45.9
30	1	Groto Sa Antipolo Chapel	REL	3+948	47.76	69.8	60.8	48.2	45.2	51.8	47.9	51.9	48
31	2	Groto Sa Antipolo Chapel	REL	3+948	47.76	69.8	60.8	51.6	48.6	55.2	51.4	55.3	51.5
32	1	Mothercare Montessori	SCH	4+577	117.27	69.8	60.8	47.4	44.5	48.6	44.9	48.7	45.1
32	2	Mothercare Montessori	SCH	4+577	117.27	69.8	60.8	48.8	45.9	50	46.3	50.1	46.6
32	3	Mothercare Montessori	SCH	4+577	117.27	69.8	60.8	49.4	46.5	50.5	46.9	50.7	47.1
32	4	Mothercare Montessori	SCH	4+577	117.27	69.8	60.8	49.8	46.9	50.9	47.3	51	47.5
33	1	PNB	COM	4+855	15.55	69.8	57.8	47.1	45.1	48.8	45.3	49	46.3
33	2	PNB	COM	4+855	15.55	69.8	57.8	47	45	48.7	45.3	48.9	46.2
33	3	PNB	COM	4+855	15.55	69.8	57.8	47.1	45.1	48.8	45.4	48.9	46.3
34	1	St Mark United Methodist Church	REL	4+907	107.3	64.2	62.3	52.9	50.4	52.9	50.4	51.7	48.9
34	2	St Mark United Methodist Church	REL	4+907	107.3	64.2	62.3	53.9	51.2	53.9	51.2	53.3	50.4

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
34	3	St Mark United Methodist Church	REL	4+907	107.3	64.2	62.3	55.2	52.3	55.2	52.3	55.2	52.3
35	1	Benigno Aquino ES	SCH	4+938	37.31	64.2	62.3	52.9	50.7	52.9	50.7	49.6	46.8
35	2	Benigno Aquino ES	SCH	4+938	37.31	64.2	62.3	54.1	52	54.1	52	49.8	47
35	3	Benigno Aquino ES	SCH	4+938	37.31	64.2	62.3	55	52.9	55	52.9	50.4	47.6
36	1	Bgy Hall 576	COM	5+063	112.34	64.2	62.3	51.5	49.3	51.5	49.3	47.8	45.1
36	2	Bgy Hall 576	COM	5+063	112.34	64.2	62.3	53	50.8	53	50.8	50	47.2
37	1	St Vincent Learning Center	SCH	5+168	82.31	64.2	62.3	54.1	52	54.1	52	49.9	47.2
37	2	St Vincent Learning Center	SCH	5+168	82.31	64.2	62.3	54.6	52.4	54.6	52.4	51	48.3
37	3	St Vincent Learning Center	SCH	5+168	82.31	64.2	62.3	55	52.6	55	52.6	52.4	49.6
38	1	Richfield Montessori	SCH	5+322	31.68	64.2	62.3	51.8	49.6	51.8	49.6	48.7	46
38	2	Richfield Montessori	SCH	5+322	31.68	64.2	62.3	52.7	50.5	52.7	50.5	48.9	46.1
38	3	Richfield Montessori	SCH	5+322	31.68	64.2	62.3	53.9	51.8	53.9	51.8	49.3	46.6
38	4	Richfield Montessori	SCH	5+322	31.68	64.2	62.3	55.3	53.2	55.3	53.2	50.4	47.6
39	1	INC	REL	5+390	39.34	64.2	62.3	54.6	52.6	54.6	52.6	48.7	45.9
39	2	INC	REL	5+390	39.34	64.2	62.3	55	53	55	53	48.8	46.1
39	3	INC	REL	5+390	39.34	64.2	62.3	55.3	53.3	55.3	53.3	49	46.3
39	4	INC	REL	5+390	39.34	64.2	62.3	55.7	53.7	55.7	53.7	49.4	46.7
40	1	LSD	COM	5+509	52.04	64.2	62.3	49.1	46.6	49.1	46.6	47	44.3
40	2	LSD	COM	5+509	52.04	64.2	62.3	50.3	48	50.3	48	47.1	44.3
40	3	LSD	COM	5+509	52.04	64.2	62.3	51.7	49.6	51.7	49.6	47.4	44.6
40	4	LSD	COM	5+509	52.04	64.2	62.3	52.6	50.5	52.6	50.5	47.7	45
41	1	Pelaez E/S	SCH	5+434	114.19	64.2	62.3	50	47.9	50	47.9	46.1	43.3
41	2	Pelaez E/S	SCH	5+434	114.19	64.2	62.3	50.7	48.5	50.7	48.5	46.4	43.7
41	3	Pelaez E/S	SCH	5+434	114.19	64.2	62.3	51.7	49.7	51.7	49.7	46.9	44.2
41	4	Pelaez E/S	SCH	5+434	114.19	64.2	62.3	52.5	50.3	52.5	50.3	48.9	46.2

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
42	1	7th Day Adventist	REL	5+732	89.83	60.6	59.9	37.9	34.8	39.6	35.6	39.7	35.8
43	1	Bgy Hall	COM	5+847	106.76	60.6	59.9	38.2	35.2	39.9	35.9	40	36.1
43	2	Bgy Hall	COM	5+847	106.76	60.6	59.9	39.5	36.5	41.3	37.3	41.4	37.5
43	3	Bgy Hall	COM	5+847	106.76	60.6	59.9	40.9	37.9	42.6	38.6	42.7	38.8
43	4	Bgy Hall	COM	5+847	106.76	60.6	59.9	41.5	38.4	43.2	39.2	43.3	39.4
44	1	PUP	SCH	6+121	15.66	60.6	59.9	44.1	41.1	45.8	41.9	46	42.1
44	2	PUP	SCH	6+121	15.66	60.6	59.9	44.4	41.4	46.1	42.2	46.3	42.3
44	3	PUP	SCH	6+121	15.66	60.6	59.9	44.7	41.7	46.4	42.5	46.6	42.7
45	1	Tzu Chi Great Love Campus	COM	6+633	41.81	60.6	59.9	41.4	38.4	43.2	39.2	43.3	39.4
45	2	Tzu Chi Great Love Campus	COM	6+633	41.81	60.6	59.9	41.7	38.6	43.4	39.4	43.6	39.6
45	3	Tzu Chi Great Love Campus	COM	6+633	41.81	60.6	59.9	41.9	38.9	43.7	39.7	43.8	39.9
45	4	Tzu Chi Great Love Campus	COM	6+633	41.81	60.6	59.9	42.2	39.2	44	40	44.1	40.2
45	5	Tzu Chi Great Love Campus	COM	6+633	41.81	60.6	59.9	42.6	39.5	44.3	40.3	44.4	40.5
46	1	El Pueblo D	SCR	6+711	34.39	60.6	59.9	43.3	40.2	45	41	45.1	41.2
46	2	El Pueblo D	SCR	6+711	34.39	60.6	59.9	43.3	40.3	45.1	41.1	45.2	41.3
46	3	El Pueblo D	SCR	6+711	34.39	60.6	59.9	43.5	40.4	45.2	41.2	45.3	41.4
46	4	El Pueblo D	SCR	6+711	34.39	60.6	59.9	43.7	40.7	45.4	41.5	45.6	41.7
46	5	El Pueblo D	SCR	6+711	34.39	60.6	59.9	44.2	41.1	45.9	41.9	46	42.1
46	6	El Pueblo D	SCR	6+711	34.39	60.6	59.9	45.1	42	46.8	42.8	46.9	43
46	7	El Pueblo D	SCR	6+711	34.39	60.6	59.9	46.7	43.7	48.4	44.5	48.6	44.7
46	8	El Pueblo D	SCR	6+711	34.39	60.6	59.9	49.3	46.3	51	47.1	51.2	47.3
46	9	El Pueblo D	SCR	6+711	34.39	60.6	59.9	53.5	50.5	55.2	51.3	55.4	51.4
46	10	El Pueblo D	SCR	6+711	34.39	60.6	59.9	58.1	55.2	59.8	55.9	59.9	56.1
46	11	El Pueblo D	SCR	6+711	34.39	60.6	59.9	59.1	56.1	60.7	56.8	60.8	57
46	12	El Pueblo D	SCR	6+711	34.39	60.6	59.9	59.5	56.6	61.1	57.3	61.3	57.5

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
47	1	Automobile Association of the Philippine	COM	7273	41.28	61.4	62.8	48.7	45.6	50.1	46.3	50.2	46.5
47	2	Automobile Association of the Philippine	COM	7273	41.28	61.4	63.8	54.9	51.8	56.2	52.4	56.3	52.7
48	1	Banal na Dugo ni Kristo – Malate	REL	8467	70.19	86.6	80.8	47.4	44.3	48.9	45	49	45.3
49	1	Kapilya ng Mapaghimala Banal Krus	REL	8431	83.03	86.6	80.8	41.6	38.5	43.3	39.4	43.4	39.6
50	1	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	46	42.9	47.4	43.6	47.4	43.8
50	2	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	46.7	43.6	48	44.2	48.1	44.5
50	3	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	47.4	44.3	48.7	44.9	48.7	45.1
50	4	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	48.4	45.3	49.6	45.9	49.7	46.1
50	5	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	49.7	46.6	50.8	47.1	50.9	47.3
50	6	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	52.1	49.1	53.1	49.5	53.2	49.7
50	7	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	56.2	53.1	57.2	53.5	57.2	53.7
50	8	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	56.6	53.5	57.5	53.9	57.6	54.1
50	9	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	56.4	53.3	57.3	53.7	57.4	53.9
50	10	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	57.4	54.3	58.3	54.7	58.4	54.9
50	11	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	57.5	54.4	58.4	54.9	58.5	55
50	12	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	57.3	54.2	58.2	54.6	58.3	54.8
50	13	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	57.2	54.1	58.1	54.5	58.1	54.7

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
50	14	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	57.1	54	58	54.4	58.1	54.6
50	15	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	57.1	54	58	54.4	58.1	54.6
50	16	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	57.1	54	58.1	54.5	58.2	54.7
50	17	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	57.2	54.2	58.3	54.7	58.4	54.8
50	18	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	57.5	54.4	58.7	55	58.7	55.2
50	19	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	57.9	54.8	59.2	55.4	59.2	55.6
50	20	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	58.4	55.3	59.8	56	59.9	56.2
50	21	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	58.9	55.8	60.3	56.5	60.4	56.7
50	22	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	59.1	56	60.5	56.7	60.6	56.9
50	23	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	59	55.9	60.4	56.6	60.5	56.8
50	24	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	58.8	55.7	60.3	56.4	60.4	56.7
50	25	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	58.7	55.6	60.1	56.3	60.2	56.5
50	26	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	58.6	55.5	60	56.2	60.1	56.4
50	27	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	58.4	55.3	59.9	56	60	56.3
50	28	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	58.3	55.2	59.7	55.9	59.8	56.1
50	29	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	58.2	55.1	59.6	55.8	59.7	56
50	30	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	58.1	54.9	59.5	55.6	59.6	55.9

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
50	31	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	57.9	54.8	59.4	55.5	59.5	55.7
50	32	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	57.8	54.7	59.2	55.4	59.3	55.6
50	33	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	57.7	54.6	59.1	55.3	59.2	55.5
50	34	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	57.6	54.5	59	55.1	59.1	55.4
50	35	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	57.4	54.3	58.9	55	59	55.2
50	36	Future SMDC ACA (2024) Condominium 36 F	PR	7563	47.4	61.4	57.9	57.3	54.2	58.7	54.9	58.8	55.1
51	1	La Funeraria del Rey 1	COM	7+635	101.92	64.9	61.8	46.6	43.4	48.4	44.4	48.6	44.6
51	2	La Funeraria del Rey 1	COM	7+635	101.92	64.9	61.8	46.4	43.2	48.2	44.2	48.4	44.4
51	3	La Funeraria del Rey 1	COM	7+635	101.92	64.9	61.8	47.2	44	49	45	49.1	45.2
51	4	La Funeraria del Rey 1	COM	7+635	101.92	64.9	61.8	47.4	44.2	49.2	45.2	49.3	45.4
51	5	La Funeraria del Rey 1	COM	7+635	101.92	64.9	61.8	55.9	52.7	57.8	53.7	57.9	53.9
52	1	La Funeraria del Rey 4	COM	7+645	81.82	64.9	61.8	48.3	45	50.1	46.1	50.3	46.2
52	2	La Funeraria del Rey 4	COM	7+645	81.82	64.9	61.8	54.6	51.4	56.5	52.4	56.6	52.6
52	3	La Funeraria del Rey 4	COM	7+645	81.82	64.9	61.8	56.3	53.1	58.1	54.1	58.3	54.3
53	1	La Funeraria del Rey	COM	7+646	106.29	64.9	61.8	48.2	44.9	50.1	46	50.2	46.1
53	2	La Funeraria del Rey	COM	7+646	106.29	64.9	61.8	50.8	47.5	52.7	48.6	52.9	48.7
54	1	San Antonio National High School	SCH	8177	7	86.6	80.8	50.8	47.7	52.1	48.3	52.2	48.5
55	1	Bagong Diwa E/S	SCH	7+793	127.71	64.9	61.8	50.2	46.8	52.1	47.9	52.3	48.1
55	2	Bagong Diwa E/S	SCH	7+793	127.71	64.9	61.8	52.9	49.5	54.8	50.7	55	50.8
55	3	Bagong Diwa E/S	SCH	7+793	127.71	64.9	61.8	57.5	54.1	59.4	55.2	59.6	55.4
55	4	Bagong Diwa E/S	SCH	7+793	127.71	64.9	61.8	58.8	55.5	60.8	56.6	61	56.7
56	1	San Isidro Labrador Chapel 1	REL	8994	99.49	86.6	80.8	46.7	43.6	48.1	44.3	48.2	44.5

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
57	1	Kapilya ng Mapaghimala Banal Krus	REL	8431	83.03	86.6	80.8	41.4	38.3	43.1	39.2	43.2	39.5
58	1	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	49.9	46.8	51.2	47.4	51.3	47.6
58	2	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	51.1	48	52.3	48.6	52.4	48.8
58	3	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	53.7	50.6	54.8	51.1	54.9	51.3
58	4	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	58.6	55.6	59.6	56	59.7	56.2
58	5	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	62.5	59.4	63.7	60	63.8	60.2
58	6	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	67.3	64.2	68.7	64.9	68.8	65.1
58	7	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	67.7	64.6	69.1	65.3	69.2	65.5
58	8	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	66.7	63.6	68.2	64.3	68.3	64.6
58	9	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	66.1	63	67.6	63.7	67.7	63.9
58	10	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	65.5	62.4	67	63.1	67.1	63.4
58	11	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	65	61.9	66.5	62.6	66.6	62.9
58	12	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	64.5	61.4	66	62.1	66.1	62.4
58	13	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	64.1	61	65.5	61.7	65.6	61.9
58	14	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	63.7	60.6	65.1	61.3	65.2	61.5
58	15	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	63.3	60.2	64.7	60.9	64.8	61.1
58	16	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	62.9	59.8	64.4	60.5	64.5	60.7
58	17	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	62.6	59.5	64	60.2	64.1	60.4
58	18	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	62.3	59.2	63.7	59.8	63.8	60.1
58	19	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	62	58.9	63.4	59.5	63.5	59.8
58	20	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	61.7	58.6	63.1	59.3	63.2	59.5
58	21	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	61.4	58.3	62.9	59	62.9	59.2
58	22	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	61.2	58.1	62.6	58.7	62.7	59
58	23	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	60.9	57.8	62.4	58.5	62.5	58.7
59	1	WESA Chapel	REL	8664	81.3	61.4	58.8	50.1	46.9	51.5	47.7	51.6	47.9

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
60	1	Banal na Dugo ni Kristo – Malate	REL	8467	70.19	86.6	80.8	50.1	47	51.7	47.8	51.8	48
61	1	BDo Kamagong	COM	7494	79.68	61.4	57.9	45.6	42.5	47	43.2	47.1	43.4
62	1	The Lienar Makati Tower 1	PR	8473	8.67	86.6	80.8	48.8	45.7	50.2	46.3	50.3	46.6
62	2	The Lienar Makati Tower 1	PR	8473	8.67	86.6	80.8	49.3	46.2	50.7	46.9	50.8	47.1
62	3	The Lienar Makati Tower 1	PR	8473	8.67	86.6	80.8	50	46.9	51.4	47.6	51.5	47.8
62	4	The Lienar Makati Tower 1	PR	8473	8.67	86.6	80.8	51.1	48	52.5	48.7	52.6	48.9
62	5	The Lienar Makati Tower 1	PR	8473	8.67	86.6	80.8	53.2	50.1	54.5	50.7	54.6	50.9
62	6	The Lienar Makati Tower 1	PR	8473	8.67	86.6	80.8	61.6	58.5	63	59.2	63.1	59.4
62	7	The Lienar Makati Tower 1	PR	8473	8.67	86.6	80.8	68.9	65.8	70.4	66.5	70.5	66.7
62	8	The Lienar Makati Tower 1	PR	8473	8.67	86.6	80.8	67.8	64.7	69.3	65.4	69.4	65.7
62	9	The Lienar Makati Tower 1	PR	8473	8.67	86.6	80.8	66.9	63.7	68.3	64.5	68.4	64.7
62	10	The Lienar Makati Tower 1	PR	8473	8.67	86.6	80.8	66.2	63.1	67.7	63.8	67.8	64
62	11	The Lienar Makati Tower 1	PR	8473	8.67	86.6	80.8	65.6	62.5	67	63.2	67.1	63.4
62	12	The Lienar Makati Tower 1	PR	8473	8.67	86.6	80.8	65	61.9	66.5	62.6	66.6	62.8
62	13	The Lienar Makati Tower 1	PR	8473	8.67	86.6	80.8	64.5	61.4	66	62.1	66.1	62.3
62	14	The Lienar Makati Tower 1	PR	8473	8.67	86.6	80.8	64	60.9	65.5	61.6	65.6	61.9
62	15	The Lienar Makati Tower 1	PR	8473	8.67	86.6	80.8	63.6	60.5	65	61.2	65.1	61.4
62	16	The Lienar Makati Tower 1	PR	8473	8.67	86.6	80.8	63.2	60.1	64.6	60.8	64.7	61
62	17	The Lienar Makati Tower 1	PR	8473	8.67	86.6	80.8	62.8	59.7	64.3	60.4	64.4	60.6
62	18	The Lienar Makati Tower 1	PR	8473	8.67	86.6	80.8	62.5	59.4	63.9	60.1	64	60.3
62	19	The Lienar Makati Tower 1	PR	8473	8.67	86.6	80.8	62.1	59	63.6	59.7	63.7	60
62	20	The Lienar Makati Tower 1	PR	8473	8.67	86.6	80.8	61.8	58.7	63.3	59.4	63.4	59.7
62	21	The Lienar Makati Tower 1	PR	8473	8.67	86.6	80.8	61.6	58.4	63	59.1	63.1	59.4
62	22	The Lienar Makati Tower 1	PR	8473	8.67	86.6	80.8	61.3	58.2	62.7	58.9	62.8	59.1
62	23	The Lienar Makati Tower 1	PR	8473	8.67	86.6	80.8	61	57.9	62.4	58.6	62.5	58.8

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
62	24	The Linear Makati Tower 2	PR	8431	10.62	86.6	80.8	49.1	46	50.5	46.7	50.6	46.9
63	1	La Concordia College 2	SCH	8+562	29.58	61.4	58.8	53	49.9	54.7	50.8	54.9	51
63	2	La Concordia College 2	SCH	8+562	29.58	61.4	58.8	54.7	51.6	56.4	52.5	56.6	52.7
63	3	La Concordia College 2	SCH	8+562	29.58	61.4	58.8	57.2	54.1	59	55	59.1	55.3
64	1	La Concordia College 8	SCH	8+639	41.87	61.4	58.8	52.2	49.2	53.8	50	53.9	50.2
65	2	La Concordia College 8	SCH	8+639	41.87	61.4	58.8	53.4	50.5	55	51.2	55.1	51.5
66	1	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	47.1	44	48.5	44.7	48.6	44.9
66	2	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	47.5	44.4	48.9	45.1	49	45.3
66	3	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	47.9	44.8	49.2	45.4	49.3	45.6
66	4	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	49.1	46	50.5	46.7	50.6	46.9
66	5	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	52.2	49.1	53.5	49.7	53.6	49.9
66	6	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	58.8	55.7	60	56.2	60.1	56.4
66	7	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	64.9	61.8	66.1	62.4	66.2	62.6
66	8	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	65.4	62.3	66.7	62.9	66.8	63.2
66	9	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	64.7	61.6	66	62.2	66.1	62.5
66	10	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	63.9	60.8	65.3	61.4	65.3	61.7
66	11	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	63.5	60.4	64.8	61	64.9	61.2
66	12	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	63.1	60	64.5	60.7	64.6	60.9
66	13	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	62.8	59.7	64.2	60.3	64.2	60.6
66	14	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	62.5	59.4	63.8	60	63.9	60.3
66	15	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	62.2	59.1	63.5	59.7	63.6	59.9
66	16	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	61.9	58.8	63.3	59.4	63.3	59.7
66	17	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	61.6	58.5	63	59.2	63.1	59.4
66	18	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	61.3	58.2	62.7	58.9	62.8	59.1
66	19	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	61.1	58	62.4	58.6	62.5	58.8

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
66	20	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	60.8	57.7	62.2	58.4	62.3	58.6
66	21	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	60.6	57.5	61.9	58.1	62	58.3
66	22	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	60.3	57.2	61.7	57.9	61.8	58.1
66	23	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	60.1	57	61.5	57.6	61.5	57.9
66	24	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	59.9	56.8	61.2	57.4	61.3	57.6
66	25	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	59.6	56.5	61	57.2	61.1	57.4
66	26	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	59.4	56.3	60.8	57	60.9	57.2
66	27	Makati Executive Tower 1	PR	8643	18.36	86.6	80.8	59.2	56.1	60.6	56.8	60.7	57
66	28	Makati Executive Tower 1	PR	8680	14.96	86.6	80.8	47	43.9	48.3	44.5	48.4	44.7
67	1	CRS Tower Apartelle	PR	8+943	84.46	61.4	58.8	47.9	45	49.5	45.8	49.6	45.9
67	2	CRS Tower Apartelle	PR	8+943	84.46	61.4	58.8	48.7	45.7	50.3	46.6	50.4	46.7
67	3	CRS Tower Apartelle	PR	8+943	84.46	61.4	58.8	50.1	47.1	51.7	48	51.9	48.1
67	4	CRS Tower Apartelle	PR	8+943	84.46	61.4	58.8	51.4	48.4	53.1	49.3	53.2	49.4
67	5	CRS Tower Apartelle	PR	8+943	84.46	61.4	58.8	53	50	54.6	50.9	54.7	51
68	1	PNR Mansion	PR	8+983	80.65	61.4	58.8	46.4	43.4	48	44.2	48.1	44.4
68	2	PNR Mansion	PR	8+983	80.65	61.4	58.8	46.7	43.8	48.3	44.6	48.5	44.7
68	3	PNR Mansion	PR	8+983	80.65	61.4	58.8	49.1	46.2	50.8	47	50.9	47.2
68	4	PNR Mansion	PR	8+983	80.65	61.4	58.8	50.5	47.5	52.2	48.4	52.3	48.5
69	1	San Isidro Labrador Chapel 2	REL	8994	100.43	86.6	80.8	46	42.9	47.4	43.6	47.5	43.8
70	1	Brgy 815 Zone 88	COM	9+009	44.86	61.4	58.8	47.4	44.3	49	45.2	49.1	45.4
70	2	Brgy 815 Zone 88	COM	9+009	44.86	61.4	58.8	46.9	43.9	48.5	44.7	48.7	44.9
71	1	DSWD District Office V & VI	COM	9+212	138.34	61.4	58.8	42.6	39.5	44.3	40.4	44.4	40.6
71	2	DSWD District Office V & VI	COM	9+212	138.34	61.4	58.8	41.5	38.4	43.2	39.3	43.3	39.5
72	1	Paco Condominium	PR	9+230	138.11	61.4	58.8	40.9	37.8	42.6	38.7	42.8	38.9
72	2	Paco Condominium	PR	9+230	138.11	61.4	58.8	40.2	37.1	41.9	38	42.1	38.2

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
72	3	Paco Condominium	PR	9+230	138.11	61.4	58.8	39.4	36.3	41.2	37.2	41.3	37.4
72	4	Paco Condominium	PR	9+230	138.11	61.4	58.8	39.2	36.1	41	37.1	41.2	37.2
73	1	Paco Bliss	PR	9+232	110.05	61.4	58.8	44.7	41.6	46.4	42.5	46.5	42.7
73	2	Paco Bliss	PR	9+232	110.05	61.4	58.8	44.7	41.6	46.4	42.5	46.6	42.7
73	3	Paco Bliss	PR	9+232	110.05	61.4	58.8	44.7	41.6	46.4	42.5	46.5	42.7
73	4	Paco Bliss	PR	9+232	110.05	61.4	58.8	45.3	42.2	47.1	43.2	47.2	43.3
74	1	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	43.3	40.1	44.3	40.6	45.2	41.3
74	2	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	43.4	40.3	44.4	40.7	45.3	41.4
74	3	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	43.5	40.4	44.5	40.9	45.5	41.6
74	4	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	43.6	40.5	44.6	41	45.6	41.7
74	5	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	43.7	40.6	44.7	41.1	45.7	41.8
74	6	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	43.8	40.7	44.8	41.2	45.8	41.9
74	7	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	43.9	40.8	44.9	41.3	45.9	42
74	8	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	44	40.9	45	41.4	46	42.1
74	9	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	44.2	41	45.2	41.5	46.1	42.2
74	10	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	44.6	41.5	45.6	42	46.5	42.6
74	11	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	45.7	42.6	46.9	43.2	47.7	43.8
74	12	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	48.1	45.1	49.6	45.8	50.1	46.2
74	13	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	53.2	50.2	54.8	50.9	55.1	51.3

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
74	14	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	56.4	53.4	58.1	54.2	58.3	54.5
74	15	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	57.9	54.9	59.6	55.7	59.8	56
74	16	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	58.2	55.2	59.9	56	60.1	56.3
74	17	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	58	54.9	59.6	55.7	59.8	56
74	18	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	58	54.9	59.6	55.7	59.9	56.1
74	19	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	58	55	59.6	55.7	59.9	56.1
74	20	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	58.2	55.2	59.7	55.8	60.1	56.3
74	21	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	58.6	55.5	59.9	56.1	60.5	56.7
74	22	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	59.1	56	60.2	56.6	61	57.2
74	23	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	59.3	56.2	60.3	56.7	61.2	57.3
74	24	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	59.1	56	60.1	56.5	61	57.1
74	25	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	58.9	55.8	59.9	56.3	60.8	56.9
74	26	Avida Towers San Lorenzo Tower	PR	12+683	36.75	63.9	58.2	58.7	55.6	59.7	56.1	60.6	56.7
75	1	Cityland Pasong Tamo Building 2	PR	12+740	20.84	63.9	58.2	45.2	42.1	46.3	42.6	47.2	43.3
75	2	Cityland Pasong Tamo Building 2	PR	12+740	20.84	63.9	58.2	45.4	42.3	46.5	42.8	47.5	43.6
75	3	Cityland Pasong Tamo Building 2	PR	12+740	20.84	63.9	58.2	45.7	42.6	46.8	43.1	47.7	43.8
75	4	Cityland Pasong Tamo Building 2	PR	12+740	20.84	63.9	58.2	45.9	42.8	47	43.3	48	44.1

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
75	5	Cityland Pasong Tamo Building 2	PR	12+740	20.84	63.9	58.2	46.2	43.1	47.3	43.6	48.2	44.3
75	6	Cityland Pasong Tamo Building 2	PR	12+740	20.84	63.9	58.2	46.5	43.4	47.5	43.9	48.5	44.6
75	7	Cityland Pasong Tamo Building 2	PR	12+740	20.84	63.9	58.2	46.7	43.6	47.8	44.1	48.7	44.9
75	8	Cityland Pasong Tamo Building 2	PR	12+740	20.84	63.9	58.2	46.9	43.8	48	44.3	49	45.1
75	9	Cityland Pasong Tamo Building 2	PR	12+740	20.84	63.9	58.2	47.4	44.3	48.4	44.8	49.3	45.4
75	10	Cityland Pasong Tamo Building 2	PR	12+740	20.84	63.9	58.2	49.7	46.6	51	47.2	51.6	47.7
75	11	Cityland Pasong Tamo Building 2	PR	12+740	20.84	63.9	58.2	57.7	54.7	59.4	55.5	59.6	55.8
75	12	Cityland Pasong Tamo Building 2	PR	12+740	20.84	63.9	58.2	61.7	58.6	63.4	59.4	63.6	59.8
76	1	Bangkal E/S	SCH	12+744	75.46	63.9	58.2	52.9	49.8	53.7	50.1	54.8	50.9
77	1	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	39.9	36.8	40.9	37.2	41.9	38
77	2	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	39.8	36.7	40.8	37.2	41.8	37.9
77	3	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	39.8	36.7	40.8	37.2	41.8	37.9
77	4	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	39.8	36.7	40.8	37.2	41.8	37.9
77	5	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	39.8	36.7	40.8	37.2	41.8	37.9
77	6	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	39.8	36.7	40.8	37.2	41.9	38
77	7	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	39.8	36.7	40.8	37.2	41.9	38
77	8	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	39.9	36.7	40.9	37.2	41.9	38
77	9	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	39.9	36.8	40.9	37.2	41.9	38
77	10	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	40	36.8	41	37.3	42	38.1
77	11	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	40	36.9	41.1	37.4	42.1	38.2
77	12	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	40.1	37	41.1	37.5	42.2	38.3
77	13	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	40.2	37	41.2	37.5	42.2	38.3

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
77	14	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	40.2	37.1	41.2	37.5	42.3	38.4
77	15	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	40.3	37.2	41.4	37.7	42.5	38.6
77	16	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	43.3	40.2	44.7	40.9	45.6	41.7
77	17	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	46.2	43.1	47.7	43.9	48.4	44.5
77	18	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	47.8	44.8	49.4	45.5	50	46.2
77	19	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	48.6	45.5	50.2	46.3	50.7	46.9
77	20	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	49.5	46.4	51.1	47.2	51.6	47.8
77	21	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	50.4	47.3	52.1	48.1	52.5	48.7
77	22	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	51	47.9	52.7	48.7	53.1	49.3
77	23	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	51.3	48.2	53	49	53.4	49.6
77	24	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	51.5	48.4	53.2	49.2	53.6	49.7
77	25	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	51.9	48.9	53.6	49.7	54	50.2
77	26	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	52.9	49.8	54.5	50.6	54.9	51.1
77	27	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	54.1	51	55.7	51.8	56.1	52.3
77	28	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	54.5	51.4	56.1	52.2	56.5	52.7
77	29	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	54.5	51.4	56.1	52.2	56.5	52.7
77	30	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	54.5	51.4	56.1	52.2	56.5	52.7
77	31	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	54.5	51.5	56.1	52.2	56.6	52.7
77	32	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	54.6	51.5	56.1	52.2	56.6	52.8
77	33	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	54.7	51.6	56.1	52.3	56.7	52.9
77	34	Citiland Pasong Tamo Tower	PR	12+744	75.46	63.9	58.2	54.9	51.8	56.2	52.4	56.9	53
77	35	Citiland Pasong Tamo Tower	PR	12+740	20.84	63.9	58.2	55.1	52	56.3	52.6	57.1	53.2
78	1	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	54.5	51.4	56.3	52.3	56.4	52.5
78	2	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	57	53.9	58.8	54.8	59	55.1
78	3	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	58	54.8	59.7	55.8	59.9	56

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
78	4	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	41.5	38.4	42.5	38.8	43.4	39.5
78	5	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	41.4	38.3	42.4	38.7	43.3	39.4
78	6	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	41.3	38.2	42.4	38.7	43.3	39.4
78	7	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	41.3	38.2	42.3	38.7	43.3	39.4
78	8	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	41.2	38.1	42.3	38.6	43.2	39.3
78	9	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	41.3	38.2	42.3	38.6	43.2	39.3
78	10	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	41.4	38.3	42.4	38.7	43.3	39.4
78	11	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	42.7	39.6	43.9	40.1	44.7	40.8
78	12	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	44.4	41.3	45.7	41.9	46.5	42.6
78	13	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	45.4	42.3	46.7	42.9	47.4	43.5
78	14	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	46	42.9	47.3	43.5	48	44.1
78	15	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	46.9	43.8	48.2	44.4	48.8	45
78	16	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	48.6	45.5	50	46.1	50.5	46.7
78	17	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	50.7	47.6	52.1	48.3	52.6	48.7
78	18	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	50.6	47.6	52.1	48.3	52.6	48.7
78	19	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	50.7	47.7	52.2	48.4	52.7	48.8
78	20	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	51.4	48.3	52.9	49.1	53.3	49.5
78	21	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	51.7	48.6	53.2	49.4	53.6	49.8
78	22	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	51.5	48.4	53.1	49.2	53.4	49.6
78	23	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	51.4	48.3	53	49.1	53.3	49.5
78	24	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	51.4	48.3	52.9	49.1	53.3	49.5
78	25	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	51.5	48.5	53.1	49.2	53.4	49.6
78	26	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	51.6	48.5	53.1	49.3	53.5	49.7
78	27	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	51.7	48.6	53.2	49.3	53.6	49.8
78	28	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	52.2	49.1	53.7	49.8	54.1	50.3

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
78	29	Laureano di Trevi Tower 2	PR	12+854	59.6	63.9	58.2	53.1	50	54.5	50.7	55	51.2
78	30	Laureano di Trevi Tower 2	PR	12+862	92.63	63.9	58.2	53.6	50.5	55	51.2	55.5	51.7
79	1	Laureano di Trevi Tower 3	PR	12+862	92.63	63.9	58.2	54.2	51.1	55.5	51.7	56.1	52.3
79	2	Laureano di Trevi Tower 3	PR	12+862	92.63	63.9	58.2	39.6	36.5	40.7	37	41.6	37.7
79	3	Laureano di Trevi Tower 3	PR	12+862	92.63	63.9	58.2	39.5	36.4	40.5	36.9	41.4	37.5
79	4	Laureano di Trevi Tower 3	PR	12+862	92.63	63.9	58.2	39.4	36.3	40.4	36.8	41.4	37.5
79	5	Laureano di Trevi Tower 3	PR	12+862	92.63	63.9	58.2	39.3	36.2	40.3	36.7	41.2	37.3
79	6	Laureano di Trevi Tower 3	PR	12+862	92.63	63.9	58.2	39.2	36.1	40.3	36.6	41.2	37.3
79	7	Laureano di Trevi Tower 3	PR	12+862	92.63	63.9	58.2	39.3	36.1	40.3	36.6	41.2	37.3
79	8	Laureano di Trevi Tower 3	PR	12+862	92.63	63.9	58.2	39.4	36.3	40.5	36.8	41.4	37.5
79	9	Laureano di Trevi Tower 3	PR	12+862	92.63	63.9	58.2	43.1	40	44.5	40.6	45.1	41.2
79	10	Laureano di Trevi Tower 3	PR	12+862	92.63	63.9	58.2	45.2	42.1	46.6	42.8	47.3	43.4
79	11	Laureano di Trevi Tower 3	PR	12+862	92.63	63.9	58.2	46.4	43.3	47.8	44	48.5	44.7
79	12	Laureano di Trevi Tower 3	PR	12+862	92.63	63.9	58.2	47.2	44.1	48.6	44.8	49.3	45.4
79	13	Laureano di Trevi Tower 3	PR	12+862	92.63	63.9	58.2	47.6	44.5	49	45.2	49.7	45.8
79	14	Laureano di Trevi Tower 3	PR	12+862	92.63	63.9	58.2	47.9	44.8	49.3	45.5	49.9	46.1
79	15	Laureano di Trevi Tower 3	PR	12+862	92.63	63.9	58.2	48.2	45.1	49.6	45.8	50.2	46.4
79	16	Laureano di Trevi Tower 3	PR	12+862	92.63	63.9	58.2	48.7	45.6	50.1	46.3	50.7	46.8
79	17	Laureano di Trevi Tower 3	PR	12+862	92.63	63.9	58.2	49.4	46.3	50.8	47	51.4	47.5
79	18	Laureano di Trevi Tower 3	PR	12+863	28.15	63.9	58.2	50.1	47	51.4	47.6	52	48.2
79	19	Laureano di Trevi Tower 3	PR	12+863	28.15	63.9	58.2	50	47	51.4	47.6	52	48.1
79	20	Laureano di Trevi Tower 3	PR	12+863	28.15	63.9	58.2	49.9	46.8	51.2	47.5	51.9	48
79	21	Laureano di Trevi Tower 3	PR	12+863	28.15	63.9	58.2	49.9	46.8	51.2	47.4	51.8	47.9
80	1	Laureno di Trevi Towers	PR	12+863	28.15	63.9	58.2	45.5	42.4	46.5	42.9	47.4	43.6
80	2	Laureno di Trevi Towers	PR	12+863	28.15	63.9	58.2	45.6	42.5	46.6	43	47.7	43.8

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
80	3	Laureno di Trevi Towers	PR	12+863	28.15	63.9	58.2	45.8	42.7	46.8	43.1	47.8	43.9
80	4	Laureno di Trevi Towers	PR	12+863	28.15	63.9	58.2	45.9	42.8	46.9	43.3	48	44.1
80	5	Laureno di Trevi Towers	PR	12+863	28.15	63.9	58.2	46.1	43	47.1	43.4	48	44.1
80	6	Laureno di Trevi Towers	PR	12+863	28.15	63.9	58.2	46.2	43.1	47.2	43.6	48.1	44.2
80	7	Laureno di Trevi Towers	PR	12+863	28.15	63.9	58.2	46.4	43.3	47.4	43.7	48.3	44.4
80	8	Laureno di Trevi Towers	PR	12+863	28.15	63.9	58.2	46.7	43.6	47.7	44.1	48.6	44.7
80	9	Laureno di Trevi Towers	PR	12+863	28.15	63.9	58.2	48.3	45.2	49.6	45.8	50.2	46.3
80	10	Laureno di Trevi Towers	PR	12+863	28.15	63.9	58.2	51.9	48.8	53.4	49.5	53.8	49.9
80	11	Laureno di Trevi Towers	PR	12+863	28.15	63.9	58.2	59.7	56.6	61	57.3	61.6	57.7
80	12	Laureno di Trevi Towers	PR	12+863	28.15	63.9	58.2	60.6	57.6	62.3	58.4	62.5	58.7
80	13	Laureno di Trevi Towers	PR	12+863	28.15	63.9	58.2	60.4	57.3	62	58.1	62.2	58.4
80	14	Laureno di Trevi Towers	PR	12+863	28.15	63.9	58.2	59.9	56.8	61.5	57.6	61.8	57.9
80	15	Laureno di Trevi Towers	PR	12+863	28.15	63.9	58.2	59.7	56.7	61.3	57.4	61.6	57.8
80	16	Laureno di Trevi Towers	PR	12+863	28.15	63.9	58.2	59.9	56.8	61.4	57.5	61.8	58
80	17	Laureno di Trevi Towers	PR	15+527	62.39	63.9	58.2	60.5	57.4	61.7	58	62.4	58.5
80	18	Laureno di Trevi Towers	PR	13+199	60.77	63.9	58.2	61.1	58	62.2	58.5	63	59.1
80	19	Laureno di Trevi Towers	PR	13+199	60.77	63.9	58.2	61	57.9	62	58.4	62.9	59
80	20	Laureno di Trevi Towers	PR	13+199	60.77	63.9	58.2	60.8	57.7	61.8	58.2	62.7	58.8
81	1	Don Bosco	PR	12+854	59.6	63.9	58.2	46.1	43	47.2	43.5	48.4	44.5
81	2	Don Bosco	PR	12+919	26.48	63.9	58.2	44.7	41.6	45.9	42.2	47.7	43.8
81	3	Don Bosco	PR	12+919	26.48	63.9	58.2	44.8	41.7	45.9	42.2	47.9	44
81	4	Don Bosco	PR	12+919	26.48	63.9	58.2	45	41.9	46.1	42.4	48	44.1
81	5	Don Bosco	PR	12+919	26.48	63.9	58.2	45.2	42.1	46.3	42.6	47.9	44
81	6	Don Bosco	PR	12+919	26.48	63.9	58.2	45.4	42.3	46.5	42.8	47.7	43.8
81	7	Don Bosco	PR	12+919	26.48	63.9	58.2	45.6	42.5	46.7	43	47.9	44

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
82	1	Bangkal E/S	PR	13+032	126.02	63.9	58.2	42.5	39.4	43.3	39.8	44.5	40.5
82	2	Bangkal E/S	PR	13+032	126.02	63.9	58.2	50.3	47.2	51.1	47.6	52.3	48.4
82	3	Bangkal E/S	PR	13+032	126.02	63.9	58.2	51.1	47.9	51.8	48.3	53	49.1
82	4	Bangkal E/S	PR	13+032	126.02	63.9	58.2	52.1	49	52.9	49.3	54	50.1
83	1	Social Welfare & Development Center	COM	13+199	60.77	63.9	58.2	47.2	44.1	48.6	44.8	48.9	45.2
84	1	South Star Plaza Condominium	PR	13+200	60.77	63.9	58.2	46.8	43.7	47.6	44.1	48.8	44.9
84	2	South Star Plaza Condominium	PR	13+201	60.77	63.9	58.2	47.3	44.2	48	44.5	49.3	45.3
84	3	South Star Plaza Condominium	PR	13+202	60.77	63.9	58.2	47.6	44.5	48.4	44.9	49.6	45.7
84	4	South Star Plaza Condominium	PR	13+203	60.77	63.9	58.2	48.8	45.6	49.5	46	50.8	46.8
84	5	South Star Plaza Condominium	PR	13+204	60.77	63.9	58.2	49.7	46.6	50.4	46.9	51.7	47.8
84	6	South Star Plaza Condominium	PR	13+205	60.77	63.9	58.2	50.5	47.4	51.2	47.7	52.5	48.6
84	7	South Star Plaza Condominium	PR	13+206	60.77	63.9	58.2	51.5	48.4	52.2	48.7	53.5	49.5
84	8	South Star Plaza Condominium	PR	13+207	60.77	63.9	58.2	52.6	49.5	53.2	49.8	54.6	50.7
84	9	South Star Plaza Condominium	PR	13+208	60.77	63.9	58.2	55.3	52.2	55.8	52.4	57.3	53.3
84	10	South Star Plaza Condominium	PR	13+209	60.77	67.8	58.2	54.9	51.7	55.3	51.9	56.8	52.9
84	11	South Star Plaza Condominium	PR	13+210	79.39	63.9	58.2	55	51.8	55.4	52	56.9	53
84	12	South Star Plaza Condominium	PR	13+211	79.39	63.9	58.2	55.8	52.7	56.1	52.8	57.7	53.8
84	13	South Star Plaza Condominium	PR	13+212	79.39	63.9	58.2	56.3	53.1	56.6	53.3	58.2	54.2
85	1	TESDA Womens Center	COM	13+500	61.31	63.9	58.2	49.1	45.9	50.9	46.9	51	47.1

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
85	2	TESDA Womens Center	COM	13+500	61.31	63.9	58.2	53.8	50.7	55.6	51.6	55.8	51.9
85	3	TESDA Womens Center	COM	13+500	61.31	73.3	69.4	56.4	53.3	58.2	54.2	58.4	54.5
86	1	West Tower	PR	13+500	61.31	73.3	69.4	44.5	41.4	45.4	41.8	46.9	43
86	2	West Tower	PR	13+500	61.31	73.3	69.4	48.3	45.2	49.2	45.6	50.4	46.5
86	3	West Tower	PR	13+500	61.31	73.3	69.4	50.7	47.6	51.6	48	52.7	48.8
86	4	West Tower	PR	13+500	61.31	73.3	69.4	52.8	49.7	53.7	50.1	54.8	50.9
86	5	West Tower	PR	13+500	61.31	73.3	69.4	56	52.9	56.8	53.3	58	54.1
86	6	West Tower	PR	13+500	61.31	73.3	69.4	56.9	53.8	57.8	54.2	58.8	55
86	7	West Tower	PR	13+500	61.31	73.3	69.4	57.3	54.2	58.2	54.6	59.2	55.3
86	8	West Tower	PR	13+500	61.31	73.3	69.4	57.6	54.5	58.6	54.9	59.5	55.6
86	9	West Tower	PR	13+500	61.31	73.3	69.4	57.9	54.8	58.8	55.2	59.8	55.9
86	10	West Tower	PR	13+500	61.31	73.3	69.4	58	54.9	58.9	55.3	59.9	56
86	11	West Tower	PR	13+501	62.31	73.3	69.4	57.9	54.8	58.9	55.2	59.8	55.9
86	12	West Tower	PR	13+502	63.31	73.3	69.4	57.8	54.7	58.8	55.2	59.7	55.8
86	13	West Tower	PR	13+503	64.31	73.3	69.4	57.7	54.6	58.7	55.1	59.6	55.7
86	14	West Tower	PR	13+504	65.31	73.3	69.4	57.7	54.6	58.7	55.1	59.6	55.7
86	15	West Tower	PR	13+505	66.31	73.3	69.4	57.8	54.7	58.7	55.1	59.6	55.8
86	16	West Tower	PR	13+506	67.31	73.3	69.4	57.8	54.7	58.7	55.1	59.6	55.8
86	17	West Tower	PR	13+507	68.31	73.3	69.4	57.7	54.6	58.7	55	59.6	55.7
86	18	West Tower	PR	13+508	69.31	73.3	69.4	57.5	54.4	58.5	54.9	59.4	55.5
86	19	West Tower	PR	13+509	70.31	73.3	69.4	57.4	54.3	58.4	54.8	59.3	55.4
86	20	West Tower	PR	13+510	71.31	73.3	69.4	57.3	54.2	58.3	54.7	59.2	55.3
87	1	AFPOVAI (Phase III) Subdivision	SCR	16+027	81.06	63.9	58.2	41.6	38.5	43.4	39.4	43.6	39.6
87	2	AFPOVAI (Phase III) Subdivision	SCR	16+027	81.06	63.9	58.2	44	40.8	45.8	41.8	45.9	42

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
88	1	Technological University of the Phil	SCH	16+309	79.39	63.9	58.2	43	39.9	44.8	40.8	44.9	41
88	2	Technological University of the Phil	SCH	16+310	79.39	63.9	58.2	45	41.8	46.7	42.8	46.9	42.9
88	3	Technological University of the Phil	SCH	16+311	70.57	63.9	58.2	47.2	44.1	49	45	49.1	45.2
88	4	Technological University of the Phil	SCH	16+312	70.57	63.9	58.2	50.3	47.2	52.1	48.1	52.2	48.3
89	1	TESDA	SCH	16+500	70.57	63.9	58.2	55.8	52.7	57.6	53.6	57.8	53.8
89	2	TESDA	SCH	13+500	61.31	63.9	58.2	56.9	53.7	58.7	54.7	58.8	54.9
89	3	TESDA	SCH	13+500	61.31	63.9	58.2	57.7	54.6	59.5	55.5	59.7	55.8
89	4	TESDA	SCH	13+500	61.31	63.9	58.2	58.5	55.3	60.3	56.3	60.4	56.5
89	5	TESDA	SCH	13+500	61.31	63.9	58.2	59.2	56	61	57	61.1	57.2
90	1	Bagong Lipunan Tenement	PR	17+978	52.72	87.3	76.3	48.1	44.9	49.8	45.9	50	46.1
90	2	Bagong Lipunan Tenement	PR	17+978	52.72	87.3	76.3	49.8	46.7	51.6	47.6	51.8	47.8
90	3	Bagong Lipunan Tenement	PR	17+978	52.72	87.3	76.3	51.8	48.7	53.6	49.6	53.8	49.9
90	4	Bagong Lipunan Tenement	PR	17+978	52.72	87.3	76.3	53.1	50	54.9	51	55.1	51.2
91	1	Sta Teresita Compound	**SCR**	20+913	24.43	74.8	73.2	44.2	40.9	47.2	43.8	47.4	44.1
91	2	Sta Teresita Compound	SCR	20+913	24.43	74.8	73.2	44.6	41.3	47.6	44.2	47.8	44.5
92	1	Miraculous Medal School Annex1	SCH	23+097	8.34	61.9	61.5	49.8	46.5	53.3	49.8	53.5	50.1
92	2	Miraculous Medal School Annex1	SCH	23+097	8.34	61.9	61.5	50.4	47.1	53.9	50.4	54	50.7
93	1	Dona Rosario East	SCR	23+179	43.1	61.9	61.5	47	43.7	50.5	47	50.6	47.3
94	1	Dona Rosario Subd West	SCR	23+194	55.7	61.9	61.5	47.1	43.8	50.6	47.1	50.8	47.4
95	1	Corinthian Villas	SCR	23+545	23.5	61.9	61.5	48.6	45.3	52	48.6	52.2	48.8
96	1	Patio Homes 2	SCR	23+734	15.44	61.9	61.5	49.9	46.6	53.4	49.9	53.6	50.2
97	2	Patio Homes 3	SCR	23+734	15.44	61.9	61.5	49.9	46.6	53.3	49.9	53.5	50.1
98	3	Patio Homes 4	SCR	23+734	15.44	61.9	61.5	50.9	47.6	54.4	50.9	54.5	51.2

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
99	1	Don Juan Bayview Subdivision	SCR	23+737	9.54	61.9	61.5	50.7	47.4	54.2	50.7	54.4	51
99	2	Don Juan Bayview Subdivision	SCR	23+737	9.54	61.9	61.5	50.8	47.5	54.3	50.9	54.5	51.2
99	3	Don Juan Bayview Subdivision	SCR	23+737	9.54	61.9	61.5	50.7	47.4	54.2	50.7	54.4	51
100	1	Don Juan Bayview Subdivision	SCR	23+737	9.54	61.9	61.5	50.8	47.5	54.3	50.9	54.5	51.2
100	2	Don Juan Bayview Subdivision	SCR	23+737	9.54	61.9	61.5	50.7	47.4	54.2	50.7	54.4	51
100	3	Don Juan Bayview Subdivision	SCR	23+737	9.54	61.9	61.5	50.8	47.5	54.3	50.9	54.5	51.2
101	1	Patio Homes 1	SCR	23+758	15.89	61.9	61.5	49	45.7	52.5	49	52.6	49.3
101	2	Patio Homes 1	SCR	23+758	15.89	61.9	61.5	49.8	46.5	53.3	49.8	53.4	50.1
101	3	Patio Homes 1	SCR	23+758	15.89	61.9	61.5	49.7	46.4	53.2	49.7	53.3	50
102	1	Don Juan Bayview Subd	SCR	23+772	30.05	61.9	61.5	48.2	44.9	51.7	48.2	51.9	48.5
103	1	Sucat E/S	SCR	23+885	73.2	61.9	61.5	46.9	43.6	50.3	46.9	50.5	47.2
104	1	St Domingo de Guzman Sub-Parish	REL	23+957	128.26	61.9	61.5	45.1	41.8	48.6	45.1	48.7	45.4
104	2	St Domingo de Guzman Sub-Parish	REL	23+957	128.26	61.9	61.5	49.9	46.6	53.4	50	53.6	50.2
104	3	St Domingo de Guzman Sub-Parish	REL	23+957	128.26	61.9	61.5	51	47.7	54.5	51	54.6	51.3
105	1	MSFI Macro Asia	COM	25+126	98.85	58.5	61.1	47.1	43.7	50.5	47.1	50.9	47.6
105	2	MSFI Macro Asia	COM	25+126	98.85	58.5	61.1	47.6	44.1	51	47.6	51.4	48.1
105	3	MSFI Macro Asia	COM	25+126	98.85	58.5	61.1	48.1	44.7	51.6	48.2	52	48.7
105	4	MSFI Macro Asia	COM	25+126	98.85	58.5	61.1	47.1	43.7	50.5	47.1	50.9	47.6
105	5	MSFI Macro Asia	COM	25+126	98.85	58.5	61.1	47.6	44.1	51	47.6	51.4	48.1
105	6	MSFI Macro Asia	COM	25+126	98.85	58.5	61.1	48.1	44.7	51.6	48.2	52	48.7
105	7	MSFI Macro Asia	COM	25+126	98.85	58.5	61.1	47.1	43.7	50.5	47.1	50.9	47.6

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
105	8	MSFI Macro Asia	COM	25+126	98.85	58.5	61.1	47.6	44.1	51	47.6	51.4	48.1
105	9	MSFI Macro Asia	COM	25+126	98.85	58.5	61.1	48.1	44.7	51.6	48.2	52	48.7
106	1	Muntinlupa Business High School	SCH	25+753	31.31	58.5	61.1	48.5	45.1	52.4	49	52.9	49.5
106	2	Muntinlupa Business High School	SCH	25+753	31.31	58.5	61.1	48.9	45.5	52.8	49.4	53.2	49.9
106	3	Muntinlupa Business High School	SCH	25+753	31.31	58.5	61.1	49.9	46.5	53.9	50.5	54.3	50.9
106	4	Muntinlupa Business High School	SCH	25+753	31.31	58.5	61.1	51.9	48.5	55.8	52.4	56.3	52.9
107	1	JRF Multipurpose Day Care Center	SCH	26+076	19.43	58.5	61.1	49.7	46.3	53.7	50.3	54.1	50.7
107	2	JRF Multipurpose Day Care Center	SCH	26+076	19.43	58.5	61.1	50.3	46.9	54.3	50.9	54.7	51.3
108	1	San Nicolas de Tolentino Parish Church	REL	26+198	130.68	58.5	61.1	48	44.6	51.8	48.4	52.6	49.2
108	2	San Nicolas de Tolentino Parish Church	REL	26+198	130.68	58.5	61.1	49.8	46.4	53.6	50.2	54.3	50.9
108	3	San Nicolas de Tolentino Parish Church	REL	26+198	130.68	58.5	61.1	52.1	48.7	56	52.6	56.5	53.1
109	1	STI Alabang	SCH	28+159	73.34	82.2	67	45.4	42	49	45.6	49.5	46.1
109	2	STI Alabang	SCH	28+159	73.34	82.2	67	46.6	43.1	50.2	46.8	50.7	47.3
109	3	STI Alabang	SCH	28+159	73.34	82.2	67	47.1	43.6	50.7	47.3	51.1	47.7
109	4	STI Alabang	SCH	28+159	73.34	82.2	67	47.8	44.3	51.4	48	51.7	48.4
109	5	STI Alabang	SCH	28+159	73.34	82.2	67	48.8	45.4	52.4	49	52.8	49.4
110	1	San Roque Medical Clinic	HSP	28+206	39.03	82.2	67	45.4	41.9	49	45.6	49.4	46
110	2	San Roque Medical Clinic	HSP	28+206	39.03	82.2	67	45.9	42.4	49.5	46.1	49.9	46.5
110	3	San Roque Medical Clinic	HSP	28+206	39.03	82.2	67	46.1	42.7	49.7	46.3	50.1	46.8
111	1	San Roque de Alabang Parish Church	REL	28+306	35.77	82.2	67	50.3	46.9	54	50.7	54.6	51.2

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
111	2	San Roque de Alabang Parish Church	REL	28+306	35.77	82.2	67	51.9	48.5	55.6	52.2	56.2	52.8
111	3	San Roque de Alabang Parish Church	REL	28+306	35.77	82.2	67	53.3	49.9	57	53.7	57.6	54.2
111	4	San Roque de Alabang Parish Church	REL	28+306	35.77	82.2	67	55.2	51.8	58.9	55.6	59.5	56.1
112	1	Star Mall Alabang	COM	28+406	24.73	82.2	67	48.7	45.2	52.2	48.9	52.5	49.2
112	2	Star Mall Alabang	COM	28+406	24.73	82.2	67	49.4	46	53	49.7	53.3	50
112	3	Star Mall Alabang	COM	28+406	24.73	82.2	67	50.2	46.7	53.7	50.4	54	50.7
112	4	Star Mall Alabang	COM	28+406	24.73	82.2	67	51	47.5	54.6	51.2	54.8	51.5
112	5	Star Mall Alabang	COM	28+406	24.73	82.2	67	51.8	48.4	55.4	52	55.7	52.3
112	6	Star Mall Alabang	COM	28+406	24.73	82.2	67	52.6	49.2	56.2	52.9	56.5	53.2
112	7	Star Mall Alabang	COM	28+406	24.73	82.2	67	53.2	49.8	56.8	53.4	57.1	53.8
113	1	Maranatha Christian School	SCH	29+245	80.83	65.2	68.4	48.2	44.6	51.7	48.4	52.4	48.9
113	2	Maranatha Christian School	SCH	29+245	80.83	65.2	68.4	48.6	45	52.2	48.8	52.9	49.4
114	1	Alternative Learning Center	SCH	29+296	14.56	65.2	68.4	48.8	45.2	52.4	49	52.8	49.3
114	2	Alternative Learning Center	SCH	29+296	14.56	65.2	68.4	49.2	45.6	52.8	49.5	53.2	49.7
115	1	Mary Mother of God Parochial School	SCH	29+403	3.23	65.2	68.4	50.4	46.8	54	50.7	54.4	50.9
116	1	Lim de Mesa Funeral Parlor	COM	29+498	67.09	65.2	68.4	49.5	45.9	53.1	49.7	53.6	50.1
116	2	Lim de Mesa Funeral Parlor	COM	29+498	67.09	65.2	68.4	49.9	46.4	53.5	50.2	54	50.5
117	1	Church of Jesus Christ Later Saint	REL	29+787	13.05	65.2	68.4	49.2	45.6	52.7	49.4	53.1	49.7
117	2	Church of Jesus Christ Later Saint	REL	29+787	13.05	65.2	68.4	49.5	45.9	53	49.7	53.4	50
118	1	INC	REL	29+999	70.71	65.2	68.4	48.5	44.9	52	48.7	52.6	49.1
118	2	INC	REL	29+999	70.71	65.2	68.4	49.6	46.1	53.2	49.9	53.7	50.2
118	3	INC	REL	29+999	70.71	65.2	68.4	50.7	47.1	54.3	51	54.8	51.3
119	1	Multiland Subdivision 2	SCR	30+558	50.8	65.2	68.4	50.2	46.6	53.6	50.3	54.1	50.6

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
119	2	Multiland Subdivision 2	SCR	30+558	50.8	65.2	68.4	50.9	47.4	54.4	51.1	54.8	51.4
120	1	Christ the King College S&T	SCR	30+654	3.42	65.2	68.4	50.6	47	52.9	49.6	53.4	49.9
121	1	Muntinlupa Institute of Technology	SCH	30+945	9.8	65.2	68.4	48.3	44.7	50.6	47.3	51	47.6
121	2	Muntinlupa Institute of Technology	SCH	30+945	9.8	65.2	68.4	48.6	45	50.9	47.6	51.4	47.9
121	3	Muntinlupa Institute of Technology	SCH	30+945	9.8	65.2	68.4	48.9	45.4	51.3	48	51.7	48.2
122	1	saved by Grace Church	REL	30+945	110.55	65.2	68.4	46.5	42.9	48.7	45.4	49.3	45.8
122	2	saved by Grace Church	REL	30+945	110.55	65.2	68.4	47.1	43.5	49.2	45.9	49.9	46.4
123	1	Museo ng Muntinlupa	SCH	31+698	122.08	56.2	47.9	40.2	36.6	43.1	39.8	43.6	40.1
124	1	Municipal City Health Office	COM	31+708	124.9	56.2	47.9	41.7	38	44.7	41.4	45.2	41.8
124	1	Muntinlupa Police Station	COM	31+709	143.69	56.2	47.9	43.2	39.5	46.3	43	46.8	43.4
124	2	Muntinlupa Police Station	COM	31+709	143.69	56.2	47.9	42.9	39.3	46.1	42.8	46.7	43.2
124	3	Muntinlupa Police Station	COM	31+709	143.69	56.2	47.9	42.7	39.1	45.9	42.5	46.5	43
124	4	Muntinlupa Police Station	COM	31+709	143.69	56.2	47.9	42.8	39.2	46	42.7	46.6	43.2
124	5	Muntinlupa Police Station	COM	31+709	143.69	56.2	47.9	43.5	39.9	46.7	43.4	47.4	44
125	1	Laguerta Health Center	HSP	31+755	30.68	56.2	47.9	46.2	42.5	48.9	45.5	49.3	45.8
125	2	Laguerta Health Center	HSP	31+755	30.68	56.2	47.9	46.6	42.9	49.3	46	49.7	46.3
126	1	Sto. Nino School of Muntinlupa	SCH	31+890	23.87	56.2	47.9	48.5	44.9	52	48.6	52.4	48.9
126	2	Holy Word Christian School	SCH	32+639	68.57	56.2	47.9	45.8	42.2	49.5	46.1	49.9	46.4
127	1	St Peregrine Parish	REL	33+233	112.77	68.9	58.4	48.6	45.1	52.3	49	52.8	49.3
127	2	St Peregrine Parish	REL	33+233	112.77	68.9	58.4	49.2	45.6	52.9	49.5	53.3	49.9
127	3	St Peregrine Parish	REL	33+233	112.77	68.9	58.4	49.5	45.9	53.2	49.8	53.6	50.1
128	1	Beato Cauilan Hospital	HSP	33+584	70.31	68.9	58.4	49.6	46	53.2	49.9	53.7	50.2
128	2	Beato Cauilan Hospital	HSP	33+584	70.31	68.9	58.4	50.8	47.2	54.4	51.1	54.9	51.4

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
128	3	Beato Cauilan Hospital	HSP	33+584	70.31	68.9	58.4	52.4	48.8	56.1	52.7	56.5	53.1
128	4	Beato Cauilan Hospital	HSP	33+584	70.31	68.9	58.4	54.8	51.2	58.5	55.2	59	55.5
129	1	Divine Mercy Viewing Chapel 1	REL	33+605	8.32	68.9	58.4	48.8	45.2	52.5	49.1	52.9	49.4
129	2	Divine Mercy Viewing Chapel 1	REL	33+605	8.32	68.9	58.4	49.3	45.7	53	49.6	53.4	49.9
129	3	Divine Mercy Viewing Chapel 1	REL	33+605	8.32	68.9	58.4	49.8	46.3	53.5	50.2	53.9	50.5
129	4	Divine Mercy Viewing Chapel 1	REL	33+605	8.32	68.9	58.4	50.4	46.9	54.1	50.8	54.5	51
129	5	Divine Mercy Viewing Chapel 1	REL	33+605	8.32	68.9	58.4	51.2	47.6	54.9	51.5	55.3	51.8
130	1	Laguna Northwestern College	REL	34+160	58.03	64.3	65.5	44.2	40.7	47.9	44.6	48.3	44.9
131	1	San Antonio de Padua Chapel	REL	34+350	117.19	64.3	65.5	40.9	37.3	44.6	41.2	45.1	41.6
131	2	San Antonio de Padua Chapel	REL	34+350	117.19	64.3	65.5	41	37.4	44.6	41.3	45.1	41.7
131	3	San Antonio de Padua Chapel	REL	34+350	117.19	64.3	65.5	41	37.4	44.7	41.3	45.2	41.7
132	1	Academia de Castillano for children	SCH	34+572	136.39	64.3	65.5	41	37.4	44.7	41.4	45.2	41.7
132	2	Academia de Castillano for children	SCH	34+572	136.39	64.3	65.5	41.8	38.3	45.5	42.2	45.9	42.5
133	1	Watsons Savemore	COM	34+907	40.11	65.5	50	46.4	42.8	49.9	46.6	50.3	46.8
133	2	Watsons Savemore	COM	34+907	40.11	65.5	50	46.3	42.7	49.8	46.5	50.2	46.7
134	1	San Pedro College of Business Admin	SCH	35+810	126.16	56.1	60.3	46	42.4	48.8	45.4	49.2	45.7
134	2	San Pedro College of Business Admin	SCH	35+810	126.16	56.1	60.3	46.3	42.7	49.1	45.8	49.5	46.1
134	3	San Pedro College of Business Admin	SCH	35+810	126.16	56.1	60.3	46.7	43.1	49.5	46.2	49.9	46.5
134	4	San Pedro College of Business Admin	SCH	35+810	126.16	56.1	60.3	47.3	43.7	50.2	46.8	50.6	47.1
135	1	Church of the Later Day Christ	REL	35+814	58.78	56.1	60.3	45	41.4	47.8	44.4	48.2	44.7

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
135	2	Church of the Later Day Christ	REL	35+814	58.78	56.1	60.3	46.3	42.7	49	45.7	49.4	46
136	1	Robinsons Supermarket Galleria South	COM	36+063	53.11	56.1	60.3	45.8	42.2	48.6	45.2	49	45.6
136	2	Robinsons Supermarket Galleria South	COM	36+063	53.11	56.1	60.3	46.5	42.9	49.3	46	49.7	46.3
136	3	Robinsons Supermarket Galleria South	COM	36+063	53.11	56.1	60.3	47.7	44.1	50.6	47.2	51	47.6
136	4	Robinsons Supermarket Galleria South	COM	36+063	53.11	56.1	60.3	49.7	46.1	52.6	49.2	53	49.5
136	5	Robinsons Supermarket Galleria South	COM	36+063	53.11	56.1	60.3	52.6	49	55.5	52.2	55.9	52.5
137	1	Robinsons Pacita Complex	COM	36+676	17.17	56.1	60.3	46.1	42.4	48.6	45.3	49	45.6
137	2	Robinsons Pacita Complex	COM	36+676	17.17	56.1	60.3	46.3	42.6	48.8	45.4	49.2	45.8
138	1	Puregold Pacita Complex	COM	36+761	24.1	56.1	60.3	47.3	43.6	50.7	47.4	51.2	47.7
138	2	Puregold Pacita Complex	COM	36+761	24.1	56.1	60.3	47.3	43.6	50.7	47.4	51.2	47.7
139	1	Westlake Medical Center	HSP	36+804	98.83	56.1	60.3	44.2	40.6	47.7	44.4	48.2	44.7
139	2	Westlake Medical Center	HSP	36+804	98.83	56.1	60.3	46.1	42.5	49.6	46.3	50.1	46.6
139	3	Westlake Medical Center	HSP	36+804	98.83	56.1	60.3	46.7	43.1	50.3	46.9	50.7	47.3
139	4	Westlake Medical Center	HSP	36+804	98.83	56.1	60.3	48.1	44.4	51.5	48.2	51.9	48.5
139	5	Westlake Medical Center	HSP	36+804	98.83	56.1	60.3	49.3	45.7	52.7	49.4	53.1	49.7
140	1	Ang Dating Daan	REL	36+865	148.79	56.1	60.3	45.9	42.3	49.4	46.1	49.8	46.4
140	2	Ang Dating Daan	REL	36+865	148.79	56.1	60.3	46.7	43.1	50.2	46.9	50.7	47.2
140	3	Ang Dating Daan	REL	36+865	148.79	56.1	60.3	48	44.4	51.6	48.3	52	48.5
141	1	Jesus Miracle Crusade	REL	37+093	135.06	56.1	60.3	48	44.4	51.6	48.3	52.3	48.8
141	2	Jesus Miracle Crusade	REL	37+093	135.06	56.1	60.3	48.2	44.6	51.8	48.5	52.4	48.9
141	3	Jesus Miracle Crusade	REL	37+093	135.06	56.1	60.3	49.8	46.2	53.5	50.1	53.9	50.5
141	4	Jesus Miracle Crusade	REL	37+093	135.06	56.1	60.3	50.3	46.8	54	50.7	54.5	51
142	1	Carmona National Highschool	SCH	37+176	62.49	56.1	60.3	46.7	43.1	50.4	47.1	50.8	47.4

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
143	1	AMA Computer College	SCH	37+311	136.69	56.1	60.3	48.9	45.4	52.6	49.3	53	49.6
143	2	AMA Computer College	SCH	37+311	136.69	56.1	60.3	49.7	46.2	53.4	50.1	53.8	50.3
143	3	AMA Computer College	SCH	37+311	136.69	56.1	60.3	51.2	47.7	54.9	51.6	55.3	51.8
143	4	AMA Computer College	SCH	37+311	136.69	56.1	60.3	52.2	48.7	55.9	52.6	56.3	52.8
144	1	Jesus Lord Church Canlalay. Laguna	REL	37+602	101.54	56.1	60.3	44.8	41.2	48.5	45.1	49	45.5
144	2	Jesus Lord Church Canlalay. Laguna	REL	37+602	101.54	56.1	60.3	44.1	40.6	47.8	44.5	48.3	44.9
144	3	Jesus Lord Church Canlalay. Laguna	REL	37+602	101.54	56.1	60.3	43.5	40	47.2	43.9	47.7	44.3
145	1	Philippine Charity Sweepstakes	COM	38+087	92.42	68.6	64.8	46.4	42.8	50	46.7	50.5	47
145	2	Philippine Charity Sweepstakes	COM	38+087	92.42	68.6	64.8	47.2	43.6	50.9	47.5	51.3	47.8
146	1	Ospital ng Binan	HSP	38+251	14.35	68.6	64.8	48.6	45	52.2	48.9	52.6	49.2
146	2	Ospital ng Binan	HSP	38+251	14.35	68.6	64.8	48.9	45.3	52.6	49.3	53	49.5
146	3	Ospital ng Binan	HSP	38+251	14.35	68.6	64.8	49.1	45.6	52.8	49.5	53.2	49.7
147	1	San Vicente Ferrer Parish Church	REL	39+183	95.5	61.3	60	43.5	39.8	45.8	42.5	46.3	42.8
147	2	San Vicente Ferrer Parish Church	REL	39+183	95.5	61.3	60	43.5	39.8	45.8	42.4	46.2	42.7
147	3	San Vicente Ferrer Parish Church	REL	39+183	95.5	61.3	60	43.8	40.1	46.1	42.7	46.5	43
148	1	Savemore Binan	COM	39+202	117.99	61.3	60	41.6	37.9	43.9	40.6	44.5	41
148	2	Savemore Binan	COM	39+202	117.99	61.3	60	41.4	37.7	43.6	40.3	44.2	40.7
149	1	INC Local Binan	COM	39+223	61.68	61.3	60	43.8	40.1	46.2	42.9	46.7	43.2
149	2	INC Local Binan	COM	39+223	61.68	61.3	60	44.1	40.4	46.6	43.2	47	43.6
150	1	7th Day Adventist Church	REL	39+380	138.44	61.3	60	40.1	36.4	43.7	40.4	44.5	41.1
150	2	7th Day Adventist Church	REL	39+380	138.44	61.3	60	41.4	37.6	45	41.6	45.7	42.2

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
151	1	University of Perpetual Help, Laguna	SCH	39+585	122.38	61.3	60	45.4	41.8	49	45.6	49.5	46
151	2	University of Perpetual Help, Laguna	SCH	39+585	122.38	61.3	60	45.7	42	49.2	45.9	49.7	46.3
151	3	University of Perpetual Help, Laguna	SCH	39+585	122.38	61.3	60	45.9	42.3	49.5	46.1	50	46.5
151	4	University of Perpetual Help, Laguna	SCH	39+585	122.38	61.3	60	46.6	43	50.2	46.8	50.7	47.2
152	1	Heaven's Park Memorial Garden	PRK	39+731	57.49	61.3	60	32.7	29.3	36.3	33	36.7	33.2
153	1	Puregold	COM	40+053	31.98	61.3	60	46.3	42.8	50	46.7	50.4	47
153	2	Puregold	COM	40+053	31.98	61.3	60	46.6	43	50.2	46.9	50.7	47.2
153	3	Puregold	COM	40+053	31.98	61.3	60	46.8	43.2	50.5	47.1	50.9	47.4
154	1	St Michael's College of Laguna	SCH	40+610	119.3	51.7	44.3	47.5	44	51.2	47.9	51.7	48.2
154	2	St Michael's College of Laguna	SCH	40+610	119.3	51.7	44.3	47.4	43.8	51.1	47.7	51.5	48.1
155	1	Springtime County Learning Center	SCH	40+716	24.74	51.7	44.3	46.5	42.9	50.1	46.8	50.6	47.1
155	2	Springtime County Learning Center	SCH	40+716	24.74	51.7	44.3	46.9	43.4	50.6	47.3	51	47.6
156	1	The Church in Binan Meeting Hall	REL	40+758	86.08	51.7	44.3	45.9	42.3	49.5	46.2	50	46.5
156	2	The Church in Binan Meeting Hall	REL	40+758	86.08	51.7	44.3	46.4	42.8	50.1	46.7	50.5	47
157	1	Haven of Jesus Christian School	SCH	40+957	103.26	51.7	44.3	45.8	42.2	49.4	46.1	49.9	46.4
157	2	Haven of Jesus Christian School	SCH	40+957	103.26	51.7	44.3	46	42.4	49.7	46.3	50.1	46.6
158	1	Robinsons Place Sta Rosa	COM	41+327	69.21	56.4	58.2	47.2	43.6	50.8	47.5	51.3	47.8
158	2	Robinsons Place Sta Rosa	COM	41+327	69.21	56.4	58.2	47.6	44.1	51.3	48	51.8	48.3
158	3	Robinsons Place Sta Rosa	COM	41+327	69.21	56.4	58.2	48.4	44.8	52.1	48.7	52.5	49

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
159	1	Mariposa Budget Hotel Sta Rosa	PR	41+536	80.86	56.4	58.2	45.5	41.9	49.2	45.9	49.9	46.4
150	1	Mt Sinai MDi Hospital	HSP	41+632	120.9	56.4	58.2	43.2	39.6	46.9	43.5	47.5	44
150	2	Mt Sinai MDi Hospital	HSP	41+632	120.9	56.4	58.2	43.1	39.6	46.8	43.5	47.6	44.2
150	3	Mt Sinai MDi Hospital	HSP	41+632	120.9	56.4	58.2	43.4	39.9	47.2	43.8	47.8	44.3
150	4	Mt Sinai MDi Hospital	HSP	41+632	120.9	56.4	58.2	44.1	40.5	47.8	44.5	48.3	44.8
150	5	Mt Sinai MDi Hospital	HSP	41+632	120.9	56.4	58.2	44.9	41.3	48.6	45.2	49.1	45.6
150	6	Mt Sinai MDi Hospital	HSP	41+632	120.9	56.4	58.2	45.8	42.2	49.5	46.2	50	46.5
151	1	New Sinai School/Colleges Sta Rosa	SCH	41+682	97	56.4	58.2	42.8	39.2	46.3	42.9	46.8	43.3
151	2	New Sinai School/Colleges Sta Rosa	SCH	41+682	97	56.4	58.2	42.9	39.3	46.4	43.1	46.9	43.5
151	3	New Sinai School/Colleges Sta Rosa	SCH	41+682	97	56.4	58.2	43.2	39.6	46.6	43.3	47.1	43.6
151	4	New Sinai School/Colleges Sta Rosa	SCH	41+682	97	56.4	58.2	43.6	40	47	43.7	47.5	44.1
152	1	Santa Rosa Cockpit	COM	41+688	6.48	56.4	58.2	44.9	41.3	48.1	44.8	48.6	45.1
152	2	Santa Rosa Cockpit	COM	41+688	6.48	56.4	58.2	45.1	41.5	48.4	45	48.8	45.4
152	3	Santa Rosa Cockpit	COM	41+688	6.48	56.4	58.2	45.5	41.9	48.7	45.4	49.2	45.7
153	1	City of Sta Rosa Multi Purpose Complex 1	COM	42+509	40.39	54.6	54.6	42.3	38.8	47	43.6	47.4	43.9
153	2	City of Sta Rosa Multi Purpose Complex 1	COM	42+509	40.39	54.6	54.6	42.6	39.2	47.3	44	47.7	44.2
154	1	Labas Brgy Hall	COM	43+339	74.89	54.6	54.6	43.9	40.4	49.6	46.3	50	46.6
154	2	Labas Brgy Hall	COM	43+339	74.89	54.6	54.6	45.1	41.7	50.8	47.4	51.2	47.7
154	3	Labas Brgy Hall	COM	43+339	74.89	54.6	54.6	45.2	41.7	50.8	47.5	51.3	47.8
155	1	Labas E/S	SCH	43+491	110.61	54.6	54.6	42.8	39.2	47.4	44.1	47.9	44.4
155	2	Labas E/S	SCH	43+491	110.61	54.6	54.6	44.1	40.6	48.8	45.5	49.3	45.9
155	3	Labas E/S	SCH	43+491	110.61	54.6	54.6	46.4	42.9	51.1	47.7	51.6	48.1

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
156	1	Grace Baptist Church	REL	43+517	22.75	54.6	54.6	47.2	43.7	51.9	48.6	52.4	48.9
156	2	Grace Baptist Church	REL	43+517	22.75	54.6	54.6	47.9	44.4	52.7	49.3	53.1	49.6
157	1	Celina Subd Phase 2	SCR	43+876	28.89	54.6	54.6	47.7	44.1	51.4	48.1	51.8	48.4
158	2	Celina Subd Phase 2	SCR	43+876	28.89	54.6	54.6	48.4	44.8	52	48.7	52.5	49
158	3	Celina Subd Phase 2	SCR	43+876	28.89	54.6	54.6	50.1	46.5	53.7	50.4	54.2	50.7
159	1	Queen Ann School of Sta Rosa	SCH	46+159	118.81	82.45	68.75	49.5	45.9	53.1	49.8	53.6	50.1
159	2	Queen Ann School of Sta Rosa	SCH	46+159	118.81	82.45	68.75	49.9	46.3	53.5	50.2	54	50.5
159	3	Queen Ann School of Sta Rosa	SCH	46+159	118.81	82.45	68.75	50.1	46.5	53.7	50.4	54.2	50.7
160	1	Asian Institute of Technology SA	SCH	46+731	137	69.5	63.2	49.1	45.5	52.7	49.4	53.4	49.9
160	2	Asian Institute of Technology SA	SCH	46+731	137	69.5	63.2	49.1	45.5	52.8	49.4	53.4	49.9
160	3	Asian Institute of Technology SA	SCH	46+731	137	69.5	63.2	49.3	45.7	52.9	49.6	53.6	50.1
161	1	Brgy 2 Community Hall	COM	47+030	24.78	69.5	63.2	48.1	44.5	51.8	48.4	52.2	48.7
161	2	Brgy 2 Community Hall	COM	47+030	24.78	69.5	63.2	48.4	44.8	52.1	48.7	52.5	49
161	3	Brgy 2 Community Hall	COM	47+030	24.78	69.5	63.2	48.6	45	52.2	48.9	52.7	49.2
162	1	MCGI Ag Dating Daan Cabuyao	REL	47+394	12.63	69.5	63.2	48.2	44.7	51.9	48.6	52.3	48.9
162	2	MCGI Ag Dating Daan Cabuyao	REL	47+394	12.63	69.5	63.2	48.5	45	52.2	48.9	52.6	49.1
163	1	Blessed Church Cabuyao	REL	49+246	9.02	65.5	50	48.8	45.2	52.5	49.2	52.9	49.4
164	1	Pamantasan ng Cabuyao	SCH	49+285	39.07	65.5	50	45.8	42.2	49.4	46.1	49.9	46.4
164	2	Pamantasan ng Cabuyao	SCH	49+285	39.07	65.5	50	45.9	42.3	49.6	46.3	50	46.5
164	3	Pamantasan ng Cabuyao	SCH	49+285	39.07	65.5	50	45.9	42.3	49.6	46.2	50	46.5
164	4	Pamantasan ng Cabuyao	SCH	49+285	39.07	65.5	50	46	42.4	49.6	46.3	50.1	46.6
165	1	Canaan Homes	SCR	51+503	50.03	63.8	61.3	47.3	43.7	51	47.7	51.4	48

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
165	2	Canaan Homes	SCR	51+503	50.03	63.8	61.3	48.5	44.9	52.1	48.8	52.6	49.1
166	1	Clarmil Manufacturing	COM	52+495	57.51	63.8	61.3	45.2	41.6	48.9	45.5	49.3	45.8
166	2	Clarmil Manufacturing	COM	52+495	57.51	63.8	61.3	45.6	42.1	49.3	46	49.7	46.3
166	3	Clarmil Manufacturing	COM	52+495	57.51	63.8	61.3	46.5	42.9	50.1	46.8	50.5	47.1
167	1	Jesus The Gateway to Heaven	REL	52+535	134.62	63.8	61.3	44	40.4	47.6	44.3	48.1	44.6
167	2	Jesus The Gateway to Heaven	REL	52+535	134.62	63.8	61.3	44.6	41	48.2	44.9	48.7	45.2
168	1	Villa Palao Subd	SCR	52+842	33.92	63.8	61.3	46	42.5	49.8	46.4	50.2	46.7
168	2	Villa Palao Subd	SCR	52+842	33.92	63.8	61.3	46.4	42.9	50.2	46.8	50.6	47.1
169	1	San Cristobal Garden Homes	SCR	53+241	97.6	63.8	61.3	44.8	41.2	48.6	45.3	49	45.6
169	2	San Cristobal Garden Homes	SCR	53+241	97.6	63.8	61.3	45.8	42.2	49.6	46.2	50	46.6
170	1	Lazaro Subd	SCR	54+684	26.43	69.5	63.2	45.4	42	49.6	46.3	49.9	46.5
171	1	mark Subd 1	SCR	54+837	8.06	69.5	63.2	46.3	42.8	50.6	47.3	51	47.5
171	2	mark Subd 1	SCR	54+837	8.06	69.5	63.2	46.9	43.4	51.2	47.8	51.6	48.1
172	1	Marck Subd	SCR	54+848	24.68	69.5	63.2	44.4	40.9	48.7	45.3	49.1	45.6
172	2	Marck Subd	SCR	54+848	24.68	69.5	63.2	44.5	41	48.8	45.4	49.1	45.7
173	1	Parian Catholic Chapel	REL	55+001	70.93	69.5	63.2	49	45.5	53.4	50.1	53.8	50.3
173	2	Parian Catholic Chapel	REL	55+001	70.93	69.5	63.2	51.5	48	56	52.7	56.4	52.9
174	1	Villa Carpio	SCR	55+032	7.79	69.5	63.2	46.2	42.7	50.5	47.1	50.8	47.4
175	1	St Peter Academy	SCH	55+083	35.4	69.5	63.2	43.8	40.2	48.2	44.8	48.6	45.1
175	2	St Peter Academy	SCH	55+083	35.4	69.5	63.2	43.6	40.1	48.1	44.7	48.6	45.1
176	1	United Church of Christ	REL	55+510	87.78	69.5	63.2	40.3	36.8	44.7	41.4	45.2	41.7
176	2	United Church of Christ	REL	55+510	87.78	69.5	63.2	40.3	36.8	44.7	41.3	45.1	41.6
177	1	Calamba Church of Christ 33AD	REL	55+583	61.89	69.5	63.2	42.5	38.9	46.9	43.5	47.3	43.8
178	1	PMCC 4th Watch	REL	55+688	21.14	69.5	63.2	44.8	41.2	49.1	45.7	49.4	46

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
178	2	PMCC 4th Watch	REL	55+688	21.14	69.5	63.2	44.9	41.4	49.2	45.9	49.6	46.1
178	3	PMCC 4th Watch	REL	55+688	21.14	69.5	63.2	45.1	41.6	49.5	46.2	49.9	46.4
178	4	PMCC 4th Watch	REL	55+688	21.14	69.5	63.2	47.5	43.9	51.9	48.6	52.2	48.8
179	1	Crossing elementary School	SCH	55+894	72.37	69.5	63.2	42.3	38.8	46.7	43.4	47.1	43.6
179	2	Crossing elementary School	SCH	55+894	72.37	69.5	63.2	43.1	39.6	47.5	44.2	47.9	44.4
180	1	STI Calamba	SCH	56+167	72.43	69.5	63.2	42.7	39.2	47.1	43.8	47.5	44
180	2	STI Calamba	SCH	56+167	72.43	69.5	63.2	43.2	39.7	47.6	44.2	47.9	44.5
180	3	STI Calamba	SCH	56+167	72.43	69.5	63.2	47.5	44	52	48.7	52.4	48.9
180	4	STI Calamba	SCH	56+167	72.43	69.5	63.2	48.9	45.4	53.4	50.1	53.8	50.3
180	5	STI Calamba	SCH	56+167	72.43	69.5	63.2	50.9	47.3	55.4	52.1	55.8	52.3
180	6	STI Calamba	SCH	56+167	72.43	69.5	63.2	53.5	50	58.2	54.8	58.5	55.1
181	1	Laguna Diagnostic Center	HSP	56+229	103.56	69.5	63.2	45.3	41.8	49.8	46.5	50.2	46.8
181	2	Laguna Diagnostic Center	HSP	56+229	103.56	69.5	63.2	45.6	42.1	50.1	46.8	50.5	47
181	3	Laguna Diagnostic Center	HSP	56+229	103.56	69.5	63.2	46.1	42.6	50.6	47.3	51	47.5
181	4	Laguna Diagnostic Center	HSP	56+229	103.56	69.5	63.2	46.9	43.3	51.4	48.1	51.8	48.3
182	1	Castle Rock Inn	PR	56+312	31.27	69.5	63.2	44.2	40.7	48.4	45.1	49.4	45.9
183	1	Lecheria Hotel 1	PR	56+437	23.82	69.5	63.2	47.8	44.3	51.8	48.4	52.2	48.7
183	2	Lecheria Hotel 1	PR	56+437	23.82	69.5	63.2	48.8	45.3	52.7	49.4	53.1	49.6
184	1	Residential Bld 3 Near Calamba Stn	SCR	56+839	81.46	65.6	50	47.4	44	51.1	47.8	51.5	48
184	2	Residential Bld 3 Near Calamba Stn	SCR	56+839	81.46	65.6	50	48.4	45	52.1	48.8	52.5	49
184	3	Residential Bldg 3 near Calamba Stn	SCR	56+901	49.86	65.6	50	47.4	44	51.1	47.7	51.4	47.9
185	1	Residential Bldg 2 near Calamba Stn	SCR	56+925	51.66	65.6	50	49.3	45.9	53	49.7	53.4	49.9
185	2	Residential Bldg 2 near Calamba Stn	SCR	56+925	51.66	65.6	50	50	46.6	53.7	50.3	54	50.5

No.	Floor	Name	Usage	Chainage	Distance from the Nearest Track	Limit		2023-2025		2025-2035		2035-2040	
						Day	Night	Leq,d	Leq,n	Leq,d	Leq,n	Leq,d	Leq,n
						[dB(A)]		1.0 m Noise Wall		1.0m Noise Wall		1.0m Noise Wall	
186	1	Residential Bldg 1 near Calamba Stn	SCR	56+957	47.22	65.6	50	47.8	44.4	51.5	48.1	51.9	48.4
186	2	Residential Bldg 1 near Calamba Stn	SCR	56+957	47.22	65.6	50	48.5	45.1	52.2	48.9	52.6	49.1

3.3.4. Vibration

3.3.4.1. Ground-borne Vibration

1527. Ground-borne vibration is the motion of the ground transmitted into a building that can be described in terms of displacement, velocity, or acceleration. Vibration velocity is used in evaluating transit projects and defined by the following:

1528. Level - Vibration is expressed in terms of vibration velocity level, using vibration decibels (VdB), with a reference of 1 micro-inch per second. The level of vibration represents how much the ground is moving. The threshold of human perception to transit and freight rail vibration is approximately 65 VdB and annoyance begins to occur for frequent events at vibration levels over 70 VdB.

1529. Frequency: Vibration frequency is expressed in Hertz (Hz). Human response to vibration is typically from about 6 Hz to 200 Hz.

1530. Time Pattern: Environmental vibration changes all the time and human response is roughly correlated to the number of vibration events during the day. The more events that occur, the more sensitive humans are to the vibration.

1531. The succeeding figure shows the typical ground-borne vibration levels for transit including railway projects and the corresponding human and structural responses to vibration. Vibration from light rail projects generates about 70 VdB near the tracks and levels are dictated by the roughness of the wheels and rails and the suspension system's resonance properties.

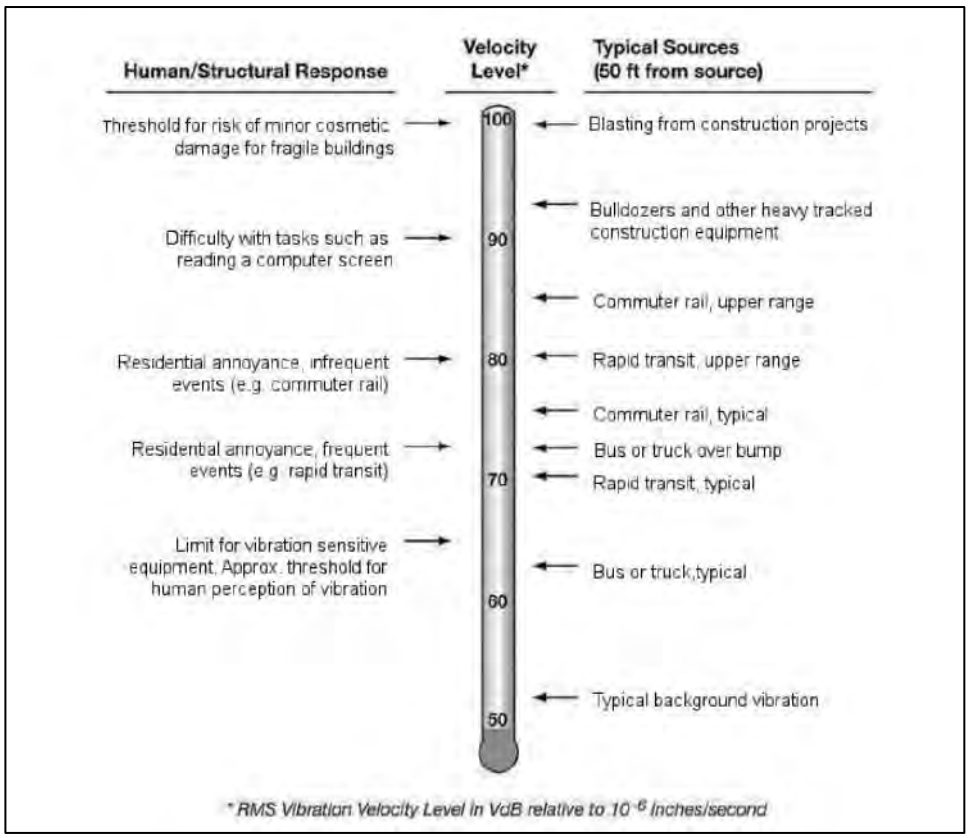


Figure 3.3.63 Typical Levels of Ground-Borne Vibration

1532. The Philippines does not have any environmental criteria for vibration. This report uses as reference the Transit Noise and Vibration Impact Assessment (TNVIA) Manual 2006 of the United States Federal Transit Administration [U.S. FTA (2006)].

(1) Vibration Criteria

1) Construction

1533. There are two (2) types of impacts related to construction vibrations presented by the U.S. FTA (2006)—1) human annoyance and 2) building damage. According to the U.S. FTA (2006), the same vibration criteria for general assessment can be applied for the evaluation of annoyance or interference with vibration-sensitive activities. These annoyances can occur when construction vibration rises above the threshold of human perception over extended periods. Often, the primary concern regarding construction vibration is its potential damage effects. Damages to buildings can be cosmetic or structural.

1534. Historical structures which are fragile are commonly vulnerable to damages caused by ground vibration. While normal buildings which are not fragile would not experience cosmetic damages at reasonable distances. The distances can considerably vary depending on soil composition and subsurface conditions. Further, buildings have different responses to vibration generated by construction equipment. The U.S. FTA's construction vibration damage criteria are presented in following table.

Table 3.3.37 Construction Vibration Damage Criteria

Building Category	Peak Particle Velocity (PPV) (in/s)
i. Reinforced-concrete, steel or timber (no plaster)	0.5
ii. Engineered concrete and masonry (no plaster)	0.3
iii. Non-engineered timber and masonry buildings	0.2
iv. Buildings extremely susceptible to vibration damage	0.12

Source: U.S. FTA, 2006

2) Operation

1535. The Vibration Impact Criteria for General Assessment and for Special Buildings of the U.S. FTA (2006) was adopted for the vibration impact assessment of the Project (

1536. **Table** 3.3.38).

1537. Vibratory motion can be generated in all directions, vertical descriptor is usually used in environmental assessments because vibration amplitude along the ground surface is greatest in the vertical direction. As the number of passing trains at specified locations are greater than those specified for “Frequent Events” assuming one vibration event equals one train pass by, the RMS vibration levels (in VdB) under “Frequent Events” were used in the evaluation. U.S. FTA (2006) defines frequent events “as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.”[11]

[11] Department of Transportation for the Asian Development Bank (2018). Proposed Multitranche Financing Facility Malolos-Clark Railway Project (Solis to Blumentritt Section of North South Railway Project) Volume 3 Noise and Vibration Analysis

Table 3.3.38 U.S. FTA Ground-Borne Vibration Impact Criteria

Receptor Land Use		RMS Vibration Levels (VdB)		
Category	**Description**	**Frequent Events[1]**	**Occasional Events[2]**	**Infrequent Events[3]**
1	Building where vibration would interfere with interior operations.	65[4]	65[4]	65[4]
2	Residences and buildings where people normally sleep.	72	75	80
3	Institutional land uses with primarily daytime use.	75	78	83
Specific Buildings	Televisions/ Recording Studios/ Concert Halls	65	65	65
	Auditoriums	72	80	80
	Theaters	72	80	80

[1] Defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.
[2] Defined as between 30 and 70 vibration events of the same source per day. Most commuter trunk line have these many operations.
[3] Defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.
[4] This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration-sensitive manufacturing or research will require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.

Source: U.S. FTA, 2006

1538. Another set of criteria values particular to the vibration during construction are provided in the Transportation and Construction Vibration Guidance Manual (Caltrans, 2013).

Table 3.3.39 Guideline Vibration Damage Potential Threshold Criteria

	Maximum PPV (in/sec)	
Structure and Condition	**Transient Sources**	**Continuous/Frequent Intermittent Sources**
Extremely fragile historic buildings, ruins, ancient monuments	0.12	0.08
Fragile buildings	0.2	0.1
Historic and some old buildings	0.5	0.25
Older residential structures	0.5	0.3
New residential structures	1.0	0.5
Modern industrial/commercial buildings	2.0	0.5

Note: Transient sources create a single isolated vibration event, such as blasting or drop balls. Continuous/frequent intermittent sources include impact pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.

Table 3.3.40 Guideline Vibration Annoyance Potential Criteria

	Maximum PPV (in/sec)	
Human Response	**Transient Sources**	**Continuous/Frequent Intermittent Sources**
Barely perceptible	0.04	0.01
Distinctly perceptible	0.25	0.04
Strongly perceptible	0.9	0.10
Severe	2.0	0.4

Note: Transient sources create a single isolated vibration event, such as blasting or drop balls. Continuous/frequent intermittent sources include impact pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.

3.3.4.2. Existing Vibration Levels

1539. Vibration measurements were conducted on February 22 - March 03, 2018 at fifteen (15) monitoring stations for the EIA Study and on April 09 - May 04, 2019 at additional twelve (12) monitoring stations for the detailed design phase of the project. The sites varied from residential areas to vacant areas near the roads in urbanized areas.

1540. At each site, 24-hour sampling was undertaken where vibration was recorded using Vibron Seismometer which is a seismic data recorder connected to geophones. Three (3) sets of vertical sensors and three (3) additional sets of triaxial sensors created the four (4) sets of sensors that are spread one (1) meter apart around each observation area. The uniaxial sensors have a natural frequency of 4.5 Hz and a sampling frequency of 147 samples per second. Each seismic sensor was deployed in pre-identified sites, on grade of concrete or asphalt pavement or on barren surface road side or grounds of the facility.

Table 3.3.41 Vibration Monitoring Stations

Station ID	Description	Coordinates		Date of Sampling
V01	Solis Station	14°37'37.35"N	120°58'32.27"E	March 2-3, 2018
V02	PNR - Sta. Mesa	14°36'1.48"N	121° 0'38.39"E	March 1-2, 2018
V03	Old Paco Station	14°34'43.86"N	120°59'56.76"E	March 1-2, 2018
V04	PNR Buendia	14°33'24.27"N	121° 0'30.35"E	February 27-28, 2018
V05	PNR – FTI	14°30'24.02"N	121° 2'7.74"E	February 27-28, 2018
V06	Sucat Station	14°27'8.64"N	121° 3'3.07"E	February 26-27, 2018
V07	PNR Alabang	14°25'0.91"N	121° 2'51.23"E	February 26-27, 2018
V08	Divine Mercy Viewing Chapel	14°22'15.09"N	121° 3'1.35"E	February 25-26, 2018
V09	Biñan Community Hospital	14°20'13.14"N	121° 4'27.12"E	February 25-26, 2018
V10	PNR Biñan	14°19'53.90"N	121° 4'50.70"E	February 24-25, 2018
V11	Cabuyao Central School Complex	14°16'36.96"N	121° 7'37.63"E	February 24-25, 2018
V12	PNR – Calamba	14°12'25.69"N	121° 9'28.80"E	February 23-24, 2018
V13	Tiyani Elementary School	14°10'43.87"N	121°11'58.96"E	February 23-24, 2018
V14	Los Baños Municipal Health Center	14°10'53.12"N	121°13'35.37"E	February 22-23, 2018
V15	Paciano Rizal Elementary School	14° 8'59.04"N	121°16'5.29"E	February 22-23, 2018
DD V01	Jose Abad Santos	14°37'21.76"N	120°58'40.67"E	June 5-6, 2019
DD V02	Elias Street	14^0 37'16.08"N	$120^0$59'15.88"E	June 7-8, 2019
DD V03	Sta. Mesa	14°35'50.98"N	121° 0'46.90"E	June 6-7, 2019
DD V04	Pedro Gil Street	14°34'43.06"N	120°59'57.59"E	June 5-6, 2019
DD V05	FTI BLISS	14°30'26.65"N	121° 2'7.47"E	June 4-5, 2019
DD V06	Alabang	14°25'5.17"N	121° 2'52.86"E	June 4-5, 2019
DD V07	Muntinlupa	14°22'36.53"N	121° 2'52.84"E	June 3-4, 2019
DD V08	Biñan	14°19'55.87"N	121° 4'51.16"E	June 2-3, 2019
DD V09	Cabuyao	14°16'33.01"N	121° 7'41.91"E	June 2-3, 2019
DD V10	Banlic Depot Site	14°13'29.10"N	121° 9'47.49"E	June 3-4, 2019
DD V11	Calamba Station	14°12'27.72"N	121° 9'26.38"E	June 1-2, 2019
DD V12	Calamba	14°11'53.39"N	121° 9'35.56"E	June 1-2, 2019

Figure 3.3.64 Vibration Monitoring Stations Map

1541. The observations of vibration at the areas along the Project indicate that sites vary in levels of vibration from a low of 83.5 VdB to a high of 100.8 VdB during feasibility study preparation and from a low of 65.4 VdB to a high of 107.4 VdB during detailed design.

1542. The areas with the highest levels of vibration during EIA are in stations V13 (Tiyani Elementary School), V11 (Cabuyao Central School), V04 (Buendia Station), and V09 (Biñan Community Hospital). Road traffic, passing trains, and walking pedestrians appear to dominate the cause of high levels of vibration. At these areas, the range of vibration levels may reach beyond 91 VdB which may be considered unpleasant by people when subjected to continuous vibration. The site with lowest level of vibration is in station V03 (Paco Station), where vibration levels range only between 80 VdB to 86 VdB.

1543. The areas with the highest levels of vibration during detailed design are in stations DD V03 (Sta. Mesa), DD V07 (Muntinlupa), and DD V10 (Banlic Depot Site). Passing trains and automobiles appear to dominate the cause of vibration. At these areas, the range of vibration levels may reach beyond 61 VdB which may be considered unpleasant and annoying to people when subjected to continuous vibration. The site with the lowest level of vibration is in station DD V10 (Banlic Depot Site), where vibration levels range only between 53 VdB to 74 VdB since the sites are mostly rural areas with less automobile pass-by.

1544. The observed peak values for velocities (in/s) and the maximum levels of RMS (dB) for the fifteen (15) monitoring stations during EIA and the additional twelve (12) monitoring stations during detailed design are shown in **Table 3.3.42** and **Table 3.3.43**, respectively.

1545. The recorded peak vibration at this site is 0.0036 in/s, as shown in **Table 3.3.42**. This level of vibration is unlikely to cause damage in any building category as prescribed in the Construction Vibration Damage Criteria of U.S FTA (2006). The maximum level of RMS amplitude recorded is 87.9 dB measured during daytime period This exceeded the threshold of Category 2 (Residences and buildings where people normally sleep) for “Frequent Events”, set at 72 VdB by Ground-Borne Vibration Impact Criteria of U.S. FTA (2006).

Table 3.3.42 Summary Peak Velocity (in/s) for Each Station

Sampling Stations		Recorded Peak Velocity (in/s)	Peak Period	Building Category that may be Impacted
V01	Solis Station	0.036	Daytime	None
V02	PNR - Sta. Mesa	0.063	Evening	None
V03	Old Paco Station	0.026	Morning	None
V04	Buendia Station	0.033	Evening	None
V05	PNR – FTI	0.039	Nighttime	None
V06	Sucat Station	0.034	Nighttime	None
V07	Alabang Station	0.047	Evening	None
V08	Divine Mercy Viewing Chapel	0.031	Morning	None
V09	Biñan Community Hospital	0.045	Nighttime	None
V10	Biñan Station	0.051	Nighttime	None
V11	Cabuyao Central School Complex	0.036	Nighttime	None
V12	PNR – Calamba	0.048	Daytime	None
V13	Tiyani Elementary School	0.125	Evening	IV
V14	Los Baños Municipal Health Center	0.033	Nighttime	None
V15	Paciano Rizal Elementary School	0.039	Evening	None
DD V01	Jose Abad Santos	0.002	Nighttime	None
DD V02	Elias Street	0.0014	Evening	None
DD V03	Sta. Mesa	0.092	Daytime	None

Sampling Stations		Recorded Peak Velocity (in/s)	Peak Period	Building Category that may be Impacted
DD V04	Pedro Gil Street	0.002	Daytime	None
DD V05	FTI BLISS	0.0009	Morning	None
DD V06	Alabang	0.003	Evening	None
DD V07	Muntinlupa	0.0008	Daytime	None
DD V08	Biñan	0.008	Daytime	None
DD V09	Cabuyao	0.002	Daytime	None
DD V10	Banlic Depot Site	0.0012	Daytime	None
DD V11	Calamba Station	0.0004	Morning	None
DD V12	Calamba	0.002	Daytime	None

Table 3.3.43 Summary of Maximum Levels of RMS Amplitude (dB) for Each Station

Sampling Stations		Maximum Levels of RMS Amplitude (dB)	U.S. FTA Receptor	Exceeded Threshold for Receptor?
V01	Solis Station	87.9	Residential	Yes
V02	PNR - Sta. Mesa	91.6	Residential	Yes
V03	Old Paco Station	86.6	Residential	Yes
V04	Buendia Station	95.9	Residential	Yes
V05	PNR – FTI	91.0	Residential	Yes
V06	Sucat Station	87.9	Residential	Yes
V07	Alabang Station	93.0	Residential	Yes
V08	Divine Mercy Viewing Chapel	83.5	Residential	Yes
V09	Biñan Community Hospital	92.1	Residential	Yes
V10	Biñan Station	92.4	Residential	Yes
V11	Cabuyao Central School Complex	98.5	Residential	Yes
V12	PNR – Calamba	90.8	Residential	Yes
V13	Tiyani Elementary School	100.8	Residential	Yes
V14	Los Baños Municipal Health Center	87.9	Residential	Yes
V15	Paciano Rizal Elementary School	89.9	Residential	Yes
DD V01	Jose Abad Santos	70.9	Residential	No
DD V02	Elias Street	66.3	Residential	No
DD V03	Sta. Mesa	107.4	Residential	Yes
DD V04	Pedro Gil Street	68.8	Residential	No
DD V05	FTI BLISS	65.4	Residential	No
DD V06	Alabang	91.9	Residential	No
DD V07	Muntinlupa	102.8	Residential	Yes
DD V08	Biñan	78.0	Residential	Yes
DD V09	Cabuyao	71.0	Institutional	No
DD V10	Banlic Depot Site	102.8	Institutional	Yes
DD V11	Calamba Station	72.3	Residential	Yes
DD V12	Calamba	68.9	Institutional	No

3.3.4.3. Vibration Impact Assessment

(1) Vibration during Construction

1546. The vibration impact assessment during the construction phase focused on the impact equipment that will be used during construction phase which were enumerated in the construction noise assessment. Note that in contrast to the previous assessment for the Malolos-Clark Railway section, the detailed engineering design team recommended the use of in-situ pile construction as opposed to the vibratory pile driving operation during foundation construction. For sites where vibrations may be a problem to the surrounding like the settlement areas surrounding the project, this decision is critical considering the vibrations created when installing bored steel pipe piles of smaller magnitude than the vibrations generated from vibratory driven piles as initially assumed[12.]

1547. In-situ board piling uses rotary drill similar to caisson drilling which has a reference vibration level at 25' of 0.089 in/sec[13], the predicted PPVs were then determined using the following equation:

$$PPV_{equip} = PPV_{ref} \times (25/D)1.5$$

where: PPVequip is the PPV in in/s of the equipment adjusted for distance
PPVref is the reference vibration level in in/s at 25 feet = 0.089 in/sec for in-situ piling and
D is the distance from the equipment to the receiver

1548. As provided in the FTA (2006) table for vibration source levels, the equipment would generate 0.1094 in/s (PPV) at 25 m distance. Within 30m, 40m, and 50m distances the predicted vibration levels are 0.011, 0.007, and 0.005 in/s, respectively. The PNR's RoW is 60m wide and therefore the nearest structure will be at a distance of 30m.

1549. The use of in-situ piling is not anticipated to cause structural damage on any structure outside the RoW and barely perceptible to humans.

1550. During the construction of foundation footing, impact equipment will be used like backhoe with breakers to break the existing pavement and hoe rams (vibro-hammers) to put shallow sheet piles on the walls of the foundation foot to protect nearby roads from settlement after excavation. The back-hoe breaker has a PPVref of 1.25 mm/sec at 30m[14] or 0.049 in/sec along the RoW which will not cause structural damage but high enough to be distinctive to humans.

1551. Vibration from vibro-hammers, which is assumed to be equal to vibratory pile driver is estimated as follows:

$$PPV_{Vibratory\ Pile\ Driver} = PPV_{Ref}\ (25/D)n\ (in/sec)$$

Where: PPVRef = 0.65 in/sec for a reference vibrator pile driver at 25 ft

D = distance from pile driver to the receiver in ft.

n = 1.5

[12] http://kth.diva-portal.org/smash/get/diva2:751565/FULLTEXT01.pdf
[13] http://www.dot.state.oh.us/projects/7071/publicmeetings/Documents/June%202010%20Noise%20Analysis/ConstructionVibrationReport.pdf
[14] https://gis.dot.nh.gov/research/12323W.SPR.FHWA-NH-RD-.pdf

1552. Within 30m, 40m, and 50m distances from the construction equipment the predicted vibration levels are 0.083, 0.054, and 0.038 in/s, respectively. The project's ROW is 60m wide and therefore the nearest structure will be at a distance of 30m. Generating a vibration level of 0.083 in/sec will cause damage to extremely fragile buildings, ruins, and monument. The oldest structures along the project alignment are the PNR owned and operated signal towers in Solis, Antipolo, and Abad Santos. These structures are made of concrete based wooden walls with galvanized iron roof and may not withstand the expected vibration considering these are located within the ROW.

(2) Vibration during Operation

1553. The succeeding Tables (**Table 3.3.44** and **Table 3.3.45**) summarizes the operational vibration general assessment. The assessment utilized the Federal Transit Administration (FTA) EMU train vibration curve and adjusted based on the source characteristics: speed, suspension, track condition, and track treatment; vibration pathway that considers elevated track configuration and soil type; and the type of receiver, in this case small masonry structures. The vibration levels were estimated from a distance of six (6) meters, up to 30 meters from the center of the track.

1554. Peak vibration will occur when the Limited Express and Express Commuter coincides at point where the speeds are highest, at 110 kph and 100 kph, resulting to 56.2 and 55.4 VdB at the edge of the RoW with a total of 58.5 VdB.

1555. The anticipated peak vibration level during operation is lower than the 72 VdB criteria value for the land use Category 2: Residences and buildings where people normally sleep and therefore will have no adverse impacts.

Table 3.3.44 Summary of the Operational Vibration Assessment for the Limited Express Running at 110 kPH, in VdB

DISTANCE FROM CENTERLINE		REFERENCE VIBRATION	ADJUSTMENTS							Expected Vibration Level (VdB)
			SOURCE				PATH			
meter	feet	Lv, RMS	Speed	Vehicle Condition	Track Condition	Track Treatment	Resilient Tie Block	Elevated Tracks	Soil	
					Very Good	Ballast Mats				
6.1	20	78.66	2.717	0	0	-10	-10	-10	6	67.38
9.15	30	76.45	2.717	0	0	-10	-10	-10	6	65.17
12.2	40	74.65	2.717	0	0	-10	-10	-10	6	63.37
15.25	50	73.12	2.717	0	0	-10	-10	-10	6	61.83
18.3	60	71.77	2.717	0	0	-10	-10	-10	6	60.49
21.35	70	70.56	2.717	0	0	-10	-10	-10	6	59.28
24.4	80	69.46	2.717	0	0	-10	-10	-10	6	58.18
27.45	90	68.46	2.717	0	0	-10	-10	-10	6	57.17
30.5	100	67.52	2.717	0	0	-10	-10	-10	6	56.24

Table 3.3.45 Summary of the Operational Vibration Assessment for the Limited Express Running at 100 kPH, in VdB

DISTANCE FROM CENTERLINE		REFERENCE VIBRATION	ADJUSTMENTS							Expected Vibration Level (VdB)
			SOURCE				PATH			
meter	feet	Lv, RMS	Speed	Vehicle Condition	Track Condition	Track Treatment	Resilient Tie Block	Elevated Tracks	Soil	
					Very Good	Ballast Mats				
6.1	20	78.66	1.89	0	0	-10	-10	-10	6	66.55
9.15	30	76.45	1.89	0	0	-10	-10	-10	6	64.34
12.2	40	74.65	1.89	0	0	-10	-10	-10	6	62.54
15.25	50	73.12	1.89	0	0	-10	-10	-10	6	61.01
18.3	60	71.77	1.89	0	0	-10	-10	-10	6	59.66
21.35	70	70.56	1.89	0	0	-10	-10	-10	6	58.45
24.4	80	69.46	1.89	0	0	-10	-10	-10	6	57.35
27.45	90	68.46	1.89	0	0	-10	-10	-10	6	56.34
30.5	100	67.52	1.89	0	0	-10	-10	-10	6	55.41

(3) Mitigation Measures

1556. In the case of the viaduct (slab), mitigation measures will not be needed to be implemented. On the other hand, the embankment will be used for the section where the alignment goes through the rural areas and no flood-prone area. However, the following measures will be taken to abate the vibration level where the residences are located within 15 m distance from the ROW.

- Undertake regular inspection, proper maintenance and reconditioning of trains and tracks such as rail grinding, slip-slide detectors and maintenance or replacement of suspension system, brakes and wheels; and
- Monitor vibration levels at identified nearby sensitive receptors (residential, school and hospital areas), old PNR structures, historical heritages including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the vibration reduction measures provided. Monitor actions on complaints, if any, and attend to unresolved cases based on Grievance Redress Mechanism.

3.3.5. Additional Vibration Assessment for Senate-FTI Underground Section

1557. An additional vibration impact assessment has been carried out for the 4.866 km underground section of the SCRP interconnecting line. Since this section is underground the vibration impacts from construction and operation of this section will be different than those of viaduct section. The construction impacts will be mostly associated with vibrations from the operation of tunnel boring machine (TBM) whereas operation stage impacts will be mostly from running of trains. The summary of the assessments is summarized herewith.

3.3.5.1. Existing Vibration Level in the Study Area

1558. As part of the EIS (2017) and EPRMP (2019) for MMSP, 2 existing vibration stations were used as reference (**Table 3.3.46** and **Table 3.3.47**). These are sampling points along the

Senate Station to FTI Station underground section (see 3.3.39(a) and 3.3.39(b)). In 2017, the measurements were conducted by Tekron Geo Matrix[15] and in 2019 by AECOM.

1559. The measured vibration levels were compared to the US FTA vibration criteria applicable for office use with a maximum level of 84 VdB measured in 1/3 octave band over 8-80 Hz frequency range. At 84 VdB, the FTA-described vibration can be felt but at levels that is appropriate for offices and similar areas. The assessment indicated that both existing vibration levels already exceeded the 84 VdB criteria value.

Table 3.3.46 Location of Existing Vibration Measurements, 2017

Site	Date and Time Conducted	Map Reference	Corresponding Component
PNR-FTI Station	30-31 March 2017	14° 30.3963' N, 121° 2.1319' E	FTI Station

Source: MMSP EPRMP, 2017

Table 3.3.47 Location of Additional Vibration Measurements, 2019

Monitoring site	Date and Time Conducted	Map Reference	Corresponding Component
Administration Building of United Hills Village	from 17:44 of 6th July 2019 to 17:44 of 7th July 2019	14° 30' 2.6922" N, 121° 2' 30.732" E	FTI Station

Source: MMSP EPRMP, 2019

15 Measurement and Assessment of Baseline Vibration Condition at Various Sites if Metro Manila for the Metro Manila Subway Project, Tekton Geo Matrix 2017

3.3.5.2. Vibration Prediction

(1) General Theoretical Background

1560. Tunneling (with TBM), soil excavation and train operation generate vibration. Vibration is an oscillatory motion that can be described in terms of the displacement, velocity, or acceleration. Vibration energy from the operation of the TBM and train will excite the surround soil creating vibration waves that will propagate through the ground and through the adjacent buildings, creating ground-borne vibration effects that potentially interfere with on-ground activities (FTA 2018). **Figure 3.3.65** illustrates Propagation of Ground-Borne Vibration into Buildings.

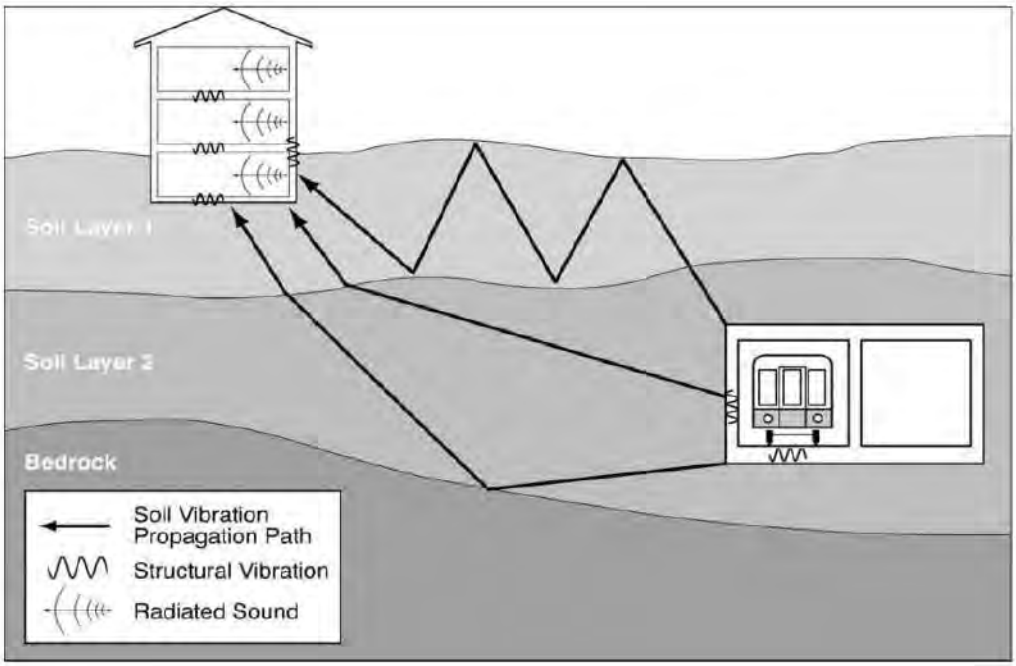


Figure 3.3.65 Propagation of Ground-Borne Vibration into Buildings (FTI 2018)

1561. Vibration is a major concern in transit project more particularly subways. Designed to improve public transportation and accessibility, subways are often located near densely populated areas and cause vibration at nearby residences and other sensitive types of land use. TBM excavation and subway operation generate vibration. These vibrations generate a dynamic state of stress in surrounding structures and depending on the structural state of such structures, might be affected by the TBM and train operation.

1562. Vibration is an oscillatory motion that can be described in terms of the displacement, velocity, or acceleration. Because the motion is oscillatory, there is no net movement of the vibration element and the average of any of the motion metrics is zero. Displacement is the most intuitive metric. Displacement units are usually expressed in mm, velocity units are in mm/sec, while acceleration units are mm/sec^2. The rate of movement of a surface is the frequency which is measured in Hz or sec-1. **Table 3.3.48** provides the US Federal Transit Administration metrics for ground-borne vibration.

Table 3.3.48 Ground-borne Vibration and Noise Metrics

Metric	Abbreviation	Definition
Vibration Decibels	VdB	The vibration velocity level in decibel scale
Peak Particle Velocity	PPV	The peak signal value of an oscillating vibration velocity waveform. Usually expressed in inches/second in the United States.
Root Mean Square	rms	The square root of the arithmetic average of the squared amplitude of the signal.
A-weighted Sound Level	dBA	A-weighted sound levels represent the overall noise at a receiver that is adjusted in frequency to approximate typical human hearing sensitivity. This unit is used to characterize ground-borne noise.

1563. Among these variables, the vibration velocity of a particle is directly related to the stress generated in structures and measured to evaluate the influence on structures or perception of people. The limits set in standards are mostly in terms of vibration velocity or more strictly speaking peak particle velocity (PPV). However, given a certain level of vibration, the structural response of a structure also depends on other factors such as: i) duration of vibration, ii) the state of stress to which the structure is subjected, iii) the properties of structure, like foundation type, the quality of materials, the method of construction, and its current state.

1564. It must be considered that the characteristics of the vibration such as amplitude and frequency content are modified as the wave propagates through the ground. The ground acts as a filter, attenuating the amplitude and filtering the higher frequencies. This is a consequence of the damping of the waves due to material deformation characteristics, that is, the attenuation and filtering characteristics of a ground is a function of its elastic parameters, density, and porosity among other attributes. Higher frequencies are attenuated more effectively than lower frequencies since damping or loss of energy is a function of the number of cycles, not distance. High frequency vibrations which undergo more cycles dissipate more energy over the same distance than lower frequency which undergo less cycles.

1565. Considering accurately all the aforementioned factors to assess the possible effects to a structure by a certain vibration source is typically not economically feasible and practical. This exercise will require structural evaluation and seismic response and in-situ measurements of wave propagation properties. Instead, a general approach in which empirical attenuation equation adequate for the source and expected ground conditions are used to predict peak particle velocities and then these predicted values are compared to standards and recommendations for relevant type of building and expected frequency content of the vibration source is more commonly employed.

1566. The existing vibration codes are mostly based on experience and statistical information from vibration damage cause by blasting and other construction activities and thus they can be applied to the specific source of vibration for which they are deployed. A distinction is often made between short- and long-term vibrations. According to the commonly used German Standard DIN 4150-3, short term vibrations are those in which the “vibration does not occur often enough to cause structural fatigue, and which does not produce resonance.” Resonance occurs when the natural oscillation frequency of the structure matches the predominant frequency of the vibrations induced by construction machinery that reach the structure producing an amplification of the response of the structure during excitation. They define long term vibrations as any that fall outside the definition of short-term vibration.

(2) Induced Vibration from TBM during Construction Phase

1567. The effects of induced vibrations on structure depends on vibration frequency and, dominant type of wave, which in turn is dependent on the type of excavation method, ground propagation characteristics, and nature of affected structure. The vibration induced by tunnel boring machines (TBM) are usually on the high frequency side and are gradually applied and of a continuous nature in contrast to drill and blast induced vibrations which tend to be of lower frequency and of impulsive type. It is widely acknowledged that gradually applied force such as those applied by the disks and soil tools of TBMs will generate high frequency vibration which tend to be attenuated faster and in shorter distances by the ground compared to low frequency sources. Furthermore, TBM excavation generates mainly compressional waves (body waves) when trusting against the face that also attenuated faster than surface waves such as Rayleigh waves. [16] [17]

1568. A review on the vibrations induced by mechanized tunneling show through measurements of actual PPV values at different distances from the source how the TBM-induced vibrations are sometimes perceptible as a deep rumble but at levels below damage causing thresholds according to commonly used codes. Hiller and Hope cite in turn Hiller and Bowers (1997) after extensive literature review on vibration data based by mechanized tunneling concluded that “mechanized tunneling generates levels of ground vibration that are unlikely to cause damage to most structures. However, disturbance to people could occur at quite considerable distance from the works.”

1569. **Figure 3.3.66** shows a comparison provided by a road header manufacturer of the typical range of PPV measured values by a road header as compared to drill and blast excavation induced vibration. This figure shows that at a distance of 10 meters from the source, the PPV values produce by a road header are already below 3 mm/s which is the threshold established in codes for especially sensitive or historical buildings (**Table 3.3.50**). The vibrations produced by a TBM are usually of less amplitude than those produced by a road header as pointed out by Speakman and Lyons[18]. The range of vibrations expected from a TBM at a distance of 10m from the source will be below 0.1-3 mm/s the range expected for road headers.

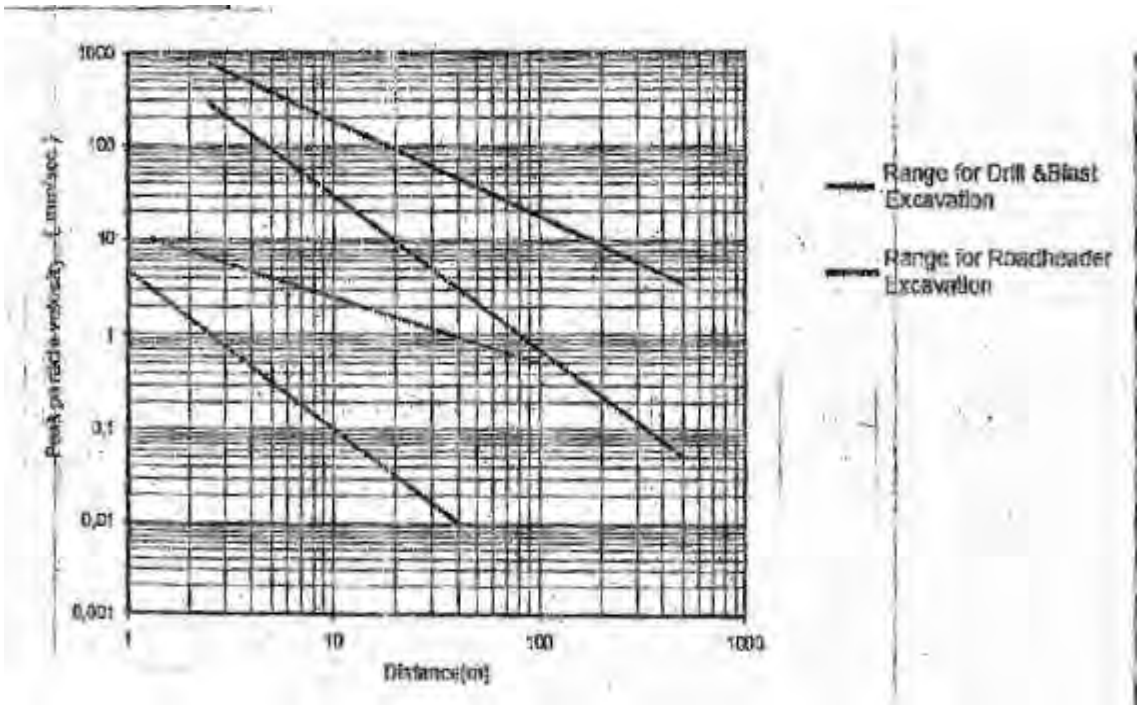
1570. Another factor in the propagation of vibration is the type of soil. In general, soils tend to absorb more energy and thus attenuate the vibrations more efficiently than rock mediums. In soils, damping is very quick and efficient as compared to rock. In turn, the higher the shear wave velocity of the ground the lower the damping shall be. This behavior is illustrated in **Figure 3.3.67** were it may be observed how for soil PPV values registered 10m of the source is already below 0.5 mm/s while for rock it may still reach up to 2 mm/s depending on the site condition. Thus, if the propagation medium is in soils the relevance of TBM vibrations and the possibility that nearby structures may suffer structural or cosmetic damage is greatly diminished and becomes almost irrelevant. On the other hand, in rock although expected peak particle velocity values are still low, TBM vibrations should be evaluated.

1571. UK’s Transport Research Laboratory (TRL) Report 429 in which a graph compiling field data on TBM vibration measured by TRL as well as from other published report sources were included. The graph indicated that among mechanical excavation methods, the resulting PPV values seemed to depend more on geology that on the excavation method. In fact, the conclusion of TRL 429 Report was that it is the type of ground being excavated, rather than

[16] Davis, D. (2010). “A review of prediction methods for ground-borne noise due to construction activities”, Proceedings of 20th International Congress on Acoustics
[17] Dowding, C, (1996). “Construction vibrations”, Prentice Hall
[18] Speakman, C. et Lyons, S.(2009) “Tunneling induced ground-borne noise modeling”, Proceedings of ACOUSTIC 2009 Adelaide, Australia

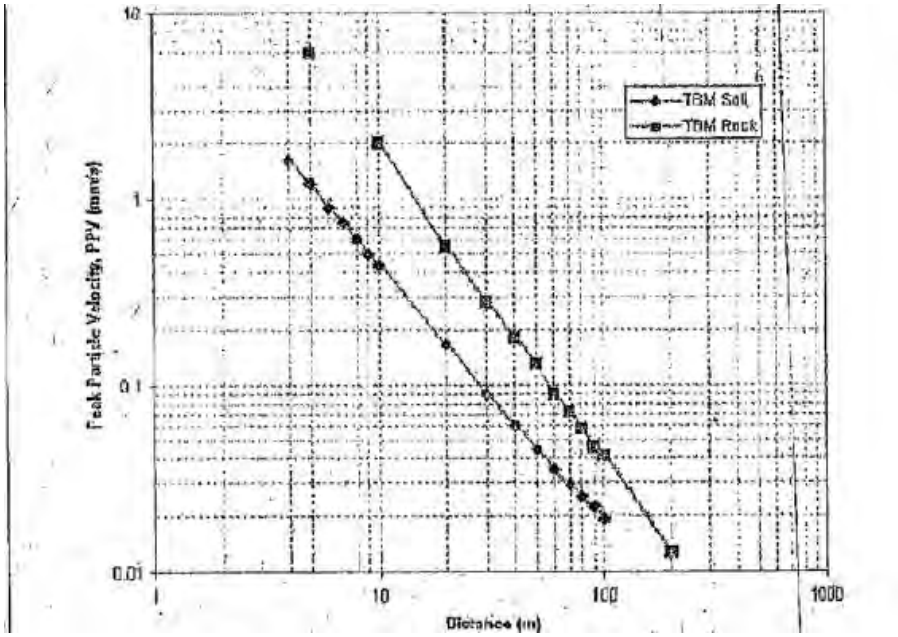
the mechanized excavation method or tunnel boring diameter that dictates the magnitude of vibration quantified in terms of PPV (**Figure 3.3.68**)**.**

1572. Hiller presented an amended version of the graph in which data from the Ramsgate Harbour Approach Road tunnel excavation in UK which was performed using the “prevault” tunneling method. As shown in the **Figure 3.3.69**, the data for Ramsgate corresponding to excavation chalk fall together with that of the road header excavation in chalk from the original graph while data from excavation in weak, soil-like chalk falls in the same range as the data of excavations in clay, sandy clay and sand of the original graph despite the fact that the excavation method used at Ramsgate is different. It is clear that not only a significant difference exists between tunneling in rock and soft ground but also as Hiller concludes it is very likely that “it is the type of ground being excavated rather than the type or size of excavator that determines the vibrations.” This hypothesis is supported by the available data and followed implicitly by several researches which have proposed attenuation equations based only on the geological medium characteristics and distance as will be discussed in the succeeding section.



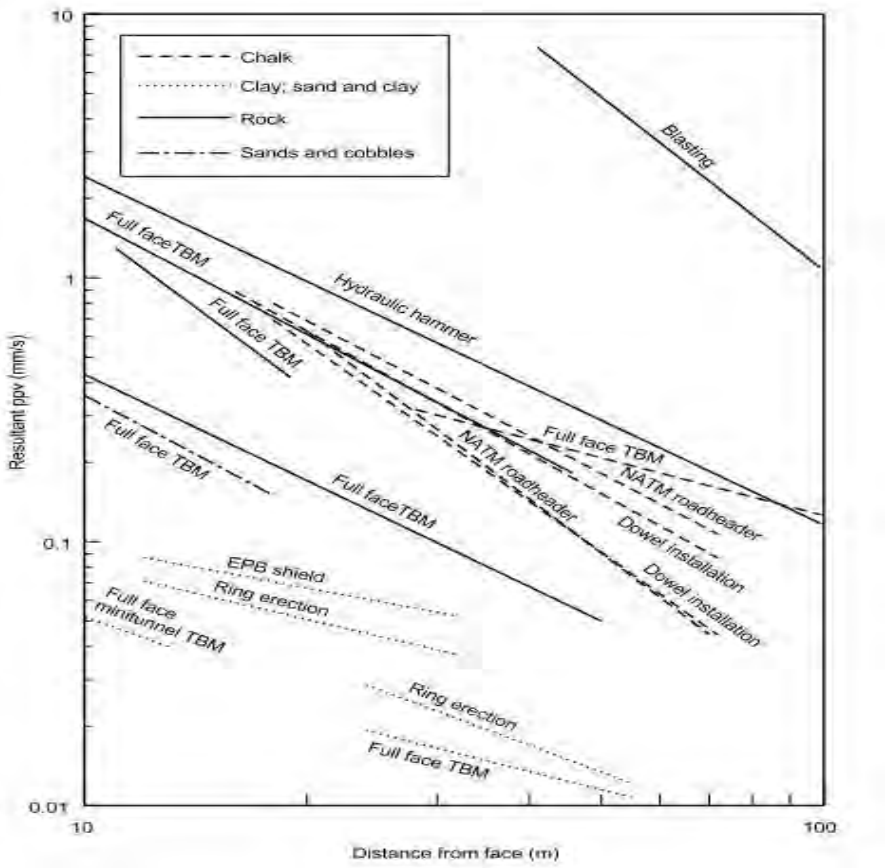
Source: Hiller and Bowers, 1997

Figure 3.3.66 Typical ranges of PPV values for different sources



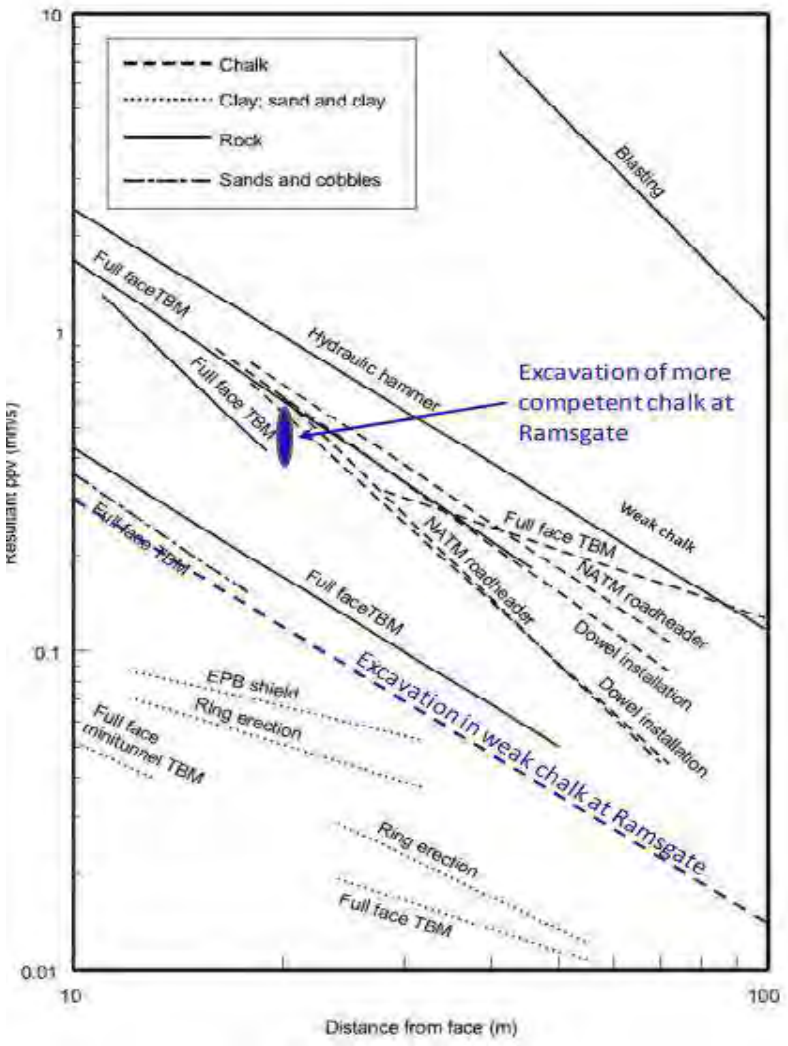
Source: Tunnel Consult, 2013

Figure 3.3.67 Attenuation of TBM vibration with distance



Source: TRL, 429

Figure 3.3.68 Ground vibration data from tunneling operations classified according to geology



Source: Hiller and Crab, 2000, amended

Figure 3.3.69 Ground vibration data from tunneling operations classified according to geology

(3) Attenuation Laws

1573. There are many vibration prediction equations for blasting and piling in the technical literature, but not many directly developed for mechanized tunneling. Attenuation equations tend to be a function of distance to the source and may or may not take into account site-specific parameters. A commonly used equation is that proposed by Godio et. al. (1992) and cited by UK Transportation Research Laboratory Report No. 429 as follows:

$$Vres = Ar^{-1.3}$$

Where:

Vres = predicted upper boundary resultant ppv (mm/s)

r = is the slope (shortest) distance (m) from the vibration source to the measurement location

A = a constant dependent on stiffness.

1574. A weakness in the use of this equation is that it does not consider source of vibration frequency and using a unique value of stiffness to describe the ground is very rough. One method for deriving site specific attenuation equations for TBM induced vibrations is that developed by Orr and Rahman[19] for the Dublin Port Tunnel. Their approach considers the propagation parameters of the local ground as well as the source frequency and can be modified to derive equations for other ground conditions.

(4) Selected Attenuation Laws in its Generalized Form

1575. The vibration prediction deriving methodology proposed by Orr and Rahman has been selected for predicting the vibration produced by the TBM which will excavate the underground section between the proposed Senate to FTI stations. The attenuation equation in its generalized form is based on the equation of Dowding (1996) as follow:

$$V1/Vo = (ro/r1)^{\beta} e^{-\alpha (r1-ro)} \qquad (1)$$

Where:

V1 = peak particle velocity at a distance r1 from the source

Vo = peak particle velocity at a distance ro from source

β = geometric spreading term dependent on wave type

= 1 for compressional waves, 0.5 for Rayleigh waves

α = ground adsorption coefficient

= 2πDf/Vs (from Massarsch)[20] (2)

Where:

D=material damping

f = predominant vibration frequency of the signal

Vs = shear wave velocity

1576. In the case of TBMs as pointed earlier, the majority of wave forms are of compressional type and thus β = 1. Also, assuming the vibration at the source will be approximately equal to that of a distance of 1 meter (ro =1), equation 1 may be written as:

$$Vi /Vo = r1 -1 e -\alpha(r1-1) \qquad (3)$$

(5) Application to the proposed Senate-FTI underground section

1577. Using the information from the borewells to estimate shear velocity and materials dampening and comparing this with shear velocity (VS30) developed by the PHIVOLCS, the anticipated vibration attenuation from the TBM operation of the proposed underground section is estimated. The maximum standard penetrating test from borewells at depths where the TBM is expected to operate (i.e. between 20-22 meters below ground surface) ranges from 7-100 blows with an average of 39 blows. [21] Using equation below to correlate to multichannel analysis of surface waves (MASW), the shear velocity is computed:

$$Vs=102.98(NSPT)^{0.3438}$$

[19] Orr, T.L.L. and Rahman, M.E. (undated). "Prediction of ground vibrations due to tunneling." www.rod.ie/images/assets/pub010.pdf
[20] Op. cit.
[21] After removing the zero values

1578. Shear velocity for the dominantly Guadalupe formation is computed at an average of 363 m/s with a maximum of 500 m/s. These values are consistent with the shear velocities provided by the Philippine Volcanology and Seismology of VS30 ranging from 360-760 m/s.

1579. The damping factor also varies depending on the type of ground and widely used damping factor was developed by Rausche et.al47 (1985) which provides a damping factor of 0.15-0.3, the lower value is used to be on the safe side.

1580. The typical vibration at the source from a TBM excavating in soft ground are in the range of 10-20 Hz[22]. The proposed attenuation equation for the link line is provided as:

V1/Vo = r1 -1e -0.06923(r1-1)

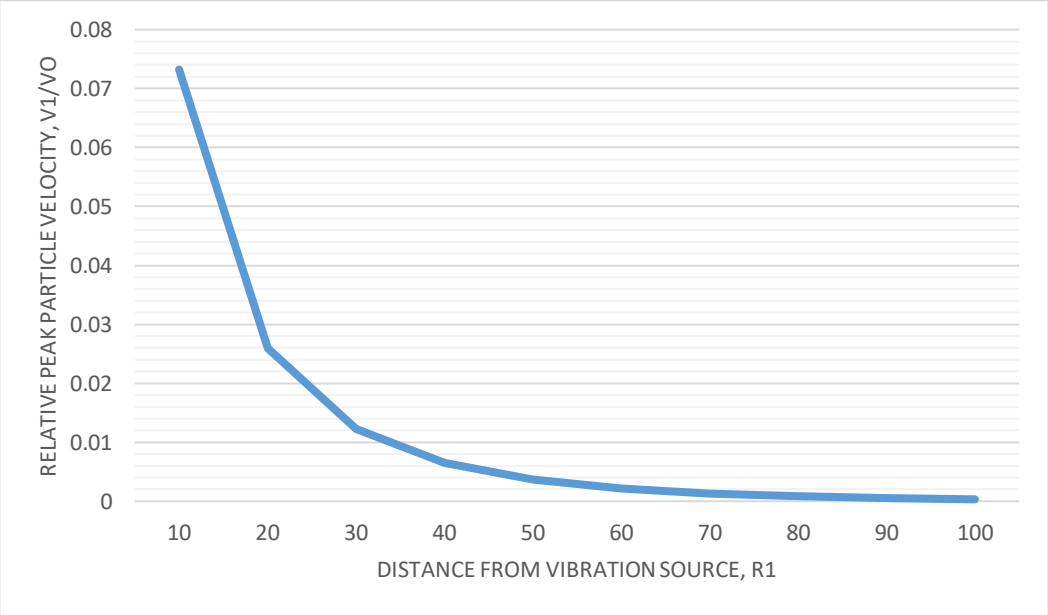


Figure 3.3.70: Derived Attenuation for the Proposed Interconnection Line

1581. The succeeding **Table 3.3.49** provides the predicted vibration levels at the ground surface during TBM operation. The distance from the tunnel was computed as the hypotenuse line between the tunnel assumed at 20 meters deep and the surface distance from the alignment centerline.

[22] Orr, T.L and Rahman (Undated) and Speakman C. et Lyons, S. (2009)

Table 3.3.49 Predicted Ground Surface Vibration from the TBM operation, mm/sec

Surface Distance from CL	Distance from tunnel	source PPV, mm/sec	V1, mm/sec
1	20.02498	10	**0.258463**
5	20.61553	10	**0.245978**
10	22.36068	10	**0.213486**
20	28.28427	10	**0.137484**
30	36.05551	10	**0.082412**
40	44.72136	10	**0.049222**
50	53.85165	10	**0.029799**
60	63.24555	10	**0.018329**
70	72.8011	10	**0.011439**
80	82.46211	10	**0.007228**
90	92.19544	10	**0.004615**
100	101.9804	10	**0.002974**

(6) Ground vibration during Senate-FTI underground section operation

1582. To predict the vibration caused by the operation of underground section, the FTA (2019) methodology was adopted with the following considerations:

- Generalized ground surface vibration level is computed as follow for subway, rapid transit, and light rail. Although vibrations from subway and at grade have very different characteristics, according to the FTA, the overall vibration velocities are comparable.

  $Lv = 85.88 – 1.06 \log (D) - 2.32 \log (D)^2 – 0.87 \log (D)^3$

  Where

  D=distance from the nearest receptor, and in this case immediately on top of the tunnel at 26m or 80 ft

  Lv = 68 VdB

- Vibration is directly proportional to speed; however, the generalized ground surface vibration was developed at a reference speed of 50 mph or 80 kph and no adjustment was applied

- The FTA allows adjustments based on the suspension system of the train, wheel condition, and wheel type. Train with stiff suspension generates higher vibration (+8 dB) that those with resilient wheels (0 dB) while wheel flats that has worn unevenly will increase vibration by as much as +10 dB. The proposed EMU train will be equipped with resilient wheels and no adjustments were applied

- The use of high-resilience fasteners will reduce vibration levels by 5dB while ballast mats can attenuate vibration by as much as -10 dB

- Path adjustments were applied to the proposed project considering the presence of Guadalupe formation and the vibration was increase by 4dB due for propagation through rock layer. Building coupling losses were also provided in analysis.

1583. The summary of the vibration assessment is provided in the **Table 3.3.50**.

Table 3.3.50 Summary of Vibration Assessment showing the adjustment factors to Predict ground-borne vibration and noise

Reference Vibration	68 VdB	EMU at 50 mph
Source Adjustments		
Source Factor	Adjustment	Comment
Speed	0 dB	Maximum design speed is 80 kph or 50 mph
Vehicle Parameter	0 dB	Use of resilient wheels
Track Condition	0 dB	Welded tracks
Track Treatment	-10 dB	Use of ballast mats and high-resilience fasteners, the greatest value was applied
Source Adjusted	*58 dB*	
Path Adjustments		
Ground Propagation	+4 dB	Rock layer at 50ft-100 ft, greatest value applied
Coupling of Foundation	-7 dB	1-2 story masonry applicable to the Villamor Airforce Base
	-13 dB	For the National Nutrition Council (Nutrition Building), larger masonry on spread footings
Path Adjusted	*55 dB* *49 dB*	*Structures at Villamor Airbase* National Nutrition Council
Receiver Factor	Adjustment	
Floor to Floor Attenuation	-2 dB -2 dB	First floor attenuation at Villamor Airbase Buildings National Nutrition Council
Amplification due to resonance of floors, walls and ceiling	+ 6 dB	Resonance of building structure
Predicted levels	 **59 dB** **57 dB** **53 dB**	**Villamor Airbase Buildings** **First Floor** **Second Floor** National Nutrition Council **1st-5th Floors**

3.3.5.3. Assessment of Results

1584. **Figure 3.3.71** and **Figure 3.3.72** show the underground line alignment and the sensitive receptors that are at risk from the vibration caused during tunnel boring and underground section operation. Figure 3.3.50(h) shows numerous structures within the Philippine Airforce Villamor Air Base are directly above the alignment and are therefore at higher risk than any structures. These structures are masonry type with no more than 3 story heights. Figure 3.3.71 shows a larger structure, the National Nutrition Council (NNC) where the link line will traverse below the building. The depth of the tunnel as provided by the design engineers is 26 meters.

1585. The predicted vibration levels during tunnel boring and underground train operation were compared with limits set by various international vibration codes. The predicted vibration levels immediately at the ground surface of the tunnel during tunnel boring machine operation

was estimated 0.26mm/s. This level is lower than the 2.5mm/s guideline value for structures with intrinsic importance as provided in German Standard DIN 4150 (**Table 3.3.51**). No anticipated damages are expected from TBM operation for all the buildings in the Villamor Airbase and the NCC.

1586. Although no structural damage is anticipated from the TBM operation, predicted vibration levels are projected to be perceptible within 20 meters from the alignment centerline at the ground level. The predicted vibration level of 0.26 mm/s is within the perception threshold of 0.154-0.483 mm/s as provided in the CalTrans Transportation and Construction Vibration Guidance Manual (2013) with reference to Whiffen (1971) (**Table 3.3.52**). Although the predicted levels during TBM operations may be perceptible, these levels will not cause disturbance, startle, cause annoyance or interfere with work activities.

1587. During the link line operation, the predicted ground borne vibration was estimated at 59 VdV 53 VdB, respectively, at the ground floors of the buildings in the Villamor Air Base and the NNC. The assessment criteria values for institutional land uses, as provided in **Table** 3.3.53, for frequent events is 75 VdB. This indicates no anticipate impacts from vibration will result during the link line operation.

1588. To convert the predicted vibration levels to ground-borne noise, applicable adjustment factor provide in the FTA Manual was adopted. For subways with the transit structures founded on rock, the dominant sound frequency is in the high range (>60 Hz) and the adjustment and conversion factor is – 20 dB. The ground borne noise in these structures are estimated at 39 dB(A), and 33 dB(A) which are lower than the criteria assessment value if 40 dB(A). No anticipated impacts from the ground-borne noise are anticipated during operation of the Senate Station to FTI Station underground section.

Table 3.3.51 DIN 4150 Guideline Values

Type of structure	Frequency (Hz)	Peak-Velocity (mm/sec)		Location of Measurement
		Short-Term	Long-Term	
Buildings used for commercial purposes, industrial buildings and similar design	1-10 10-50 50-100 All	20 20-40 40-50 40	- - - 10	Foundation of structure Foundation of structure Foundation of structure On horizontal plane of highest floor
Dwellings and buildings of similar design or occupancy	 1-10 10-50 50-100 All	5 5-15 15-20 15	- - - 5	Foundation of structure Foundation of structure Foundation of structure On horizontal plane of highest floor
Structure that, because of their sensitivity to vibration cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed building under preservation order)	1-10 10-50 50-100 All	3 3-8 8-10 8	- - - 2.5	Foundation of structure Foundation of structure Foundation of structure On horizontal plane

Table 3.3.52 Human Response to Continuous Vibration from Traffic

PPV		Human Response
In/sec	Mm/sec	
0.4-0.6	10.16-15.24	Unpleasant
0.2	5.08	Annoying
0.1	2.54	Begins to annoy

PPV		Human Response
In/sec	Mm/sec	
0.08	2.03	Readily perceptible
0.006-0.019	0.154-0.483	Threshold of perception

Source: Caltrans (2013)

Table 3.3.53 Indoor Ground-Borne Vibration (GBV) and Ground-Borne Noise (GBN) Impact Criteria for General Vibration Assessment

Land Use Category	GBV Impact Levels (VdB re 1 micro-inch /sec)			GBN Impact Levels (dBA re 20 micro Pascals)		
	Frequent Events	Occasional Events	Infrequent Events	Frequent Events	Occasional Events	Infrequent Events
Category 1: Buildings where vibration would interfere with interior operations.	65 VdB*	65 VdB*	65 VdB*	N/A**	N/A**	N/A**
Category 2: Residences and buildings where people normally sleep	72 VdB	75 VdB	80 VdB	35 dBA	38 dBA	43 dBA
Category 3: Institutional land uses with primarily daytime use	75 VdB	78 VdB	83 VdB	40 dBA	43 dBA	48 dBA

This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. For equipment that is more sensitive, a Detailed Vibration Analysis must be performed.
** Vibration-sensitive equipment is generally not sensitive to ground-borne noise; however, the manufacturer's specifications should be reviewed for acoustic and vibration sensitivity

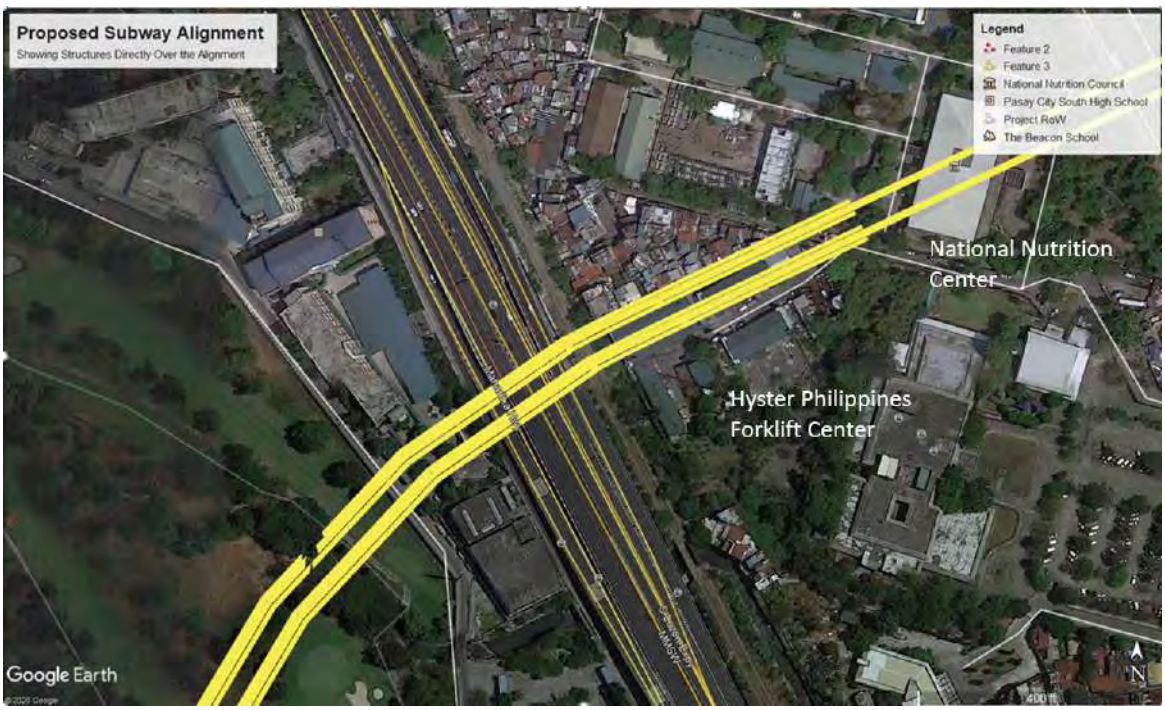


Figure 3.3.71 Underground alignment directly under the National Nutrition Center and Hyster Philippines Forklift Center, where vibration levels during tunneling are projected to be perceptible

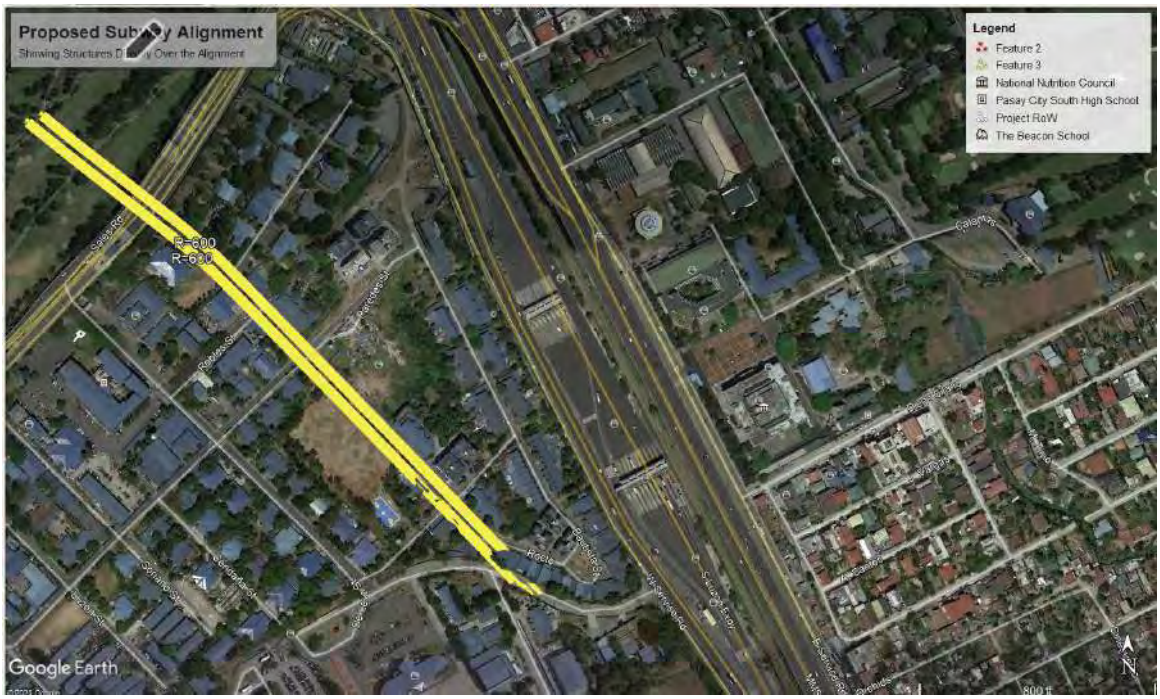


Figure 3.3.72 Underground alignment directly under the Villamor Airbase Buildings, where vibration levels during tunneling are projected to be perceptible

3.3.5.4. Conclusion

1589. Two sensitive receptors to ground-borne vibration were identified along the proposed Senate-FTI underground section and these include the numerous structures within the Philippine Airforce Villamor Air Base and National Nutrition Council (NNC) Nutrition Building. These structures are located directly above the Senate-FTI underground section. The predicted vibration levels during tunnel boring was estimated 0.26mm/s which is lower than the 2.5mm/s guideline value and no anticipated damages are expected from TBM operation. No mitigation measures are needed. Although no structural damage is anticipated, predicted vibration levels project will be perceptible at 0.26 mm/s which is within the human perception threshold of 0.154-0.4826 mm/s. The predicted level is, however, low enough not to cause disturbance, startle, cause annoyance or interfere with work activities. Vibration monitoring will be conducted during tunneling works at these two sensitive receptors.

1590. During operation of the underground section, the predicted ground borne vibration was estimated at 59 VdV 53 VdB, respectively, at the ground floors of the buildings in the Villamor Air Base and the NNC. The assessment criteria values for institutional land uses, as provided in **Table 3.3.53** for frequent events is 75 VdB. This indicates no adverse impact from vibration is anticipated during operation of the underground section. No mitigation measures are needed.

Table 3.3.54 Summary of Impact Identification, Prediction, Assessment and Mitigation for Air

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/ Mitigation/ Enhancement Measures
GENERAL				
• Pre-construction, Construction and Operation activities	Land, Water, Air and People			• Comply with the relevant laws: o RA 6969: storage, transport, handling, treatment and disposal of hazardous waste o RA 9003: management and disposal of solid wastes o RA 8749: comprehensive air pollution control policy o RA 9275: comprehensive water quality management and for other purpose • Implementation of Emergency Response Plan and Health and Safety Management Plan to include but not limited to: o Distribution of manual/guideline for workers/employee on health and safety, environment management. o Orientation and continuous training of qualified workers/ employee/ operator on Environment Management, Basic and Construction Occupational Safety and Health, Scaffolding Safety, Fire Safety and Safe Use of Chemicals at Work. • Provision of earthquake, fire drills for workers • Provision of appropriate PPE for workers • Provision of security personnel. • Regular monitoring of site condition
PRE-CONSTRUCTION / CONSTRUCTION				
• Operation of construction machinery, equipment and vehicles • Removal of trees and other vegetation	Climate change	Exhaust emission from movement of equipment and vehicles, excavated soil carried by vehicles and other heavy loaders.	C-	[Pre-Construction] • Plan and design structures that will minimize the removal of vegetation and alteration of topography if possible. • Plan and design structures considering climate-related risks [Construction] • Conduct proper inspection and preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standard • Use electric or fuel-efficient equipment, machineries and vehicles and maximize its operation if possible
• Climate risk	Meteorology/ climatology	Restrictions/ disruption of construction due to soil erosion /landslides /and flooding.	A-	[Pre-Construction] • Take account of change in local micro climate such as rainfall, temperature pattern for 2020 and 2050 in project design criteria and schedule of construction works. • Integrate climate-related risks and mitigating measures in DED • Ensure robust engineering design and construction standards for facilities • Based on the hydrological and geodetic study, design and install train system considering climate change and related extreme events including drainage, passenger facilities and structures (viaduct, embankment, and tunnels) i.e. train
		Slower drainage, soil erosion, disruption in construction by increased rainfall	B-	

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/ Mitigation/ Enhancement Measures
		overheating of construction equipment, vehicles / heat stress by high temperature and heat waves	C-	facilities to be above the flood level (except for underground section), installation of drainage pumping system. [Construction] • Adjust construction activities considering local climate / extreme events such as extreme heat to avoid overheating of construction equipment and service vehicles and heat stress to workers. • Implement Emergency Response Plan.
• Earthworks including excavation activities • Site clearance including removal of topsoil at the SCRP Depot site	Air Quality	Degradation of air quality due to dust generation from transportation of excessive soil / spoil to fill area construction activities	B-	[Pre-Construction] • Design to minimize alteration of topography and removal of vegetation. [Construction] • Minimize alteration of topography and removal of vegetation. • Adjust construction activities in consideration of weather conditions, identifying periods of high winds and drought that may aggravate dust transport. • Conduct prompt inspection and regular maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standards • Check and maintain or monitor engine conditions and machines used for construction at least once a week • Conduct weekly maintenance of vehicles and equipment to ensure emissions comply with standards. • Control vehicle movement maintaining the speed limit within the construction site to <10kph and minimize vehicle transport by maximizing the use of site generated materials • Equipment dispatching will be monitored closely in order to eliminate unnecessary use. • Conduct regular cleaning and clearing of construction access / sites surfaces of spoils and debris from construction equipment and vehicles and wetting of ground soil in the construction site when necessary. • Implement materials handling program or a site protection and rehabilitation program. • Monitor air quality at identified nearby sensitive receptors regularly and evaluate effectiveness of the air pollution reduction measures provided. • Implement materials handling or a site protection and rehabilitation program. • Haul the excavated materials from the construction areas as soon as possible • Conduct water sprinkling in areas prone to dust emission such as at soil excavation areas or stockpile of aggregates and under the elevated stations. Keep excavated soil and stockpiles moist. • Impose speed limit of no more than 30kph on construction vehicles particularly when passing communities, residential or commercial areas or sensitive areas such as hospitals, schools or religious institutions such as temples, mosques and churches.
Operation of construction machinery, equipment and vehicles	Air Quality	Degradation of air quality due to gaseous emissions from machineries and service vehicles	C-	

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/ Mitigation/ Enhancement Measures
				• Require Contractors to wash wheels of vehicles before leaving the construction area particularly at the SCRP Depot and transition areas to avoid mud tracking on roads that cause dust emission later on. • Require materials delivery trucks to provide cover when transporting materials • Install board-ups or fence at the construction area not less than 2 meters high. • In case of accidental spill of materials during transport, the Contractors will be required to immediately clean-up spilled materials. • Prohibit burning of waste materials in accordance to RA 9003. Unauthorized burning of construction materials and wastes shall be subject to penalties for the Contractors. • Ready mixed concrete produced and mixed outside the construction area shall be used to prevent and mitigate impacts on communities around the construction area.. • Designate at least 3-4 workers per construction area to clean the site after the completion of daily activities and arrange material piling in order to prevent dust diffusion. • For the elevated structures, provide nets and scaffoldings for falling debris from construction of elevated structures to avoid dust emission and hazards from falling debris. • Subcontractors' vehicles to undergo emission testing prior to contract award. • Fuel burning equipment will be managed through the utilization of low sulphur fuel, where possible. • Traffic management guidelines will be included in the induction seminar of workers.
• Operation of construction machinery, equipment and vehicles • Earthworks • Construction of structures and facilities	Acoustic Noise	• Increase in ambient noise level • Threat to existence and/or loss of important local species and habitat • Threat to abundance, frequency and distribution of species	B-	[Pre-Construction /Construction] • Position storage and other large equipment to function as noise barriers • Identify haul roads that minimizes noise impacts • Consider traffic re-routing • Maximize the use of existing structures like fences, walls, and other structures as noise barriers. • Select sites (i.e. construction yard, temporary facilities, access routes) in consideration to sensitive receptors including ecologically significant areas (if any) likely to be affected • Plan and implement construction activities in consideration to time, duration, and scale to optimize the use of construction equipment, machineries, and vehicles in accordance to the noise emission standard. • Design to minimize alteration of topography and removal of vegetation. • Provision of effective noise barriers on each side of the track for the SCRP main railway. A continuous 1 m high concrete wall throughout alignment except 887m length in 3 sections all in Makati City i.e. from chainage 10+464 to 10+743, north bound; from chainage 12+557 to 12+970, north bound; and from chainage 13+093 to 13+288, south bound.. A composite noise protection wall with a vertical element of

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/ Mitigation/ Enhancement Measures
				3.0 m, and on top two elements of 0.25 m and slope of 45 degree is provided at these three locations. • Design and adopt long rails and ballast-less track with elastic and absorbent sleeper support to minimize noise generation from train operation • Design and install absorbers along the alignment during construction especially in areas with sensitive facilities. [Construction] • Sequence the construction operation: i) Schedule noisy activities at the same time since the combined noise levels may not be significantly higher that noise levels from individual equipment operation; ii) Install temporary noise barriers in the early stages of project construction • Use of alternative construction methods: i) Do not use pile driving. Only vibration, hydraulic insertion, or auger drill techniques shall be applied; ii) use of electric compressors which is quieter than gasoline or diesel-fed compressors. • Contract Specifications to include: i) Construction noise criteria limits as follows: Lmax in sensitive areas (residences, institutions, and hotels) <85dB(A) daytime and evening, and <80 dB(A) during nighttime; <140 dB(A) at any time; ii) Training for contractors to be administered by the construction supervision consultant on project specific noise requirement, project personnel in-charge with noise management, equipment noise level specifications, and personal protective equipment • Source Mitigation: i) use of less noisy equipment; ii) installation of mufflers on all internal combustion engines; iii) installation of noise shields to particular equipment; iv) dampeners through equipment modification; v) installation of aprons or curtains using absorptive mats; vi) enclosures; and vii) Equipment operating training • Consultations with affected community: Public involvement regarding noise impact and its mitigation is required under project during the noise assessment process and discuss the effectiveness of the mitigation measures. The need for coordination with the local officials to protect future development on areas identified to be exposed to elevated noises during construction and operation is an important input in the town and land use planning. The local government units can also assist in the dissemination of information to residents. • Implement construction activities in consideration of time, duration, and scale to optimize the use of construction equipment, machineries, and vehicles in accordance to the noise emission standard. • Minimize alteration of topography and removal of vegetation which generate noise. • Install noise control devices such as mufflers and noise suppressors to all construction equipment and machineries. Use of electric instead of diesel-powered equipment, hydraulic tools instead of pneumatic tools. • Install 3-m temporary mobile noise barrier made of wood or metal at active construction sites. This will reduce construction noise to Ldn 60 dB(A) during footing construction activities resulting to no residual impacts. The same wall can reduce

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/ Mitigation/ Enhancement Measures
				impacts during in-situ piling from moderate to no impact except for the houses located along the ROW that may be exposed to moderate impacts. • For underground section, install a 290 m long 3-m high peripheral temporary wall around construction site of the cut-and-cover section at FTI station • Use noise barriers and sound absorption materials with no less than 70% and 80% of sound absorption coefficient at 1,000 and 500 hertz, respectively. • Provide appropriate PPE to construction workers • Monitor noise levels at identified nearby sensitive receptors (residential, school and hospital areas) including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the noise reduction measures provided. • Noise levels from equipment and machinery shall conform to the noise standards and WB-IFC Environmental, Health and Safety Guidelines. • For construction works between nighttime hours of 10 pm to 6am, proper consultation will be conducted with the affected persons and local officials prior to construction activities, and all adverse environmental impacts are mitigated to acceptable levels. In case of activities that will cause noise exceeding the acceptable level, permission from DOTr-PMO and concerned LGU must be secured and advance notice to the public will be issued at least 24 hours before the start of construction activities. • Workers will be required to wear appropriate PPE including ear plugs or earmuffs in areas generating excessive noise. • Require drivers of construction vehicles to minimize blowing of horn and limit speed when passing through residential areas. • DOTr-PMO and Contractors to continuously operate Grievance Redress Mechanism (GRM) to urgently respond to the complaint and resolve the problem.
• Conduct of geotechnical investigation • Operation of construction machinery, equipment and vehicles • Pile driving for piers • Tunneling works	Ground vibration	• Increase in ambient vibration level and threat to the health and safety of sensitive receptors • Threat to existence and/or loss of important local species and habitat • Threat to abundance, frequency and distribution of species	C-	[Pre-Construction / Construction] • Select sites in consideration to sensitive receptors including ecologically significant areas (if any) likely to be affected. • Plan and implement construction activities in consideration to time, duration, and scale to optimize the use construction equipment, machineries, and vehicles in accordance to the noise emission standard. • Review and amend, as needed, predicted vibration level study for the TBM and drilling during construction and tunnel subway operation. • Conduct building condition survey of old PNR structures and buildings adjacent to the alignment to provide proper protection provision measures and continuous monitoring from the impact of vibration. • Strategic scheduling of vibration-induced works. • Installation of vibration control measures such as i) vibration insulating sleeper; ii) sleeper with elastic layer directyl fastened track; and iii) secondary lining. • Prepare and submit work plan for building and structures of historic concerns [Construction]

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/ Mitigation/ Enhancement Measures
				• Implement construction activities in consideration of time, duration, and scale of construction to optimize the use construction equipment, machineries, and vehicles with minimal vibration generation. • Select construction equipment and machineries matching the scale of the construction and with minimal vibration generation if possible • Provide training on vibration mitigation and provide appropriate PPE to construction workers; • Monitor vibration levels including identified nearby sensitive receptors, old PNR structures including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the vibration reduction measures provided. • Coordinate with sensitive receptors prior to pile driving. • Strictly control construction activities close to historical/ archaeological sites. • If construction activities will cause continuous vibration, especially foundation excavation, it is necessary to reduce energy at each excavation. • Require vehicles transporting construction materials and equipment to follow traffic rules strictly and limit speed not to exceed 30 kph and the load shall not exceed 25 tonnes if passing communities or commercial or sensitive areas (e.g. health premises, schools, educational institutions or religious institutions such as temples, mosques and churches). • In case of vibration due to construction activities, the construction works will be carried out only in daytime from 8am to 6pm unless proper consultation has been conducted and agreement has been reached with the affected persons and local officials, and all adverse environmental impacts are mitigated to acceptable levels to minimize disturbance to people. • Monitor vibration level at the Philippine Airforce Villamor Air Base and National Nutrition Center Building during tunneling works.
OPERATION				
• Climate Risk • changes in the rainfall pattern and local temperature	Meteorology/ climatology	Restrictions/ disruption of construction due to soil erosion /landslides /and flooding.	A-	• Regular inspection and preventive maintenance of railway structures and facilities to ensure optimum working condition; • When necessary, install improvement of railway system to make it more resilient to temperature and rainfall increase; • Planting of vegetation as much as possible in open areas at the SCRP Depot, around the stations and along the railway track; • Implementation of an Emergency Response Plan;
		slower drainage, soil erosion, disruption in construction by increased rainfall	B-	
		overheating of construction equipment, vehicles / heat stress by high	C-	

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/ Mitigation/ Enhancement Measures
		temperature and heat waves		
• Operation of trains, SCRP Depot, passenger facilities (stations), service vehicles, etc.	Climate change	Reduction of Greenhouse Gases	B+	• Provide incentives and information dissemination activities to encourage commuters to use rail transit and its benefits over other modes of transport (Modal Shift) • Plant and manage vegetation as much as possible in open areas at the SCRP Depot, around the stations and along the railway track • Conduct Energy/water conservation program such as use energy efficient products (i.e. LED lights) and monitor carbon footprint monitoring • Conduct regular inspection and proper maintenance of railway systems and facilities, and equipment and machinery
• Operation of trains, SCRP Depot, passenger facilities (stations), service vehicles, etc.	Air Quality	• Degradation of air quality in the vicinity of the station and in the SCRP Depot area • Increase in Vehicle Exhaust emission and entrained dust due to increased movement of people	C-	• Select appropriate operation and maintenance equipment that are fuel efficient to reduce emission. • Conduct regular inspection and maintenance of heavy equipment, machineries, facilities and service vehicles and facilities such as generator etc. to meet the DENR emission standards. • Regular cleaning and clearing of road from spoils and debris and wetting of ground in the periphery of the SCRP Depot when necessary. • Comply with environmental permitting requirements for the storage, transport, handling, and treatment of hazardous material/ wastes and contaminated soil in accordance with RA 6969 at SCRP Depot area, and provide appropriate PPE for the concerned personnel • Control service vehicle movement maintaining the speed limit to <10kph. Minimize vehicle transport by maximizing the use of site generated materials. • Monitor air quality at the identified sampling stations considering to possible impact in vicinity to stations and evaluate effectiveness of the air quality reduction measures provided.
• Operation of trains	Acoustic Noise	Reduction of noise due to decrease in traffic volumes	B+	• Provide incentives to and information dissemination activities to encourage commuters to use rail transit over other modes of transport
• Operation of trains, depot, passenger facilities (stations), service vehicles, etc.	Acoustic Noise	Increase in ambient noise level	C-	• Optimize the number of train operation at night time to reduce generated noise • Provision of effective height of noise barriers on each side of the track especially on areas with sensitive receptors such as school, hospital, residential area, including but not necessarily limited to: provide continuous 1 m high concrete wall throughout alignment except 887m length in 3 sections all in Makati City i.e. from chainage 10+464 to 10+743, north bound; from chainage 12+557 to 12+970, north bound; and from chainage 13+093 to 13+288, south bound. A composite noise protection wall with a vertical element of 3.0 m, and on top two elements of 0.25 m and slope of 45 degree is provided at these three locations. • Provision of noise control device such as muffler to all stationary sources (i.e. generator set)

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/ Mitigation/ Enhancement Measures
				• Install traffic signs in the areas before and after passing all stations, e.g. directional signs, speed limit signs, no blowing of horn signs, etc • Inspect the strength and efficiency of sound absorbing materials installed at the routes or areas under the stations at least once a month. Change the material in case these are damaged or their efficiency has decreased by more than 40%. • Regular inspection and proper maintenance of trains and tracks to ensure its optimal operation and functionality • Monitor noise levels including identified nearby sensitive receptors including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the noise reduction measures provided.
• Operation of trains, SCRP Depot, passenger facilities (stations), service vehicles, etc.	Ground vibration	Increase in ground vibration level	C-	• Undertake regular inspection, proper maintenance and reconditioning of trains and tracks such as rail grinding, slip-slide detectors and maintenance or replacement of suspension system, brakes and wheels; and • Monitor vibration levels at identified nearby sensitive receptors (residential, school and hospital areas), old PNR structures, historical heritages including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the vibration reduction measures provided. Monitor actions on complaints, if any, and attend to unresolved cases based on Grievance Redress Mechanism. • The strength and efficiency of rail pads at the train stations or hubs must be inspected at least once or twice a month. In case of damage or decrease in efficiency of the pads by more than 40%, these should be replaced.

Note:
A+/-: Significant positive/negative impact is expected.
B+/-: Moderate positive/negative impact is expected to some extent.
C+/-: Minor / Negligible positive/negative impact is expected to some extent.
D: Extent of impact is unknown.

3.4. PEOPLE

1591. Baseline data are presented at LGU level where such data are available. Where data is not available, provincial data are used. The data also sometimes differ in reference years, and this is always reflected in the text and tables to enable the reader to distinguish the timelines of the data. All information are based on secondary data, except for the data on PAPs which were derived from the primary socio-economic surveys conducted during the data gathering phase in the month of April 25, 2018.

1592. The baseline data cover the impact areas in Metro Manila and Laguna. In Metro Manila, the Project will traverse through host cities namely: Manila, Makati, Taguig, Parañaque, Pasay, and Muntinlupa. In the province of Laguna, the Project will pass through San Pedro, Biñan, Sta. Rosa, Cabuyao, and Calamba.

3.4.1. Demography

3.4.1.1. Population

1593. The populations of the LGUs traversed by SCRP are presented in **Table 3.4.1**.

1594. Generally, the population of all host LGUs had increased from 2010 to 2015. Taguig had the highest (4.3%) growth rate while Manila had the lowest (1.4%). Although Manila had the lowest growth rate, the city remains as the most populated among the host LGUs since 2010. In the same way, Cabuyao remains as the least populated. In terms of population density, Makati is the most densely populated with 27,000 persons per square kilometer while Calamba is the least densely populated with 3,040 persons per square kilometer.

Table 3.4.1 Total Population and Household Population of the Host LGUs

LGU	Land Area (km^2)	Total Population		Growth Rate *	Population Density (person/ km^2)	HH Population	No. of HHs	HH Size
		2010	2015			2015		
Manila	75.97	1,652,171	1,780,148	1.4	22,425	1,763,348	435,154	4.05
Makati	27.36	529,039	582,602	1.9	27,000	579,433	154,095	3.76
Taguig	45.38	644,473	804,915	4.3	17,804	801,143	198,256	4.04
Pasay	18.50	392,869	416,522	1.12	22,515	412,497	107,619	3.83
Parañaque	46.57	588,126	665,822	2.4	14,297	663,733	163,074	4.07
Muntinlupa	46.70	459,941	504,509	1.8	12,692	481,762	122,286	3.94
San Pedro	22.60	294,310	325,809	2.0	13,547	325,252	73,030	4.50
Biñan	43.50	283,396	333,028	3.1	8,270	332,170	86,752	3.12
Sta. Rosa	55.52	284,670	353,767	4.2	6,451	353,592	101,385	3.49
Cabuyao	42.92	282,436	308,745	4.2	7,130	307,998	81,573	3.78
Calamba	144.80	389,377	454,486	3.0	3,040	449,908	123,071	3.66

Notes: *2010-2015; Excluding those situated on relocation sites

Source: 2010 & 2015 Census of Population and Housing, Philippine Statistics Authority

1595. Meanwhile, average household size of PAPs is presented in **Table 3.4.2.** Around 42% or 4,710 households have 3-4 members, about 3,203 or 29% have 1-2 household members, 2,333 or 21% have 5-6 household members, 623 or 6% have 7-8 household members, 180 or 2% have 9-10 household members, and 48 or 0.43% have more than 10 household members. most of those who have more than 10 household members are located in Manila (20) and Calamba (10). There are, however, 17 or 0.15% respondents who did not indicate household size.

Table 3.4.2 Household Size of PAPs

City	1-2	3-4	5-6	7-8	9-10	10<	N/R	Total	Ave
Manila	954	1,744	879	210	61	20	0	3,868	3.8
Makati	63	54	23	8	7	6	0	161	3.1
Taguig	129	164	69	13	2	1	0	378	3.4
Parañaque	11	12	9	5	1	0	0	38	3.8
Muntinlupa	377	557	277	62	22	2	2	1,299	3.7
San Pedro	82	127	67	18	6	1	0	301	3.8
Biñan	742	830	372	111	19	5	2	2,081	3.7
Sta. Rosa	145	177	71	25	6	3	8	435	3.6
Cabuyao	37	47	13	7	2	0	0	106	2.7
Calamba	663	998	553	164	54	10	5	2,447	3.8
Total	3,203	4,710	2,333	623	180	48	17	11,114	3.7
%	29%	42%	21%	6%	2%	0.43%	0.15%	100%	

Source: Resettlement Action Plan (RAP) Socio-Economic Survey (SES) May 2020 version, JICA Design Team

3.4.1.2. Gender and Age Profile

(1) Gender and Age Profile of Host LGUs

1596. Based on the population of the host LGUs as shown in **Table 3.4.3**, there are almost equal number of males and females. In terms of age, at least 68 out of 100 individuals are 15-64 years old and above. 33 out of 100 individuals are dependents; 28 of which are young dependents and 4 are elderly dependents.

Table 3.4.3 Gender and Age Distribution by LGU

LGU	TOTAL	Gender Distribution				Age Group					
		Male		Female		0-14		15-64		65 & above	
		Total	%	Total	%	Total	%	Total	%	Total	%
Manila	1,780,148	876,687	49.2	876,687	50.7	598,272	28.6	1,110,381	67.4	71,495	4.0
Makati	582,602	276,269	47.4	276,269	52.6	132,882	22.8	421,002	72.3	28,718	4.9
Taguig	804,915	403,861	50.2	403,861	49.8	228,744	28.4	554,185	68.9	21,986	2.7
Pasay	416,522	206,982	49.7	209,540	50.3	103,862	24.94	297,303	71.38	15,357	3.68
Parañaque	665,822	325,043	48.8	325,043	51.2	167,349	25.1	471,360	70.8	27,113	4.1
Muntinlupa	504,509	259,116	51.4	259,116	48.6	129,645	36.5	355,507	58.1	19,357	5.4
San Pedro	325,809	161,614	49.6	161,614	50.4	89,705	27.5	221,494	68	14,610	4.5
Biñan	333,028	166,039	49.9	166,039	50.1	92,862	27.9	230,065	69.1	10,101	3.0
Sta. Rosa	353,767	173,912	49.2	173,912	50.8	91,676	25.9	251,555	71.1	10,536	3.0
Cabuyao	308,745	153,748	49.8	153,748	50.2	91,008	29.5	208,983	67.7	8,754	2.8
Calamba	454,486	226,683	49.9	226,683	50.1	129,318	28.5	310,421	68.3	14,747	3.2
Total	6,530,353	3,229,954	49.5	3,232,512	49.5	1,855,323	28.4	4,432,256	67.87	242,839	3.72

Source: 2015 Census of Population and Housing, Philippine Statistics Authority

(2) Gender and Age Distribution of PAPs by LGU

1597. **Table 3.4.4** shows the distribution of gender of household heads among project affected families (PAFs). 130. Out of the 11,114 households, 53% are male-headed households while 47% are female-headed households. This trend is consistent in the cities of Makati, Taguig,

Muntinlupa, San Pedro, Binan, Sta. Rosa, Cabuyao, and Calamba while Manila and Paranaque recorded a higher ratio of female-headed to male-headed households.

1598. In terms of age, majority of the household heads when combined are within the ages of 21-30 (2,858 or 26%) and 31-40 (2,833 or 25%) years old. About 2,206 or 20% belong to the 41-50 years old age bracket and 1,648 15% belong to the 51-60-year-old bracket. A few household heads are 20 years old and below (287 or 3%) while 1,256 or 11% are already above 60 years old (see **Table** 3.4.5). Further, as the alignment in Pasay City is underground, there is no considered PAPs aboveground hence, count for the said city is not possible.

Table 3.4.4 Gender Distribution of Household Heads of PAPs

City/ Municipality	Male		Female		Total	
	No.	%	No.	%	No.	%
Manila	1,253	11	2,615	24	**3,868**	35
Makati	95	1	66	1	**161**	1
Taguig	253	2	125	1	**378**	3
Parañaque	17	0	21	0	**38**	0
Muntinlupa	844	8	455	4	**1,299**	12
San Pedro	191	2	110	1	**301**	3
Biñan	1,357	12	724	7	**2,081**	19
Sta. Rosa	307	3	128	1	**435**	4
Cabuyao	77	1	29	0	**106**	1
Calamba	1,498	13	949	9	**2,447**	22
Total	**5,892**	**53**	**5,222**	**47**	**11,114**	**100**

Source: Resettlement Action Plan (RAP) Socio-Economic Survey (SES) May 2020 version, JICA Design Team

Table 3.4.5 Age Distribution of Household Heads of PAPs

City/Municipality	20 years old and below	21-30 years old	31-40 years old	41-50 years old	51-60 years old	Above 60 years old	NR	Total
Manila	42	882	932	771	664	574	3	**3868**
Makati	0	33	44	32	28	24	0	**161**
Taguig	13	101	104	84	44	32	0	**378**
Parañaque	1	11	13	10	3	0	0	**38**
Muntinlupa	36	319	318	265	222	136	3	**1299**
San Pedro	6	70	88	66	39	31	1	**301**
Biñan	94	685	515	385	247	149	6	**2081**
Sta. Rosa	29	135	98	75	56	37	5	**435**
Cabuyao	1	31	23	20	16	15	0	**106**
Calamba	65	591	698	498	329	258	8	**2447**
Total	**287**	**2,858**	**2,833**	**2,206**	**1,648**	**1,256**	**26**	**11,114**
%	3	26	25	20	15	11	0.23	**100**

Source: Resettlement Action Plan (RAP) Socio-Economic Survey (SES) May 2020 version, JICA Design Team

3.4.1.3. Literacy Rate and Educational Attainment

(1) Literacy Rate and Educational Attainment Profile of LGUs

1599. **Table 3.4.6** presents the basic literacy rate in the host LGUs based on household population 10 years old and over. Basic or simple literacy is the ability of a person to read and

write with understanding a simple message in any language or dialect[1]. In 2015, majority (99.8%) of the household population 10-year old and over of the host LGUs have basic literacy. Basic literacy rate in the host LGUs is generally high but highest (99.9%) in Makati, Muntinlupa and Pasay and lowest (99.7%) in San Pedro, Biñan and Calamba.

Table 3.4.6 Literacy Rates of Household Population 10 Years Old and Over

LGU	Household Population 10 years old and over			Literacy Rate (with respect to the HH Population)					
	Total	Male	Female	Total		Male		Female	
				No.	%	No.	%	No.	%
Manila	1,412,632	684,683	727,949	1,410,170	99.8	683,427	99.8	726,743	99.8
Makati	490,104	228,487	261,617	489,487	99.9	228,160	99.9	261,327	99.9
Taguig	643,476	319,059	324,417	642,107	99.8	318,406	99.8	323,701	99.8
Pasay	341,880	167,841	174,039	341,537	99.9	167,632	99.9	173,905	99.9
Parañaque	549,659	264,948	284,711	548,788	99.8	264,524	99.8	284,264	99.8
Muntinlupa	394,155	191,993	202,162	393,607	99.9	191,706	99.9	201,901	99.9
San Pedro	265,518	130,121	135,397	264,751	99.7	129,687	99.7	135,064	99.8
Biñan	268,607	132,802	135,805	267,753	99.7	132,360	99.7	135,393	99.7
Sta. Rosa	291,396	141,816	149,580	290,956	99.9	141,596	99.8	149,360	99.9
Cabuyao	246,400	121,470	124,930	245,988	99.8	121,269	99.8	124,719	99.8
Calamba	360,163	176,639	183,524	359,093	99.7	176,089	99.7	183,004	99.7
Total	5,263,990	2,559,859	2,704,131	5,254,237	99.8	2,554,856	99.8	2,699,381	99.8

Source: Philippine Statistics Authority (2015)

1600. **Table 3.4.7** presents the highest educational attainment of population five years and above in the host LGUs, indicating that the majority of their population is high school educated (38.5%) followed by elementary educated population (18.4%), except in the cities of Makati, Parañaque and Pasay where there are more academic degree holders than elementary educated population.

Table 3.4.7 Population 5 Years Old and Over by Highest Educational Attainment

Educational Attainment		Manila	Makati	Taguig	Parañaque	Pasay	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
Pre-School	No	34,132	11,117	18,242	13,586	6,023	10,059	6,633	6,985	7,038	7,087	9,815	138,838
	%	2.2	2.1	2.6	2.3	1.6	2.3	2.3	2.4	2.2	2.6	2.5	2.3
Elementary	No	318,354	76,732	140,303	114,806	63,112	87,839	59,607	71,146	64,903	60,462	87,638	1,215,437
	%	20.5	14.6	20.1	19.4	16.6	20.3	20.6	24.2	20.5	22.2	22.0	18.4
High School	No	609,088	169,294	287,659	231,492	147,119	187,285	120,198	132,994	144,375	131,407	190,790	2,472,809
	%	39.2	32.2	41.2	39.0	38.7	43.3	41.5	45.3	45.5	48.2	47.8	38.5
Post-Secondary	No	28,476	16,050	12,530	11,125	8,354	6,986	6,325	3,900	6,824	6,304	6,416	118,208
	%	1.8	3.0	1.8	1.9	2.2	1.6	2.2	1.3	2.2	2.3	1.6	1.8
College Under-graduate	No	274,021	97,148	120,763	87,707	73,165	61,034	41,694	36,727	43,132	34,486	48,566	958,636
	%	17.7	18.5	17.3	14.8	19.2	14.1	14.4	12.5	13.6	12.6	12.2	13.9
Academic Degree Holder	No	288,127	155,913	118,621	134,327	73,628	79,787	55,107	41,782	50,769	32,873	55,781	1,120,935
	%	18.6	29.6	17	22.7	19.4	18.4	19	14.2	16	12.1	14.0	16.7
Total Population 5 yrs <	No	1,552,198	526,254	698,118	593,043	380,484	432,990	289,564	293,534	317,041	272,619	399,006	6,039,987
	%	100	100	100	100	100	100	100	100	100	100	100	100

[1] Simple Literacy, as defined by Philippine Statistics Authority.
https://psa.gov.ph/tags/literacy-education-and-mass-media?page=1

Source: 2015 Census of Population and Housing, Philippine Statistics Authority

(2) Educational Attainment of PAPs

1601. **Table 3.4.8** presents the highest educational attainment of project affected persons (PAPs). Most of the PAPs have graduated from high school (44%). Following are PAPs who have reached elementary level (25%). In terms of tertiary education, the number of PAPs who took up vocational/ technical courses (12%) is slightly higher than those who earned a college degree (11%).

Table 3.4.8 Highest Educational Attainment of PAPs

Gender	Male		Female		Total	
	No.	%	No.	%	No.	%
Preschool	741	2	677	2	**1,418**	4
Elementary	5,166	14	4314	12	**9,480**	25
High School	8,553	23	7,919	21	**16,472**	44
Vocational	2,083	6	2,287	6	**4,370**	12
College Level	870	2	488	1	**1,358**	4
College Graduate	2,177	6	1,949	5	**4,126**	11
Advance Degree	58	0	58	0	**116**	0.31
Total	**19,648**	**53**	**17,692**	**47**	**37,340**	**100**

Source: Resettlement Action Plan (RAP) Socio-Economic Survey (SES) May 2020 version, JICA Design Team

3.4.2. Migration Profile

3.4.2.1. In-Migration

1602. In-migration refers to a form of geographical spatial mobility of people involving a change in usual residence within a country (region, province, city/ municipality) during a specified period of observation for a reason such as economic, social, political and cultural (Siegel and Swanson, 2004 localized to the Philippine setting).

1603. **Table 3.4.9** shows the percentage of population that were born in another LGU. This data represents the migration from another barangay, city/municipality, province, and country. As of 2010 data, Manila has the highest count of in-migration from another city/municipality and from another province. On the other hand, Makati has the highest count from another country.

Table 3.4.9 In-Migration in Host LGUs

HH Population		Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba
2000	Total	1,390,467	417,913	400,438	394,297	324,907	203,092	175,879	162,787	92,492	243,706
	A	1,240,641	358,676	14,901	339,876	289,090	176,456	161,646	134,408	75,935	214,063
	%	89.2	85.8	3.7	86.2	89.0	86.9	91.9	82.6	82.1	87.8
	B	6,657	3,974	14,901	7,441	4,648	1,231	1,609	4,321	4,027	2,691
	%	0.5%	1.0%	3.7%	1.9%	1.4%	0.6%	0.9%	2.7	4.4	1.1
	C	58,296	27,530	28,585	23,803	18,368	17,980	8,915	18,905	9,335	17,231
	%	4.2%	6.6%	7.1%	6.0%	5.7%	8.9%	5.1%	11.6%	10.1%	7.1%
	D	4,932	3,178	846	1,018	1,866	501	255	359	258	330
	%	0.4%	0.8%	0.2%	0.3%	0.6%	0.2%	0.1%	0.2%	0.3%	0.1%

HH Population		Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba
2010	Total	1,480,508	483,104	570,995	530,825	395,776	264,227	253,083	254,154	219,019	344,819
	A	1,409,934	447,129	537,358	509,595	379,326	248,743	228,794	231,603	184,794	327,774
	%	95.2%	92.6%	94.1%	96.0%	95.8%	94.1%	90.4%	91.1%	84.4%	95.1%
	B	9,434	4,534	8,458	5,129	3,001	1,667	3,291	4,755	8,406	3,010
	%	0.6%	0.9%	1.5%	1.0%	0.8%	0.6%	1.3%	1.9%	3.8%	0.9%
	C	58,923	27,477	24,440	15,023	11,892	13,407	20,787	17,358	25,564	13,724
	%	4.0%	5.7%	4.3	2.8	3.0	5.1	8.2	6.8	11.7	4.0
	D	2,005	3,887	737	1,072	1,556	410	210	435	255	307
	%	0.1	0.8	0.1	0.2	0.4	0.2	0.1	0.2	0.1	0.1
Increase 2000-2010	+/-	90,041	65,191	170,557	136,528	70,869	61,135	77,204	91,367	126,527	101,113
	%	6.5	15.6	42.6	34.6	21.8	30.1	43.9	56.1	136.8	41.5

Note: A – Within the same the city/municipality; B – Migrated from another city/municipality; C – Migrated from another province; D – Migrated from another country
Source: 2000 & 2010 Census of Population and Housing, Philippine Statistics Authority

3.4.2.2. Profile of Informal Settler Families (ISFs)

1604. **Table 3.4.10** presents the existing number of informal settler families (ISFs) in host localities indicating further the barangays where they are located and various locational reasons for encroachment. Generally, ISFs pertain to individuals or groups/households who occupy private or public lands (government-owned lands, no-build zones, hazard-prone areas and/or special management areas) without the express consent of the landowner. As presented, all affected localities have existing ISFs. Manila has the highest number of ISFs while Cabuyao has the lowest.

Table 3.4.10 Informal Settler Families Profile

LGU	Barangay	Name of Barangays	No. of ISFs	Year	Reason
Manila	254	Not indicated	99,730	1999	ISFs are located near garbage dumpsites, beside railroad tracks, along river creeks and coastlines, under bridges, and beside market places and slaughter houses
Makati	7	Cembo, Comembo, Northside, Pitogo, Pinagkaisahan, South Cembo, West Cembo	1,626	2017	ISFs in government lots (830 are in danger areas)
	5	Guadalupe Nuevo, Guadalupe Viejo, Pinagkaisahan, Rizal, West Rembo	2,311	2017	ISFs in private lots (11 are in danger areas)
Taguig	16	Bagumbayan, Bambang, Hagonoy, Ibayo-Tipas, Lower Bicutan, Napindan, New Lower Bicutan, Tuktukan, Ususan, Fort Bonifacio, North Daang Hari, Pinagsama, South Daang Hari, Tanyag, Upper Bicutan, Western Bicutan	No. of informal settlers: 27,988 Estimated no. of ISFs (based on HH size): 6,997	2013	ISFs in private/ public lands

LGU	Barangay	Name of Barangays	No. of ISFs	Year	Reason
	21	Bagumbayan, Bambang, Calzada, Hagonoy, Ibayo-Tipas, Ligid-Tipas, Lower Bicutan, Napindan, New Lower Bicutan, Palingon, Sta. Ana, Tuktukan, Ususan, Wawa, Central Signal, Fort Bonifacio, Maharlika Village, North Signal Village, Pinagsama, South Daang Hari, Upper Bicutan	No. of informal settlers: 3,672 Estimated no. of ISFs (based on HH size): 918	2013	ISFs near/along waterways
Pasay	Not indicated	South Sectors	34,450	2011	
Parañaque	6	San Isidro, Don Bosco, Don Galo, Sto. Niño, La Huerta, San Dionisio	738	2015	ISFs in government lands
	13	San Isidro, San Antonio, BF Homes, Marcelo Green, Sun Valley, Merville, Moonwalk, San Martin de Porres, Don Bosco, Tambo, Don Galo, Sto. Niño, San Dionisio	17,158	2015	ISFs in private lands
	14	San Isidro, San Antonio, BF Homes, Marcelo Green, Sun Valley, Merville, Moonwalk, Don Bosco, Baclaran, Tambo, Don Galo, Sto. Niño, La Huerta, San Dionisio	6,565	2015	ISFs near/along waterways
Muntinlupa	6	Sucat, Buli, Cupang, Alabang, Putatan, Poblacion	4,180	2013	ISFs in government lands
	7	Sucat, Cupang, Alabang, Bayanan, Putatan, Poblacion, Tunasan	16,653	2013	ISFs in private lands
	8	Sucat, Buli, Cupang, Alabang, Bayanan, Putatan, Poblacion, Tunasan	13,265	2013	ISFs in danger zones
San Pedro	6	GSIS, Langgam, Sampaguita, San Antonio, San Roque, San Vicente	1,699	2015	ISFs in government lots (including open spaces and NAPOCOR-owned)
	11	Cuyab, GSIS, Landayan, Langgam, Laram, Magsaysay, Nueva, Sampaguita, San Antonio, San Vicente, UBL	5,733	2015	ISFs in private lands (including sequestered and private)
	19	Bagong Silang, Calendola, Cuyab, Estrella, GSIS, Landayan, Langgam, Laram, Magsaysay, Narra, Nueva, Riverside, Sampaguita, San Antonio, San Roque, Sto. Niño, San Vicente, United Bayanihan, UBL	4,877	2015	ISFs in danger areas (creek, seashore, lakeshore, railways, road lot, under the bridge)
Biñan	14	Sto. Niño, Bungahan, De La Paz, Tubigan, Soro-Soro, Malaban, Sto. Tomas, Casile, Loma, Mamplasan, San Vicente, Sto. Domingo, Timbao, Ganado	2,228	2016	ISFs in public/private lands and danger zones (along creeks, railway and under high tension wires)
Sta. Rosa	15	Aplaya, Balibago, Caingin, Dila, Dita, Ibaba, Labas, Macabling, Malitlit, Market Area, Pooc, Pulong Santa Cruz, Sinalhan, Sto. Domingo, Tagapo	4,345	2006-2013	ISFs came from different provinces; Near work place and cannot afford to

LGU	Barangay	Name of Barangays	No. of ISFs	Year	Reason
					purchase or rent formal housing
Cabuyao	14	Dos, Tres, Baclaran, Banaybanay, Banlic, Diezmo, Niugan, Baybay Ilat, Salang Langka, Niugan, Riverside, Latian, San Isidro, Marinig	723	2015	living in danger areas and who are basically incapable of addressing their housing needs independently.
Calamba	Not indicated	Not indicated	10,400	1999	residing in danger zones as well as the expected in-migrating families of workers in industrial firms

Source: City Planning and Development Offices, Urban Poor Affairs Offices

(1) Project Affected ISFs

1605. Given that the project utilizes the existing PNR ROW, **Table 3.4.11** indicates that majority of the PAFs identified are ISFs (10,406) who encroached the existing ROW with a few legal PAFs (708) due to additional land acquisition required for the project.

Table 3.4.11 Number of Project Affected Structures and Households

City/ Municipality	Affected Occupied Structures		Project Affected Households		
	No.	%	Formal Settler Families/ Households	Informal Settler Families/Households	Total
Manila	**1,580**	20	346	3522	**3,868**
Makati	**48**	1	22	139	**161**
Taguig	**157**	2	17	361	**378**
Parañaque	**30**	0.37	0	38	**38**
Muntinlupa	**665**	8	132	1167	**1,299**
San Pedro	**192**	2	24	277	**301**
Biñan	**1,584**	20	37	2044	**2,081**
Sta. Rosa	**314**	4	11	424	**435**
Cabuyao	**88**	1	5	101	**106**
Calamba	3,388	42	114	2333	**2,447**
Total	**8,046**	**100**	**708**	**10,406**	**11,114**

Source: Resettlement Action Plan (RAP) Socio-Economic Survey (SES) May 2020 version, JICA Design Team, JICA Design Team

(2) Project Affected Vulnerable

1606. Among the PAFs, there are members of the households who are below the poverty line, and who may be elderly, persons with disabilities and/or needing special assistance, and solo parents. The SES also noted PAPs who may be vulnerable or who may require additional compensation and/or other forms of assistance, as indicated in **Table 3.4.12.**

1607. Among the vulnerable groups, majority were dependents – either as babies or toddlers (67%) or elderly (22%). There were also some PAPs who were pregnant (4%), had mental disorders (1%), were seriously ill (1%), blind (1%) or mute or deaf (1%).

Table 3.4.12 Vulnerability of PAPs

Vulnerabilities	Total	
	No.	%
Baby/Toddler	4,057	67
Pregnant	226	4
Elderly	1,362	22
Mental Disorder	61	1
Needs Assistance in Walking/ Cannot Walk	115	2
Seriously Ill	51	1
Blind	37	1
Mute/Deaf	44	1
Other illness / disability	110	2
Total (Individual)	4,701	100
Elderly Headed Household	1,256	28
Solo Parent (Separated + Widow/er)	1,489	33
HH Below Poverty Threshold	1,347	30
HH with PWD	418	9
Total (Household)	4,510	100

Source: Resettlement Action Plan (RAP) Socio-Economic Survey (SES) May 2020 version, JICA Design Team

3.4.2.3. Housing Programs and Availability

1608. The existing housing programs identified by each host LGU are presented in **Table 3.4.13**. The list includes resettlement projects and housing financing programs of national government agencies (NGAs) and non-government organizations (NGOs) that may be accessed by LGUs as potential sources of funds for shelter provision. The common components of housing programs include purchase of land, site development, upgrading of sites and facilities as well as housing construction.

Table 3.4.13 Existing Housing Programs in Host LGUs

LGU	Resettlement Site		No. of Housing Units	Administration	Other Housing Programs
	Name/Location	Area (Ha.)			
Manila	Paradise Heights, SMDRP, Tondo, Manila	N/A	970 (Medium Rise)	NHA, LGU	Land for the Landlesss and Housing Program
Makati	N/A	N/A	N/A	N/A	Dreamland Ville, Bulacan
					Makati Home Ville, Laguna
Taguig	Bagong Lipunan Condominium	5.50	253	NHA, LGU	Socialized Housing Areas: • Calzada, Napindan, Ibayo Tipas, Ligid Tipas, Bagong Tanyag, Western Bicutan, Signal Village and Palingon
	Philippine Centennial Village, Brgy. Western Bicutan	7.8	N/A	NHA, LGU	
Parañaque	Bagong Paranaque Homes I	N/A	N/A	NHA, LGU	Other NGO-Assisted Projects: • Gawad Kalinga: Maralit, Marva et.al, Monsod, Aspillera, Maxima Valenzuala, Cruz, Elizabeth Cheng, Locsin, & Gamboa Properties • Habitat for Humanity: Sagarada Familia, Sitio Fatima Project, Foremost Golf Inc., Santos Property
	Paranaque Homes II/ Bagong Paranaque Homes II	1.72	N/A	NHA, LGU	
	V.C. Ponce Property (Sampaguita Hills HOA), Brgy. Marcelo Green	1.83	N/A	NHA, LGU	
	Bagong Buhay Neighborhood, Sitio Libjo, Barangay San Dionisio	0.31	N/A	NHA, LGU	
	Perpetual Help Neighborhood, Sitio Libjo, Barangay San Dionisio	0.38	N/A	NHA, LGU	

LGU	Resettlement Site		No. of Housing Units	Administration	Other Housing Programs
	Name/Location	Area (Ha.)			
	Paradise Neighborhood, Barangay San Isidro	0.30	N/A	NHA, LGU	
	Carmelita Navarro Property, Fourth Estate, Barangay San Antonio	N/A	N/A	NHA, LGU	
	GK European Village	N/A	N/A	NHA, LGU, Gawad Kalinga	
Muntinlupa	South Green Heights, Putatan	0.2	40	NHA, LGU	Community Mortgage Program (CMP) Slum Upgrading / LGU: • Bagong Umaga sa 7B HOAI • Pasong Makipot Home-owners Association
	St. Catherine Laboure (Near PNR), Bruger St., Putatan	0.6929	150	NHA, LGU	
	Harmony Ville, Purok 3, Aplaya Cupang	1.6112	200 Row House 2013-2014	NHA, LGU	Direct Purchase Projects for Slum Upgrading / LGU: • Samahang Magkakapit-bahay ng Munting Nayon • Diamond Hills Neighborhood Association • Dreamhome Ville HOAI • Muntinlupa Habitat Ville HOAI • Espeleta Pantalan (Cristy Cacao) • Samahang Magkakapit-bahay ng Estehonor • Quezon Aplaya
	Southville 3	N/A	N/A	NHA, LGU	
San Pedro	Brgy. San Antonio	N/A	2,574	NHA, LGU	-
	Brgy. San Vicente	N/A	137	LGU, Gawad Kalinga, Alaska Milk Corporation	
Biñan	Southville Resettlement Site	14	N/A	NHA, LGU	-
	Biñan Socialized Housing and Resettlement Program (not yet constructed)	-	-	-	-
Sta. Rosa	Southville Subdivision	N/A	6,173	NHA, LGU	-
	Brgy. Caingin	N/A	2,178	NHA, LGU	
	Brgy. Pooc	N/A	5,335	NHA, LGU	
	Brgy. Pulong Santa Cruz	N/A	1,010	NHA, LGU	
Cabuyao	Southville Subdivision	55	N/A	NHA, LGU	-
	Brgy. Niugan	N/A	N/A	NHA, LGU	
	Brgy. Marinig	N/A	N/A	NHA, LGU	
	Brgy. Banaybanay	N/A	N/A	NHA, LGU	
Calamba	Southville VI Housing, Brgy. Kay Anlog		1,000	NHA, LGU	Bagong Buhay Resettlement Program

Source: City/ Municipal Planning and Development Offices, Collected data on January 2019

3.4.3. Indigenous Peoples

1609. There are no indigenous peoples living within the project area. Most of the impact areas are fully industrialized. In NCR, no community of Indigenous peoples (IPs) is present. Based on NCIP Census in year 2000, IPs called the Dumagat-Remontado Tribe in the Laguna de Bay Region are present only in the Province of Rizal.[2] The Rizal Province is on the Northern and Eastern shores of Laguna Lake (Laguna de Bay), the Project will traverse along the Western and Southern shores of the Laguna Lake.

[2] *Indigenous People (IP) Plan for the PhilWAVES Project in the Laguna de Bay Region.* Laguna Lake Development Authority (LLDA). URL: http://www.llda.gov.ph/dox/philwaves/ip-plan.pdf

3.4.4. Historical and Cultural Heritage

3.4.4.1. Historic Sites and Structures Declared by NHCP

1610. The National Historical Commission of the Philippines (NHCP) declares historic sites and structures in the country based on their demonstrable historical significance, age (at least 50 years old), and authenticity (70.0 %) in accordance with NHCP Guideline on the Identification, Classification, and Recognition of Historic Sites and Structures in the Philippines (2011) under the National Cultural Heritage Act of 2009 or RA 10066 (2009).

1611. **Table 3.4.14** indicates the NHCP-declared historic sites and structures in close proximity to the project and construction access roads. **Table 3.4.15** presents additional structures listed in the Philippine Registry of Cultural Property.

Table 3.4.14 Historic Sites and Structures Declared by NHCP

No.	Heritage	Location	Distance to Alignment (km)	Distance to Access Road (km)
1	Manuel Acuna Roxas	Paco, Manila, NCR	0.30	0.02
2	Kataastaasan Kagalanggalang na Katipunan ng mga Anak ng Bayan Asociacion de Damas de Filipinas, Inc., Settlement House	Paco, Manila, NCR	0.20	0.01
3	Philippine Columbian Association	Paco, Manila, NCR	0.20	0.01
4	Lord Justo Ukon Takayama Monument	Plaza Dilao, Paco, Manila, NCR	0.08	0.02
5	PNR Paco Station	Paco, Manila, NCR	0.00	0.01
6	Concordia College	Paco, Manila, NCR	0.10	0.08
7	Rizal Monument	Calamba, Laguna	0.05	0.08

Source: NHCP

Table 3.4.15 Additional Structure Listed in the Philippine Registry of Cultural Property

No.	Heritage	Location	Distance to Alignment (m)	Distance to Access Road (m)
1	Paaralang Legarda	Lealtad Street, Sampaloc, Manila	103	0
2	Maria Paz Mendoza-Guazon (1884-1967) Marker	Metro Manila	48	14
3	Yulo Townhomes	Don Bosco Street, Makati City, Metro Manila	0	0
4	Galleria de Magallanes Townhomes	Makati City, Metro Manila	52	20
5	Chapel of St. Alphonsus Liguori	Magallanes Village, Makati City, Metro Manila	56	20
6	Garden of the Risen Christ	Humabon Place, Magallanes Village, Makati City, Metro Manila	82	45
7	National Nutrition Center of the Philippines	Chino Roces Avenue Extension, Taguig City, Metro Manila	118 (main railway) 26 (vertical, (underground section)	32
8	Philippine Center for Population Development	Chino Roces Avenue Extension, Taguig City, Metro Manila	11	110
9	Asian Center for Training and Research for Social Welfare	Osmeña Highway, Makati City, Metro Manila	3	49

No.	Heritage	Location	Distance to Alignment (m)	Distance to Access Road (m)
10	Our Lady of Miraculous Medal Shrine	Muntinlupa City	170	0
11	Our Lady of the Abandoned Church	Muntinlupa City	150	0
12	Ang Magpipinipig Monument	Biñan City	20	0
13	Sarmiento Ancestral House	Santa Rosa City	77	0

Source: https://ncca.gov.ph/philippine-registry-cultural-property-precup/

1612. Correspondingly, the location of the underground interconnecting line (Senate-FTI-Bicutan segment) identifies the National Nutrition Council (NNC) of the Philippines as in its immediate impact area, which was raised as a concern during the consultation conducted on 4 March 2020 between AECOM and National Museum Representatives. National Museum's Director General, Mr. Jeremy R. Barns suggested that further consultations be conducted with the concerned entities such as but not limited to the Department of Education (DepEd, the property owner), National Commission for Culture and the Arts (NCCA) and National Museum as part of the project's compliance prior the development in the area to ensure that the NNC is spared from the impact of the project. The proceeding of the said meeting is attached as **Annex 3-6.**

1613. Table 3.4.16**Table 3.4.16** shows the old PNR stations and railway bridges within the project area that are existing for over 50 years for purposes of identifying structures of historical significance that require preservation. Relative thereto, DOTr had conducted series of meetings with cultural agencies (National Commission for Culture and the Arts (NCCA), NHCP and National Museum (NM)), otherwise known as Tripartite Technical Working Council (TWC) on Built Heritage Issues and Concerns, and PNR to consult them on qualifying appropriate protection measures for the identified old PNR structures during construction; hence, the Matrix of Existing PNR Structures of Historical Importance was created. As of July 2019, DOTr has submitted to PNR the revised proposal for their approval of each proposed action for every structure and for their decision on what preservation measures to be done for each structure. Once a decision is made by PNR, the approved matrix is to be turned over to cultural agencies for further action.

Table 3.4.16 Old PNR Stations and Bridges within the Project Area

No.	Item	Location (approximate)	Current condition and use	Historical Age
1	Solis Signal Tower (Casitas)	Solis St., Manila City, NCR (14°37'34.39"N 120°58'31.85"E)	Part of the PNR Solis Station Rail skates and rickshaws run along the line PNR still uses this line to travel to the Caloocan depot NSCR Preservation Plan recommends the relocation of the structure within the vicinity A caretaker resides on a temporary shelter beside the structure	1891 127 years
2	Abad Santos Signal Tower (Casitas)	Abad Santos corner Old Antipolo St., Manila City, NCR	First structural restoration project of the Railways and Industrial Heritage Society of the	1916 102 years

No.	Item	Location (approximate)	Current condition and use	Historical Age
		(14°37'23.25"N 120°58'40.63"E)	Philippines, Inc. which began in 2010 The heritage structure was rehabilitated but was not maintained	
3	No Bridge Name	Alegeciras St. cor. Antipolo St., Blumentritt, Manila, NCR (14°36'52.95"N 120°59'40.23"E)	Two bridges in this location I-beam bridge structure for deconstruction and retrieval if affected	1913 105 years
4	No Bridge Name	Sampaloc, Arevalo St. Manila, NCR (14°36'19.29"N 121°0'12.56"E)	Two bridges in this location I-beam bridge structure for deconstruction and retrieval if affected	1913 105 years
5	Pandacan Bridge	Pasig River, Pandacan, Boundary of Sta. Mesa and Pandacan, Manila City, NCR (14°35'39.86"N 121°0'43.96"E)	Traverses the Pasig River, beside the Paco-Sta. Mesa Bridge Two bridges in this location	1938 80 years
6	Beata Bridge	Estero de Pandacan – Beata St., Manila City, NCR (14°35'27.33"N 121°0'33.54"E)	Two bridges in this location I-beam bridge structure for deconstruction and retrieval if affected	1913 105 years
7	Kahilum Bridge	Balagtas – Beata St., Along Francisco Balagtas St. Manila City, NCR (14°35'8.58"N 121° 0'17.46"E)	Two bridges in this location RC Slab and I-beam bridge structure for deconstruction and retrieval if affected	1913 105 years
8	Concordia Bridge	Estero de Pandacan – Quirino, Along Quirino Avenue, Manila City, NCR (14°34'56.44"N 121° 0'7.18"E)	Two bridges in this location I-beam bridge structure for deconstruction and retrieval if affected	1913 105 years
9	Paco Station	Quirino Avenue, Paco, Manila City, NCR (14°34'48.70"N 120°59'59.80"E)	As of September 2017, plans were made to revive the structure, by the Railways and Industrial Heritage Society Currently designated as a significant cultural property	September 5, 1913 105 years

No.	Item	Location (approximate)	Current condition and use	Historical Age
10	Paco Bridge	Estero de Paco, Quirino Avenue, Paco, Manila City, NCR (14°34'33.48"N 120°59'53.13"E)	Two bridges in this location RC Slab bridge structure for deconstruction and retrieval if affected	1913 105 years
11	Paco Creek Bridge	Estero de Pandacan – Perlita, Along Perlita St., Manila City, NCR (14°34'26.09"N 120°59'56.78"E)	Two bridges in this location I beam and RC Slab bridge structure for deconstruction and retrieval if affected	1913 105 years
12	Vito Cruz Station	Barangay 759, Manila City, NCR (14°34'00.21"N 121°00'11.18"E)	Used as PNR office	1931 87 years
13	Buendia Station	Dela Rosa St. corner Osmeña Highway, Makati City, NCR (14°33'27.48"N 121°0'28.02"E)	In 2009, the platforms were raised, and the station area was renovated In 2017, the station was closed due to short platforms	1931 87 years
14	No Bridge Name	Tripa de Galiena Creek, Pasay, Manila City, NCR (14°32'41.96"N 121° 0'53.05"E)	Two bridges in this location RC Slab bridge structure for deconstruction and retrieval if affected	1948 70 years
15	No Bridge Name	Villamor Air Base, Magallanes, Manila City, NCR (14°31'50.55"N 121°1'20.69"E)	Two bridges in this location I-beam and RC slab bridge structure for deconstruction and retrieval if affected	1948 70 years
16	No Bridge Name	Fort Bonifacio, PSCA College, Manila City, NCR (14°31'40.91"N 121° 1'25.86"E)	Two bridges in this location RC Slab bridge structure for deconstruction and retrieval if affected	1948 70 years
*	Villar Bridge	Ilang-Ilang street, Parañaque City, NCR (14°27'53.93"N 121° 3'8.55"E)	OWST bridge structure	1948 70 years

No.	Item	Location (approximate)	Current condition and use	Historical Age
*	No Bridge Name	Parañaque City, NCR (14°27'30.04"N 121°3'5.87"E)	RC slab bridge structure for deconstruction and retrieval if affected Culvert Bridge covered in thick vegetation	1948 70 years
17	Conception Bridge	Sucat River, Parañaque City, NCR (14°26'46.75"N 121° 3'0.75"E)	I-beam bridge structure for deconstruction and retrieval if affected	1948 70 years
18	Buli Bridge	Barangay Buli at Muntinlupa Business School, Muntinlupa City, NCR (14°26'27.02"N 121° 2'58.48"E)	I-beam bridge structure for deconstruction and retrieval if affected	1948 70 years
19	Cupang Bridge	Vinalon St., Muntinlupa City, NCR (14°25'52.01"N 121° 2'54.44"E)	I-beam bridge structure for deconstruction and retrieval if affected	1948 70 years
20	Alabang Bridge	Alabang-Mangangate River, Muntinlupa City, NCR (14°25'36.37"N 121° 2'52.69"E)	OWST (UCRB) bridge structure for deconstruction and retrieval if affected	1948 70 years
21	Alabang Station (with restroom structure)	Alabang, Muntinlupa City, NCR (14°25'10.41"N 121° 2'52.02"E)	Old PNR Alabang station is currently being used as a PNR storage area, PNR barracks and office of the foreman.	August 26, 1959 59 years
22	Banayan Bridge	Bayanan Creek, Muntinlupa City, NCR (14°24'39.65"N 121° 2'51.55"E)	DPG bridge structure for deconstruction and retrieval if affected	1948 70 years
23	Bucal Bridge	Poblacion River, Muntinlupa City, NCR (14°23'28.89"N 121° 2'51.38"E)	DPG bridge structure for deconstruction and retrieval if affected	1948 70 years
24	Prinza Bridge	Magdaong River, Muntinlupa City, NCR	DPG bridge structure for deconstruction and retrieval if affected	1948 70 years

No.	Item	Location (approximate)	Current condition and use	Historical Age
		(14°23'18.39"N 121° 2'51.33"E)		
25	Tunasa Culvert	Tunasa, RMT Crossing, Tunasan River, Muntinlupa City, NCR (14°22'26.32"N 121°2'54.74"E)	I-beam bridge structure for deconstruction and retrieval if affected	1948 70 years
26	Pacwood Bridge	Tunasan River, Muntinlupa City, NCR (14°22'10.22"N 121° 3'3.82"E)	HTPG bridge structure for deconstruction and retrieval if affected	1948 70 years Re-girdering of bridge (2012)
27	San Pedro Bridge	San Isidro River, San Pedro, Laguna (14°21'50.71"N 121° 3'14.43"E)	PNR held excavation works for Bored Pile in anticipation of an additional track of railway Bailey bridge identified URCB bridge structure for deconstruction and retrieval if affected	1940's 78 years Re-girdering of bridge (2012) Widening of bridge (2016)
28	San Pedro Station	San Pedro, Laguna (14°21'35.91"N 121° 3'22.15"E)	Structure was made during the Marcos administration (1965-1986)	1965-1986 53 years
29	PNR Office, San Pedro	San Pedro, Laguna (14°21'36.23"N 121° 3'22.96"E)	Structure was made during the Marcos administration (1965-1986) Structure was used as a PNR office according to PNR representatives and locals	1965-1986 53 years
*	El Vinda Bridge	El Vinda Crossing, San Pedro, Laguna (14°21'25.30"N 121° 3'28.52"E)	Old wooden bridge structure with heavily corroded steel components I beam bridge structure for deconstruction and retrieval if affected	1948 70 years
30	SPACBA Bridge	Begonia St., San Pedro, Laguna (14°21'19.40"N 121° 3'31.77"E)	I-beam bridge structure for deconstruction and retrieval if affected	1948 70 years
*	Pacita Complex 2 Bridge	San Pedro, Laguna (14°20'42.32"N 121°03'56.32"E)	Not indicated in PNR MLS list but indicated in PNR network diagram	1948 70 years

No.	Item	Location (approximate)	Current condition and use	Historical Age
			I-beam bridge structure for deconstruction and retrieval if affected	
31	Pacita Station	San Pedro, Laguna (14°20'48.07"N 121° 3'50.10"E)	ISFs were living in the structure, a fence and the boarding of windows were put in place by PNR to deter ISFs	May 27, 1949 69 years
*	Pacita Signal Outpost	San Pedro, Laguna (14°20'47.72"N 121° 3'50.39"E)	Existing signal outpost as well as the linear park beside were made during the Arroyo administration (2001-2010)	2001-2010
32	Canlalan 1 Bridge	Barangay Nueva, San Pedro, Laguna (14°20'41.57"N 121° 3'57.08"E)	I-beam bridge structure for deconstruction and retrieval if affected	1948 70 years
*	Halang 1 Bridge	Almazora St., San Pedro, Laguna (14°20'33.96"N 121°04'5.73"E)	I - beam bridge structure for deconstruction and retrieval if affected	1948 70 years
*	No Bridge Name	After Halang Road, Biñan, Laguna (14°20'20.46"N 121°04'21.12"E)	RC slab bridge structure for deconstruction and retrieval if affected	1948 70 years
33	Biñan Station	Biñan, Laguna (14°19'52.26"N 121° 4'53.51"E)	Currently used as PNR staff house and storage (since 2014) 11 PNR staff (care takers) stay in the structure	October 29, 1948 70 years
34	Biñan Bridge	Biñan, Laguna (14°19'49.82"N 121° 4'55.93"E)	Utilized by the locals as foot bridge	1948, 70 years Renovated 1990
35	Puntod Bridge	Florenceville Subdivision, Sta. Rosa, Laguna (14°19'0.06"N 121° 5'52.37"E)	I-beam bridge structure for deconstruction and retrieval if affected	1949 69 years
36	Tagapo Bridge	SM Sta. Rosa, Laguna (14°18'48.86"N 121° 6'5.11"E)	BU bridge structure for deconstruction and retrieval if affected	1949, 69 years Re-girdering of bridge (not yet started)

No.	Item	Location (approximate)	Current condition and use	Historical Age
37	Putol Bridge	Silang – Santa Rosa River, Sta. Rosa, Laguna (14°18'38.69"N 121° 6'16.50"E)	HTPG bridge structure for deconstruction and retrieval if affected	1949 69 years
38	Bayan Bridge	North Pearl Drive, Sta. Rosa, Laguna (14°18'36.28"N 121° 6'19.31"E)	I-beam bridge structure for deconstruction and retrieval if affected	1949 69 years
39	No Name Bridge	Orient Drive, Sta. Rosa, Laguna (14°18'34.04"N 121° 6'21.82"E)	I-beam bridge structure for deconstruction and retrieval if affected	1949 69 years
40	Ilayang Bulo Bridge	Barangay Dila / Pooc, Sta. Rosa, Laguna (14°18'18.36"N 121° 6'39.66"E)	I-beam bridge structure for deconstruction and retrieval if affected	1949 69 years
41	Pook Bridge	Captain Perlas St., Sta. Rosa, Laguna (14°18'3.53"N 121° 6'56.54"E)	DPG bridge structure for deconstruction and retrieval if affected	1949, 69 years Re-girdering of bridge (not yet started)
42	No Name Bridge	South Ville IV, Sta. Rosa, Laguna (14°17'51.03"N 121° 7'8.83"E)	I-beam bridge structure for deconstruction and retrieval if affected	1949 69 years
43	Bamban Mayor Bridge	NIA Road, Sta. Rosa, Laguna (14°17'48.84"N 121° 7'9.77"E)	I-beam bridge structure for deconstruction and retrieval if affected	1949 69 years
44	Kamada Bridge	Golden City, Sta. Rosa, Laguna (14°17'40.17"N 121° 7'13.35"E)	I-beam bridge structure for deconstruction and retrieval if affected	1949 69 years
45	Mayora Bridge	Barangay Dila, Sta. Rosa, Laguna (14°17'18.21"N 121° 7'22.31"E)	I-beam bridge structure for deconstruction and retrieval if affected	1949 69 years
46	No Name Bridge	Apple St., Sta. Rosa, Laguna	I-beam bridge structure for deconstruction and retrieval if affected	1949, 69 years

No.	Item	Location (approximate)	Current condition and use	Historical Age
		(14°17'10.66"N 121° 7'25.34"E)		Re-girdering of bridge (not yet started
47	Cabuyao Bridge	Barangay Uno (Poblacion), Cabuyao, Laguna (14°17'0.87"N 121° 7'29.37"E)	Links Sta. Rosa Station with Cabuyao Station Crosses Cabuyao River RCC bridge structure for deconstruction and retrieval if affected	1949 69 years
*	Bigaa Rd. Culvert	Cabuyao, Laguna (14°16'53.04"N 121° 7'32.53"E)	Road drainage passes underneath the PNR railroad Not indicated in PNR list and PNR Network diagram	1949 69 years
48	Cabuyao Station	Cabuyao, Laguna (14°16'46.00"N 121° 7'35.06"E)	Structure is dilapidated and abandoned	May 27, 1949 69 years
49	Southville Bridge	Maring Creek, Cabuyao, Laguna (14°16'40.22"N 121° 7'37.74"E)	I-beam bridge structure for deconstruction and retrieval if affected	1949, 69 years
*	NHA Bridge	Cabuyao, Laguna (14°16'20.64"N 121°7'45.70"E)	I-beam bridge structure for deconstruction and retrieval if affected	1940's
50	No Name Bridge	Cabuyao, Laguna (14°16'20.65"N 121° 7'45.74"E)	I-beam bridge structure for deconstruction and retrieval if affected	1940's
51	No Name Bridge	Tarican Road, Cabuyao, Laguna (14°16'4.45"N, 121° 7'52.31"E)	I-beam bridge structure for deconstruction and retrieval if affected	1940's
52	No Name Bridge	Cabuyao River tributary, Laguna (14°15'57.27"N 121° 7'55.23"E)	Links Cabuyao Station with Mamatid Station, both located in Cabuyao Traverses Cabuyao River, also known as Salang Langka Bridge I-beam bridge structure for deconstruction and retrieval if affected	1949 69 years

No.	Item	Location (approximate)	Current condition and use	Historical Age
53	Sala-Langka Bridge	Cabuyao, Laguna (14°15'46.56"N 121° 7'59.58"E)	I-beam bridge structure for deconstruction and retrieval if affected	1940's
54	No Name Bridge	Burmingham Village Rd., Cabuyao, Laguna (14°14'48.55"N 121° 8'23.27"E)	I-beam bridge structure for deconstruction and retrieval if affected	1940's
55	Mamatid Station	Mamatid, Cabuyao, Laguna (14°13'58.90"N 121° 8'43.80"E)	Used as PNR staff house	August 13, 1942 76 years
56	Mamatid Bridge	Cabuyao, Laguna (14°13'50.14"N 121° 8'46.97"E)	I-beam bridge structure for deconstruction and retrieval if affected	1940's
57	San Cristobal Bridge	San Cristobal, Calamba, Laguna (14°13'11.70"N 121° 9'4.18"E)	Extends the PNR line up to Calamba Station in Laguna Traverses San Cristobal River 2 OWST/1 I-beam bridge structure for deconstruction and retrieval if affected	1940-1950 78 years Renovated 2001-2010 8 years
58	San Juan River Bridge	Calamba, Laguna (14°12'32.17"N 121° 9'24.83"E)	2 OWST/1 DPG bridge structure for deconstruction and retrieval if affected	1940-1950 78 years
59	Calamba Signal Outpost	Calamba, Laguna (14°12'28.05"N 121° 9'26.81"E)	To determine with PNR Engineering	Arroyo Administration approx. (2013) according to interviews
60	Calamba Dormitory House (Train conductor)	Calamba, Laguna (14°12'25.55"N 121° 9'27.38"E)	Currently in use as a dormitory by PNR staff	January 24, 1909 109 years
61	Calamba Dormitory House (Train driver)	Calamba, Laguna (14°12'25.04"N 121° 9'27.66"E)	Currently in use as a dormitory by PNR staff	January 24, 1909 109 years
62	Calamba Station Shed and Yard	Calamba, Laguna (14°12'21.81"N 121° 9'29.48"E)	PNR reps. mentioned the shed was destroyed during World War 2	January 24, 1909 109 years

No.	Item	Location (approximate)	Current condition and use	Historical Age
			Repaired by LGU according to interviews with locals (1990)	Renovated 2013
*	Pansol Station	Calamba, Laguna (14°10'43.48"N 121°10'59.58"E)	Currently used by ISF as a bakery, Collette's Buko Pie bakery 10 people reside in the structure	May 23, 1950 68 years
*	Pansol Bridge Structure	Calamba, Laguna (14°10'40.17"N 121°11'6.48"E)	Recently renovated Used as walkway by locals	1950 68 years Renovated 2016

Note: * To be verified with PNR Corporate and Resource Planning if item can be removed from matrix

Source: JICA Design Team

3.4.4.2. Potential Presence of Unexploded Ordinances

1614. As Metro Manila was historically affected by the World War II, there is a possibility that some unexploded ordnances (UXOs) are still buried and scattered within the area of influence of the tunneling works. Based on the interviews with the National Museum, Philippine National Police (PNP) and UXO Specialist (see **Annex 3-6 and 3-7** for the minutes of the meeting) there has been no nationwide or even Metro Manila-wide assessment/scanning to identify possible locations of UXOs. Available information is based on the report of developers who encountered UXOs during their construction activities.

1615. The PNP, which is the armed, civilian national police force in the Philippines and is the main entity responsible for the UXO-related safety of civilian, said that due to lack of capacity to conduct a region-wide assessment of UXOs, they are dependent on the information that civilians report to them.

1616. The depth of the buried UXOs will depend on the type of soil and type of ordnances used. Based on the experience of the PNP, the deepest UXO that they recovered was from 2 to 3 meters. Meanwhile, the weight of these UXOs range from 100 pounds to 2,000 pounds. Further, from November 2019 to February 2020, the total number of recovered and reported UXOs from to their office was 179 of which, 148 are from the Southern Police District where the Senate-FTI-Bicutan underground segment will be situated. **Table 3.4.17** shows the summary of the recovered UXOs in Metro Manila.

Table 3.4.17 Summary of Recovered UXOs in Metro Manila (Nov-19 to Feb-20)

NCR POLICE OFFICE DISTRICTS	MONTH				TOTAL
	NOV '19	DEC '19	JAN '20	FEB '20	
Northern Police District *(Caloocan, Malabon, Navotas, Valenzuela)*	-	-	-	1	**1**
Eastern Police District *(Marikina, Pasig, Mandaluyong, San Juan)*	1	-	-	1	**2**
Manila Police District	1	1	2	10	**14**
Southern Police District *(Pasay, Makati, Parañaque, Las Piñas, Muntinlupa, Taguig, Pateros)*	2	-	11	135	**148**
Quezon City Police District	1	-	1	12	**14**
TOTAL	**5**	**1**	**14**	**159**	**179**

Note: Available data from PNP is limited to what is presented in the table

Source: Philippine National Police, EOD/K-9 Group – Central Office

1617. With an average depth of 26m, it is highly unlikely that tunneling works will encounter UXOs. A site survey prior to tunneling works at such depths is also impossible. PNP advised to proceed with the construction/tunneling works without prior site scanning/clearing, but advised that a standard operating procedures should be put in place by the Contractors, in accordance with the following key steps:

1. When a metal object is found during tunneling or excavation activities, Contractors are advised do not mine/remove it;
2. If accessible to workers or the general public, access shall be strictly controlled;
3. The find shall be reported to the nearest PNP District in the area. The PNP District will immediately report this to the PNP EOD Unit which will be attending to the matter;
4. The PNP EOD Unit will identify the metal object first upon the arrival on the site. If found to be an UXO, they will conduct the removal;
5. No works shall proceed until PNP EOD Unit has declared the site safe for construction;
6. Recovered UXOs are temporarily put in an explosive magazine in an undisclosed area. Once full, they will transfer it to Crow Valley for final disposal.

3.4.5. Basic Infrastructure and Services

3.4.5.1. Power Supply

(1) Power Supply of Affected LGUs

1618. **Table 3.4.18** presents information on power supply services in the affected localities indicating the sole power distribution utility and its capacity that deliver to the demands of its customers.

1619. Power for all the affected LGUs is distributed 24/7 by Manila Electrical Company (MERALCO). Bulk of its supply is sourced from National Power Corporation (NPC). As of 2015, MERALCO's total number of connections is 5,781,845 with a peak demand rate of 6,298 MW. The five million connections are composed of 5,295,458 residential connections, 472,322 commercial connections, 472,322 industrial connections, and 4,495 connections categorized as others. MERALCO provides electricity to 36 cities and 75 municipalities with a franchise area of 9,685 km^2. The combined capacity of its substations is 17,198 MVA with four substations located in host LGUs including Manila (Paco), Muntinlupa (Sucat), Biñan and Sta. Rosa. The largest instance of simultaneous power usage, also known as peak demand, for MERALCO is 6,298 MW.

Table 3.4.18 Power Supply in Host LGUs

Supplier	Coverage	Combined Capacity	Peak demand	No.	Residential	Commercial	Industrial	Others	Total
MERALCO	Host LGUs: Metro Manila, Laguna	17,198 MVA	6,298 MW	Connections	5,295,458	472,322	9,570	4,495	5,781,845
	Others (Luzon): Pampanga (partial), Bulacan, Cavite, Quezon, Batangas City			Sales (MWh)	11,116,664	12,535,211	5,253,633	188,221	29,093,729

Note: Figures for peak demand, number of connections, and volume of sales are based on the total distribution of power utilities (including non-project LGUs).
Source: Distribution Development Plan 2016-2025 & Distribution Utilities Profile, Department of Energy (DOE)

(2) Access to Electricity of PAFs

1620. Majority of the PAFs have access to electricity through own/individual electricity connection (46.26%) and shared connection (45.39%) with 6.3% having no connection. The locality with the greatest number of PAFs with access to electricity is Manila where most have individual electric meter but it also has a fair share of shared electricity connections. Shared connections pertain to ISFs who share electricity with their neighbors or community (**Table 3.4.19**).

Table 3.4.19 Access to Electricity of PAFs

LGU	Own Electric Meter for Power Connection	Shared Connection	No Connection	Others	N/R	Total
Manila	2,844	1,494	31	104	18	4,491
Makati	118	40	0	2	1	161
Taguig	121	227	25	3	2	378
Parañaque	69	77	5	0	0	151
Muntinlupa	689	443	150	15	1	1,298
San Pedro	127	92	79	2	1	301
Biñan	528	1,330	188	10	25	2,081
Sta. Rosa	76	257	82	8	12	435
Cabuyao	22	41	41	0	2	106
Calamba	888	1,378	148	16	18	2,448
Total	5,482	5,379	749	160	80	11,850
%	46.26	45.39	6.32	1.35	0.68	100.00

Source: JICA Design Team

(3) Project-Affected Power Supply Facilities

1621. **Table 3.4.20** indicates the number of existing and affected power supply facilities/ utilities in the host LGUs with available data which are further classified according to power supplier and facility type. The power facilities considered in the table include not only those inside the project ROW but also those outside and parallel the project ROW as all the listed facilities below are covered by the standard safe clearance for construction and safety provision for electrical facilities based on 2017 Philippine Electrical Code.

Table 3.4.20 Affected Power Supply Facilities in Host LGUs

LGU	Supplier	Type of overhead power facility	No. of affected facilities	Total
Manila	MERALCO	Wires, secondary line	1	290
		Wires, Head guy only	1	
		Wires (Guy/support)	16	
		Secondary pole	1	
		Poles and Medium Voltage wires	1	
		Poles & Low - Medium Voltage wires	1	
		Poles	1	
		Pole Guy/Support wire	15	
		Neutral line only, wires	1	
		Medium-High Voltage wires & poles	6	
		Medium-High Voltage wires & pole	2	
		Medium-High Voltage wires	11	
		Medium Voltage wires & poles	13	
		Medium Voltage wires	13	
		Medium voltage	1	
		Low-medium voltage wires& poles	50	
		Low-Medium Voltage wires	4	

LGU	Supplier	Type of overhead power facility	No. of affected facilities	Total
		Low-High Voltage wires & poles	27	
		Low-High Voltage wires	3	
		Low Voltage wires & poles	31	
		Low Voltage wires & pole	6	
		Idle meralco pole	3	
		High Voltage wires & pole	1	
		High Voltage wires & poles	22	
		High Voltage wires	8	
		Head guy	3	
		Guy support	1	
		230KV TL, pole & tower (truss type)	2	
		230KV TL and towers (truss type)	2	
		230KV TL and tower (truss type)	5	
		230KV TL & posts	1	
		230KV TL, poles & wires	1	
		230KV TL & poles	6	
		230KV TL & pole	13	
		230KV TL	14	
		Poles & Low Voltage wires	1	
		Poles & Low - Medium Voltage wires	1	
		Poles & Medium Voltage wires	1	
Makati	MERALCO	230KV TL	3	
		230KV TL & pole	36	
		230KV TL & poles	6	
		High Voltage poles & wires	5	
		High Voltage wires	3	
		Low Voltage poles & wires	1	
		Low Voltage wires & pole guy/support wires	1	75
		Low-High Voltage wires & poles	3	
		Low-Medium Voltage wires & poles	8	
		Medium Voltage wires	1	
		Medium Voltage wires & poles	1	
		Medium-High Voltage wires	3	
		Pole Guy/Support wire	4	
Taguig	MERALCO	230KV TL	1	
		230KV TL & pole	10	
		Low-Medium Voltage wires & poles	1	
		Medium-High Voltage wires	1	21
		Medium-High Voltage wires & poles	5	
		High Voltage wires	2	
		guy/ support pole	1	
Parañaque	MERALCO	No data yet	No data yet	-
Muntinlupa	MERALCO	No data yet	No data yet	-
San Pedro	MERALCO	No data yet	No data yet	-
Biñan	MERALCO	No data yet	No data yet	-
Sta. Rosa	MERALCO	No data yet	No data yet	-
Cabuyao	MERALCO	No data yet	No data yet	-
Calamba	MERALCO	No data yet	No data yet	-

Source: JICA Design Team

3.4.5.2. Water Supply

1622. **Table 3.4.21** presents information on average water production and consumption in the host LGUs serviced by Level III water suppliers. Generally, a level III water supply facility has a source, a reservoir, a piped distribution network with adequate treatment facility and household taps.

1623. In total, there are six major Level III water supply service providers in the affected LGUs, namely: (1) Maynilad Water Services, Inc. (MWSI); (2) Manila Water Company (MWC); (3) San Pedro Water District; (4) Laguna Water District; (5) Cabuyao Water District, and; (6) Calamba Water District.

Table 3.4.21 Average Water Supply Production and Consumption by Host LGUs

Water Service Provider	Host LGUs Served	Monthly Production (m^3 / month)	No. of connection				Average water consumption (m3 / month)			
			Domestic	Government	Commercial/ Industrial	Bulk	Domestic	Government	Commercial	Bulk
MWSS-MWSI	Manila, Makati, Parañaque, Pasay Muntinlupa	58,164,243.33	1,205,169	0	60,341	0	32,571,933.30	0.00	7,561,341	0.00
MWSS-MWCI	Manila, Makati, Taguig	43,617,426.13	922,578	0	53,743	0	29,223,641.40	0.00	9,159,648.80	0.00
San Pedro Water District	San Pedro	877,074	29,759	60	1,275	0	31,094	21.34	134.35	59.29
Laguna Water	Biñan, Sta. Rosa, Cabuyao	1,036,710	36,669	229	1,407	2	38,307	0.00	0.00	0.00
Cabuyao Water District	Cabuyao	291,530	11,536	0	115	0	11,651	18.41	0.00	18.41
Calamba Water District	Calamba	1,395,235	46,595	0	2,979	0	49,574	18.66	0.00	18.66

Note:
1. Average monthly water consumption for MWSI was estimated based on annual water use of 697,970,000 m^3 with 56% domestic use, 13% commercial/ industrial use and 31% non-revenue water.
2. Average monthly water consumption for MWC was estimated based on annual water use of 523,408,503 m3 with 67% domestic use, 21% commercial/industrial use and 12% non-revenue water.

Source: Philippine Water Districts Average Production and Consumption Data, 2019; Philippine Water Utilities Data Book, 2015

3.4.5.3. Oil Supply Facilities

1624. A 117-km non-operational oil pipeline owned by the First Philippine Industrial Corporation (FPIC) runs from Batangas to Pandacan, Manila. A portion of the pipeline used for black oil which runs along the National Highway in Muntinlupa City traverses the decommissioned STPP. **Figure 3.4.1** and **Figure 3.4.2** show the location of the oil pipeline and the existing PNR ROW. The pipeline was ordered to be shut down in 2010 due to the gas leak discovered by the residents of the West Condominium Tower in Makati City caused by leakage from the FPIC pipeline. DoE has recommended the reopening of FPIC pipeline in 2012 but as of 2019, the black oil line remains non-operational.

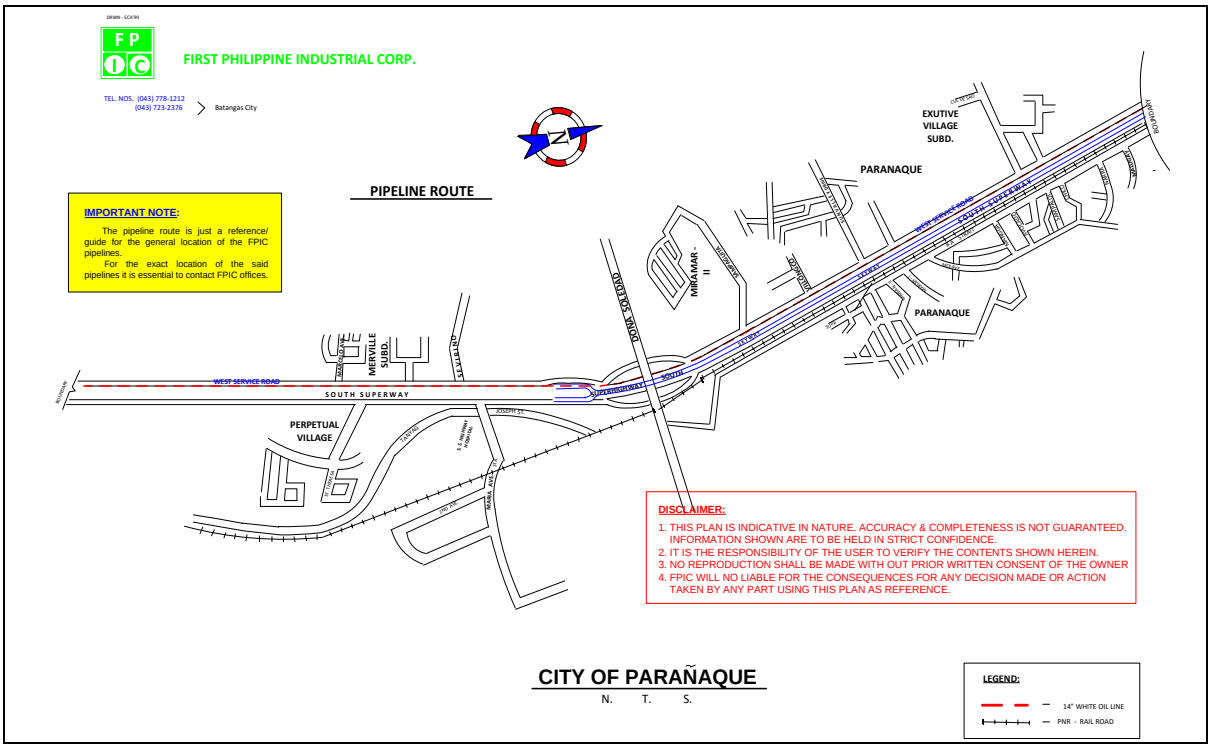


Figure 3.4.1 Pipeline Location at City of Parañaque

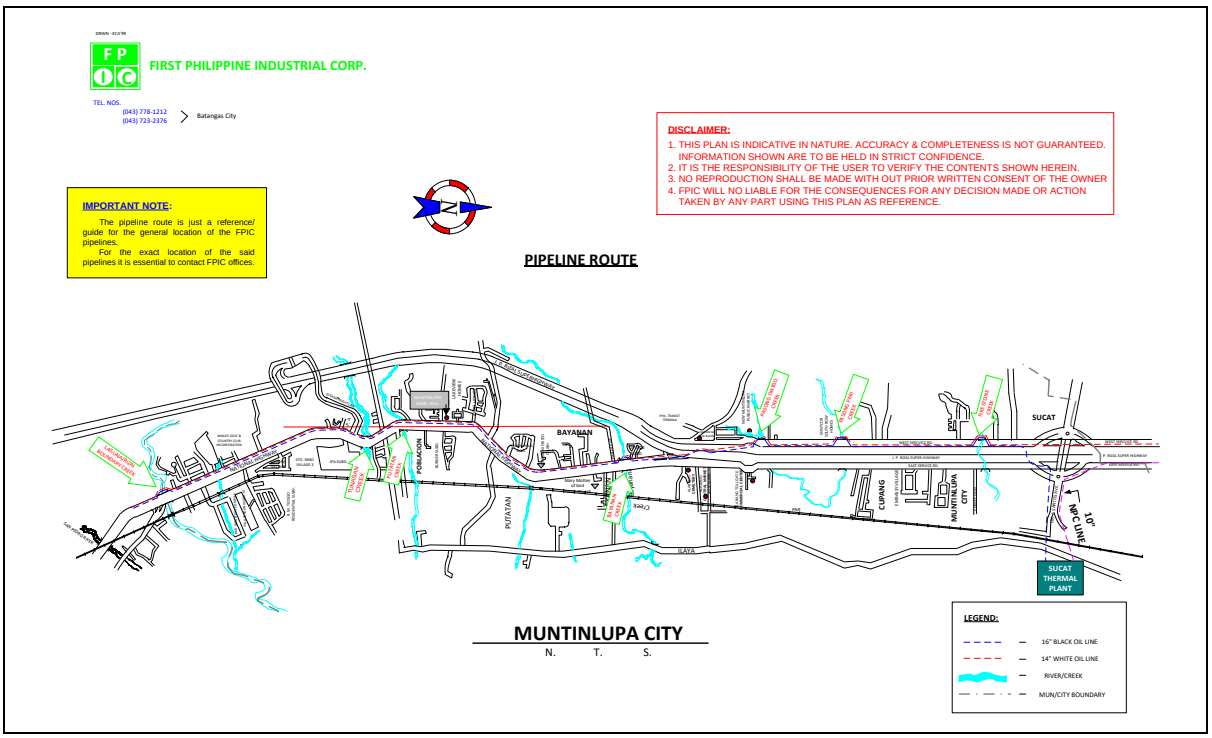


Figure 3.4.2 Pipeline Location at Muntinlupa City

3.4.5.4. Open Space and Recreational Area

1625. **Table 3.4.22** presents the current open space allocation as well as existing sports and recreational facilities of each affected LGU. It further indicates the directly affected open space and recreational facilities in the LGUs. Generally, open space are areas reserved exclusively for parks, playgrounds, recreational uses and other similar facilities and amenities.

1626. Based on the Enhanced Comprehensive Land Use Plan Guidebook Volume 2, Sectoral Studies and Tools for Analysis (2014), the standards for recreational facilities are as follows:

- A minimum of 500 sq.m. per 1,000 population for city or municipal park.
- A minimum of 0.5 hectare per 1,000 population for playfield/athletic field.

1627. The affected locality with the most expansive open space allocation is Sta. Rosa (1,209.00 ha) covering 21.8% of its total land area. On the other hand, the locality with the smallest open space allocation is Makati (0.7107 ha). The number of sports and recreational facilities is highest in Makati while three is accounted Calamba. Only the cities of Manila, Sta. Rosa and Calamba are identified to have affected recreational facilities including a basketball court, multi-purpose building and pavilions.

Table 3.4.22 Open Space Allocation and Sports/Recreational Facilities

LGU	Open Space		Sports and Recreational Facilities			Affected Open Space/ Recreational Facilities
	Land Area Allocated for Open Space (Ha)	% of Total Land Area	Type	No. / Area (Ha)	Data as of	
Manila	11.91	7.9	Public Plaza	53 / 11.91	2000	Brgy. 811 Basketball court
			Basketball Court	11		
Makati	31.00	1.1	Sports	51 / 2.91	2018	No affected open space/ recreational facilities.
			Multi-purpose hall	10 / 0.25		
			Community complex	11 / 0.70		
			Others	4 / 1.00		
Taguig	243.00	5.4	Basketball Court	5	2000	No affected open space/ recreational facilities.
			Playground	1		
			Golf Club	1		
Pasay	88.12 (includes parks and recreation)	4.9	Open Space Opposite of Saint Therese Church along Manlunas St	0.62	2002	
			Enclosed/ roofed recreational space (Cuneta Astrodome)			
			Greenbelt-parkway	13		
Parañaque	122.74	2.6	Recreational zones	2	2017	No affected open space/ recreational facilities.
Muntinlupa	78.00	1.7	Parks	12	2014	No affected open space/ recreational facilities.
			Sports club	1		
			Open spaces	5		
San Pedro	273.32	11.7	Basketball/volleyball court	68	2013	No affected open space/ recreational facilities.
			Tennis court	12		
			Playground	27		
			Park	2		
Biñan	41.12 (parks & recreation)	1.0	Sports arena	1	2018	No affected open space/ recreational facilities.
Sta. Rosa	1,209.00	21.8	Basketball court	15 / 368.00	1999	1 multi-purpose building
Cabuyao	859.32	19.9	Basketball court	18	2015	No affected open space/ recreational facilities.
			Golf course	1		
			Plaza/gymnasium	1		
Calamba	41.98	1.2	Recreational facilities	3	1999	2 pavilions

Source: City/Municipal Planning and Development Offices, Collected data on January 2019

1628. **Table 3.4.23** presents the existing and affected educational facilities in the host LGUs traversed by the project categorized by facility ownership and educational level. Further, the directly and indirectly (within 50 m from proposed alignment) affected educational institutions are indicated below.

1629. The locality with the greatest number of existing schools from primary to tertiary level is Manila.

1630. The localities with the least number of existing schools by educational level are: Cabuyao for primary; Taguig for secondary (6), and; Sta. Rosa and Cabuyao, both in Laguna, for tertiary. In terms of facility ownership, public educational institutions are mostly in Manila (131) while only 28 in Cabuyao. Private educational institutions, on the other hand, are mostly in Manila (370) while only 5 in Taguig.

1631. Among the existing educational institutions, nine are directly affected or within the project ROW including day care centers in Manila (2), Muntinlupa (1), Biñan (1) and Calamba (1); primary schools in Manila (1) and Calamba (2); and, a state university in Manila. Further, there are indirectly affected educational institutions (32) or those outside the project ROW but within 50 meters from the project alignment centerline including six in Manila; seven in Makati; two in Taguig; one in Parañaque; seven in Muntinlupa; two in San Pedro; one in Sta. Rosa; two in Cabuyao; and, four in Calamba.

Table 3.4.23 Educational Institutions in Host LGUs

LGU	Type of Institution	Primary	Secondary	Tertiary	Affected Educational Facilities	
					Within the project ROW	Outside the project ROW but within 50 m from the centerline of the alignment
Manila	public	81	44	6	Day Care Center Kabaka Barangay 473 Day Care Center Gregoria De Jesus Elementary School Polytechnic University of the Philippines	Lakandula Elementary School Bethel Lutheran School Manuel L Quezon High School Holy Spirit Elementary School Aldana Elementary School Benigno Aldana Elementary School
	private	149	146	75		
Makati	public	27	13	1	No affected schools	San Antonio National High School Reach International School University of Makati AMA Computer College Asia Pacific College Pasay City South High School* Philippine State College of Aeronautics*
	private	85	47	21		
Taguig	public	23	20	2	No affected schools	Technological University of the Philippines – Taguig Campus Gat Andres Bonifacio High School
	private	N/A	N/A	5		
Pasay	Public	20	5	1	None	None
	Private	16	16	6	None	None
Parañaque	public	22	14	1	No affected schools	Grace Special School
	private		33	14		
Muntinlupa	public	19	9	2	Day Care Center-Gumt Property	Sto. Domingo Pascual Academy Muntinlupa Business High School Cupang Elementary School Muntinlupa Institute of Technology San Roque Catholic School Adonai Christian Academy Santo Niño School of Muntinlupa
	private	88	88	14		
San Pedro	public	20	8	1	No affected schools	Living Waters Christian School St. Peter Academy
	private	74	48	13		
Biñan	public	25	11	8		No affected schools

LGU	Type of Institution	Primary	Secondary	Tertiary	Affected Educational Facilities	
					Within the project ROW	Outside the project ROW but within 50 m from the centerline of the alignment
	private	73	39		Barangay Platero Day Care Center	
Sta. Rosa	public	18	10	1	No affected schools	Canossa School
	private	90	53	4		
Cabuyao	public	19	8	1	No affected schools	Cabuyao Central School Pamantasan ng Cabuyao
	private	N/A	43	4		
Calamba	public	51	21	1	Poblacion I Day Care Center Tiyani Elementary School Banlic Elementary School	Olaso Child Study Center Rizal College of Laguna Sunflower Learning Center Crossing Calamba Elementary School
	private	103	59	16		

Note:
Based on Republic Act No. 10533, otherwise known as the "Enhanced Basic Education Act of 2013, the Department of Education (DepEd) is mandated to implement the new basic education curriculum, the K-to-12 Program, which further categorizes secondary education to Junior High School (Grades 7-10) and Senior High school (Grades 11 and 12). Currently, the program is still in transition period (2016-2021). As such, presented data do not yet reflect more specific details on high school (secondary education) categories.

1. *The public tertiary level or higher education institutions (HEIs) include state universities and colleges (SUCs) and local universities and colleges (LUCs).*
2. *For cells with N/A, no data were provided yet which may later affect the corresponding discussion for the table.*

Source: Region 4 DepEd, and DepEd Masterlist accessed on April 2019, DepEd Makati 2017, CHED 2018

3.4.5.5. Communication

1632. **Table 3.4.24** presents the communication services available in the affected localities. Available communication facilities or services include mobile phone and landline, television, radio, print media, internet, postal and courier services. Other telecommunication providers are also indicated.

1633. All affected LGUs have available communication services and facilities. Other communication services particularly those that require subscription and are location-based are only available for specific LGUs such as particular local television channels and radio stations.

Table 3.4.24 Communication Services and Related Facilities

Communication facility/service	Available in all LGUs	Available in specific LGUs
Mobile phone	Globe, Smart, Sun	-
Landline phone	PLDT	NCR: Bayantel Laguna: DIGITEL, Intelco
Television (Free)	National channels (ABS-CBN, GMA, PTV4, TV5)	-
Television (Cable)	Royal Cable, SkyCable, Cignal Cable	-
Local Radio	National and local radio stations depending on signal and location	-
Print Media / Newspaper	Philippine Star, Daily Inquirer, Malaya, Manila Bulletin	-
Internet	PLDT, Sky, Globe, Smart, Sun	-
Postal	At least one postal office is available in each LGU	-
Courier	JRS Express, LBC Express, Universal Stonefront Services Corp. (USSC) Republic Courier Services, Inc., FEDEX, DHL	-
Others (Telecommunications)	-	Muntinlupa: JFM Installation & Telecom Services Inc., APN Philippines, Inc., INNOVE Communications Inc., and

Communication facility/service	Available in all LGUs	Available in specific LGUs
		Universal Storefront Services Corp.

Source: City/ Municipal Planning and Development Offices

3.4.5.6. Peace and Order (Protective Services)

1634. **Table 3.4.25** below shows the different bodies responsible for maintaining the peace and order in the local government units (LGUs). For each city or municipality, facilities for police, fire protection, and jail management are mandated through the Department of Interior and Local Government. The police (PNP) are tasked to implement anti-criminality activities, the jail management (BJMP) is mandated to direct, supervise and control the operation of all district, city and municipal jails, while the BFP oversees administration and management of fire emergency services which include fire prevention and firefighting. Apart from this, LGUs each have their own office for implementing public order and safety measures.

1635. The Philippine National Police (PNP), under the DILG, is mandated to have one police station, also called by police as headquarters (HQ), per LGU. The minimum ratio of police officers to civilians based on Philippine standard is 1:2,000. The data presented in the table below were gathered from LGUs' CLUPs. Common staff and equipment for PNP stations are police personnel (commissioned and non-commissioned), mobile patrol units, and motorcycle units.

Table 3.4.25 Level of Authority on Protective Services

Level	Philippine National Police	Bureau of Jail Management and Penology	Bureau of Fire Protection	LGU
City/ Municipal	Head Quarters Police Stations	City/ Municipal Jails	Fire Stations Substations	City/Municipal Public Safety/Order Office*
Barangay	Substations, Precincts	None	Substations	
Personnel and Equipment	Police Mobile Patrol Units Motorcycle Patrol Units	None	Fire fighters Fire trucks	Barangay tanod or Barangay Peace/Safety Officers

Note: Name of offices vary per LGU

Source: Philippine National Police, Bureau of Fire Protection, Bureau of Jail Management and Penology

1636. The data presented in the **Table 3.4.26** below were gathered from LGUs' CLUPs. Available data were stations, personnel and equipment for the PNP and BFP. Not all LGUs provided data for their jail facilities and LGU peace/safety office. Common staff and equipment for PNP stations are police personnel (commissioned and non-commissioned), mobile patrol units, and motorcycle units. Similar with BFP, data provided were on fire stations, fire fighters, and fire-fighting equipment.

Table 3.4.26 Police and Fire Service Facilities

LGU	PNP		BFP	
	Stations	Staff and Equipment	Stations	Staff and Equipment
Manila	Manila HQ 11 Stations 40 Substations 170 Outposts	2,984 Police Personnel - 441 Traffic	Central Fire Station 15 Stations	335 Fire Fighters
Makati	Makati HQ 9 Precincts 1 Traffic Management Group	489 Police Personnel 57 Mobile Patrol Units 33 Motorcycle Units	Central Fire Station 10 Substations	119 Fire Fighters 11 Fire Trucks 1 Ambulance
Taguig	Taguig HQ 11 Substations	357 Police Personnel	Central Fire Station 2 Substations	48 Fire Fighters 5 Fire Trucks 1 Ambulance
Pasay	Pasay HQ 12 Substations/Precincts	440 Police Personnel	Central Fire Station 4 Substations	10 Fire Trucks

LGU	PNP		BFP	
	Stations	Staff and Equipment	Stations	Staff and Equipment
Parañaque	Parañaque HQ 16 Substations	356 Police Personnel	Central Fire Station 3 Substations	88 Fire Fighters 11 Volunteer Corps
Muntinlupa	Muntinlupa HQ 6 Stations	529 Police Personnel	Central Fire Station 3 Substations	126 Fire Fighters 14 Fire Engines 2 Volunteers
San Pedro	San Pedro HQ 5 Stations	131 Police Personnel 5 Mobile Patrol Units 58 Firearms 15 Handcuffs 13 Base Radios 30 Handheld Radios 1 Finger Print Kit	North Head Quarters South Head Quarters	33 Fire Fighters 3 Fire Trucks
Biñan	Biñan HQ 6 Substations	33 Police Personnel	Central Fire Station 3 Substations	No Data
Sta. Rosa	Sta. Rosa HQ 4 Police Assistance Centers 10 Police Outposts	162 Police Personnel	Central Fire Station	35 Fire Fighters 4 Fire Trucks
Cabuyao	Cabuyao HQ	76 Police Personnel 4 Mobile Patrol Units 2 Motorcycle Units 3 Radio Receivers	Central Fire Station	24 Fire Fighters 2 Fire Trucks
Calamba	Calamba HQ 12 Outposts	105 Police Personnel 90 Traffic Personnel	Central Fire Station	27 Fire Fighters 3 Fire Trucks

Source: City/ Municipal Planning and Development Offices, collected January 2019

3.4.5.7. Sewerage Management

1637. Local government units and some establishments and institutions are also mandated by Philippine laws to provide separate treatment facilities. The Local Government Code and DILG MC 2019-62 mandate that the barangay and municipality/city provide facilities for sewage and septage system, while establishments and institutions enumerated in DENR-AO 2016-08 which produce effluents that exceed environmental standards are required to have their own sewage treatment plants.

1638. Metropolitan Manila Waterworks and Sewerage System (MWSS) is the government body in charge of water supply, and sewage and septage treatment for NCR and Rizal. Part of its concessionaires' responsibilities (Manila Water for east and Maynilad for west) is to provide sewerage and septage facilities for its respective coverage areas. As of 2018, the region has only met 14 percent of its required number of sewerage treatment plants to accommodate wastewater from its 15 million inhabitants[3]. Cities in Laguna do not have existing sewerage system yet. Most of the connections are reliant on household septic tanks. The LGUs have their own proposed projects for the improvement of their sewerage and septage system.

3.4.5.8. Solid Waste Management

1639. The main laws governing solid waste management in the Philippines are the Local Government Code (RA7160) and Ecological Solid Waste Management Act of 2000 (RA9003). RA7160 mandates the local government to provide for the collection of solid waste – biodegradable, compostable, and reusable materials to be collected by the barangay, non-recyclable materials and special wastes to be collected by the municipality or city. RA9003, on the other hand, primarily mandates the following: (1) that the LGU prepare its own 10-year Solid Waste Management (SWM) Plan, (2) mandatory segregation of solid waste at source, (3) and all open dumps be shut down or converted into controlled dumps.

[3] https://news.abs-cbn.com/news/03/21/18/metro-sewerage-problem-10-times-worse-than-boracays-mwss

1640. According to 2010 PSA data, 11 out of 12 households in the affected LGUs usually dispose of their waste through the collection by garbage trucks. Despite the garbage collection, there are still households that practice prohibited disposal methods such as dumping and burning as shown on **Table 3.4.27**.

Table 3.4.27 Usual Manner of Garbage Disposal in the Host LGUs

LGU	HHs	Usual Manner of Garbage Disposal (%)						
		Picked up by garbage truck	Dumping in individual pit (not burned)	Burning	Composting	Burying	Fed to animals	Others
Manila	435,154	96.6	2.0	0.2	0.1	0.1	0.2	0.7
Makati	154,095	98.4	1.0	0.4	0.0	0.0	0.0	0.1
Taguig	198,256	95.0	3.3	1.3	0.1	0.1	0.0	0.1
Pasay	97,966	97.8	1.28	.09	.03	.06	0.0	.65
Parañaque	163,074	95.6	2.7	0.9	0.1	0.1	0.4	0.3
Muntinlupa	122,286	94.6	2.6	2.5	0.1	0.1	0.0	0.2
San Pedro	73,030	93.8	1.0	4.4	0.2	0.3	0.3	0.0
Biñan	86,752	91.0	2.3	5.8	0.3	0.4	0.0	0.3
Sta. Rosa	101,385	95.0	2.2	2.6	0.1	0.1	0.0	0.0
Cabuyao	81,573	96.3	0.6	2.6	0.4	0.1	0.0	-
Calamba	123,071	87.4	2.2	9.2	0.2	0.8	0.0	0.2

Source: 2010 Census of Population and Housing, Philippine Statistics Authority

1641. The 2016 Local Government Unit Solid Waste Management Compliance and Audit Report (LGU-SWM-SCMAR) computed the projected volume of solid waste generation of the affected LGUs from 2016 to 2020. Despite of San Pedro's low count of population compared with other LGUs, it has the highest waste generation to population ratio (see **Table 3.4.28**).

Table 3.4.28 Solid Waste Generation by LGU 2016-2020 (tons per year)

LGU	Population	2015	2016	2017	2018	2019	2020
Manila	1,780,148	396,350.0	399,442.0	402,558.1	405,698.6	408,863.5	412,053.2
Makati	582,602	174,654.1	177,095.5	179,571.1	182,081.2	184,626.5	174,654.1
Taguig	804,915	205,655.8	213,113.7	220,842.2	228,850.8	237,150.0	245,750.0
Parañaque	665,822	167,687.3	172,052.8	176,531.9	181,127.6	185,843.0	190,681.2
Muntinlupa	504,509	99,438.7	101,314.8	103,226.3	105,173.9	107,158.2	109,179.9
San Pedro	325,809	59,460.1	61,176.7	62,942.8	64,759.8	66,629.3	68,552.8
Biñan	333,028	85,088.7	87,545.0	90,072.3	92,672.6	95,347.9	98,100.5
Sta. Rosa	353,767	90,387.5	92,996.8	95,681.5	98,443.7	101,285.6	104,209.6
Cabuyao	308,745	78,884.4	81,161.6	83,504.6	85,915.3	88,395.5	90,947.4
Calamba	454,486	116,121.2	119,473.4	122,922.4	126,471.0	130,122.1	133,878.5

Source: Revised LGU-SWM-SCMAR, 2016

1642. **Table 3.4.29** briefly describes the solid waste management of the host LGUs for garbage collection, material recovery facilities (MRFs) and its locations for disposal.

1643. Based on the table, all LGUs had engaged in a contract for the collection of waste from households. These are then transferred to MRFs for segregation, recycling, and composting. After which, remaining waste that cannot be recycled nor composted, also known as residual waste, are brought to engineered sanitary landfills. All the project-affected cities in NCR dispose their residual waste in Rizal Provincial Sanitary Landfill, while project-affected cities in Laguna dispose in landfills located within the same province.

Table 3.4.29 Waste Management Services of LGUs

LGU	Garbage collection	MRF	Disposal
Manila	Leonel Waste Management	Vitas Transfer Station	Tanza Facility, Navotas Rodriguez Facility, Marikina

LGU	Garbage collection	MRF	Disposal
Makati	EC Sarrol International Solid Waste Integrated Management Specialist (ISWIMS) SM Coronado Steriplus Corporation-Ecosafe Hazmat Treatment Inc. (special waste)	19 mobile MRFs 1 MRF van	Rizal Provincial Sanitary Landfill
Taguig	Leonel Waste Management, Inc. IPM Construction	28 Homeowners' Association MRFs 108 registered junk shops	Rizal Provincial Sanitary Landfill
Pasay	Hauling Contractors	16 barangay MRFs	Rizal Provincial Sanitary Landfill
Parañaque	Leonel Waste Management, Inc. Roll-on Roll-off Waste Depository Containers	Sunflower Green MRF Brgy. Sto Niño MRF Brgy. Merville Park MRF 16 barangay MRFs	Rizal Provincial Sanitary Landfill
Muntinlupa	REN Transport Corporation		Rodriguez Facility San Pedro Facility and Laguna
San Pedro	Pilotage Trading and Construction (PTAC)	San Pedro Central MRF	PTAC Sanitary Landfill
Biñan	Severiano B. Hain Enterprises	1 Central MRF in Brgy. Timbao	Severiano B. Hain Enterprises
Sta. Rosa	Pilotage Trading and Construction (PTAC)		PTAC Sanitary Landfill
Cabuyao			Cabuyao sanitary landfill
Calamba	RC Bella Waste Management	PaLiSam MRF 66 registered junk shops	Suri Waste Management and Disposal Services

Source: Solid Waste Management Plans

3.4.5.9. Public Health Services

1644. In the delivery of public health services, the Department of Health (DOH) serves as the steward of national policies, plans, standards and regulations on health, while the LGUs are responsible in managing and providing direct health services at the local level. DOH provides technical assistance, capacity building and advisory services to LGUs that directly deliver public health services. Specific campaigns and dedicated national programs such as National TB Control Program are coordinated between the LGU and DOH.

1645. **Table 3.4.30** summarizes the available data on health facilities and personnel for each city affected by the project. All the LGUs have levels 1 and 2 hospitals, but only Manila, Makati, Parañaque, Muntinlupa, and Biñan have level 3 hospitals. As for emergency services, all hospitals (levels 1, 2, and 3) have emergency services as per DOH standard.

1646. There are only two health facilities identified to be traversed by the project (December 2018) which are Maria Clara Health Center in Manila and Barangay Platero Health Center in Biñan, Laguna.

Table 3.4.30 Health Facilities in Host LGUs

LGU	Barangay Health Station	Rural Health Unit	Hospital					Others
			Level 1	Level 2	Level 3	Unspecified	Total	
Manila	1	64	8	2	17	5	32	1
Makati		28	1	1	2	1	5	2
Taguig		35	6	2			8	10
Pasay		14				6	6	
Parañaque	1	16	5	4	1	1	11	4
Muntinlupa	2	15	4	4	1		9	4
San Pedro	21	2	5	1		1	7	4

LGU	Barangay Health Station	Rural Health Unit	Hospital					Others
			Level 1	Level 2	Level 3	Unspecified	Total	
Biñan	24	2	1	2	1		4	5
Sta. Rosa	19	2	4	4			8	3
Cabuyao	15	2	2	1			3	9
Calamba	60	1	5	3		5	13	18
Total	**143**	**181**	**41**	**24**	**22**	**19**	**106**	**60**

Note:
1. Others comprised of birthing home, infirmary, psychiatric care facility, and social hygiene clinic.
2. Hospitals not categorized as level 1, level 2 or level 3 general hospitals were classified as speciality hospitals.

Source: National Health Facility Registry, Department of Health, Accessed on April 25, 2019; CLUP of the respective LGUs

3.4.6. Environmental Health and Sanitation Profile

3.4.6.1. Morbidity and Mortality

(1) Rates of Affected LGUs

1647. Due to unavailability of recent data for crude birth and death rates per LGU, rates for the year 2017 were computed using the following data: (1) 2017 estimated population from the Department of Health's Field Health Services Information System, (2) 2017 total number of registered births by usual place of residence, and (3) 2017 total number of registered deaths by usual place of residence. As for the leading causes of morbidity and mortality, information was gathered from LGUs' city land use plans with different base year data and is presented in **Table 3.4.31** and **Table 3.4.32.**

1648. Due to unavailability of city-level data for top causes of morbidity for Makati and Muntinlupa, regional level data are also presented in Prevalent causes for mortality are diseases of the heart, pneumonia, cancer and diabetes. The top cause being diseases of the heart is consistent with the leading cause of mortality for the whole country. Based on the 2015 Philippine Health Statistics prepared by the Department of Health, majority of deaths from the leading causes of mortality were unattended by a medical doctor or any allied health officer during their illness. Dying without the attention of a medical doctor could be somehow an evidence of unaffordable health cost in the country. Prevalent causes for mortality are diseases of the heart, pneumonia, cancer and diabetes. The top cause being diseases of the heart is consistent with the leading cause of mortality for the whole country.

1649. Prevalent causes for mortality are diseases of the heart, pneumonia, cancer and diabetes. The top cause being diseases of the heart is consistent with the leading cause of mortality for the whole country. Based on the 2015 Philippine Health Statistics prepared by the Department of Health, majority of deaths from the leading causes of mortality were unattended by a medical doctor or any allied health officer during their illness. Dying without the attention of a medical doctor could be somehow an evidence of unaffordable health cost in the country.

Table 3.4.31 Leading Causes of Mortality

LGU	Birth Rate	Death Rate	Year	First	Second	Third	Fourth	Fifth
Manila	1.7	0.7	2001	Pneumonia	Diseases of the heart	Cancer	HPN Cerebro-vascular Diseases	Prematurity
Makati	1.3	0.5	2015	Diseases of the heart	Cancer	Cerebro-vascular Diseases	Pneumonia	Diabetes Mellitus

LGU	Birth Rate	Death Rate	Year	First	Second	Third	Fourth	Fifth
Taguig	1.8	0.5	2015	Diseases of the heart	Cerebro Vascular Diseases	Cancer	Pneumonia	Diabetes Mellitus
Pasay	18	5.6	2010	Myocardial Infarction	Hypertensive Cardiovascular Disease	Pneumonia	Cancer all forms	Diabetes Mellitus
Parañaque	1.6	0.5	2011	Coronary artery diseases	No further data			
Muntinlupa	1.4	0.6	2015	Diseases of the heart	Cancer	Cerebro-vascular Diseases	Pneumonia	Diabetes Mellitus
San Pedro	1.4	0.6	2011	Cardio-pulmonary arrest	No further data			
Biñan	1.8	0.6	2015	Cardiac arrest	Senility	Pneumonia	Pulmonary disease	Renal Failure
Sta. Rosa	1.6	0.5	2014	Pneumonia	Multiple organ failure	Ischemic heart disease	Type II diabetes	Septicemia
Cabuyao	1.6	0.5	2008	Cardiovascular diseases	Stroke	Cancer (all forms)	Diabetes	Hypertension
Calamba	1.7	0.6	2006	Pulmonary tuberculosis (all forms)	Myocardial infarction	Diabetes mellitus	Cancer (all forms)	Cardiovascular accident/ stroke

Source: LGUs' City Planning and Development Offices, Department of Health

Table 3.4.32 Leading Causes of Morbidity

LGU	Year	First	Second	Third	Fourth	Fifth
Manila	2001	Diarrhea	Bronchitis	Pneumonia	Tuberculosis respiratory	Influenza
Makati	2003	Bronchitis	Diarrhea	Pneumonia	No further data	-
Taguig	2003	Tuberculosis	Diarrhea	Dengue fever	Bronchitis/bronchiolitis	Pneumonia
Pasay	2006-2010	Upper Respiratory Tract Infection	Pneumonia	No. Pneumonia (Cough n Colds)	Bronchitis	Urinary Tract Infection
Parañaque	2011	Upper respiratory tract infection	No further data	-	-	-
Muntinlupa	2013	Acute upper respiratory tract infection	Open wounds	Urinary tract infection	Acute bronchitis	Non-infective gastroenteritis
San Pedro	2011	Influenza	Diarrhea	Urinary tract infection	No further data	
Biñan	2015	Acute lower respiratory infection	Essential primary hypertension	Influenza	Infectious gastroenteritis and colitis	Exposure to unspecified factor
Sta. Rosa	2014	Acute upper respiratory tract infection	Acute viral infection	Iron deficiency	Hypertension	Tonsillitis
Cabuyao	2008	Diarrhea	Hypertension	Tuberculosis	No further data	-
Calamba	2006	Acute respiratory infection	Influenza	HPN	Skin problem/allergic contact dermatitis	Musculoskeletal diseases (arthritis)
NCR	2015	Acute watery Diarrhea	Acute haemorrhagic fever	Measles	Acute bloody Diarrhea	Acute febrile illness

Source: LGUs' City Planning and Development Offices

(2) Morbidity and Mortality Rates of PAPs

1650. The Socioeconomic Survey (SES) also noted the PAFs with members who experienced health problem in the past year (morbidity) and the causes of death for members of the family (mortality). **Table 3.4.33** indicates that most of the PAFs had members who experienced flu (42.1%). This observation was applicable to all the affected cities. There was a low incidence of hypertension (6.3%), heart problems (2.3%), diarrhea (3.1%), dengue (1.4%) and typhoid fever (1.2%) among the PAPs during the time the survey was taken.

1651. In terms of mortality, the main causes of death among members of PAFs were hypertension (18.1%), heart problems (14.1%), cancer (4.4%) and diabetes (3.9%), as indicated in **Table 3.4.34**.

Table 3.4.33 Morbidity of PAPs

LGU	HIV/AIDS	Malaria	Dengue	Typhoid fever	Diarrhea	Skin diseases	Pneumonia	Flu	Cancer	Heart problems	Hyper-tension	Diabetes	None	Others	Total
Manila	0	1	20	2	17	17	37	529	9	43	194	56	524	74	1,523
%	0.0	0.1	1.3	0.1	1.1	1.1	2.4	34.7	0.6	2.8	12.7	3.7	34.4	4.9	100.0
Taguig	0	0	3	3	6	2	7	127	1	7	18	3	40	35	252
%	0.0	0.0	1.2	1.2	2.4	0.8	2.8	50.4	0.4	2.8	7.1	1.2	15.9	13.9	100.0
Parañaque	0	0	0	1	3	0	3	16	1	0	0	0	10	7	41
%	0.0	0.0	0.0	2.4	7.3	0.0	7.3	39.0	2.4	0.0	0.0	0.0	24.4	17.1	100.0
Muntinlupa	0	0	9	28	37	10	29	422	3	28	51	19	236	151	1,023
%	0.0	0.0	0.9	2.7	3.6	1.0	2.8	41.3	0.3	2.7	5.0	1.9	23.1	14.8	100.0
San Pedro	0	0	2	0	13	3	5	134	1	5	19	1	45	38	266
%	0.0	0.0	0.8	0.0	4.9	1.1	1.9	50.4	0.4	1.9	7.1	0.4	16.9	14.3	100.0
Biñan	0	0	26	22	71	16	43	749	3	34	69	26	513	320	1,892
%	0.0	0.0	1.4	1.2	3.8	0.8	2.3	39.6	0.2	1.8	3.6	1.4	27.1	16.9	100.0
Sta. Rosa	1	0	7	3	14	9	20	226	3	3	20	6	98	89	498
%	0.2	0.0	1.4	0.6	2.8	1.8	4.0	45.4	0.6	0.6	4.0	1.2	19.7	17.9	100.0
Cabuyao	0	0	1	1	10	0	6	36	0	3	8	1	23	11	100
%	0.0	0.0	1.0	1.0	10.0	0.0	6.0	36.0	0.0	3.0	8.0	1.0	23.0	11.0	100.0
Calamba	0	1	81	67	156	50	133	2,248	17	120	291	122	1,076	713	5,075
%	0.0	0.0	1.6	1.3	3.1	1.0	2.6	44.3	0.3	2.4	5.7	2.4	21.2	14.0	100.0
Total	1	2	149	127	327	107	283	4,487	38	243	670	234	2,565	1,438	10,670
%	0.0	0.0	1.4	1.2	3.1	1.0	2.7	42.1	0.4	2.3	6.3	2.2	24.0	13.5	100.0

Source: JICA Design Team

Table 3.4.34 Mortality of PAPs by LGUs

LGU	HIV/AIDS	Malaria	Dengue	Typhoid fever	Diarrheal	Skin diseases	Pneumonia	Flu	Cancer	Heart problems	Hyper-tension	Diabetes	None	Others	Total
Manila	1	2	39	3	10	2	44	17	39	170	345	71	655	81	1479
%	0.1	0.1	2.6	0.2	0.7	0.1	3.0	1.1	2.6	11.5	23.3	4.8	44.3	5.5	100.0
Taguig	0	1	3	0	3	0	4	0	3	71	83	11	48	67	294
%	0.0	0.3	1.0	0.0	1.0	0.0	1.4	0.0	1.0	24.1	28.2	3.7	16.3	22.8	100.0
Parañaque	0	0	2	0	1	0	3	0	7	5	6	3	11	9	47
%	0.0	0.0	4.3	0.0	2.1	0.0	6.4	0.0	14.9	10.6	12.8	6.4	23.4	19.1	100.0
Muntinlupa	0	0	68	6	8	3	13	9	57	149	242	46	274	224	1099
%	0.0	0.0	6.2	0.5	0.7	0.3	1.2	0.8	5.2	13.6	22.0	4.2	24.9	20.4	100.0
San Pedro	0	0	8	0	6	0	10	2	7	37	52	7	63	70	262

LGU	HIV/AIDS	Malaria	Dengue	Typhoid fever	Diarrheal	Skin diseases	Pneumonia	Flu	Cancer	Heart problems	Hyper-tension	Diabetes	None	Others	Total
%	0.0	0.0	3.1	0.0	2.3	0.0	3.8	0.8	2.7	14.1	19.8	2.7	24.0	26.7	100.0
Biñan	1	3	134	6	80	17	33	49	35	281	341	45	446	546	2017
%	0.0	0.1	6.6	0.3	4.0	0.8	1.6	2.4	1.7	13.9	16.9	2.2	22.1	27.1	100.0
Sta. Rosa	0	0	98	1	16	6	17	12	20	65	76	10	114	112	547
%	0.0	0.0	17.9	0.2	2.9	1.1	3.1	2.2	3.7	11.9	13.9	1.8	20.8	20.5	100.0
Cabuyao	0	0	5	0	1	0	6	5	3	10	13	3	37	5	88
%	0.0	0.0	5.7	0.0	1.1	0.0	6.8	5.7	3.4	11.4	14.8	3.4	42.0	5.7	100.0
Calamba	2	7	480	81	119	31	114	92	331	799	1017	247	1239	972	5531
%	0.0	0.1	8.7	1.5	2.2	0.6	2.1	1.7	6.0	14.4	18.4	4.5	22.4	17.6	100.0
Total	4	13	837	97	244	59	244	186	502	1587	2,175	443	2,887	2,086	11,364
%	0.0	0.1	7.4	0.9	2.1	0.5	2.1	1.6	4.4	14.0	19.1	3.9	25.4	18.4	100.0

Source: JICA Design Team

3.4.6.2. Infectious diseases such as HIV/AIDS and Community health

1652. Prevalent diseases along the Project are malaria and dengue fever and sexual diseases. Reported HIV/AIDS cases have increased by 48,051 from January 2014 to January 2019 and the Philippines has become the country with the fastest growing HIV/AIDS epidemic in Asia and the Pacific and has become one of eight countries that account for more than 90.0 % of new HIV infections in the region. (Joint United Nations Program on HIV/AIDS).

1653. For the aforementioned period, NCR (17,622 cases /36.7 %), Region 4A (7,682 cases /16.0 %) and Region III (4,662 cases /9.7 %) are the top three regions with reported cases of HIV/AIDS. According to 2015 Philippine Health Statistics, Region 4A had 209 deaths due to Dengue fever and 4 deaths due to Malaria. For HIV, project affected LGUs in NCR and Laguna had a total of 53 and 4, respectively, with Manila as the highest contributor (27 cases).

3.4.6.3. Sanitation Profile

(1) Sanitation Profile of Affected LGUs

1654. The results of the 2010 Census of Population and Housing showed that most households in Metro Manila (Manila, Makati, Taguig, Parañaque and Muntinlupa) and Laguna (San Pedro, Biñan, Sta. Rosa, Cabuyao and Calamba) use either their own faucet tapped to community water system or bottled water as water source for drinking (**Table 3.4.67**). Majority of the households used toilet type water sealed sewer septic tank that is used exclusively by the household as indicated in **Table 3.4.35**.

1655. Consistent with the information under sewerage system, at least 10 out of 12 households for all LGUs have water-sealed toilets connected to sewer septic tanks, either exclusively used or shared.

Table 3.4.35 Percentage Distribution of Toilet Facility used by Households

LGU	Toilet Facility							
	Water-sealed (sewer septic tank)		Water-sealed (other depository)		Closed Pit	Open Pit	Pail system and others	None
	Used exclusively by household	Shared with other households	Used exclusively by household	Shared with other households				
Manila	71.7	17.0	3.3	3.1	0.8	0.7	2.0	1.4
Makati	84.7	11.1	1.3	2.0	0.0	0.1	0.5	0.4
Taguig	84.9	8.7	3.1	2.0	0.5	0.4	0.4	0.1
Pasay	74.9	15.3	3.3	3.5	0.68	1.21	0.9	0.1
Paraña-que	84.7	8.1	2.0	1.5	2.3	0.5	0.8	0.2
Muntinlupa	76.7	12.0	4.2	4.0	1.0	0.3	1.2	0.7
San Pedro	88.8	4.5	2.9	1.0	1.3	0.5	0.8	0.3
Biñan	74.1	10.9	8.4	3.8	1.3	0.3	1.0	0.3
Sta. Rosa	84.0	7.1	4.6	2.1	1.3	0.2	0.4	0.2
Cabuyao	89.2	3.8	3.6	1.9	1.0	0.2	0.3	0.0
Calamba	81.8	6.2	4.8	3.1	2.0	1.0	0.7	0.3
Total	82.1	8.9	3.8	2.5	1.2	0.4	0.8	0.4

Source: CPH 2010, PSA

(2) Sanitation Profile of PAFs

1656. **Table 3.4.36** indicates the status of PAFs' access to water per LGU. In general, most of the PAFs had access to water through piped connection (27.63%). At least 25% have access to deep well and 16% to shared water connection.

1657. A per-LGU analysis indicates varying trends in water access. In the cities of Manila and Taguig, more families had access to water through Maynilad or MWSS – with 54.8% in Manila and 31.8% in Taguig. In Parañaque, however, at least 8 out of 10 families bought from water vendors, and the remaining proportion either had own connection (17.1%) or had access through deep wells (2.9%). In San Pedro, Biñan, Santa Rosa and Cabuyao, most families had access to water through deep wells. In Muntinlupa, majority also had access through deep wells, but at least 2 out of 10 families had access through Maynilad or MWSS.

Table 3.4.36 Access to Water of PAFs

LGU	Piped Connection	Shared with Neighbor (Community Faucet)	Deep well	Shallow Well	Buy from Water Vendors	Others	N/R	Total
Manila	2,687	1,334	25	1	235	269	27	4,578
Makati	132	28	0	0	0	0	0	160
Taguig	176	80	26	0	39	66	1	388
Parañaque	79	43	1	0	28	0	0	151
Muntinlupa	438	112	459	3	441	84	5	1,542
San Pedro	74	20	149	2	77	31	1	354
Biñan	45	104	1,568	62	985	178	7	2,949
Sta. Rosa	13	25	238	78	152	82	6	594
Cabuyao	17	10	48	12	37	10	1	135
Calamba	81	462	904	9	297	921	17	2691
Total	3,742	2,218	3,418	167	2,291	1,641	65	13,542
%	27.63	16.38%	25.24	1.23	16.92	12.12	0.48	100.00

Source: JICA Design Team

1658. In terms of access to sanitation, at least seven (7) out of 10 PAFs had their own water-sealed toilets, as indicated in **Table 3.4.37**. The remaining had other sources of sanitation (14.98%), while at least 10.8% had communal or barangay toilet facilities. Among the PAPs, 314 PAFs had no access to sanitation. Among these, majority were in Manila (79 families), followed by Muntinlupa (54 families), Santa Rosa (52 families), Calamba (51 families), Biñan (26 families) and Taguig (25 families).

Table 3.4.37 Types of Toilet Facilities used by PAFs

LGU	Own Water Sealed Toilets	Open Pit	Communal/ Barangay Toilet	No Toilet	Others	N/R	Total
Manila	3,603	17	681	79	96	15	4,491
Makati	124	0	36	0	0	1	161
Taguig	216	2	32	25	102	1	378
Parañaque	112	0	21	6	12	0	151
Muntinlupa	944	7	68	54	214	11	1,298
San Pedro	171	2	35	13	80	0	301
Biñan	1,148	3	190	26	684	30	2,081
Sta. Rosa	167	10	35	52	164	7	435
Cabuyao	45	12	26	8	15	0	106
Calamba	1,814	10	150	51	408	15	2,448
Total	8,344	63	1,274	314	1,775	80	11,850
%	70.41	0.53	10.75	2.65	14.98	0.68	100.00

Source: JICA Design Team

3.4.6.4. Public Safety

1659. According to data from the Philippine National Police for the period of January to May 2018, NCR and Region 4A have crime efficiency rates of 43.97% and 53.97% respectively for index crimes. Index crimes against persons include murder, homicide, rape, and physical injuries. Index crimes against property include robbery and theft.

Table 3.4.38 Regional Index Crime Rates (Jan-May 2018)

Region	Against persons	Against property	Total	Solved	Efficiency
NCR	2201	3693	5894	3181	43.97%
R4A	1729	1914	3643	1602	53.97%

Source: Philippine National Police

1660. For non-index crimes, the regional efficiency rates are higher with 70.74% for NCR and 53.77% for Region 4A. Non-index crimes, as defined by the PNP, are less serious crimes which are violations of special laws and of local ordinances. Crimes resulting from reckless imprudence are those that were without intent but committed due to lack of precaution on the part of the person who committed the crime.

1661. The military zone of Barangay Fort Bonifacio in Taguig, meanwhile have their own security systems. As a constituent barangay of Taguig City, it is also served by the local police force and corresponding police multipliers (e.g., the ‘tanods’) at the community level.

Table 3.4.39 Regional Non-Index Crime Rates (Jan-May 2018)

Region	Reckless Imprudence Resulting in			Violation of special laws	Other non-index crimes	Total	Solved	Efficiency (%)
	Homicide	Physical Injuries	Damage to property					
NCR	149	5,903	31,064	9,091	4145	50,352	39,787	70.74
R4A	320	2,784	4,826	5,827	1181	14,938	8,389	53.77

Source: Philippine National Police

3.4.6.5. Occupational Injuries and Diseases

1662. According to PSA, the number of occupational accidents in the Philippines reached a total of 44,739 in 2015, a decline of 5.7 % from 2013. Despite this reduction, the resulting occupational injuries in 2015 grew by 3.8 % from 49,118 in 2013 to 50,961. Across industry sectors, manufacturing accounted for the highest shares of total occupational injuries in 2015 and 2013 at 50.4%. (25,667) and 48.1 %. (23,641), respectively. Construction industry share of accidents in 2013 was 4.3%, which increased in 2015 to 10.1%. In 2013, more than half (58.3% or 306) of the 525 cases of occupational injuries with workdays lost in the construction industry were caused by superficial injuries and open wounds. Other types of injuries include foreign body in the eye (12.4%); fractures (10.1%); and dislocations, sprains and strains (7.2 %). Laborers and unskilled workers were the mostly injured in the construction industry posting the highest share at 70.1 %. The rest of the occupations showed comparatively lower shares of injuries which include craft and related trade workers (10.5 %); plant and machine operator s and assemblers (7.4 %); and technicians and associate professionals (5.9 %). Total of 4,175 cases of occupational diseases were recorded in the construction industry in 2013. By type of disease, 5 in every 8 occupational diseases (62.5 % or 2,610), were caused by other work-related musculoskeletal diseases. This was followed by other diseases with relatively fewer cases namely: back pains (5.6 %); occupational dermatitis (4.9 %) and essential hypertension (4.4 %).

3.4.6.6. Occupational Safety and Health Practices

1663. The mandatory rules set in Occupational Safety and Health (OSH) Standards is enforced by the Department of Labor and Employment. It aims to protect every working man and woman against the dangers of injury, sickness or untimely death through safe and healthy working conditions. Employers are required to submit a Summary Report including; Work Accident/Illness Report, Annual Exposure Data Report, Report of Safety Organization, Minutes of the Meetings of Health and Safety Committee, Annual Medical Report.

1664. Seven out of ten establishments in construction industry implemented the following OSH policies/programs: accident prevention program (78.9%); accident investigation program (70.5%); drug free workplace policy program (68.1%); DOLE-approved construction safety and health (67.5%); and monitoring/surveillance of occupational and work - related injuries and illnesses (67.2%).

1665. As preventive and control measures against work safety and health hazards, almost all of the establishments in construction had posted safety signage or warnings (98.3%) and provided workers orientation on safety and health hazards at work (98.2%) as part of their preventive and control measures against work safety and health hazards in the workplace.

1666. In addition, a total of 921 establishments in construction had availed of various work safety and health related trainings/seminars for their employees: 40-hour construction safety training (90.4%); fire safety training (67.4%); and 1-day occupational safety and health orientation (64.7%) etc.

3.4.6.7. Community Issues among Project Affected Families

1667. **Table 3.4.40** highlights some community issues identified by the PAPs – flooding (19.3%), drugs (16.7%), garbage collection (16.3%), and safety/security (13.2%). In Taguig, a high proportion of the PAPs stated that garbage collection was one of their main concerns, while in Manila, the main concern of the PAPs was safety and security, with 23.7% indicating it as one of the issues in their area. In Parañaque, garbage collection (33.9%) and water and sanitation (28.8%) pose as major issues. In the cities of San Pedro and Cabuyao, garbage collection and flooding were mentioned as the main concerns. However, in Biñan, most reported drugs (24.8%) as their main concern.

Table 3.4.40 Community issues among PAFs per LGU

LGU	Health	Water/ Sanitation	Flooding	Safety/ Security	Drugs	Job / Employment	Garbage Collection	Others	N/R	Total
Manila	104	298	94	442	164	69	335	217	142	1,865
%	5.6%	16.0%	5.0%	23.7%	8.8%	3.7%	18.0%	11.6%	7.6%	100.0%
Taguig	8	10	40	34	53	16	75	17	35	288
%	2.8%	3.5%	13.9%	11.8%	18.4%	5.6%	26.0%	5.9%	12.2%	100.0%
Parañaque	5	17	0	1	1	6	20	7	2	59
%	8.5%	28.8%	0.0%	1.7%	1.7%	10.2%	33.9%	11.9%	3.4%	100.0%
Muntinlupa	23	108	167	131	201	99	135	134	101	1,099
%	2.1%	9.8%	15.2%	11.9%	18.3%	9.0%	12.3%	12.2%	9.2%	100.0%
San Pedro	9	27	49	32	32	40	53	42	21	305
%	3.0%	8.9%	16.1%	10.5%	10.5%	13.1%	17.4%	13.8%	6.9%	100.0%
Biñan	31	125	460	332	573	184	321	167	118	2,311
%	1.3%	5.4%	19.9%	14.4%	24.8%	8.0%	13.9%	7.2%	5.1%	100.0%
Sta. Rosa	19	48	187	57	77	89	101	42	26	646
%	2.9%	7.4%	28.9%	8.8%	11.9%	13.8%	15.6%	6.5%	4.0%	100.0%
Cabuyao	11	20	25	9	13	14	6	9	2	109
%	10.1%	18.3%	22.9%	8.3%	11.9%	12.8%	5.5%	8.3%	1.8%	100.0%
Calamba	180	191	1331	575	924	417	940	536	398	5,492
%	3.3%	3.5%	24.2%	10.5%	16.8%	7.6%	17.1%	9.8%	7.2%	100.0%
Total	390	844	2,353	1,613	2,038	934	1,986	1,171	845	12,174
%	3.2%	6.9%	19.3%	13.2%	16.7%	7.7%	16.3%	9.6%	6.9%	100.0%

Source: JICA Design Team

3.4.7. Economic Profile

3.4.7.1. Local Economy

1668. In 2016, Makati City, considered as the financial district of the country, had the most revenue among the host cities to the project. Its revenue was approximately PhP 14.3 B. Manila City was next with PhP 12.8 B. Taguig City came in next with revenue of PhP 6.3 B (COA, Financial Profile, 2016). **Table 3.4.41** shows the financial profile of each host LGU.

Table 3.4.41 Classification of Provinces, Cities and Municipalities

Classification	Province	City	Municipality
First Class (1st Class)	Php 450M or more	Php 400M or more	Php 55M or more
Second Class (2nd Class)	Php 360M or more but less than Php 450M	Php 320 or more but less than Php 400M	Php 45M or more but less than Php 55M
Third Class (3rd Class)	Php 270M or more but less than Php 360M	Php 240M or more but less than Php 320M	Php 35M or more but less than Php 45M
Fourth Class (4th Class)	Php 180M or more but less than Php 270M	Php 160M or more but less than Php 240M	Php 25M or more but less than Php 35M
Fifth Class (5th Class)	Php 90M or more but less than Php 180M	Php 80M or more but less than Php 160M	Php 15M or more but less than Php 25M
Sixth Class (6th Class)	Below Php 90M	Below Php 80M	Below Php 15M

Source: DEPT OF FINANCE, DO 23-08

1669. For NCR, the sector with the highest average gross regional domestic product (GRDP) growth rate is the service sector. The region has zero activities under mining and quarrying, and lowest growth rate for fishing. On the other hand, Region 4A has the highest growth for service sector category for other services. The region has yet to recover from the 10% decrease in growth rate for its fishing activities.

Table 3.4.42 Gross Regional Domestic Product Growth Rates at Current Prices, 2013-2018

INDUSTRY/YEAR	13-14	14-15	15-16	16-17	17-18
NCR					
I.AGRICULTURE, HUNTING, FORESTRY & FISHING	**20.1**	**19.5**	**3.0**	**1.5**	**-1.7**
a. Agriculture and Forestry	20.6	19.7	3.0	1.5	-1.8
b. Fishing	-13.0	1.4	-2.0	3.7	10.0
II.**INDUSTRY SECTOR**	**5.7**	**7.4**	**4.2**	**2.1**	**6.3**
a. Mining and Quarrying	-	-	-	-	-
b. Manufacturing	7.8	6.2	6.7	5.7	0.7
c. Construction	-1.5	8.0	-0.3	-14.1	23.4
d. Electricity, Gas and Water Supply	7.2	11.2	0.4	6.6	11.7
III.**SERVICE SECTOR**	**9.7**	**8.1**	**10.6**	**10.3**	**9.0**
a. Transportation, Storage & Communication	8.2	11.5	10.3	4.9	7.9
b. Trade and Repair of Motor Vehicles, Motorcycles, Personal and Household Goods	8.7	7.4	9.9	11.1	8.7
c. Financial Intermediation	10.3	6.7	9.2	11.3	11.6
d. Real Estate, Renting & Business Activities	16.1	11.2	14.1	10.3	5.5
e. Public Administration & Defense; Compulsory Social Security	2.1	1.5	13.1	14.6	21.3
f. Other Services	6.3	7.4	7.2	7.6	8.1
GROSS DOMESTIC PRODUCT	**9.0**	**7.9**	**9.5**	**8.9**	**8.6**
REGION 4A - CALABARZON					
I.AGRICULTURE, HUNTING, FORESTRY & FISHING	**8.2**	**-0.8**	**5.9**	**8.5**	**0.5**
a. Agriculture and Forestry	13.4	-0.4	7.8	9.0	0.2
b. Fishing	-10.2	-2.8	-3.0	6.1	2.0
II.INDUSTRY SECTOR	**8.2**	**-0.5**	**1.4**	**8.0**	**12.1**
a. Mining and Quarrying	10.8	19.6	2.7	6.7	7.1
b. Manufacturing	8.9	-0.9	1.1	6.7	11.7
c. Construction	5.4	5.7	4.4	18.1	15.3
d. Electricity, Gas and Water Supply	2.9	-6.6	0.6	8.5	11.2
III.SERVICE SECTOR	**6.4**	**8.0**	**8.2**	**8.3**	**11.0**
a. Transportation, Storage & Communication	6.4	8.0	4.4	4.7	6.1
b. Trade and Repair of Motor Vehicles, Motorcycles, Personal and Household Goods	8.1	5.3	7.2	6.4	11.8
c. Financial Intermediation	3.2	7.1	9.3	10.2	13.7
d. Real Estate, Renting & Business Activities	6.9	8.5	8.8	9.0	8.8
e. Public Administration & Defense; Compulsory Social Security	2.9	2.0	12.5	14.0	20.7
f. Other Services	4.5	14.8	11.4	10.7	14.1
GROSS DOMESTIC PRODUCT	**7.6**	**2.3**	**4.1**	**8.1**	**11.0**

Source: The Gross Regional Domestic Product, Philippine Statistics Authority

1670. Majority of the affected LGUs are mainly involved in trade and industry due to their urban nature and presence of business districts. Economic activities involve manufacturing, general merchandise, services, and retail trade. In spite of this, LGUs in Laguna are still involved in the agricultural sector with activities ranging from fishing, crop production, and livestock. In the past decades, there has been a shift in the land use of some NCR LGUs due to the transfer of industrial companies to Laguna encouraged by wider available land, lower taxes imposed to the private sector by the LGU, and tax incentives for special economic zones.

Table 3.4.43 Financial Profile, Calendar Year 2016

LGU	Income Class & Revenue*	Primary sectors	Main Economic Activities	Industrial Estate	Shopping Malls	Tourist area
Manila	1st class 12,832,646	Service Industry	Manufacturing - Textile, food, personal products, chemical/pharmaceutical, rubber/plastic Services – leisure, amenities	None	Robinsons Place Manila	Intramuros Rizal Park
Makati	1st class 14,266,491	Commerce and Trade	General merchandise, services, real estate	TECO Industrial Plant	Glorietta Malls, SM Makati, Rustan's	Ayala Museum Makati Museum Guadalupe Ruins
Taguig	1st class 6,318,460	Trade and Industry	General merchandise, services, food industry, medical services	Food Terminal Incorporated Special Economic Zone (SEZ), AFP-RSBS Industrial Park Fort Bonifacio Global City (business, financial, and lifestyle district)	SM Aura Market! Market!	Mind Museum Fort Bonifacio (military camp)
Parañaque	1st class 4,819,981	Agriculture and Industry	Fisheries, manufacturing, clothing industry, tourism	None	SM BF Parañaque, SM Bicutan, SM Sucat, Pergola Mall, Solaire Resort, City of Dreams, Okada Manila	Baclaran Church, Las Piñas-Parañaque Critical Habitat and Ecotourism Area
Muntinlupa	1st class 4,553,378	Trade and Industry	Commercial, information technology, service-oriented establishments, education	None (patches of industrial areas but no industrial estate)	Festival Supermall, Starmall, Vista Malls, SM Muntinlupa, Madison Mall	Jamboree Lake, Muntinlupa Museum, River Park, Sucat People's Park
San Pedro	1st class 1,105,909	Industry Agriculture	Manufacturing Agriculture – fishing, farming, poultry, livestock	None	Robinsons Galleria South, Harmony Village Mall, SM City San Pedro	Santo Sepulcro Shrine, TAT Pilipinas Golf Course,
Biñan	1st class 1,798,628	Industry and Services	Manufacturing, construction, energy, water, wholesale and retail trade	Laguna International Industrial Park, Ayala Land Inc., Laguna	Central Mall, Southwoods Mall, Pavilion Mall, Robinsons Mall	Splash Island Resort, Southwood Golf Course, Ancestral houses

LGU	Income Class & Revenue*	Primary sectors	Main Economic Activities	Industrial Estate	Shopping Malls	Tourist area
				Technopark Annex,		
Sta. Rosa	1st class 2,930,873	Industry Agriculture	Manufacturing – cars/vehicle Agriculture - fishing	Laguna Technopark Inc., Greenfield Auto Park, Santa Rosa IT Park, Toyota SEZ	Solenad, SM Sta. Rosa, Vista Mall, Robinsons Mall, Crosstown Mall, Paseo de Santa Rosa	Enchanted Kingdom, Nuvali Park, Museo de Sta. Rosa, Marcos Twin Mansion
Cabuyao	1st class 1,664,572	Industry	Manufacturing Services	Light Industry and Science Park	Centro Mall, Walter Mart, Ataw Shopping Center, Centennial Plaza	Poor Clare's Monastery, St. Policarp's Parish, Sta. Elena Golf Course and Country Club, Light Industry and Science Park
Calamba	1st class 3,170,264	Industry, Trade, Tourism, Agriculture	Manufacturing (computer products, food and consumer, garments and textile), wholesale/retail trade, local tourism	Calamba Premiere International Park, Carmelray International Business Park, Carmelray Industrial Park 1 & 2, Filinvest Technology Park, YTMI Realty SEZ, SMPIC SEZ	CityMall, SM Calamba, Walter Mart, Lianas Shopping Centre, Checkpoint Mall, Carolina Mall,	Hot spring resorts, Mount Makiling Forest Reserve, Laguna de Bay, Rizal's Tallest Monument
Pasay	1st class 3,535,557	Commerce and Trade Institutional	Commercial Services Transportation (International Airport)	Formerly part of military base (Philippine Air Force). Includes Newport City (lifestyle district), NAIA Terminal 3		

*in Thousand Philippine Pesos
Source: Republic of the Philippines, Commission on Audit, Financial Profile Calendar Year 2016, 2016 Annual Financial Report, Google Maps 2019

3.4.7.2. Labor Force and Employment

(1) Labor Force and Employment Profiles

1671. Due to unavailability of city-level data, regional level data for NCR and Region 4A on labor force and employment are presented in **Table 3.4.44**. Through the recent years, both NCR and Region 4A had a decline in LFPR, while their unemployment rates also decreased. Employment rates for NCR for the past six years were fluctuating from 90.7% to 93.4%, while the employment rate for Region 4A went up every year.

Table 3.4.44 Labor Force and Employment Data

Labor Force Characteristics	2013	2014	2015	2016	2017	2018
NCR						
LFPR (%)	63.5	64.5	63.2	63.1	61.1	60.3
Employment Rate (%)	92.9	93.4	90.7	93.4	92.6	93.4

Labor Force Characteristics	2013	2014	2015	2016	2017	2018
Unemployment Rate (%)	7.1	6.6	9.3	6.6	7.4	6.6
Underemployment Rate (%)	19.3	18.4	8.8	18.3	9.3	7.2
Region 4 – CALABARZON						
LFPR (%)	64.5	65.5	65.1	64.2	63.7	62.7
Employment Rate (%)	90.8	92.0	92.1	92.8	93.0	93.4
Unemployment Rate (%)	9.2	8.0	7.9	7.2	7.0	6.6
Underemployment Rate (%)	17.9	18.6	16.5	15.5	14.0	13.4

Source: 2013- 2018 Labor Force Survey, Philippine Statistics Authority

(2) Income of Project Affected Families

1672. **Table 3.4.45** indicates that the PAPs had varying income levels, with 20.8% having a monthly income of Php 12,000 to Php 15,999, 13% had an income of Php 9,000-9,999, and 11% an income of Php 16,000-19,999. In the cities of Manila, Taguig, and Calamba, a higher proportion of PAPs earned from Php 12,000 to 15,999 monthly, with 22%, 25% and 19.7%, respectively. The same was observed in the city of Muntinlupa (24.6%), the city of San Pedro (16.4%) and the city of Biñan (21.3%). However, in the City of Santa Rosa and Cabuyao, the income level of the PAPs varied with higher proportions of PAPs with income belonging to (1) Php 12,000-15,999, (2) Php 8,000-9,999, and (3) Php 6,000-7,999.

Table 3.4.45 Income Bracket of PAFs

LGU	Income Bracket (in thousand Php)													
	>2	2-3.9	4-5.9	6-7.9	8-9.9	10-11.9	12-15.9	16-19.9	20-24.9	25-29.9	30-49.9	<50	N/R	Total
Manila	7	24	45	74	107	95	339	204	179	109	246	97	15	1541
%	0.5	1.6	2.9	4.8	6.9	6.2	22.0	13.2	11.6	7.1	16.0	6.3	1.0	100
Taguig	2	12	15	14	27	18	55	25	23	10	13	4	2	220
%	0.9	5.5	6.8	6.4	12.3	8.2	25.0	11.4	10.5	4.5	5.9	1.8	0.9	100
Parañaque	0	6	8	5	6	3	4	1	1	0	0	0	1	35
%	0.0	17.1	22.9	14.3	17.1	8.6	11.4	2.9	2.9	0.0	0.0	0.0	2.9	100
Muntinlupa	12	34	43	69	97	67	222	93	98	45	76	28	17	901
%	1.3	3.8	4.8	7.7	10.8	7.4	24.6	10.3	10.9	5.0	8.4	3.1	1.9	100
San Pedro	4	16	26	28	38	16	38	26	12	11	10	2	5	232
%	1.7	6.9	11.2	12.1	16.4	6.9	16.4	11.2	5.2	4.7	4.3	0.9	2.2	100
Biñan	22	89	126	211	315	226	406	176	117	70	98	22	29	1,907
%	1.2	4.7	6.6	11.1	16.5	11.9	21.3	9.2	6.1	3.7	5.1	1.2	1.5	100
Sta. Rosa	14	19	35	53	72	37	80	29	41	9	12	7	25	433
%	3.2	4.4	8.1	12.2	16.6	8.5	18.5	6.7	9.5	2.1	2.8	1.6	5.8	100
Cabuyao	2	7	8	11	14	5	15	7	2	2	5	0	0	78
%	2.6	9.0	10.3	14.1	17.9	6.4	19.2	9.0	2.6	2.6	6.4	0.0	0.0	100
Calamba	49	120	200	341	579	439	844	505	460	198	367	118	71	4,291
%	1.1	2.8	4.7	7.9	13.5	10.2	19.7	11.8	10.7	4.6	8.6	2.7	1.7	100
Total	112	327	506	806	1,255	906	2,003	1,066	933	454	827	278	165	9,638
%	1.2	3.4	5.3	8.4	13.0	9.4	20.8	11.1	9.7	4.7	8.6	2.9	1.7	100

Source: JICA Design Team

1673. **Table 3.4.46** shows the distribution of primary source of household income for all PAPs. This resulted to a big percentage (73%) for wage-based income. This is followed by enterprise-based (921.54%), and remittance-based (2.03%)

Table 3.4.46 Primary Source of Household Income

LGU	Land-Based	Wage-Based	Enterprise Based	Remittance-Based	Others	Total
Manila	30	5,757	1,470	203	428	7,888

LGU	Land-Based	Wage-Based	Enterprise Based	Remittance-Based	Others	Total
Makati	0	240	77	6	17	340
Taguig	2	421	116	14	8	561
Parañaque	0	206	58	25	0	289
Muntinlupa	5	1,529	479	33	50	2,096
San Pedro	2	340	132	8	13	495
Biñan	7	2,314	740	43	25	3,129
Sta. Rosa	8	467	163	6	8	652
Cabuyao	6	128	44	1	5	184
Calamba	23	3186	1029	67	63	4,368
Total	**83**	14,588	4,308	**406**	617	20,002
%	0.41	72.93	21.54	2.03	3.08	100.00

Source: JICA Design Team

3.4.8. Transportation Network

3.4.8.1. Inter-region Networks

(1) Air

1674. The Manila International Airport (MIA), located in Pasay City, is accessible to the project-affected cities through Epifanio Delos Santos Avenue (EDSA) and South Luzon Expressway (SLEx). The MIA, with four terminals, is currently the largest airport operating in the Philippines. Two of its terminals, terminal 2 and 4, cater only to domestic flights while terminals 1 and 3 cater to both domestic and international flights. As of 2018, the airport serviced 36 airlines which made a total of 72,897 arriving domestic flights, 72,984 departing domestic flights, 56,854 arriving international flights, and 56,963 departing international flights.

(2) Highways

1675. The major roads that provide access to the affected cities and their neighboring LGUs are the EDSA, C-5, C-6, SLEx, Skyway, and Manila South Road. EDSA is a 23.8 km road providing inter-city access to the cities of National Capital Region (NCR). Metro Rail Transit Line 3 (MRT-3) also runs along EDSA. The C5 and C6 are two of many major circumferential roads conveying traffic in and out of Metro Manila and surrounding cities/municipalities. The SLEx is an expressway that connects the NCR to Region 4 where Laguna is located. On the first segment of SLEx runs a 31km parallel elevated toll expressway called Skyway. Manila South Road, also known as the Old National Highway, is a 27.3km highway that forms a component of the Pan-Philippine Highway network (AH26), running from Muntinlupa to Laguna passing through the following cities: San Pedro, Biñan, Sta. Rosa, and Calamba.

(3) Railways

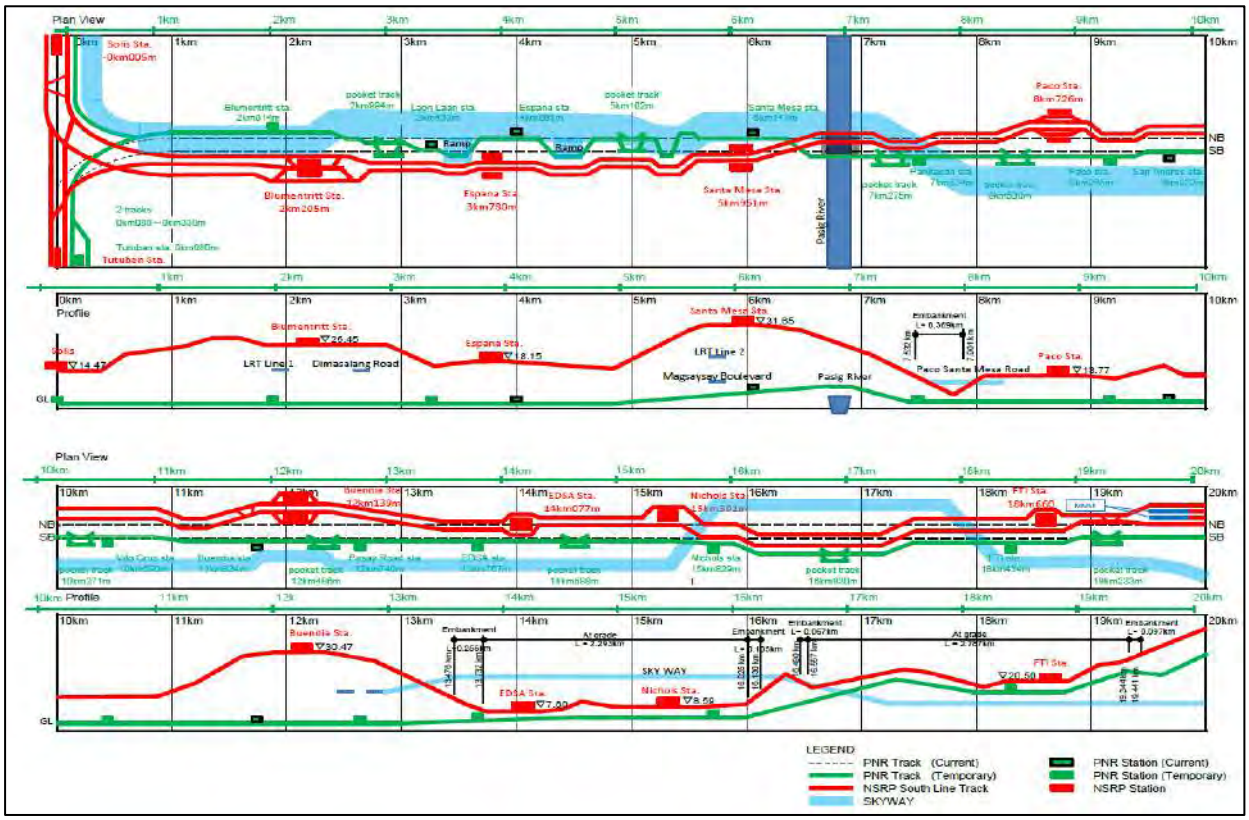
1676. There are four existing rail transport systems with stations in the affected LGUs: PNR South Line, Light Rail Transit (LRT) Lines 1 and 2, and Metro Rail Transit Line 3 (MRT-3). The PNR traverses nine of the ten affected cities, from Manila City to Biñan, Laguna. LRT Lines 1 and 2 have stations only in Manila City, and the MRT-3 has stations in Makati City.

1677. The PNR is a railway company owned by the Philippine Government that operates a commuter line service in Metro Manila and another line to the Bicol Region. The Metro Manila line, also known as Metro Commuter Line, has two train routes: Tutuban-Alabang (South) and Gov. Pascual-FTI (North). The South line has a total of 17 stations with an estimated travel time

of two hours while the North line has a total of 18 stations. In 2010, PNR carries 8,000 passengers daily through its commuter line service.

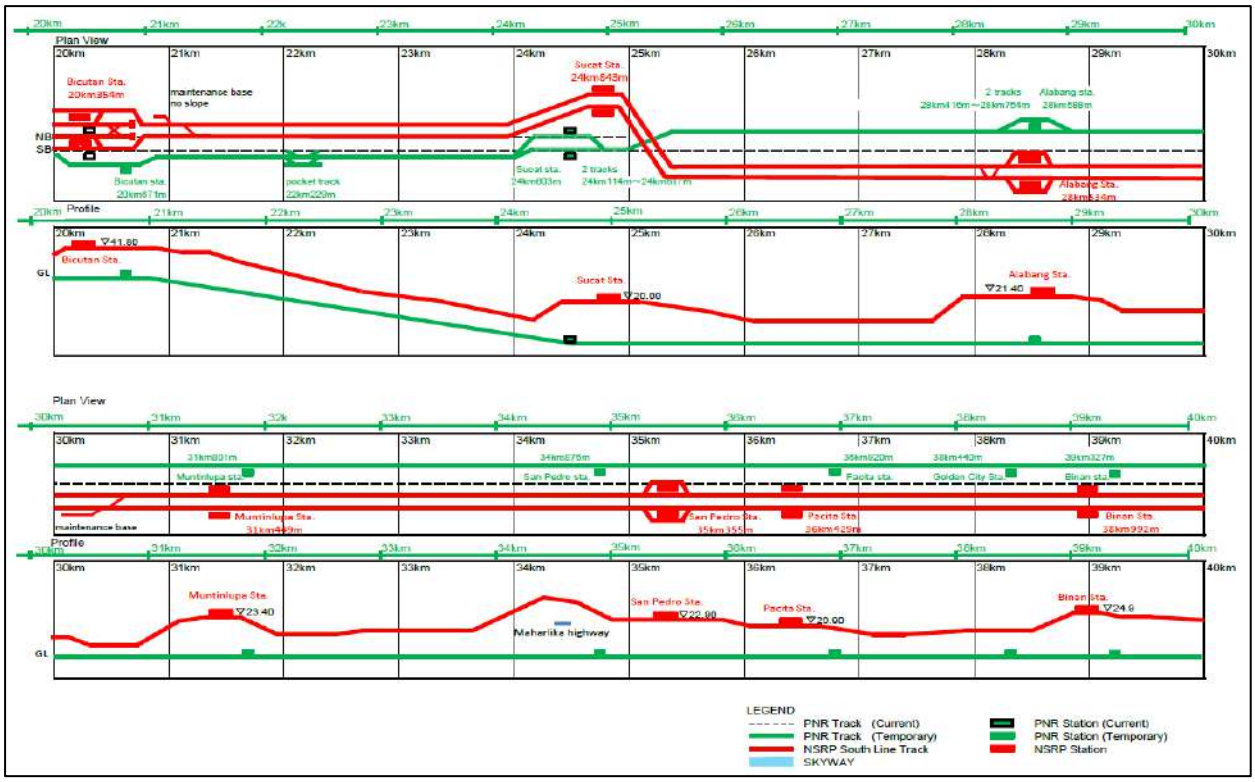
1678. Light Rail Transit Line 1 (LRT1) originally operates from Taft Avenue to Monumento with eighteen (18) stations. In October 2010, its north extension project began commercial operations up to Roosevelt with two (2) additional stations. Soon, LRT 1 will connect with the EDSA MRT 3 at North Avenue. In 2011, LRT 1 has an average total daily passenger boarding of 435,121. The Sen. Gil Puyat Station of LRT 1 directly serves Makati commuters. Light Rail Transit Line 2 (LRT 2), with an average daily ridership of 180,000 passengers, runs along the R-6 Corridor and is connected to both LRT1 and MRT3. Metro Rail Transit 3 (MRT 3) is also known as EDSA MRT because it runs almost the entire stretch of EDSA. This is thus far the most important rail system that serves Makati since four (4) of its stations are located inside the city. With estimated peak-hour passenger volume in 2011, these stations include Guadalupe (5,463 passengers); Sen. Gil Puyat (3,499 passengers); Ayala (6,247 passengers) and, Magallanes (5,130 passengers) (Makati City, CLUP 2013-2023).

1679. The PNR Railway line at grade will continue to be used for a long-haul service and a freight service. Where the location of the line conflicts with the construction of the Project the line will be diverted by the proponent onto a new track alignment. The services will continue to run during the construction phase through realigning existing tracks. An outline diversion plan of exiting PNR tracks is shown in **Figure 3.4.3** to **Figure 3.4.5**.



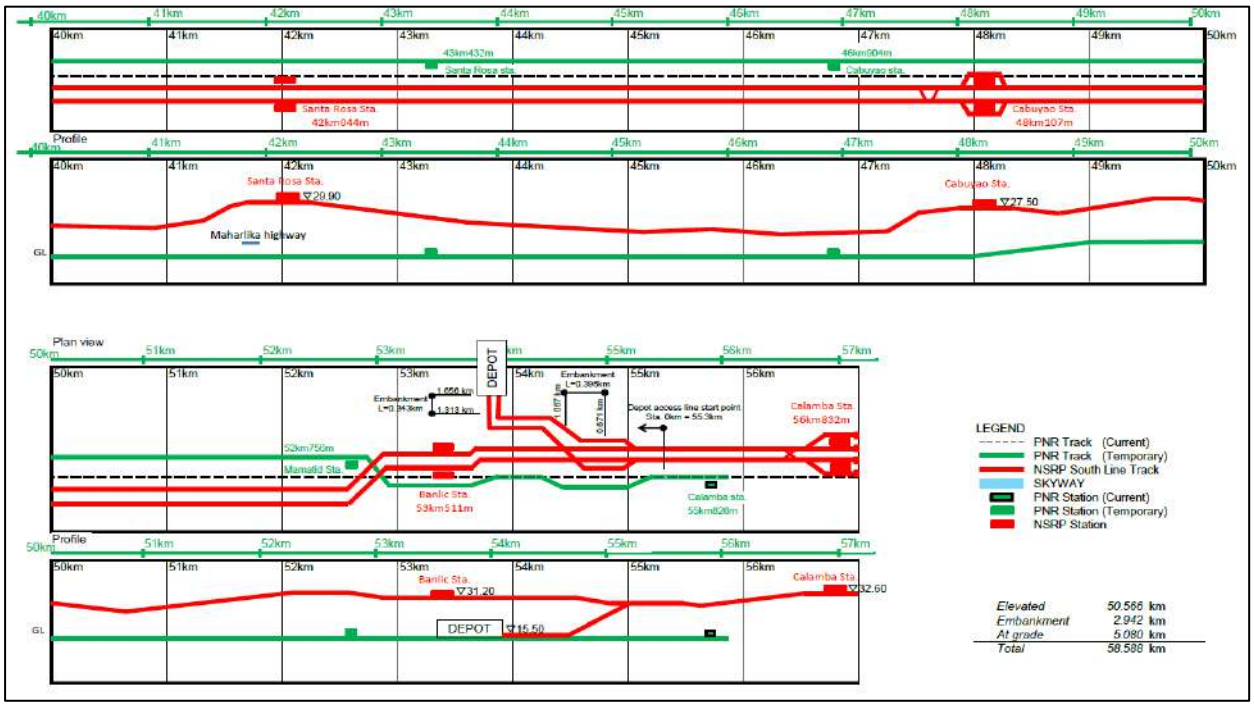
Source: JICA Design Team

Figure 3.4.3 Outline diversion plan of exiting PNR tracks (1 of 3)



Source: JICA Design Team

Figure 3.4.4 Outline diversion plan of exiting PNR tracks (2 of 3)



Source: JICA Design Team

Figure 3.4.5 Outline diversion plan of exiting PNR tracks (3 of 3)

1680. In addition to the four existing rail transport systems operating within the affected LGUs, the Metro Manila Subway (MMS) is already under construction and is expected to be fully operational by 2025. It has a total of 15 stations where one is located adjacent with the PNR Line (Senate Station). The SCRP and MMSP are envisioned to be seamlessly connected at the Senate Station, providing easy and convenient rail transfer of passengers between the two rail lines. Based on the passenger demand forecast conducted by JICA Design Team, by 2025, the peak hour boarding plus alighting passenger generation of Senate Station is at 7,552 passengers.

(4) Local network

1681. The DPWH classified the national road into three (3), namely: Primary, Secondary and Tertiary. National Primary Roads include roads that directly connect major cities (at least around 100,000 people). National Secondary Roads include roads that directly connect cities to national primary roads, except in metropolitan area and roads that directly connects major ports and ferry terminals to national primary road, among others. National Tertiary Roads are the existing roads under DPWH which perform a local function. **Table 3.4.47** presents the national road classification.

Table 3.4.47 National Primary, Secondary and Tertiary Road Classification

National Primary: a. Directly connects Major Cities (at least around 100,000 people); Cities within Metropolitan Areas are not covered by the criteria
National Secondary: a. Directly connects Cities to National Primary Roads, except in Metropolitan Area b. Directly connects Major Ports and Ferry Terminals to National Primary Road c. Directly connects Major Airports to National Primary Road d. Directly connects Tourist Service Centers to National Primary Roads or other- e. Directly connects Cities (not included in the category of Major Cities) f. Directly connects Provincial Capitals within the same Region g. Directly connects to Major National Government Infrastructure to National Primary h. Roads or Other National Secondary Roads
National Tertiary: a. Other existing roads under DPWH which perform a local function

Source: https://psa.gov.ph/content/road-classification (Date Retrieved: 04/26/18)

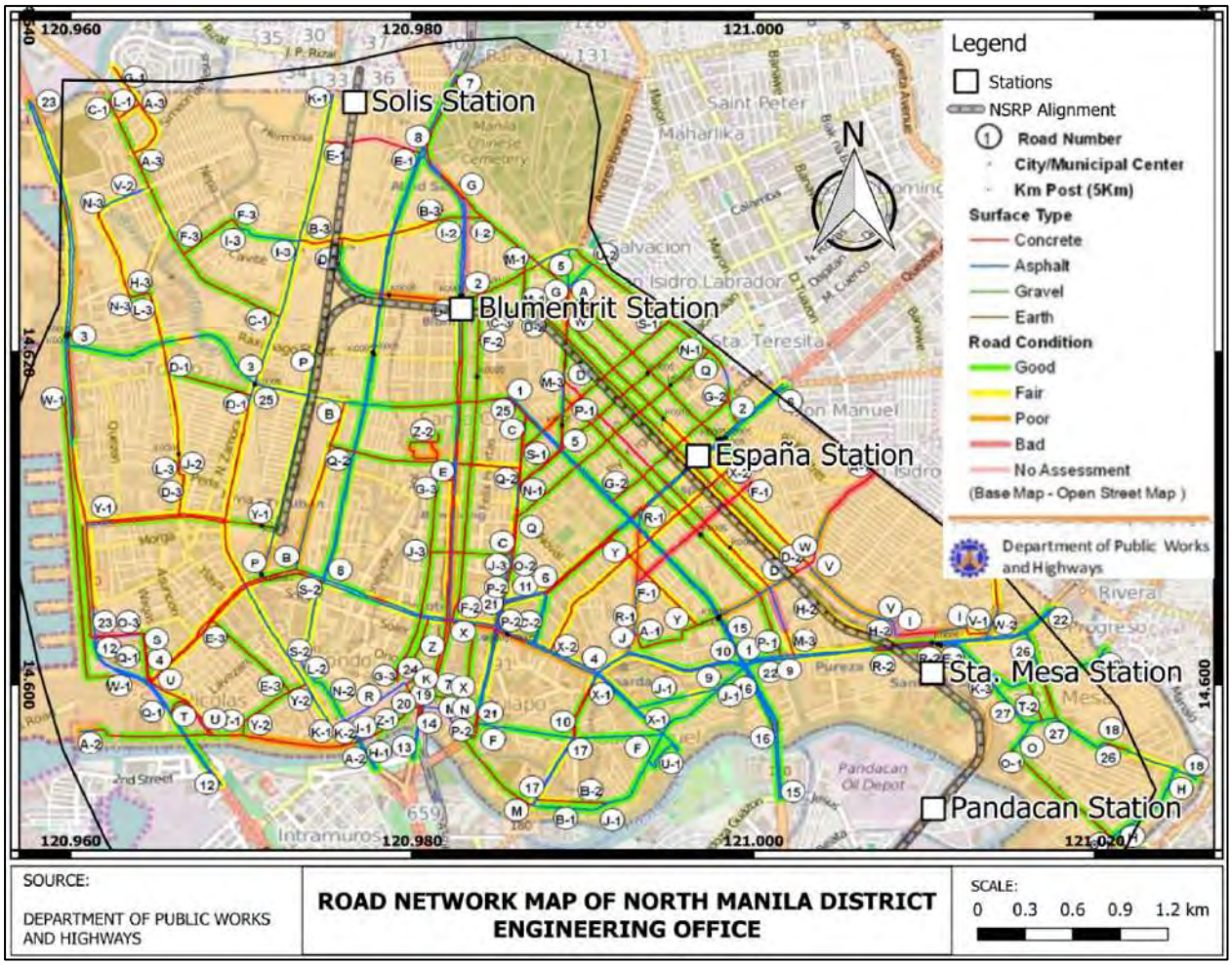
Manila

1682. The entire road network in Manila City is composed of about 770 km of roads, less than 3% of which remains unpaved. Roads and street are administratively classified as national and local.

1683. The total number of city streets in Manila is 1,580 with a total length of 553.07 km and occupying a total area of 3,644,000 square meters. The total number of national roads is 258 with a total length of 240.5 km and occupying a total area of 3,162,000 square meters.

1684. Major modes of land public transport in Manila are bus, taxi, FX, jeepney, and tricycle while informal land transport systems are *kalesa*, pedicab and *kuliglig*. The PNR and the LRTA operate the railway systems in Manila. The PNR has six (6) terminals or stations within Manila, which includes Blumentritt, España, Laong Laan, Pandacan, Pedro Gil, and Tutuban. The LRT-1 (Yellow Line) that runs along the length of Taft Avenue (R-2) and Rizal Avenue (R-9), and the LRT-2 (Purple Line) that runs along Ramon Magsaysay Blvd (R-6) are the only mass rail rapid transit lines traversing Manila. As the chief seaport of the Philippines, the Port of Manila along Manila Bay served as the city's main entry/exit point accessible via passenger/ cruise ships, while the Pasig River can be traversed via ferry service.

1685. According to Origin Destination Matrix (O-D), Manila ranks second to the top generators of trips, accounting for about 11% of the total Trip Origins and about 12% of Trip Destinations within the sixteen (16) zones considered.



Source: DPWH[4]

Figure 3.4.6 Road Network of North Manila District

[4] http://www.dpwh.gov.ph/dpwh/atlas/2015%20DPWH%20Road%20Data/Road%20Data%202015/north_manila.htm (04/24/18)

Source: DPWH[5]

Figure 3.4.7 Road Network of South Metro Manila District

[5] http://www.dpwh.gov.ph/dpwh/atlas/2015%20DPWH%20Road%20Data/Road%20Data%202015/north_manila.htm (04/24/18)

Makati

1686. Makati is a major traffic generator for the greater Metropolitan Manila Area because it is the primary Central Business District (CBD) of the country. The city attracts a large amount of vehicle traffic due to its relatively large resident population and its predominantly service-oriented economy. Therefore, the city regulates the in-bound and out-bound traffic during the morning and afternoon peak hours, respectively. Mobility and accessibility is one of Makati's most important requirements. However, continuing population growth, economic development, and corresponding increases in vehicular trips that are internally generated or are passing through the city have constrained regional accessibility and local circulation. It is, therefore, a great concern that any further development in the city must be sustainable in terms of its traffic carrying capacity, or programs are identified to mitigate potential severe congestion.

1687. The city's road network is part of a system of circumferential and radial roads of Metro Manila. Traffic congestion within Makati is compounded by the fact that major expressways exist in north and south of Metro Manila, but they are not interconnected. As a result, north and south through traffic is fed to major roads that are at the same time the major gateways to Makati.

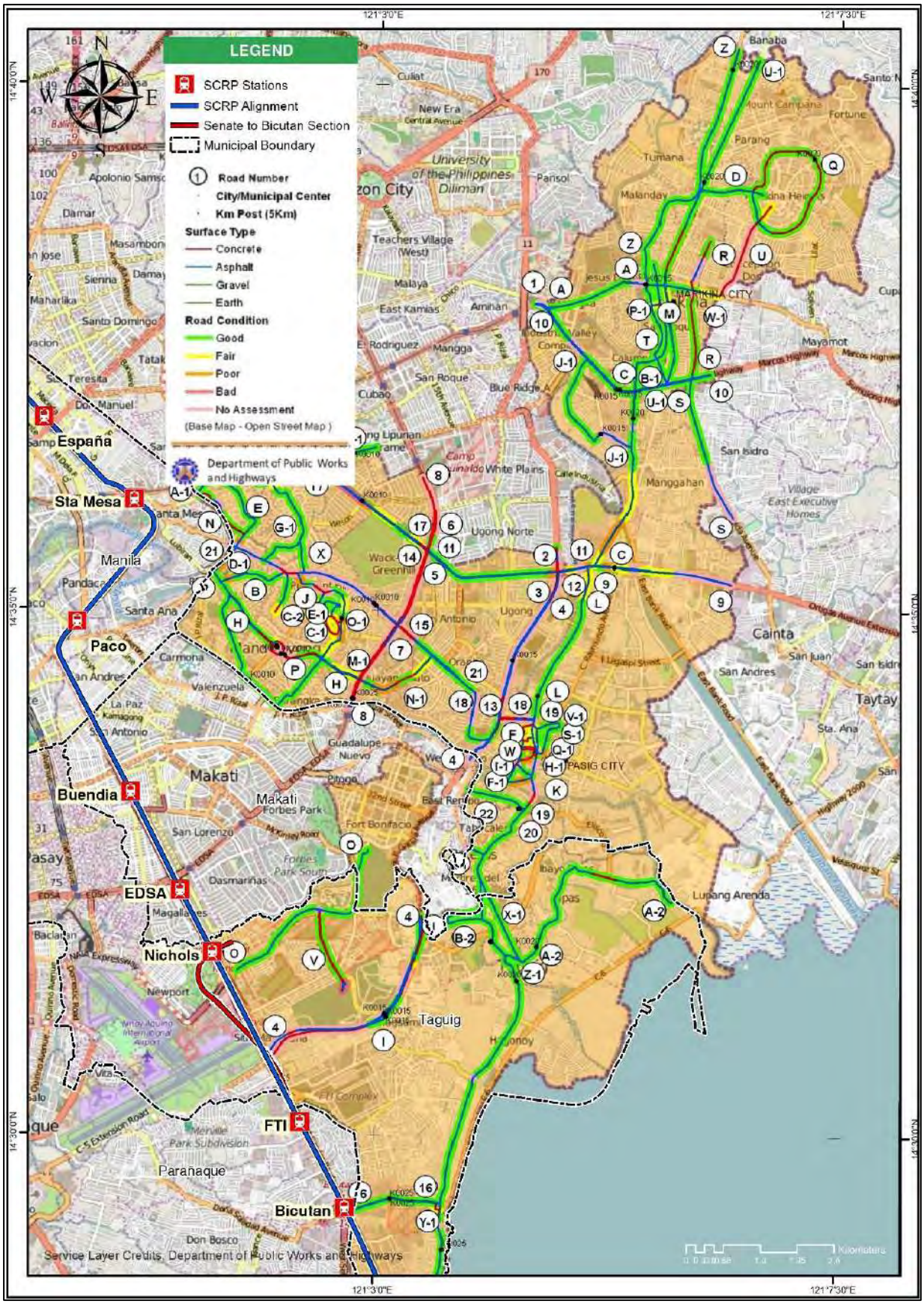
1688. These gateways are Roxas Boulevard, Osmeña Highway, EDSA, and C5. Among these roads, EDSA is the busiest with 170,000 vehicles per day along the stretch from Guadalupe Bridge to Sen. Gil Puyat Avenue. Next is C5 with 136,000 vehicles per day within the vicinity of Kalayaan Avenue and Fort Bonifacio. Osmeña Highway has 115,000 vehicles per day within the Don Bosco area, while Roxas Boulevard has 75,000 vehicles per day within the segment south of Sen. Gil Puyat Avenue.

1689. The transit systems in the city are road-based (jeepneys and buses) and rail-based (rail). For road-based transit, jeepneys are taken mainly for local circulation while buses, with the exception of Fort Bus, are regional in scope and service. Rail-based transit lines that serve Makati are all part of the regional system. This includes the LRT 1, MRT 3, and the PNR.

Taguig

1690. At present, Taguig is served only by South Super Highway to the west and R4 to the north with C5 in-between. There is limited access to all three (3) from the most populated regions of the city. Given Taguig's large area and population, these few links to regional travel routes are far from sufficient. Within Taguig, only one (1) sub-standard roadway connects most of the barangays, and most streets are too narrow to handle the current traffic load.

1691. Transportation is already a problem within Taguig, with narrow streets, a lack of through-roads, and heavy traffic loads. The growing population and new development will only further burden an already inadequate system. The Strategic Concept Plan recommends a series of improvements, both long term and short term, with the goal of having a well-integrated and hierarchal differentiated road network. Better public transportation systems with connections to other parts of the metropolitan region are also proposed.



Source:http://www.dpwh.gov.ph/dpwh/atlas/2015%20DPWH%20Road%20Data/Road%20Data%202015/north_manila.htm (04/24/18)

Figure 3.4.8 Road Network of First District of Metro Manila

Parañaque

1692. Public Transportation vehicles plying along the main thoroughfares within the city are the taxis and jeepneys. Public buses are plying along the South Super Highway, Coastal Road and the northern part of the city. In residential areas, tricycles and the pedicabs are the most common means of transporting passengers and their loads. The present number of public utility vehicles is reasonable enough to accommodate the demand of the population.

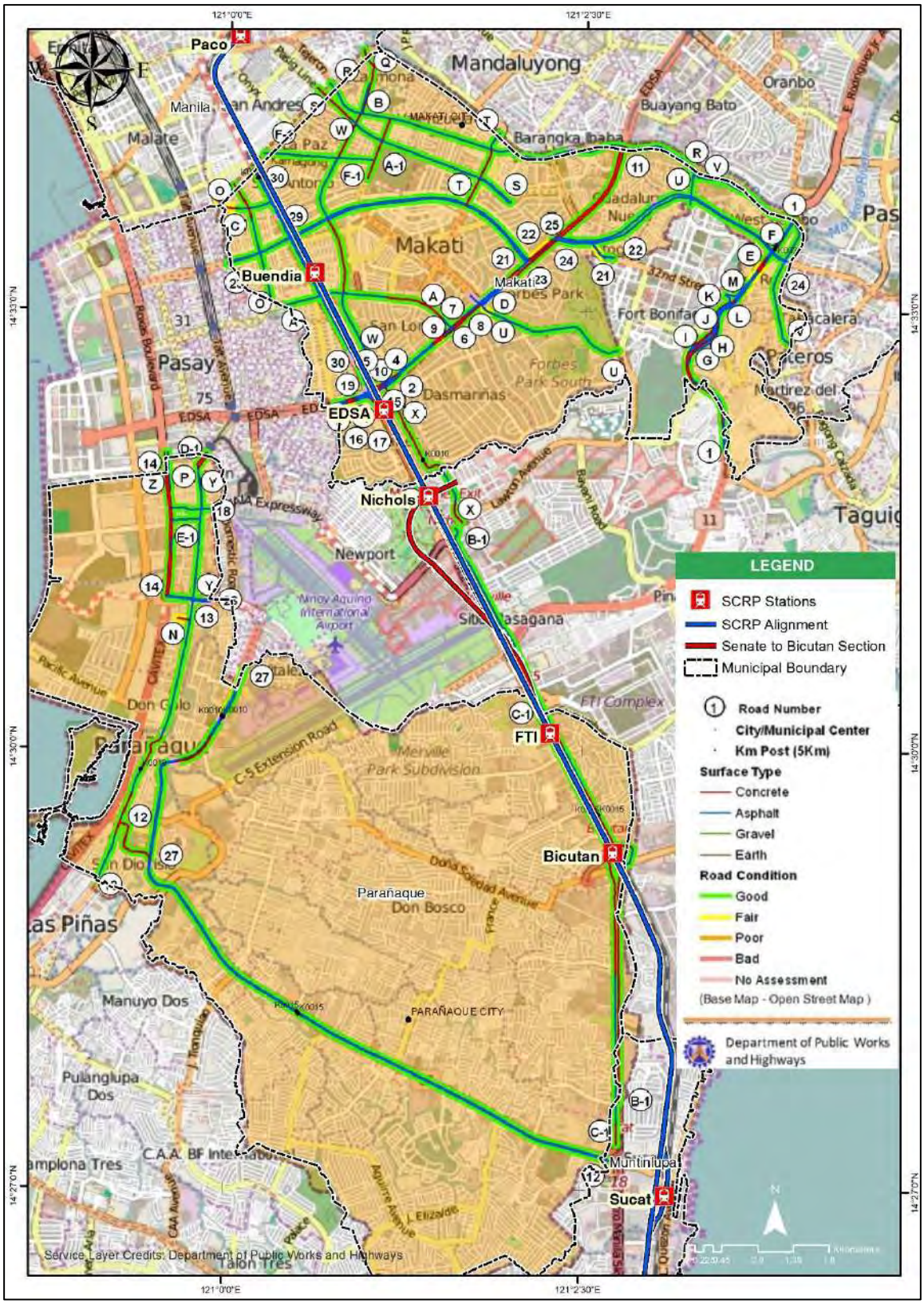
1693. The overall road network of the city is 358.186 km. The road network in general is better condition and very passable.

1694. The southern segment of C-5 is a component of the major road system of Metro Manila that will connect Radial Road in Parañaque to Radial Road-4 in Makati, traversing along NAIA, crossing the South Luzon Tollways (SLT) by overpass/flyover and leading to the southern portion of Fort Bonifacio Military Reservation.

1695. The fastest alternative road from Alabang to Buendia during rush hours is the Metro Manila Skyway. The Skyway is a “package system”: the elevated highway plus the South Luzon Tollways which will be upgraded. Motorists choosing the Skyway will enjoy a smooth uninterrupted drive from Alabang all the way to Makati. On the other hand, motorists who choose the South Luzon Tollway will find traffic flow faster since other motorists will opt for the Skyway.

1696. The City Government of Parañaque has already addressed the perennial traffic problem along the corner of Dr. A. Santos Avenue and the East Service Road by implementing a strict no parking rule for public utility vehicles within that area. Along Bicutan Interchange, it has successfully devised a re-routing scheme in the area and traffic has been contained to a manageable level. With coordination with other government agencies, most notably the MMDA, it hopes to find better solutions to other congested areas of the city.

1697. Areas identified as traffic-congested are entry/exits of municipalities namely: Bicutan (Brgy. San Martin de Porres), Sucat Interchange (Brgy. BF), Canaynay Avenue/Evacon (Brgy. San Dionisio along DASA), Kabihasnan Road (Brgy. San Dionisio along Quirino Ave.), MIA Road (Brgy. Tambo along Quirino Ave. and along Coastal Road), and Baclaran Rotonda (Brgy. Baclaran).



Source: DPWH[6]

Figure 3.4.9 Road Network of Second District of Metro Manila

6 http://www.dpwh.gov.ph/dpwh/atlas/2015%20DPWH%20Road%20Data/Road%20Data%202015/north_manila.htm (04/24/18)

Muntinlupa

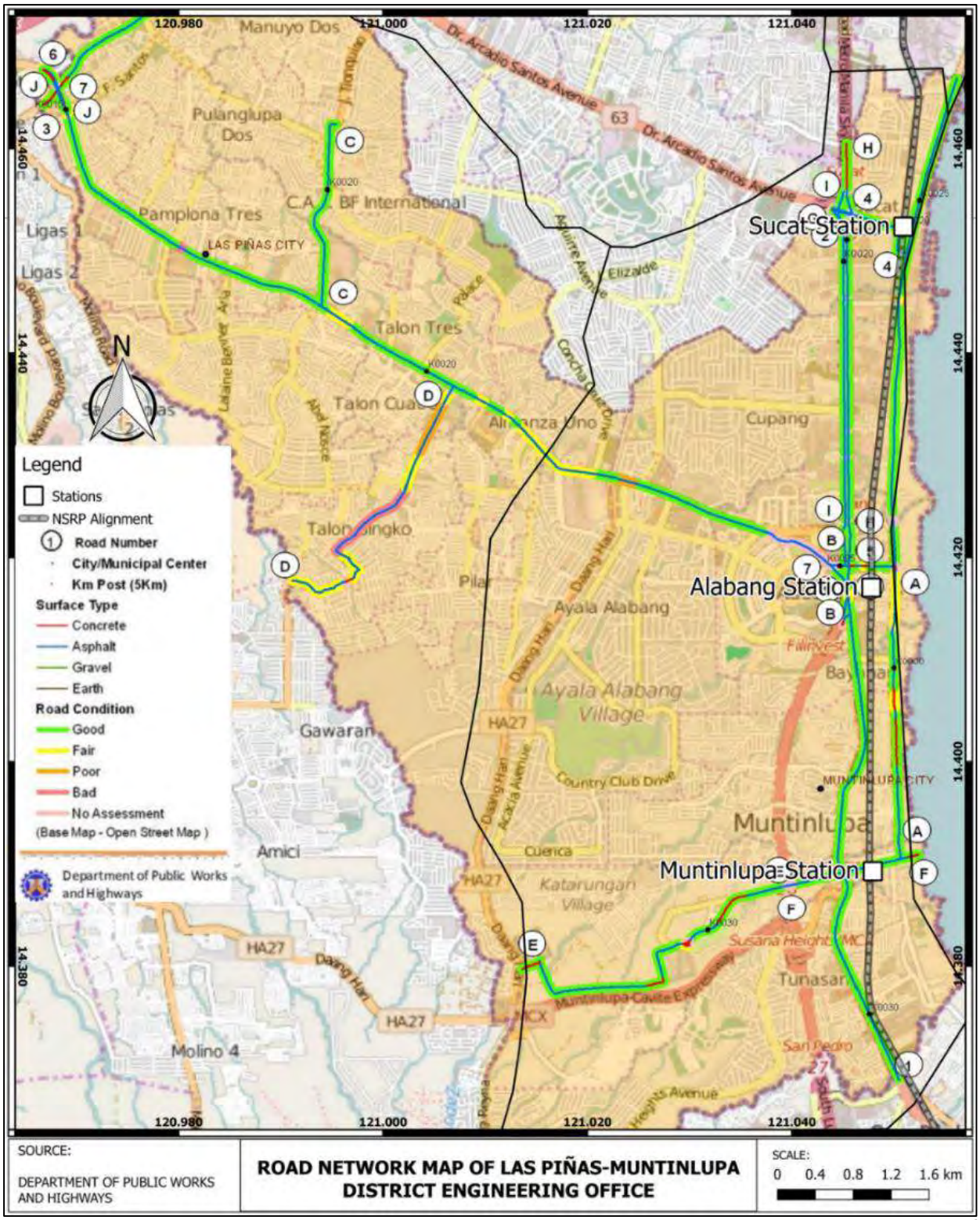
1698. Buses have stations in Starmall Alabang and South Station Alabang which have routes passing through EDSA to Quezon City, Navotas or Valenzuela. Provincial buses are found in South Station Alabang which have routes to Batangas City, Lucena, Quezon, and even to Bicol Region. Buses also pass through the Alabang viaduct from EDSA to Pacita Station.[7] Jeepneys have stations in Starmall Alabang and South Station Alabang which have routes to General Mariano Alvarez in Cavite, Calamba and Pasay going through Metro Manila Skyway, Alabang-Zapote Road, or National Road (Maharlika Highway). Tricycles and pedicabs serve the interior of barangays and residential areas.

1699. The city is traversed by the PNR. PNR Terminals in Muntinlupa City include Sucat Station (along Meralco Road), Alabang Station (along T. Molina Street at the back of Starmall), and Muntinlupa Station (Rizal Street).

1700. Traffic in Cavite, Las Piñas, and especially in the City of Muntinlupa have been decongested with the aid of the Muntinlupa-Cavite Expressway (MCX), which connects the SLEx and the Daang Hari Road, has recently been completed. It is a sample of a successful Private-Public Partnership (PPP) between Ayala Corporation and DPWH. It involved the construction of a 4-kilometer, 4-lane paved toll road, passing through the NBP reservation that connects Bacoor, Cavite to SLEx. Travel time from Daang Hari to Alabang interchange is reduced by an average of 45 minutes.

1701. The proposed Laguna Lake Expressway Dike (LLEd) Project is currently on the process of consultation evaluation and preparation for bidding. The project will provide a high standard highway cum dike that will facilitate traffic flow and mitigate flooding in the western coastal communities along Laguna Lake, from Bicutan, Taguig in Metro Manila through Calamba to Los Baños in Laguna. The proposed alignment runs 500 meters away but following the shoreline of the Laguna Lake.

[7] Muntinlupa. Wikipedia. URL: https://en.wikipedia.org/wiki/Muntinlupa#Public_utility_vehicles



Source: DPWH[8]

Figure 3.4.10 Road Network of Las Piñas Muntinlupa District

[8] http://www.dpwh.gov.ph/dpwh/atlas/2015%20DPWH%20Road%20Data/Road%20Data%202015/north_manila.htm (04/24/18)

San Pedro

1702. Buses with lines from Metro Manila serve the city. Jeepneys provides service between the city and nearby areas and the city's barangays. Tricycles and pedicabs serves the barangays and subdivisions (gated communities). The existing PNR railroad lines traversing the city also provide mobility for the San Pedro populace. The PNR has two stations in San Pedro; namely: San Pedro Station and Pacita MG Station.

1703. San Pedro City is accessible by land from its adjoining municipalities. It is approximately 29 kilometers from Manila via South Superhighway and 61 kilometers from Sta. Cruz, the provincial Capitol. The City's circulation system is made up of a network of radial and circumferential roads, which link the city. The major arterial road, which traverses through the central business district of the town, is the National Highway connecting the cities of Biñan and Muntinlupa.

1704. In addition to the arterial road, the city is also served by a single loop of collector road around the town, which is being maintained by the national government. At present, this road links most of the barangays of San Pedro including those in the Resettlement Area and the villages/subdivisions as well. As designed, this road start from the major urban road, Mabini Street, and then pass through Magsaysay Road upwards to Narra Road, Holiday Hills, then to the Resettlement Area to Calendola Village to Barangay San Vicente and back to A. Mabini.

1705. Meanwhile, service roads, which branch out of this collector road, serve as the access of the population from the majority of the neighborhood nits as well as from the existing industrial establishments to the other portions of the city.

1706. Finally, on the western middle part of San Pedro is the South Expressway, which runs from Magallanes to Calamba. This extension does not, however, have an interchange exclusively to and from San Pedro passing through South Expressway. From the North, the nearest entry is the Susana Heights interchange and from the South, the nearest entry is the Southwoods interchange and vice-versa.

Biñan

1707. Public transportation within the city is facilitated mostly by jeepneys. Tricycles and the motor-driven three-wheeled pedicabs are used for short trips or distances. Subdivisions may either be accessed via multicab shuttles and tricycles. The PNR currently operates a commuter line from Tutuban, Manila to Cabuyao, Laguna.

1708. The City of Biñan can be accessed through these main roads: 1 National road (South Luzon Expressway) which serves Northern and Southern Luzon; two (2) regional/provincial roads (Old National Highway serving the Province of Laguna and CALAX Expressway serving Cavite and Laguna); and three (3) SLEx junctions (San Francisco/Southwoods Exit, Carmona Exit, and Mamplasan Exit.

1709. Access/ circulation limitations are presented by narrow roads, traffic congestion in and around the poblacion, and right-of-way problems. Traffic congestion on the Old National Road southeast of the intersection is due to the crossing of traffic on the P. Burgos Street, Gen. Capinpin Street and San Vicente Road/J. Gonzales Street. Traffic is heavy in front of the University of Perpetual Help during traffic hours due to the private cars and public vehicles waiting for the students to come out. Main traffic at Southwoods Ave. occurs at Rotonda and Rosario Complex road towards the City of San Pedro.

Sta. Rosa

1710. A grid network of roads, a railway and a ferry system define the movement systems in Santa Rosa. These systems shall be closely inter-connected and provided with adequate transition (such as enhanced accessibility to PNR terminals and the proposed ferry station) in order to maximize their service potentials.

1711. Santa Rosa may be seen as being divided into three major sectors: eastern, central and western. These divisions are defined by existing major roads and development patterns. The eastern sector is defined by areas east of the Manila South Road. The city center has since been expanding along the Manila South Road. This sector is also the site of the city hall, is the central business district and is where most of the old residential areas of Santa Rosa may be found. The area is traversed by the Philippine National Railway's (PNR) south line with an inactive passenger station located near the Poblacion.

1712. The central sector is wedged in between the SLEx and the Manila South Road. This is a relatively new development area and may be characterized by the presence of idle lands, sporadic agricultural areas, sprawling subdivisions, commercial and industrial establishments as well as the Enchanted Kingdom.

1713. The western sector is between the city of Silang and the SLEx. It is a fast urbanizing area and is characterized by sprawling industrial estates and residential subdivisions as well as vast idle lands (most of which are reportedly held in Land Bank). At the westernmost part is a military camp. The western sector has been earmarked as the location of a major town center by one of the leading property developers in the country. Of significance in this sector is the development of universities near the sector's boundary with Silang which will undoubtedly attract a large volume of pedestrian and vehicular traffic.

1714. Significant stretches of the National Road perpendicular to the SLEx (from Brgy. Balibago to the boundary of Silang) is already experiencing heavy vehicular traffic. Future projects are expected to further depend on this road and will definitely add to its present level of congestion. The Manila South Road (from Biñan to Cabuyao) is also heavily congested. Given the situation that the private sector controls huge land banks (a good deal of which are still undeveloped/idle) the opening of new roads to alleviate present and expected conditions has become difficult. (Sta. Rosa CLUDP, 2000-2015)

Cabuyao

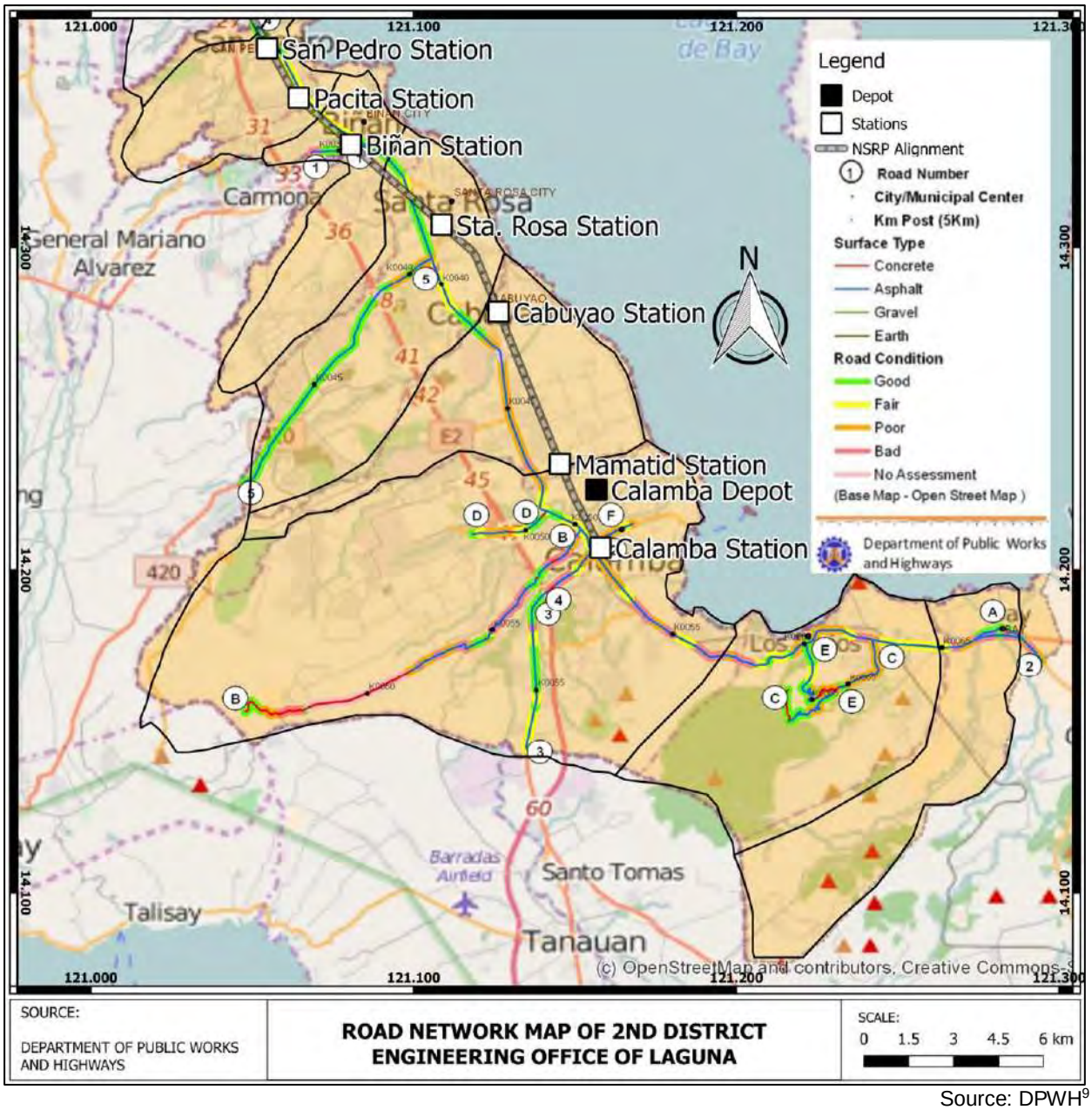
1715. Public conveyances are available in Cabuyao City. The main mode of land transportation is the jeepney, which has the highest number of registered vehicles in the city. Barangays are served either by jeepneys or tricycles, which have regular trips. In Brgy. Casile however, trips are quite irregular. Added to this is the absence of access road linking the upland barangays to the Poblacion. People have to go to Canlubang and use it as entry and exit access.

1716. In terms of access, a network of city roads adequately serves the town center and lowland barangays. Cabuyao has a total road length of 40.58 kms., spread circumferentially in the Poblacion and in the other barangays except for the three (3) upland barangays which are not accessible through Cabuyao but through Canlubang.

1717. The 7-km railway of the PNR was not operating in Cabuyao before 2001-2010. Its road signs and rail were not in good condition and needed total rehabilitation.

1718. The present road system in Cabuyao can still handle the volume of traffic. At certain point in time, however, especially during peak hours (7-9 AM and 4-7 PM), vehicular traffic is quite congested at certain choke points such as the National Highway – Pulo-Diezmo Road intersection, San Isidro-Pulo Diversion Road, Banlic and at the CBD of the city.

1719. Traffic incidence recorded was 536 for year 2009. This incidence as well as traffic congestion could be due to traffic management (e.g. traffic signs, road signs, traffic rules implementation) and the size of the roads, as well as human factors as driver's attitudes and behavior.



Source: DPWH[9]

Figure 3.4.11 Road Network of Second District of Laguna

Calamba

1720. Tricycles, buses, and jeepneys, are popular modes of transportation in Calamba. There is also a PNR station in the city. Calamba is bounded on the east by Laguna de Bay. It is demarcated by Cabuyao on the northern part. It is adjacent to Los Baños on the southern portion. The western part brings the city near to the towns of Tanauan and Sto. Tomas in Batangas.

9 http://www.dpwh.gov.ph/dpwh/atlas/2015%20DPWH%20Road%20Data/Road%20Data%202015/north_manila.htm (04/24/18)

(5) Ferry Service at Pasig River

1721. The Pasig River Ferry Service is the only water-based transportation in Metro Manila that cruises the Pasig River from Pinagbuhatan in Pasig to Intramuros in the City of Manila. The system is owned and operated by a private company, SCC Nautical Transport Services Incorporated. Although commonly referred to as a ferry, it is more similar to a water bus.

1722. The latest Pasig Ferry Service, operated by Nautical Transport Services Incorporated, was re-activated on April 28, 2014 to alleviate the traffic situation in Metro Manila in light of the infrastructure projects being constructed simultaneously. The ferry service is operated by MMDA until a private investor takes over.

1723. There is a possibility that the Project might affect the ferry operation during its construction traversing Pasig River. Appropriate measures will be done by DOTr including coordination with the concerned parties. As of 12 April 2017, there are twelve (12) operational ferry stations as presented in **Table 3.4.48**.

Table 3.4.48 Stations of Pasig Ferry Service

#	Station	Location	Notes
1	Plaza de Mexico (Manila)	Intramuros, Manila	Near Bureau of Immigration (Philippines), Manila Cathedral and Manila Central Post Office
2	Escolta Street	Binondo, Manila	Near Jones Bridge
3	Liwasang Bonifacio	Liwasang Bonifacio, Ermita, Manila	Near Quezon Bridge, Liwasang Bonifacio and Manila Central Post Office
4	Polytechnic University of the Philippines	Santa Mesa, Manila	Near Philippine Coast Guard Station
5	Santa Ana	Santa Ana, Manila	Santa Ana Public Market and Savemore
6	Lambingan	Punta, Santa Ana, Manila	Bautista Street, Brgy. 897, Zone 99
7	Valenzuela	Valenzuela, Makati	Near Bonaventure Garden Homes, Riverside Studios Manila and LTO Makati District Office
8	Hulo	Hulo, Mandaluyong	Near Parish of Our Lady of the Abandoned Church
9	Guadalupe	Guadalupe Nuevo, Makati	Near Guadalupe MRT Station and Commercial Mall
10	Maybunga	Maybunga, Pasig	Beside Maybunga Barangay Hall
11	San Joaquin	San Joaquin, Pasig	Near Sumilan and Bambang Bridge
12	Pinagbuhatan - Acacia	Pinagbuhatan, Pasig	Near C6 Bridge Philippine Coast Guard Station

Source: MMDA Website, accessed April 13, 2018

3.4.8.2. Potentially Affected Access Points

(1) Roads to be traversed by the Project

1724. **Table 3.4.49** summarizes the inventory of roads to be traversed by the Project based on the topographic survey conducted by the JICA Design Team. The number of roads that will be traversed are 32 for Manila, 8 for Makati, 6 for Taguig, none for Parañaque, 20 for Muntinlupa, 8 for San Pedro, 12 for Biñan, 11 for Santa Rosa, 10 for Cabuyao, and 19 for Calamba.

Table 3.4.49 Roads to be traversed by the Project

LGU	Number of Roads to be Traversed			Major Roads and Railways to be Traversed
	<9m width	>10m width	Total	
Manila	12	20	32	Jose Abad Santos Street, Rizal Avenue, Blumentritt Station (LRT-1), España Boulevard, R. Magsaysay Boulevard, LRT-2, San Andres/Diamante Street,
Makati	1	7	8	Sen. Gil Puyat Ave., Antonio Arnaiz Ave., EDSA Magallanes Interchange, MRT-3
Taguig	0	6	6	Nichols Interchange, SLEX
Parañaque	0	0	0	None
Muntinlupa	17	3	20	Montillano Street, RMT Industrial Complex Road

LGU	Number of Roads to be Traversed			Major Roads and Railways to be Traversed
	<9m width	>10m width	Total	
San Pedro	7	1	8	A. Mabini Street
Biñan	8	4	12	Mamplasan Access Road
Santa Rosa	10	1	11	Manila South Road
Cabuyao	10	0	10	Katapatan Road
Calamba	14	5	19	Manila South Road, Pili Drive

Source: JICA Design Team

(2) Bridges to be traversed by the Project

1725. **Table 3.4.50** below shows the names of bodies of water with existing bridges that will be traversed by the Project. There are bodies of water that were unidentified and labelled as unknown during the survey; most of these are bodies of water that are narrower than rivers.

Table 3.4.50 Bridges to be traversed by the Project

LGU	Rivers	Unknown	Total	Name of Rivers
Manila	1	0	1	Pasig River
Makati	0	4	4	None
Taguig	0	0	0	None
Parañaque	0	0	0	None
Muntinlupa	3	7	10	Bayanan River, Magdaong River, Putatan River
San Pedro	2	2	4	San Pedro River, Tunasan River
Biñan	1	2	3	Biñan River
Sta. Rosa	2	9	11	Silang Santa Rosa River, Floodway Channel
Cabuyao	1	9	10	Cabuyao River
Calamba	3	10	13	Calamba River, La Mesa River, San Cristabal River

Source: JICA Design Team

(3) Potentially Affected Transportation Terminals

1726. All the cities affected by the Project are known to have terminals for buses, UVs, taxis, jeeps, tricycles, and pedicabs. Data for number of terminals for each transportation mode were not available from the documents collected from the LGUs. Based on the RAP survey, there are no transportation terminals located along the ROW, therefore there are also no potentially affected terminals.

(4) Affected Public Access

1727. **Table 3.4.51** lists the access points which may be blocked by the proposed Project. The reasons considered for potential loss of access are: (1) land that will be locked by structures upon construction of project and (2) no alternative access.

Table 3.4.51 Access Roads that intersect with the Proposed Project

LGU	Section		Street Name	Classification	Loss of Access
Manila	1+410	1+416	Nara St. cor. Old Antipolo St.	Public	2 structures land locked; For negotiation with DOTr
Manila	1+610		Tindalo Extension cor. Old Antipolo St.	Public	2 structures presumed land locked (1+640) ; Access to verified
Manila	1+780		Kusang Loob St. cor. Old Antipolo St.	Public	1 structure presumed land locked (1+800) ; Access to verified; Possible Alley
Manila	1+820		Severino Reyes St. cor. Old Antipolo St.	Public	1 structure presumed land locked (1+860) ; Access to verified; Possible Alley
Manila	2+800	4+880	Algeciras St.	Public	Row of structures facing Algeciras St. are possibly landlocked.

LGU	Section		Street Name	Classification	Loss of Access
Manila	2+928		Simoun St. cor. Algeciras St.	Public	Row of structures facing Algeciras St. are possibly landlocked.
Manila	3+088		Maria Clara St. cor. Algeciras St.	Public	Row of structures facing Algeciras St. are possibly landlocked. Sidewalk is not affected.
Manila	3+248		Laon-Laan Rd. cor. Algeciras St.	Public	Row of structures facing Algeciras St. are possibly landlocked. Sidewalk is not affected.
Manila	3+405	3+566	Dapitan St. cor. Algeciras St.	Public	Row of structures facing Algeciras St. are possibly landlocked.
Manila	3+566	3+618	Piy Margal St. cor. Algeciras St.	Public	Row of structures facing Algeciras St. are possibly landlocked.
Manila	4+070		Loyola St. cor. Algeciras St.	Public	Row of structures facing Algeciras St. are possibly landlocked. Sidewalk affected.
Manila	4+231		J. Fajardo St. cor. Algeciras St.	Public	Row of structures facing Algeciras St. are possibly landlocked.
Manila	4+554		Firmeza St. cor. Algeciras St.	Public	Row of structures facing Algeciras St. are possibly landlocked.
Manila	4+709		Honradez St. cor. Algeciras St.	Public	Row of structures facing Algeciras St. are possibly landlocked.
Manila	4+880		Algeciras Extension	Public	Possible informal structures who use PNR ROW for access are landlocked; to verify if alley available for access.
					Also known as G. Tuazon Interior 1838 St.
Manila	5+990	6+420	Anonas St.	Public	Residential structures (6+030 - 6+050) will be landlocked. To verify if rear access is available. Barangay Multi-purpose Hall will lose access to road (6+380).
Manila	6+900	7+200	Pandacan Alley	Illegal	Along ROW, Existing alleys to be used as access by landlocked ISFs.
Manila	7+220	7+297	Laura St.	Unknown	Street within PNR ROW, possibly illegal, to verify with DPWH
Manila	8+240	8+540	Narrowlane	Unknown	Small road is parallel to PNR ROW, yet is outside PNR ROW (to verify with Parcellary); Small road may be informal, to confirm with DPWH.
Manila	9+440	9+660	Parking Bay	Public	Access to Parking Bay is affected (SAPARI);
					Access to Estero de Paco Headwater Park (9+397) may be affected;
					Multiple ISFs using PNR ROW for access may be land-locked, however alleys and bridges (over the Estero) may be used for alternative access.
Manila	9+860	10+010	Perlita St.	Public	Loss of access for Residential low-medium rise structures, and Barangay basketball court / multi-purpose hall. 2.6 meters from building face to Project ROW.
					Public roads within Project ROW to be removed and replicated or allowed access during construction and operation.
Manila	10+010		Agusto Francisco St.	Public	Road may be dead-end;
					Barangay Hall / Office affected by Project ROW
Manila	10+040	10+220	Opalo St. cor. Perlita St.	Public	Loss of access for Residential low-medium rise structures;
					Road may be a dead-end if no access provided

LGU	Section		Street Name	Classification	Loss of Access
Manila	10+220	10+290	Dagohoy St. cor. Perlita St.	Public	Loss of access for Residential low-medium rise structures
Manila	10+290	10+390	Madre Peralta St. cor. Perlita St.	Public	Loss of access for Residential low-medium rise structures;
					Road may be a dead-end if no access provided
Manila	10+390	10+460	Estrada St. cor. Perlita St.	Public	Loss of access for Residential low-medium rise structures;
					Road may be a dead-end if no access provided
Manila	10+460	10+510	Granito St. cor. Perlita St.	Public	Loss of access for Residential low-medium rise structures;
					Road may be a dead-end if no access provided
Manila	10+510	10+572	Marmol St. cor. Perlita St.	Public	Loss of access for Residential low-medium rise structures;
					Road may be a dead-end if no access provided
Makati	11+300	11+380	St. Paul Road cor Mayapis St.	Public	St. Paul Road to be dead-end; Mayapis Street to be acquired. Linear Park affected along PNR ROW (11+300 - 11+578).
					Commercial structures may be landlocked, however to verify (PAB marking) if sidewalk is not (affected for pedestrian access.)
Makati	11+380	11+465	Bakawan St. cor. Mayapis St.	Public	Commercial structures may be landlocked (car access affected), however to verify if sidewalk is not (affected for pedestrian access.)
Makati	11+465		Mayapis St. cor. Malugay St.	Public	The Linear Makati may be landlocked (car drop-off affected), however to verify if sidewalk is not (affected for pedestrian access.)
Makati	11+578		Malugay St. - Emilia St.	Public	No remarks
Makati	11+700	11+770	Medina St.	Public	City Land Executive Towers may be landlocked (Medina St. within Project ROW). However, viaduct columns do not affect Medina St.
					DOTr to decide on (1) Street will be closed / fenced during construction? (2) Contractor to provide temporary access? (3) Medina Street to open for public access during operation?
					Sidewalk not affected by Project ROW.
Makati	11+770	11+924	Dela Rosa St. cor. Medina St.	Public	Low-Mid-rise Commercial establishments (6) may be landlocked. (Medina St. within Project ROW).
					Typical case.
Muntinlupa	24+200	25+363	Alleys	Unknown	Alleys are located along the Sucat Spur line and can be used as alternative access, to be verified on-site. PAPs vary from Legal owners with titles and ISFs, to be verified with SES and PAB research.
Muntinlupa	24+400	25+160	Dir. A. Bunye St. - Manuel L. Quezon St.	Public	Road affected by Project ROW
Muntinlupa	24+780	25+363	Dirt Road	Illegal	ISF Residential structures may be landlocked facing PNR ROW. To be verified. Cars are parked along PNR ROW.
Muntinlupa	25+547	25+780	Espeleta St.	Public	ISF Residential structures may be landlocked facing PNR ROW. Alleys to be used as alternative access.

LGU	Section		Street Name	Classification	Loss of Access
Muntinlupa	25+960	26+020	Alley	Illegal	ISF Residential structures may be landlocked facing PNR ROW. Alleys to be used as alternative access.
Muntinlupa	26+900		I.R. Arevalo St.	Public	ISF Residential structures may be landlocked facing PNR ROW. Alleys to be used as alternative access.
Muntinlupa	26+950		Germillo St.	Public	ISF Residential structures may be landlocked facing PNR ROW. Alleys to be used as alternative access.
Muntinlupa	27+280		Alley	Illegal	ISF Residential structures may be landlocked facing PNR ROW. Alleys to be used as alternative access.
Muntinlupa	27+360	28+196	Unknown Roads	Unknown	Unknown roads are parallel and perpendicular to PNR ROW. Various ISF Residential structures may be landlocked facing PNR ROW. Alleys to be used as alternative access.
Muntinlupa	28+330		Unknown Road	Unknown	Various Interior ISF Residential structures may be landlocked.
Muntinlupa	28+380		Unknown Road	Unknown	Various Interior ISF Residential structures may be landlocked.
Muntinlupa	28+440		Unknown Road	Unknown	Various Interior ISF Residential structures may be landlocked.
Muntinlupa	28+560	29+095	Unknown Roads	Unknown	An Unknown Road is within and parallel to PNR ROW, other unknown roads connect to this road from 3rd Street - Ilaya Street. Lots in L&B Compound II until Bayanan River use the road to access the rear of their properties and use the PNR ROW as parking space.
Muntinlupa	29+095	29+149	Unknown Road cor. Bautista St.	Public	ISF Residential structures may be landlocked facing PNR ROW via Unknown Road, parallel to PNR ROW. Possibly side canals of the railroad that have been developed as box culverts (drainage canals). To verify if road is for PNR service/maintenance or LGU-Public use.
Muntinlupa	29+194	29+287	Bautista St. cro. Unknown Road	Public	ISF Residential structures may be landlocked facing PNR ROW. To be verified. (Typical)
Muntinlupa	29+287		Feeder St. cor. Unknown Road	Public	Apartment structure may be landlocked facing PNR ROW.
Muntinlupa	29+380	29+892	Unknown Road		ISF Residential structures may be landlocked facing PNR ROW. To be verified. (Typical)
Muntinlupa	29+892		Private Road	Private	Private road used to access Bus Terminal Parking Area. To verify if Private roads (of compounds) have MOA with PNR.
Muntinlupa	29+892	30+310	Private Road cor. Unknown road	Private	Residential structures may be landlocked facing PNR ROW. To verify if alleys can be used as alternative access to Private Road.
Muntinlupa	30+310		Taverna Compound Road	Private	Various Residential structures may be landlocked with only access through PNR ROW. To verify if Private roads (of compounds) have MOA with PNR.
Muntinlupa	30+409		National Irrigation Authority Road	Public	To verify NIA Road MOA with PNR. One commercial structure may lose access using Unknown road along PNR ROW.
Muntinlupa	30+680		Freewill HOA Road	Public	Residential structures (1-3) facing PNR ROW may lose access.

LGU	Section		Street Name	Classification	Loss of Access
Muntinlupa	30+790	30+870	Unknown Road	Unknown	Residential structures may be landlocked facing PNR ROW. To verify if alleys can be used as alternative access to Private Road.
Muntinlupa	31+000	31+272	Unknown Road	Unknown	Residential structures may be landlocked facing PNR ROW. To verify if alleys can be used as alternative access. A dirt road is also parallel to PNR ROW.
					Paved road parallel to railroad, possibly DPWH box culvert.
Muntinlupa	31+272	31+354	Unknown Road	Unknown	Residential structures may be landlocked facing PNR ROW. To verify if alleys can be used as alternative access.
					Paved road parallel to railroad, possibly DPWH box culvert.
Muntinlupa	31+354	31+438	Quezon St.	Public	Residential structures may be landlocked facing PNR ROW. To verify if alleys can be used as alternative access.
Muntinlupa	31+438	31+560	Rizal St.	Public	Residential structures may be landlocked facing PNR ROW. To verify if alleys can be used as alternative access.
Muntinlupa	32+189		Unknown Road	Unknown	Paved road parallel to railroad, possibly DPWH box culvert.
Muntinlupa	32+316	32+640	Unknown Road	Unknown	Residential structures may be landlocked facing PNR ROW.
Muntinlupa	32+907	33+386	Unknown Road	Unknown	Paved road parallel to railroad, possibly DPWH box culvert.
Muntinlupa	33+386	33+316	Unknown Road	Unknown	Paved road parallel to railroad, possibly DPWH box culvert.
San Pedro	34+022		A. Manini St. cor. Ma. Aurora Ave.	Public	Super 8 Warehouse rear service access affected by Project ROW.
San Pedro	34+313		Quezon St.	Public	Residential structures (34+110 - 34+360) may be landlocked facing PNR ROW. To verify if alleys can be used as alternative access.
San Pedro	34+448	34+644	Unknown Road	Unknown	Residential structures may be landlocked facing PNR ROW. To verify if alleys can be used as alternative access.
San Pedro	34+644	34+800	San Vicente Road	Public	Residential structures may be landlocked by Project ROW. To verify if alleys can be used as alternative access. Barangay Nueva Health Center affected.
San Pedro	35+160	35+410	Begonia St.	Private	Sidewalk of road is affected by Project ROW.
San Pedro	35+321		Main Road	Public	Residential structures (35+600-35+620) may be landlocked facing PNR ROW. To verify if alleys can be used as alternative access.
San Pedro	36+290		Tanguile St.	Public	Road to be dead end. One structure landlocked facing ROW.
San Pedro	36+678	36+950	1st St.	Public	Street is parallel to Project ROW and is not affected;
					ISF structures (37+190 - 37+225) landlocked using PNR ROW for access.
Biñan	37+580	37+790	Dirt Road	Illegal	ISF structures may be landlocked (37+580 -37+620; 37+715 -37+790) by Project ROW.
Biñan	38+314	39+092	Dirt Road	Illegal	ISF structures (38+840 - 38+960) landlocked using PNR ROW for access.
Biñan	38+980	39+092	Forest Lake Memorial Road	Private	Road is affected by Project ROW (4.96 remaining)
Biñan	39+092	29+300	Purok 4 Road	Public	Barangay road is affected by Project ROW.

LGU	Section		Street Name	Classification	Loss of Access
					Residential structures are landlocked, alleys to identified for alternative access.
Biñan	39+379		Sto. Niño Rd.	Public	Sto. Niño Day care center affected by Project ROW
					Residential structures (39+340 - 39+370) may be landlocked; alleys to be identified for alternative access.
Biñan	40+120	40+218	Dirt Road	Illegal	Dirt Road is parallel to PNR railroad. ISFs structures (40+120 - 40+150) may be landlocked.
Biñan	40+865	40+944	Unknown Road	Illegal	Road leads to Barangay Basketball court, boundary of court is until the railroad tracks.
Biñan	40+944	41+000	Dirt Road	Illegal	Dirt Road is parallel to PNR railroad. ISFs structures (40+960 - 41+000) may be landlocked.
Santa Rosa	41+000	41+043	Dirt Road	Illegal	Dirt Road is parallel to PNR railroad. ISFs structures (41+000 - 41+043) may be landlocked.
Santa Rosa	41+200	41+400	Sub-division Rd.	Private	Road is parallel to Project ROW. Sidewalk and gutter may be affected.
Santa Rosa	41+596	41+690	Dirt Road	Illegal	Dirt Road is parallel to PNR railroad. ISFs structures (41+000 - 41+043) may be landlocked. Alleys to be identified for alternative access.
Santa Rosa	43+260	43+375	Dirt Road	Illegal	Residential structures may be landlocked (40+830 - 40+865) beside PNR station. To verify if ISF structure or farm structures.
Santa Rosa	43+375	44+152	Dirt Road	Illegal	Residential structures may be landlocked using PNR ROW for access.
Santa Rosa	43+919		Villa Mercadas Rd.	Public	Espiritu Compound; One Residential structure may be landlocked, to be verified.
Santa Rosa	44+090	44+178	Dirt Road	Illegal	Residential structures may be landlocked using PNR ROW for access.
Santa Rosa	45+484		Mabuhay Homes Rd.	Private	Subdivision may be landlocked if access is lost.
Santa Rosa	46+375		Dirt Road	Illegal	Farm houses may be landlocked
Cabuyao	46+640	46+854	Dirt Road	Illegal	Affected Trike terminal and service road
Cabuyao	46+854	47+060	Dirt Road	Illegal	Dirt Road is parallel to PNR railroad. ISFs structures may be landlocked. Alleys to be identified for alternative access.
Cabuyao	48+230		NIA Road	Illegal	Farm storehouse may be landlocked
Cabuyao	48+440		NIA Road	Illegal	Farm houses may be landlocked
Cabuyao	50+310		Dirt Road	Illegal	Farm houses may be landlocked
Calamba	54+209		Unknown Road	Public	Road may be DPWH pipe cel. Farm houses may be landlocked.
Calamba	54+900				
Calamba	55+478	55+840	Barangay Rd	Public	Road will be affected by Project ROW. Residential structures will be landlocked, alleys to be identified for alternative access.

Source: JICA Design Team

3.4.9. Perception Survey

1728. This section discusses the results of the two separate household perception surveys conducted both for SCRP main line (Solis-Calamba) and for the SCRP interconnecting line (Senate-FTI-Bicutan Segment). For SCRP main line, the survey was conducted at the host barangays in the cities of Manila, Makati, Taguig, Parañaque, Muntinlupa in Metro Manila and cities of San Pedro, Biñan, Sta. Rosa, Cabuyao and Calamba in Laguna from February 6-27,

2018. The respondents in the survey were the Barangay Council and Multi-sectoral Representatives (women representatives, men group representative, senior citizen, church group representative and other authority figures of the community).

1729. For the SCRP interconnecting line, the perception survey was conducted from 30 May to 03 June 2019 in three barangays, including Barangay 183, Villamor in Pasay City (May 30), Barangay Fort Bonifacio in Taguig City (May 31) and Barangay San Martin de Porres (SMDP) in Parañaque City (June 3).

3.4.9.1. Respondents' Profile

(1) SCRP Main Line (Solis to Calamba)

1730. **Table 3.4.52** shows that more than half (52.8%) of the respondents are male while 47.2% are female. Manila, Biñan, Sta. Rosa, Cabuyao and Calamba have more male than female respondents, while Makati and Muntinlupa have more female respondents. Taguig, Parañaque and San Pedro have equal male-female respondents' ratio.

Table 3.4.52 Total Number of Respondents

Sex	Manila	Makati	Taguig	Para-ñaque	Muntin-lupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
Male	485	16	32	4	25	19	23	40	59	79	782
%	52.2	42.1	50.0	50.0	35.2	50.0	56.1	80.0	65.6	52.0	52.8
Female	444	22	32	4	46	19	18	10	31	73	699
%	47.8	57.9	50.0	50.0	64.8	50.0	43.9	20.0	34.4	48.0	47.2
Total	929	38	64	8	71	38	41	50	90	152	1481
%	100	100	100	100	100	100	100	100	100	100	100

Source: GEOSPHERE, 2018

1731. **Table 3.4.53** shows that a majority of the respondents (68%) were born in the city where they currently reside, most of them residing in the barangays where they were born. Other respondents were from other cities/municipalities (9.32%), while a notable number of respondents came from other provinces (22.8%). The largest percentage of respondents that are born in their city are from Cabuyao (74%) and Biñan (63%), while largest percentage of respondents that are born from other provinces are in Taguig and Makati, each with 34%.

Table 3.4.53 Place of Birth of the Respondents

Place of Birth	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
In this Barangay	510	16	21	2	38	22	26	25	67	80	807
%	54.9	42.1	32.8	25.0	53.5	57.9	63.4	50.0	74.4	52.6	54.5
Another Barangay but same LGU	146	7	8	1	6	6	7	5	5	8	199
%	15.7	18.4	12.5	12.5	8.5	15.8	17.1	10.0	5.6	5.3	13.4
Another LGU	43	2	13	4	16	2	5	10	12	31	138
%	4.6	5.3	20.3	50.0	22.5	5.3	12.2	20.0	13.3	20.4	9.3
Another Province	230	13	22	1	11	8	3	10	6	33	337
%	24.8	34.2	34.4	12.5	15.5	21.1	7.3	20.0	6.7	21.7	22.8
Total	929	38	64	8	71	38	41	50	90	152	1481
%	100	100	100	100	100	100	100	100	100	100	100

Source: GEOSPHERE, 2018

1732. **Table** 3.4.54 shows that a little more than half (54.0%) of the respondents were in the 41-60 years old, and respondents within working age bracket account for a little over 83.46% of the total. Table 3.4.55 shows that almost all (94.2%) of the respondents are Tagalog.

Table 3.4.54 Age of the Respondents

Age	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
15-20	12	1	5	0	1	0	0	0	2	2	23
%	1.3	2.6	7.8	0.0	1.4	0.0	0.0	0.0	2.2	1.3	1.6
21-30	79	3	14	1	5	1	4	3	9	14	133
%	8.5	7.9	21.9	12.5	7.0	2.6	9.8	6.0	10.0	9.2	9.0
31-40	181	5	15	4	11	7	5	11	24	17	280
%	19.5	13.2	23.4	50.0	15.5	18.4	12.2	22.0	26.7	11.2	18.9
41-50	233	12	15	1	21	6	13	15	30	40	386
%	25.1	31.6	23.4	12.5	29.6	15.8	31.7	30.0	33.3	26.3	26.1
51-60	244	12	12	2	22	22	16	12	16	56	414
%	26.3	31.6	18.8	25.0	31.0	57.9	39.0	24.0	17.8	36.8	28.0
61-70	143	5	3	0	11	2	2	4	9	22	201
%	15.4	13.2	4.7	0.0	15.5	5.3	4.9	8.0	10.0	14.5	13.6
71-above	37	0	0	0	0	0	1	5	0	1	44
%	4.0	0.0	0.0	0.0	0.0	0.0	2.4	10.0	0.0	0.7	3.0
Total	929	38	64	8	71	38	41	50	90	152	1481
%	100	100	100	100	100	100	100	100	100	100	100

Source: GEOSPHERE, 2018

Table 3.4.55 Ethnicity of the Respondents

Ethnicity	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
Tagalog	865	33	62	7	70	37	41	50	88	142	1395
%	93.1	86.8	96.9	87.5	98.6	97.4	100.0	100.0	97.8	93.4	94.2
Ilokano	2	0	1	0	0	0	0	0	0	2	5
%	0.2	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.3
Kapangpangan	1	1	0	0	0	0	0	0	0	0	2
%	0.1	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Others	61	4	1	1	1	1	0	0	2	8	79
%	6.6	10.5	1.6	12.5	1.4	2.6	0.0	0.0	2.2	5.3	5.3
Total	929	38	64	8	71	38	41	50	90	152	1481
%	100	100	100	100	100	100	100	100	100	100	100

Source: GEOSPHERE, 2018

1733. **Table 3.4.56** shows that the respondents are mostly Roman Catholic (91.0%), while only a few are either Protestant, Aglipayan or INC.

Table 3.4.56 Religion of the Respondents

Religion	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
Catholic	837	35	61	6	61	37	39	48	88	136	1348
%	90.1	92.1	95.3	75.0	85.9	97.4	95.1	96.0	97.8	89.5	91.0

Religion	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
Protestant	20	0	0	1	0	1	0	0	0	4	26
%	2.2	0.0	0.0	12.5	0.0	2.6	0.0	0.0	0.0	2.6	1.8
Aglipayan	10	0	2	0	3	0	0	0	0	0	15
%	1.1	0.0	3.1	0.0	4.2	0.0	0.0	0.0	0.0	0.0	1.0
INC	16	3	0	0	2	0	1	0	0	2	24
%	1.7	7.9	0.0	0.0	2.8	0.0	2.4	0.0	0.0	1.3	1.6
Others	46	0	1	1	5	0	1	2	2	10	68
%	5.0	0.0	1.6	12.5	7.0	0.0	2.4	4.0	2.2	6.6	4.6
Total	929	38	64	8	71	38	41	50	90	152	1481
%	100	100	100	100	100	100	100	100	100	100	100

Source: GEOSPHERE, 2018

1734. **Table 3.4.57** shows that most of the respondents had formal education they acquired from community schools, and majority (47.1%) of them attended college. This is higher than the 32.8% who had secondary education. Comprising 13.7% of the total respondents were those who were able to attend technical-vocational courses.

Table 3.4.57 Highest Educational Attainment of Respondents

Highest Level	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
None	1	0	0	0	0	5	0	9	0	0	15
%	0.1	0.0	0.0	0.0	0.0	13.2	0.0	18.0	0.0	0.0	1.0
Elementary	46	0	0	0	1	10	1	12	2	8	80
%	5.0	0.0	0.0	0.0	1.4	26.3	2.4	24.0	2.2	5.3	5.4
High School	313	9	12	2	23	1	18	21	25	62	486
%	33.7	23.7	18.8	25.0	32.4	2.6	43.9	42.0	27.8	40.8	32.8
Vocational	120	6	5	0	14	17	2	0	14	25	203
%	12.9	15.8	7.8	0.0	19.7	44.7	4.9	0.0	15.6	16.4	13.7
College	449	23	47	6	33	5	20	8	49	57	697
%	48.3	60.5	73.4	75.0	46.5	13.2	48.8	16.0	54.4	37.5	47.1
Total	929	38	64	8	71	38	41	50	90	152	1481
%	100	100	100	100	100	100	100	100	100	100	100

Source: GEOSPHERE, 2018

1735. **Table 3.4.58** shows that about 58.6% of the respondents confirmed that they are married, while 26.3% are single. The remaining percentage are either widowed or separated. This only shows that marriage remains an important social institution in the cities surveyed.

Table 3.4.58 Civil Status of the Respondents

Civil Status	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
Single	217	5	20	4	18	30	13	41	16	26	390
%	23.4	13.2	31.3	50.0	25.4	78.9	31.7	82.0	17.8	17.1	26.3
Married	572	23	39	3	41	3	21	4	61	101	868
%	61.6	60.5	60.9	37.5	57.7	7.9	51.2	8.0	67.8	66.4	58.6
Widow	79	6	2	1	9	3	4	3	9	16	132

Civil Status	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
%	8.5	15.8	3.1	12.5	12.7	7.9	9.8	6.0	10.0	10.5	8.9
Separated	61	4	3	0	3	2	3	2	4	9	91
%	6.6	10.5	4.7	0.0	4.2	5.3	7.3	4.0	4.4	5.9	6.1
Total	929	38	64	8	71	38	41	50	90	152	1,481
%	100	100	100	100	100	100	100	100	100	100	100

Source: GEOSPHERE, 2018

1736. **Table 3.4.59** shows that majority (50.7%) of the respondents have 1 to 3 children, and almost all have up to 6 children only.

Table 3.4.59 Number of Children of the Respondents

No. of children	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
None	184	8	20	4	17	6	15	10	15	22	301
%	19.8	21.1	31.3	50.0	23.9	15.8	36.6	20.0	16.7	14.5	20.3
1 to 3	454	23	28	2	37	25	17	23	51	91	751
%	48.9	60.5	43.8	25.0	52.1	65.8	41.5	46.0	56.7	59.9	50.7
4 to 6	248	6	14	2	13	7	9	16	21	31	367
%	26.7	15.8	21.9	25.0	18.3	18.4	22.0	32.0	23.3	20.4	24.8
7 to 10	34	1	2	0	3	0	0	1	3	8	52
%	3.7	2.6	3.1	0.0	4.2	0.0	0.0	2.0	3.3	5.3	3.5
10-above	9	0	0	0	1	0	0	0	0	0	10
%	1.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.7
Total	929	38	64	8	71	38	41	50	90	152	1,481
%	100	100	100	100	100	100	100	100	100	100	100

Source: GEOSPHERE, 2018

1737. **Table 3.4.60** shows that more than half (53.8%) of the respondents have been residents of their respective municipalities for 21 to 50 years. Only 5.9% have been residents of their city for 10 years or less.

Table 3.4.60 Years of Residency of the Respondents

Years of Residency	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
1-10	62	4	4	0	1	0	0	1	6	9	87
%	6.7	10.5	6.3	0.0	1.4	0.0	0.0	2.0	6.7	5.9	5.9
11-20	108	2	7	1	4	1	2	4	12	11	152
%	11.6	5.3	10.9	12.5	5.6	2.6	4.9	8.0	13.3	7.2	10.3
21-30	116	7	18	5	6	9	7	6	10	31	215
%	12.5	18.4	28.1	62.5	8.5	23.7	17.1	12.0	11.1	20.4	14.5
31-40	204	7	21	0	19	5	6	13	21	25	321
%	22.0	18.4	32.8	0.0	26.8	13.2	14.6	26.0	23.3	16.4	21.7
41-50	156	7	6	0	17	13	5	9	18	30	261
%	16.8	18.4	9.4	0.0	23.9	34.2	12.2	18.0	20.0	19.7	17.6
51-60	128	8	3	0	7	3	8	8	11	31	207
%	13.8	21.1	4.7	0.0	9.9	7.9	19.5	16.0	12.2	20.4	14.0
61-Above	127	2	3	2	6	5	8	4	7	15	179

%	13.7	5.3	4.7	25.0	8.5	13.2	19.5	8.0	7.8	9.9	12.1
N/A	28	1	2	0	11	2	5	5	5	0	59
%	3.0	2.6	3.1	0.0	15.5	5.3	12.2	10.0	5.6	0.0	4.0
Total	929	38	64	8	71	38	41	50	90	152	1,481
%	100	100	100	100	100	100	100	100	100	100	100

Source: GEOSPHERE, 2018

1738. **Table 3.4.61** shows that majority (41.5%) of the respondents belong to traditional families where husbands are the primary providers of income, although most of the households have multiple income providers, which 60.0% are earning from their regular salaried jobs, while the rest have either contractual jobs (11.2%) or other sources of income (10.2%).

1739. Most of the respondents (46.6%) earn at least Php 10,000 or higher in a month, near to or higher than the minimum wage rate of approximately Php 11,300. This percentage is lower than the percentage of respondents having regular salaried jobs, which means some of them earn below the minimum wage. There are a few respondents who earn less than Php 1,000 in a month, while 14.1% earn more than Php 20,000 per month.

Table 3.4.61 Household Employment and Income

	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
Provider in the Family											
Husband	460	16	33	4	36	20	18	34	47	90	758
%	41.9	32.0	39.8	36.4	40.4	37.0	35.3	40.0	41.6	46.6	41.5
Wife	206	15	26	2	23	16	12	21	24	54	399
%	18.8	30.0	31.3	18.2	25.8	29.6	23.5	24.7	21.2	28.0	21.8
Son	155	10	5	2	9	9	7	11	12	25	245
%	14.1	20.0	6.0	18.2	10.1	16.7	13.7	12.9	10.6	13.0	13.4
Daughter	124	5	7	1	7	3	11	9	10	24	201
%	11.3	10.0	8.4	9.1	7.9	5.6	21.6	10.6	8.8	12.4	11.0
No answer	153	4	12	2	14	6	3	10	20	0	224
%	13.9	8.0	14.5	18.2	15.7	11.1	5.9	11.8	17.7	0.0	12.3
Total	1098	50	83	11	89	54	51	85	113	193	1827
%	100	100	100	100	100	100	100	100	100	100	100
Source of Income											
Salary	480	36	47	6	53	32	30	39	71	98	892
%	51.7	94.7	71.2	66.7	74.6	84.2	73.2	78.0	77.2	64.5	60.0
Contractual Job	131	1	3	0	9	1	2	3	2	14	166
%	14.1	2.6	4.5	0.0	12.7	2.6	4.9	6.0	2.2	9.2	11.2
Farming	4	0	0	0	0	0	0	0	2	9	15
%	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	5.9	1.0
Selling	93	0	3	1	3	3	5	3	4	15	130
%	10.0	0.0	4.5	11.1	4.2	7.9	12.2	6.0	4.3	9.9	8.7
Others	116	1	7	0	1	0	2	2	6	16	151
%	12.5	2.6	10.6	0.0	1.4	0.0	4.9	4.0	6.5	10.5	10.2
No answer	105	0	6	2	5	2	2	3	7	0	132
%	11.3	0.0	9.1	22.2	7.0	5.3	4.9	6.0	7.6	0.0	8.9
Total	929	38	66	9	71	38	41	50	92	152	1486
%	100	100	100	100	100	100	100	100	100	100	100
Earning in a month											
Less than 1,000	50	2	3	0	8	0	0	2	3	7	75
%	5.4	5.3	4.7	0.0	11.3	0.0	0.0	4.0	3.3	4.6	5.1
P1,000 - 4,999	176	3	7	0	12	6	8	5	4	19	240
%	18.9	7.9	10.9	0.0	16.9	15.8	19.5	10.0	4.4	12.5	16.2
P5,000 - 9,999	250	11	9	2	27	13	8	2	27	30	379
%	26.9	28.9	14.1	25.0	38.0	34.2	19.5	4.0	30.0	19.7	25.6
P10,000 - 14,999	165	10	8	0	6	6	14	10	12	45	276

	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
%	17.8	26.3	12.5	0.0	8.5	15.8	34.1	20.0	13.3	29.6	18.6
P15,000 - 20,000	98	5	16	2	4	6	4	19	19	32	205
%	10.5	13.2	25.0	25.0	5.6	15.8	9.8	38.0	21.1	21.1	13.8
More than 20,000	114	5	19	4	4	5	6	12	21	19	209
%	12.3	13.2	29.7	50.0	5.6	13.2	14.6	24.0	23.3	12.5	14.1
No answer	76	2	2	0	10	2	1	0	4	0	97
%	8.2	5.3	3.1	0.0	14.1	5.3	2.4	0.0	4.4	0.0	6.5
Total	929	38	64	8	71	38	41	50	90	152	1,481
%	100	100	100	100	100	100	100	100	100	100	100

Source: GEOSPHERE, 2018

1740. **Table 3.4.62** shows that with regard to problems in the community, the prevalence of illegal drugs (14.6%), traffic congestion (11.3%) and problems concerning wastes (i.e. garbage) (11.2%) are the most common concerns among respondents. This might have resulted from the current government's campaign on drugs, therefore, raising the importance of solving the problem on illegal drugs, while sentiment on traffic congestion and waste management may likely come from the respondents' daily experience. Respondents in each city differ in the problems they think should be prioritized. For example, in Muntinlupa, poor local government service ranks on top, while flooding ranks on top for respondents from Sta. Rosa.

1741. While, 16.9% of the respondents want to implement curfew hours to curb local disturbance, and 13.2% expressed daily collection of wastes/garbage as important solutions that need to be implemented in their respective cities. The percentages per city show that the respondents differ in giving importance to the solutions needed in their community. In Parañaque and Cabuyao, for example, road widening is paramount, while respondents from San Pedro desire more regular collection of wastes and garbage.

Table 3.4.62 Problems in the Community

Problems	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
Problem in the Community											
Traffic congestion	111	16	17	6	4	0	2	20	6	6	188
%	11.9	29.1	12.3	31.6	3.9	0.0	4.3	27.8	5.5	3.9	11.3
Drugs	112	0	27	1	9	7	10	4	34	40	244
%	12.1	0.0	19.6	5.3	8.8	17.1	21.7	5.6	31.2	25.8	14.6
Fire	21	2	0	1	0	0	1	1	12	0	38
%	2.3	3.6	0.0	5.3	0.0	0.0	2.2	1.4	11.0	0.0	2.3
Wastes	89	0	11	0	5	9	6	11	0	56	187
%	9.6	0.0	8.0	0.0	4.9	22.0	13.0	15.3	0.0	36.1	11.2
Flood	45	1	3	0	0	7	0	22	4	11	93
%	4.8	1.8	2.2	0.0	0.0	17.1	0.0	30.6	3.7	7.1	5.6
Lack of street lights	13	0	16	0	5	0	7	1	1	0	43
%	1.4	0.0	11.6	0.0	4.9	0.0	15.2	1.4	0.9	0.0	2.6
Public Service	41	6	23	1	30	0	0	0	3	0	104
%	4.4	10.9	16.7	5.3	29.4	0.0	0.0	0.0	2.8	0.0	6.2
Drainage	13	3	7	4	0	1	1	3	11	0	43
%	1.4	5.5	5.1	21.1	0.0	2.4	2.2	4.2	10.1	0.0	2.6
Lack of Livelihood	88	4	3	2	4	1	0	2	0	25	129
%	9.5	7.3	2.2	10.5	3.9	2.4	0.0	2.8	0.0	16.1	7.7
No permanent homes	33	0	7	2	3	0	4	0	1	14	64
%	3.6	0.0	5.1	10.5	2.9	0.0	8.7	0.0	0.9	9.0	3.8

Problems	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
Lack of housing program	26	0	6	0	13	0	1	0	9	0	55
%	2.8	0.0	4.3	0.0	12.7	0.0	2.2	0.0	8.3	0.0	3.3
Stubborn Citizens	58	2	0	0	3	1	3	2	5	3	77
%	6.2	3.6	0.0	0.0	2.9	2.4	6.5	2.8	4.6	1.9	4.6
Lack of education	0	8	14	0	0	0	0	0	0	0	22
%	0.0	14.5	10.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3
No answer	279	13	4	2	26	15	11	6	23	0	379
%	30.0	23.6	2.9	10.5	25.5	36.6	23.9	8.3	21.1	0.0	22.7
Total	929	55	138	19	102	41	46	72	109	155	1666
%	100	100	100	100	100	100	100	100	100	100	100
Possible Solutions to Community Problems											
Smooth Traffic flow	47	8	18	1	4	6	19	9	11	0	123
%	5.0	22.9	13.6	11.1	3.8	15.4	42.2	11.7	10.6	0.0	8.0
Road widening	64	7	4	4	1	0	0	0	40	0	120
%	6.8	20.0	3.0	44.4	0.9	0.0	0.0	0.0	38.5	0.0	7.8
"Tokhang" Program against illegal drugs	100	0	12	2	0	0	5	0	0	0	119
%	10.7	0.0	9.1	22.2	0.0	0.0	11.1	0.0	0.0	0.0	7.8
Daily collection of wastes/garbage	161	0	7	0	5	20	1	5	3	0	202
%	17.2	0.0	5.3	0.0	4.7	51.3	2.2	6.5	2.9	0.0	13.2
Rehabilitation program	55	0	13	0	5	2	1	3	0	0	79
%	5.9	0.0	9.8	0.0	4.7	5.1	2.2	3.9	0.0	0.0	5.2
Street lights	62	0	27	0	5	7	6	14	2	0	123
%	6.6	0.0	20.5	0.0	4.7	17.9	13.3	18.2	1.9	0.0	8.0
Housing program	0	3	22	0	5	0	5	0	7	8	50
%	0.0	8.6	16.7	0.0	4.7	0.0	11.1	0.0	6.7	17.4	3.3
Proper drainage system	26	4	17	0	31	0	0	0	8	3	89
%	2.8	11.4	12.9	0.0	29.2	0.0	0.0	0.0	7.7	6.5	5.8
Enhanced employment	12	2	2	0	9	0	6	0	2	13	46
%	1.3	5.7	1.5	0.0	8.5	0.0	13.3	0.0	1.9	28.3	3.0
Implement curfew hours	223	0	8	0	0	4	0	22	0	0	257
%	23.8	0.0	6.1	0.0	0.0	10.3	0.0	28.6	0.0	0.0	16.9
Strict implementation of laws	45	0	2	0	3	0	1	0	7	22	80
%	4.8	0.0	1.5	0.0	2.8	0.0	2.2	0.0	6.7	47.8	5.2
Housing program	80	2	0	0	12	0	0	1	7	0	102
%	8.5	5.7	0.0	0.0	11.3	0.0	0.0	1.3	6.7	0.0	6.7
No answer	61	9	0	2	26	0	1	23	17	0	139
%	6.5	25.7	0.0	22.2	24.5	0.0	2.2	29.9	16.3	0.0	9.1
Total	936	35	132	9	106	39	45	77	104	46	1,529
%	100	100	100	100	100	100	100	100	100	100	100

Source: GEOSPHERE, 2018

1742. **Table 3.4.63** shows that the majority of the respondents either own (40.7%) or rent (22.2%) the property where they reside. In Manila and Makati, respondents who rent are slightly more than those who own their property.

Table 3.4.63 Land Ownership of the Respondents

Ownership	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
Owner	239	16	51	3	48	21	27	38	66	94	603
%	26	42	80	38	68	55	66	76	73	62	40.7
Tenant	166	1	3	0	4	1	1	2	5	13	196
%	18	3	5	0	6	3	2	4	6	9	13.2
Renting	254	18	0	2	13	5	7	1	5	24	329

%	27	47	0	25	18	13	17	2	6	16	22.2
Others	168	3	7	3	2	10	5	2	5	21	226
%	18	8	11	38	3	26	12	4	6	14	15.3
No answer	102	0	3	0	4	1	1	7	9	0	127
%	11	0	5	0	6	3	2	14	10	0	8.6
Total	929	38	64	8	71	38	41	50	90	152	1,481
%	100	100	100	100	100	100	100	100	100	100	100

Source: GEOSPHERE, 2018

1743. **Table 3.4.64** shows that the majority (72.4%) of the respondents do not cultivate crops, and the rest cultivates common crops such as vegetables and sweet potato. Rice is still cultivated but owing to the urban environment of the impact areas, the percentages are low.

Table 3.4.64 Cultivated Crops of the Respondents

Cultivated Crops	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
Rice Plant	27	0	1	0	1	0	3	0	6	6	44
%	25.7	42.1	79.7	37.5	67.6	55.3	65.9	76.0	73.3	61.8	40.7
Corn	166	1	3	0	4	1	1	2	5	13	196
%	17.9	2.6	4.7	0.0	5.6	2.6	2.4	4.0	5.6	8.6	13.2
Vegetables	254	18	0	2	13	5	7	1	5	24	329
%	27.3	47.4	0.0	25.0	18.3	13.2	17.1	2.0	5.6	15.8	22.2
Banana	168	3	7	3	2	10	5	2	5	21	226
%	18.1	7.9	10.9	37.5	2.8	26.3	12.2	4.0	5.6	13.8	15.3
Sweet potato	102	0	3	0	4	1	1	7	9	0	127
%	11.0	0.0	4.7	0.0	5.6	2.6	2.4	14.0	10.0	0.0	8.6
Others	25.7	42.1	79.7	37.5	67.6	55.3	65.9	76.0	73.3	61.8	40.7
%	166	1	3	0	4	1	1	2	5	13	196
None	17.9	2.6	4.7	0.0	5.6	2.6	2.4	4.0	5.6	8.6	13.2
%	254	18	0	2	13	5	7	1	5	24	329
Total	931	38	65	8	83	41	42	53	94	152	1507
%	100	100	100	100	100	100	100	100	100	100	100

Source: GEOSPHERE, 2018

1744. **Table 3.4.65** shows that the majority of the respondents (64.7%) have been ill at least three (3) times in the last year.

Table 3.4.65 Frequency of Being Sick in the Past Year

Frequency	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao,	Calamba	Total
1	293	13	33	3	25	12	15	19	29	64	506
%	31.5	34.2	51.6	37.5	35.2	31.6	36.6	38.0	32.2	42.1	34.2
2	182	7	11	1	15	9	6	14	15	39	299
%	19.6	18.4	17.2	12.5	21.1	23.7	14.6	28.0	16.7	25.7	20.2
3	106	5	6	0	5	5	3	1	8	14	153
%	11.4	13.2	9.4	0.0	7.0	13.2	7.3	2.0	8.9	9.2	10.3
4	32	4	0	0	3	3	8	4	4	8	66
%	3.4	10.5	0.0	0.0	4.2	7.9	19.5	8.0	4.4	5.3	4.5
5	17	2	0	0	0	1	0	0	1	5	26
%	1.8	5.3	0.0	0.0	0.0	2.6	0.0	0.0	1.1	3.3	1.8
6 or more	44	4	4	1	3	0	0	1	5	3	65
%	4.7	10.5	6.3	12.5	4.2	0.0	0.0	2.0	5.6	2.0	4.4
No answer	255	3	10	3	20	8	9	11	28	19	366
%	27.4	7.9	15.6	37.5	28.2	21.1	22.0	22.0	31.1	12.5	24.7
Total	929	38	64	8	71	38	41	50	90	152	1,481

Frequency	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao,	Calamba	Total
%	100	100	100	100	100	100	100	100	100	100	100

Source: GEOSPHERE, 2018

1745. **Table 3.4.66** shows that fever is the most common (34.8%) cause of illness among the respondents, followed by upper respiratory diseases (27.5%), and 30.0% get medical treatment at barangay health centers, slightly more than those that get treatment at hospitals (28.5%). This may be due to more costly treatment at hospitals. A significant percentage also opts for treatment at private clinics (16.9%), while a few still gets treated by herbalists, or simply gets treated at home (self-treatment).

Table 3.4.66 Health Situation of the Respondents

Health Situation	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao,	Calamba	Total
Kind of illness											
Diarrhea	145	7	10	0	10	13	9	0	5	18	217
%	11.4	12.7	8.5	0.0	11.1	22.8	20.9	0.0	4.7	11.2	11.0
Upper Respiratory	344	18	29	2	26	12	10	16	27	59	543
%	27.0	32.7	24.8	25.0	28.9	21.1	23.3	25.8	25.2	36.6	27.5
Fever	439	16	35	2	26	23	13	21	49	62	686
%	34.5	29.1	29.9	25.0	28.9	40.4	30.2	33.9	45.8	38.5	34.8
Others	161	8	22	0	13	5	4	7	9	22	251
%	12.6	14.5	18.8	0.0	14.4	8.8	9.3	11.3	8.4	13.7	12.7
No answer	185	6	21	4	15	4	7	18	17	0	277
%	14.5	10.9	17.9	50.0	16.7	7.0	16.3	29.0	15.9	0.0	14.0
Total	1,274	55	117	8	90	57	43	62	107	161	1,974
%	100	100	100	100	100	100	100	100	100	100	100
Place where they are treated											
House	100	5	3	0	7	1	3	3	1	17	140
%	9.0	10.6	3.2	0.0	9.0	2.6	7.1	5.3	1.0	10.9	8.1
Health center	349	23	18	2	29	19	13	8	23	35	519
%	31.6	48.9	19.1	22.2	37.2	48.7	31.0	14.0	22.8	22.4	30.0
Barangay Health Worker	19	0	0	1	3	0	2	1	4	8	38
%	1.7	0.0	0.0	11.1	3.8	0.0	4.8	1.8	4.0	5.1	2.2
Private clinic	154	10	25	1	13	8	6	9	26	41	293
%	13.9	21.3	26.6	11.1	16.7	20.5	14.3	15.8	25.7	26.3	16.9
Herbalist	8	0	0	0	2	0	1	0	2	4	17
%	0.7	0.0	0.0	0.0	2.6	0.0	2.4	0.0	2.0	2.6	1.0
Hospital	318	5	34	2	14	6	12	19	32	51	493
%	28.8	10.6	36.2	22.2	17.9	15.4	28.6	33.3	31.7	32.7	28.5
No answer	158	4	14	3	10	5	5	17	13	0	229
%	14.3	8.5	14.9	33.3	12.8	12.8	11.9	29.8	12.9	0.0	13.2
Total	1,106	47	94	9	78	39	42	57	101	156	1,729
%	100	100	100	100	100	100	100	100	100	100	100

Source: GEOSPHERE, 2018

1746. **Table 3.4.67** shows that most respondents rely on community water system for their drinking water supply (64.2%) and for their household chores like laundry and washing (65.3%).

Table 3.4.67 Sources of Water for Drinking

Source	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao,	Calamba	Total
Spring	21	0	1	0	0	0	0	1	1	7	31
%	2.3	0.0	1.6	0.0	0.0	0.0	0.0	2.0	1.1	4.6	2.1
Deep well	21	0	0	0	23	2	9	6	19	25	105
%	2.3	0.0	0.0	0.0	32.4	5.3	22.0	12.0	21.1	16.4	7.1
River	11	0	0	0	0	0	0	0	1	0	12
%	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.8
Water system	617	35	55	7	39	31	16	26	43	82	951
%	66.4	92.1	85.9	87.5	54.9	81.6	39.0	52.0	47.8	53.9	64.2
Others	200	1	6	1	6	2	13	11	23	38	301
%	21.5	2.6	9.4	12.5	8.5	5.3	31.7	22.0	25.6	25.0	20.3
No answer	59	2	2	0	3	3	3	6	3	0	81
%	6.4	5.3	3.1	0.0	4.2	7.9	7.3	12.0	3.3	0.0	5.5
Total	929	38	64	8	71	38	41	50	90	152	1,481
%	100	100	100	100	100	100	100	100	100	100	100

Source: GEOSPHERE, 2018

Table 3.4.68 Sources of Water for Household Chores

Source	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
Spring	20	1	1	0	0	0	0	2	2	9	35
%	2.2	2.6	1.6	0.0	0.0	0.0	0.0	4.0	2.2	5.9	2.4
Deep well	38	1	0	0	26	2	19	11	28	41	166
%	4.1	2.6	0.0	0.0	36.6	5.3	46.3	22.0	31.1	27.0	11.2
River	1	0	6	7	0	0	0	0	6	2	22
%	0.1	0.0	9.4	87.5	0.0	0.0	0.0	0.0	6.7	1.3	1.5
Water system	636	36	54	1	40	32	16	28	46	78	967
%	68.5	94.7	84.4	12.5	56.3	84.2	39.0	56.0	51.1	51.3	65.3
Others	168	0	3	0	2	2	4	5	8	22	214
%	18.1	0.0	4.7	0.0	2.8	5.3	9.8	10.0	8.9	14.5	14.4
No answer	66	0	0	0	3	2	2	4	0	0	77
%	7.1	0.0	0.0	0.0	4.2	5.3	4.9	8.0	0.0	0.0	5.2
Total	929	38	64	8	71	38	41	50	90	152	1481
%	100	100	100	100	100	100	100	100	100	100	100

Source: GEOSPHERE, 2018

1747. **Table 3.4.69** shows that most respondents (86%) use either flush or water-sealed sanitary toilet facilities, and the rest are either utilizing hole on the ground or none at all.

Table 3.4.69 Toilet Facility of the Respondents

Toilet Facility	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
None	24	1	18	6	0	0	0	0	10	2	61
%	2.6	2.6	28.1	75.0	0.0	0.0	0.0	0.0	11.1	1.3	4.1
Flush	322	23	16	2	27	13	16	32	5	53	509
%	34.7	60.5	25.0	25.0	38.0	34.2	39.0	64.0	5.6	34.9	34.4

Toilet Facility	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
Water sealed	499	13	28	0	39	23	24	12	35	91	764
%	53.7	34.2	43.8	0.0	54.9	60.5	58.5	24.0	38.9	59.9	51.6
House hole on the ground	17	0	1	0	1	0	0	0	3	3	25
%	1.8	0.0	1.6	0.0	1.4	0.0	0.0	0.0	3.3	2.0	1.7
Hole on the ground	9	0	0	0	1	0	0	0	1	3	14
%	1.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0	1.1	2.0	0.9
Anywhere	9	0	0	0	0	0	0	0	14	0	23
%	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.6	0.0	1.6
No answer	49	1	1	0	3	2	1	6	22	0	85
%	5.3	2.6	1.6	0.0	4.2	5.3	2.4	12.0	24.4	0.0	5.7
Total	929	38	64	8	71	38	41	50	90	152	1,481
%	100	100	100	100	100	100	100	100	100	100	100

Source: GEOSPHERE, 2018

(2) SCRP Interconnecting Line (Senate-FTI-Bicutan Segment)

1748. The perception survey done for SCRP interconnecting line covered three barangays (barangay 183, barangay San Martin de Porres, and barangay Fort Bonifacio). A total of 281 respondents were surveyed, of whom more than half (51%) or 143 respondents are male, while female comprised the remaining 138 respondents (49%).

1749. The survey involved only people 18 years old and above, with the exception that younger participants can be interviewed only if they were aware or have knowledge of the project. Majority of the respondents (15% or 44 respondents) were under the age group of 25-29 years old followed by age group 20-24 which accounts to 14 percent (40 respondents). The age and sex distribution of the participants in the three barangays are presented in Figure 3.4.12 and **Figure 3.4.13**, respectively.

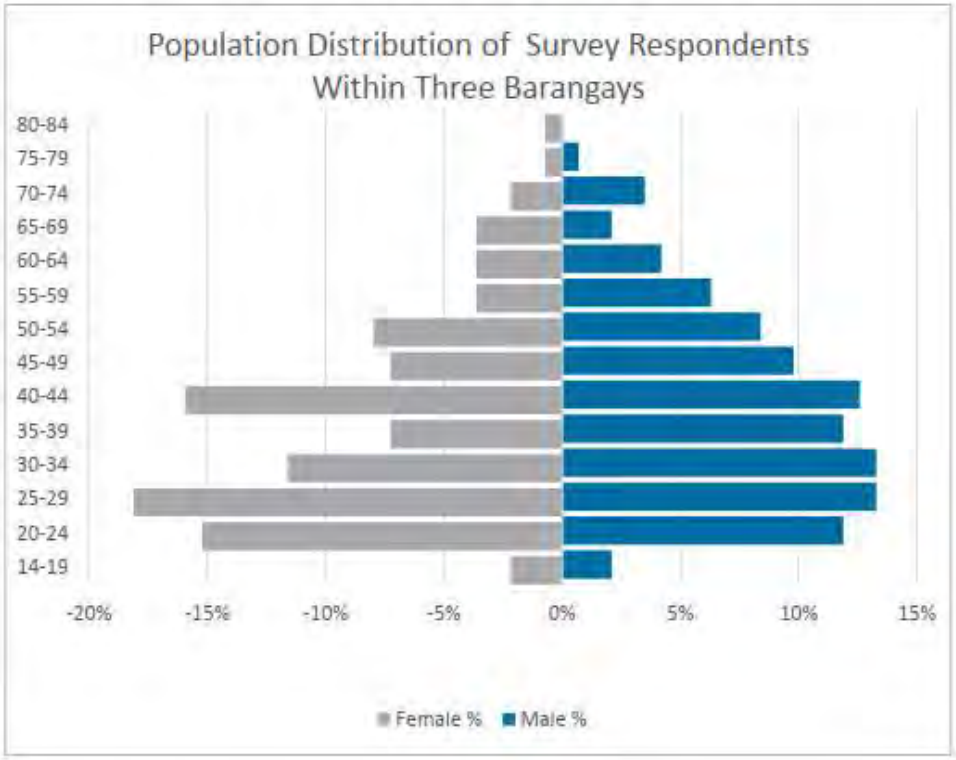
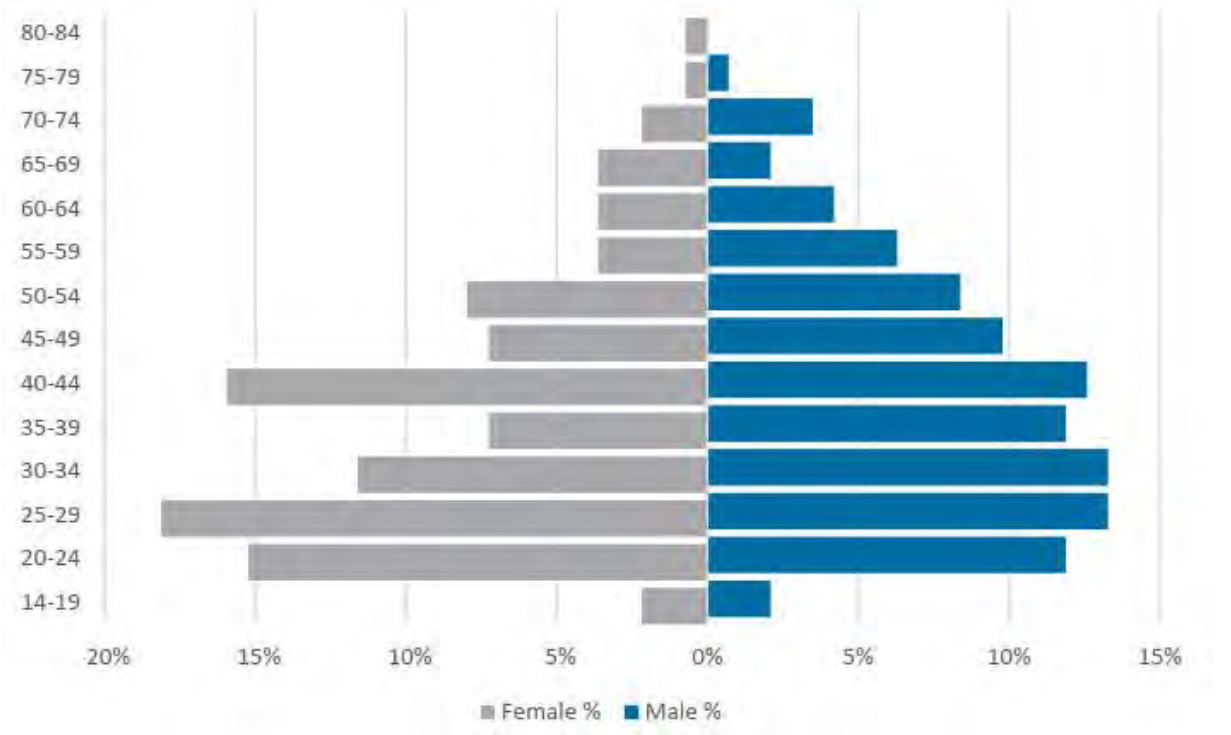


Figure 3.4.12 Age distribution of SCRP interconnecting line survey respondents



Source: MMSP EPRMP 2019

Figure 3.4.13 Sex distribution of SCRP interconnecting line survey respondents

1750. In terms of tenure, only 271 provided a response and almost half stated that they have been residing in the area for more than 10 years already (49 % or 132 respondents). Others were relatively new to the community and are living only for less than a year (14 % or 38 respondents). In addition, some respondents were residing in the respective barangay for only three to four years (12 % or 33 respondents) or one to two years (10 percent or 27 respondents). Some of these are tenants or those who came to work in the barangay as household or small business helpers. Figure 17 presents the distribution of the respondents based on their length of stay in their respective barangays.

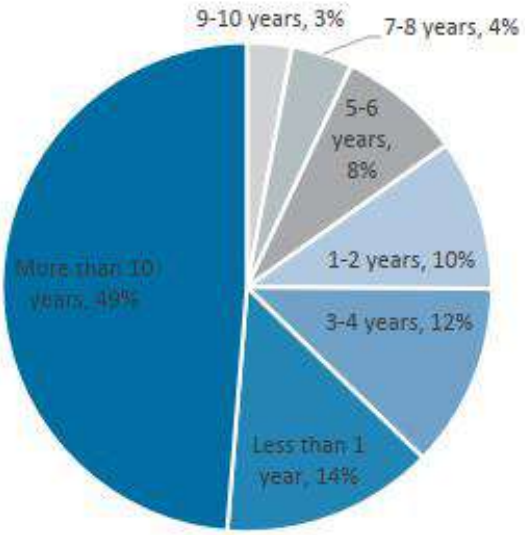


Figure 3.4.14 Length of Residence of SCRP interconnecting line survey respondents

3.4.9.2. Perception Survey Results

(1) SCRP Main Line (Solis to Calamba)

1751. Majority (83.1%) of the respondents are aware of the project through various means. About 62.8% of the respondents were made aware of the project through information disseminated in the barangays (Table 3.4.70). Majority (73.7%) of the respondents were in favor of the proposed project. Most respondents in the host cities were in favor of the project.

Table 3.4.70 Awareness and Acceptance of the Respondents on the Project

Awareness and Acceptance	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
Awareness on the Project											
Yes	796	26	53	6	49	30	29	41	65	135	1230
%	85.7	68.4	82.8	75.0	69.0	78.9	70.7	82.0	72.2	88.8	83.1
No	102	12	11	1	15	5	6	6	19	17	194
%	11.0	31.6	17.2	12.5	21.1	13.2	14.6	12.0	21.1	11.2	13.1
No answer	31	0	0	1	7	3	6	3	6	0	57
%	3.3	0.0	0.0	12.5	9.9	7.9	14.6	6.0	6.7	0.0	3.8
Total	929	38	64	8	71	38	41	50	90	152	1,481
%	100	100	100	100	100	100	100	100	100	100	100
Source of Information											
Neighbor	56	1	4	0	2	4	2	0	5	4	78
%	6.0	2.6	6.2	0.0	2.8	10.5	4.9	0.0	5.4	2.6	5.2
Barangay	621	15	33	3	40	20	26	34	35	107	934
%	66.8	39.5	50.8	37.5	56.3	52.6	63.4	68.0	37.6	69.5	62.8
Other person	41	2	2	0	0	0	0	2	8	10	65
%	4.4	5.3	3.1	0.0	0.0	0.0	0.0	4.0	8.6	6.5	4.4
IEC/ Public Scoping	117	8	21	3	19	10	2	5	25	33	243
%	12.6	21.1	32.3	37.5	26.8	26.3	4.9	10.0	26.9	21.4	16.3
No answer	94	12	5	2	10	4	11	9	20	0	167
%	10.1	31.6	7.7	25.0	14.1	10.5	26.8	18.0	21.5	0.0	11.2
Total	929	38	65	8	71	38	41	50	93	154	1,487

Awareness and Acceptance	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
%	100	100	100	100	100	100	100	100	100	100	100
Acceptance of the Proposed Project											
Yes	623	38	53	7	59	28	32	44	77	130	1091
%	67.1	100.0	82.8	87.5	83.1	73.7	78.0	88.0	85.6	85.5	73.7
No	229	0	10	0	3	8	8	1	0	22	281
%	24.7	0.0	15.6	0.0	4.2	21.1	19.5	2.0	0.0	14.5	19.0
No answer	77	0	1	1	9	2	1	5	13	0	109
%	8.3	0.0	1.6	12.5	12.7	5.3	2.4	10.0	14.4	0.0	7.4
Total	929	38	64	8	71	38	41	50	90	152	1,481
%	100	100	100	100	100	100	100	100	100	100	100

Source: GEOSPHERE, 2018

1752. **Table 3.4.71** shows that 38.3% of the respondents were anticipating that the Project will provide a much faster commute from Metro Manila to Laguna, and 31.4% believe the Project will result to less traffic congestion.

1753. About 45.4% of the respondents were concerned that the Project will demolish the houses near the railway. The largest percentage came from Biñan with 53% of the respondents expressing concern over the impact of the Project on the settlers near the railway.

Table 3.4.71 Possible Impacts of the Project Listed by the Respondents

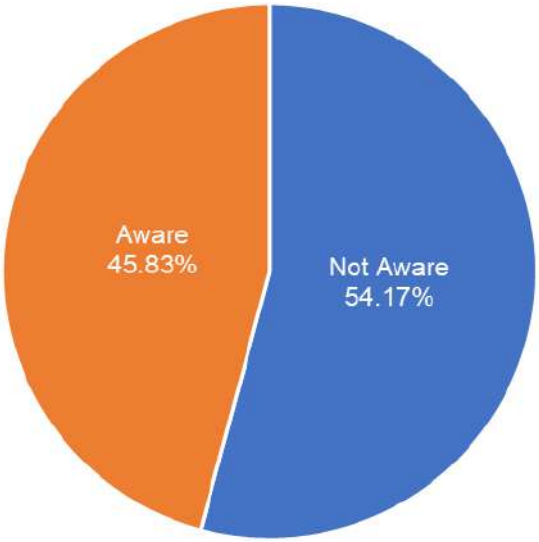
Particular	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
Benefits of the Project											
Express transport from Metro Manila to Laguna	525	32	46	6	37	22	22	27	58	104	879
%	38.1	40.5	38.7	35.3	32.5	42.3	37.9	37.5	39.2	39.8	38.3
Less traffic congestion	431	24	34	5	31	17	14	23	41	102	722
%	31.3	30.4	28.6	29.4	27.2	32.7	24.1	31.9	27.7	39.1	31.4
Less air pollution and noise from the vehicles	222	13	28	4	18	8	20	13	28	50	404
%	16.1	16.5	23.5	23.5	15.8	15.4	34.5	18.1	18.9	19.2	17.6
Others	71	9	8	1	9	1	0	6	7	5	117
%	5.2	11.4	6.7	5.9	7.9	1.9	-	8.3	4.7	1.9	5.1
No answer	128	1	3	1	19	4	2	3	14	0	175
%	9.3	1.3	2.5	5.9	16.7	7.7	3.4	4.2	9.5	0	7.6
Total	1,377	79	119	17	114	52	58	72	148	261	2,297
%	100	100	100	100	100	100	100	100	100	100	100
Negative Impacts of the Project											
Demolition of houses near the railway	571	13	40	3	22	18	23	23	35	109	857
%	46.9	31.0	46.0	30.0	23.9	41.9	53.5	37.1	31.3	60.9	45.4
Closure of the roads that traverse the railway	262	10	20	2	27	15	12	19	22	42	431
%	21.5	23.8	23.0	20.0	29.3	34.9	27.9	30.6	19.6	23.5	22.8
Noise during construction	176	9	17	0	12	3	4	11	19	23	274
%	14.4	21.4	19.5	0	13.0	7.0	9.3	17.7	17.0	12.8	14.5
Others	77	2	5	2	5	0	0	4	3	5	103
%	6.3	4.8	5.7	20.0	5.4	0	0	6.5	2.7	2.8	5.5
No answer	132	8	5	3	26	7	4	5	33	0	223

Particular	Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba	Total
%	10.8	19.0	5.7	30.0	28.3	16.3	9.3	8.1	29.5	0	11.8
Total	1,218	42	87	10	92	43	43	62	112	179	1,888
%	100	100	100	100	100	100	100	100	100	100	100

Source: GEOSPHERE, 2018

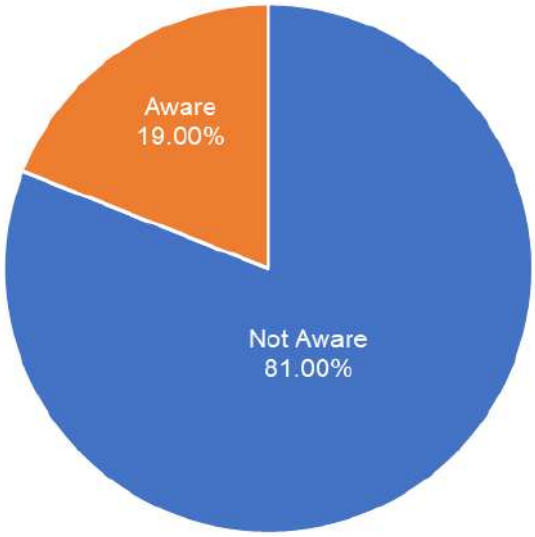
(2) SCRP Interconnecting Line (Senate-FTI-Bicutan Segment)

1754. In general, more than half (54%) of the respondents were aware of the SCRP, the MMSP and the interconnecting line (Senate-FTI-Bicutan segment). Information was acquired primarily through mass media such as television, newspapers or radio (53%). Other sources of information were from the government (13 %) or heard from relatives or neighbours (11 %). On the other hand, about 81 % of the respondents were not aware that the alignment will pass through the areas of Taguig, Parañaque and Pasay. **Figure 3.4.15** and **Figure 3.4.16** present the level of awareness of the respondents on the project and their awareness on the portion of alignment that will pass through their area, respectively.



Source: MMSP EPRMP, 2019

Figure 3.4.15 Awareness on the Project



Source: MMSP EPRMP, 2019

Figure 3.4.16 Respondents' Awareness on the Alignment that will Pass through their Area

1755. Based on the survey most of the respondents from all three barangays believe that the project will improve mass transportation within Metro Manila (35% or 208 respondents), while others understood that it would increase employment opportunities for the residents (20% or 117 respondents). Other significant positive impacts identified were establishment of more business within the community (18%) and social development or progress in the barangay (17%).**Table 3.4.72** presents the perceived positive impacts of the project and its percentage.

Table 3.4.72 Perceived positive impacts of the Respondents on the project

Positive impact (multiple responses)	Responses	Percentage
Increased Employment	117	20
Increased business/establishment of business in the community	108	18
Progress in the barangay of town/ social development	97	17

Positive impact (multiple responses)	Responses	Percentage
Improved mass transportation	208	35
No positive effect	6	1
No Idea	14	2
Others	37	6
Total	**587**	**100**

1756. Source: MMSP EPRMP, 2019Table 3.4.73 on the other hand presents the perceived negative impacts of repondents. Among the significantly identified impacts were loss of property (19 %), removal of trees and other vegetation (12 %), and safety issues (12 %). Residents who responded that they would lose their property were those located within the direct impact area based on the conceptual design, which will possibly be cleared for the construction. Majority of them were property owners or small and medium enterprise owners who lease the property (i.e. sari-sari store, canteen, convenience store). In terms of safety issues, some respondents were concerned if transportation underground will be safe since there were concerns about earthquake, particularly “The Big One” in Metro Manila.

Table 3.4.73 Perceived negative impacts of the Respondents on the project

Negative impact (multiple responses)	Responses	Percentage
Loss of property	99	19
Loss of access	36	7
Pollution to water	26	7
Pollution to air	29	5
Removal of trees and other vegetation	62	12
Loss of work and livelihood opportunities	38	7
Health problems leading to accidents	20	4
Safety issues	62	12
No negative effects	37	7
No idea	37	7
Others	72	14
Total	**518**	**100**

Source: MMSP EPRMP, 2019

1757. To address these identified negative impacts, the respondents were asked how they think it can be addressed. Among the respondents, only 26.7% (or 75 respondents) provided their insights on how these impacts can be mitigated. Of the respondents that provided mitigation measure, 12 of those (4.3%) said that the project should avoid areas with numerous trees to prevent removal of trees and vegetation and replace those trees that will be affected. These responses evidently came from government workers of NAMRIA in Barangay Fort Bonifacio who took in consideration the DENR’s mandate on protection of trees and other natural resources. In addition, the other 10 respondents (3.6%) stated that there should be proper compensation and relocation for those houses and establishments that will be affected by the project. Meanwhile, about 73.3% (206 respondents) either do not have an idea or have no response on the query. **Table 3.4.74** presents the summary of mitigating measures which were suggested by the respondents.

Table 3.4.74 Suggested Mitigating Measures for Perceived Negative Impacts

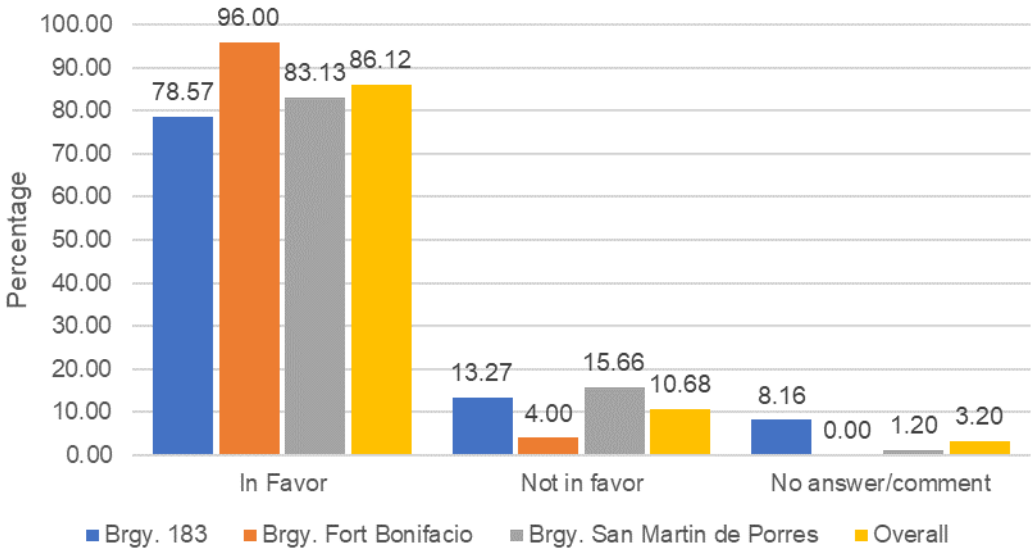
Mitigating Measure for Negative Impacts	Responses	Percentage
Avoid areas with numerous trees and replace affected trees	12	4.3
Ensure proper compensation and relocation for project affected population	10	3.6
Ensure construction materials for the project are of good quality	6	2.1

Mitigating Measure for Negative Impacts	Responses	Percentage
Ensure good and synergised project planning	6	2.1
Ensure security and minimise safety risk	6	2.1
Ensure capability of SCRP interconnecting line to geotechnical hazards and flooding	6	2.1
Proper IEC, coordination and consultation activities with areas to be affected	5	1.8
Provision of alternative routes and lessen unnecessary road closure	4	1.4
Ensure project transparency to avoid corruption	3	1.1
Assurance of the capability of the Contractor to implement the project	3	1.1
Provision of alternative routes and lessen unnecessary road closure	3	1.1
Full support, cooperation and appreciation of general public for the project	3	1.1
Ensure subway fare affordability	2	0.7
Ensure regular and effective train maintenance during subway operations to avoid existing MRT/LRT problems	2	0.7
Avoid areas with numerous people find alternative areas	1	0.4
Implement earth balling for trees to be affected	1	0.4
Ensure good plans for soil integrity	1	0.4
Policy on shifting of business hours	1	0.4
No idea/no answer	206	73.3
Total	**281**	**100.0**

Source: MMSP EPRMP, 2019

1758. Overall, the acceptance of the project in all three barangays is high with 242 respondents (86.12 %) in favor of the project. Only 30 out of the 242 (10.68 %) were not in favor, while nine respondents (3.20 %) were still undecided.

1759. **Figure 3.4.17** presents the level of acceptance of the respondents per barangay and its overall rate.



Source: MMSP EPRMP, 2019

Figure 3.4.17 Level of Acceptance of the Respondents

3.4.10. Impact Identification, Prediction, Assessment and mitigation

3.4.10.1. Pre-Construction and Construction Phase

(1) Displacement of Settlers

1) Displacement/Disturbance of Residents, Properties and Business / Institutional Establishments

1760. One of the significant impacts of the Project is the demolition of properties for land acquisition. Based on the census, tagging and socio-economic survey (SES) conducted from Calamba City to Manila City within the PNR ROW, an estimated 11,114 families will be displaced.

1761. The necessity to acquire additional land for the project ROW arises from the need to achieve the design parameters such as 60m width of the proposed stations, areas already with a PNR ROW less than the required 30m and realignment of curves for the target train speeds. There is no alternative to the displacement of households, businesses and commercial establishments, and displacement from the source of livelihood. Moreover, many parts of the PNR ROW has been taken over by ISFs who disregard the hazard of living along the PNR ROW.

1762. During the planning stage, the need to avoid residential, commercial and productive agricultural areas were taken into consideration. DOTr have maximized the use of the existing the PNR ROW from Calamba City to Manila. The segment detour to Sucat Old Power Station is to enable a transport mode intersection to be built, which will be located outside the existing PNR ROW.

1763. In addition, the PNR ROW from Solis Station to Sta. Mesa Station in Manila City is already committed for the NLEx/SLEx Connector Road project of the DPWH which will start construction in 2019. Hence, DOTr will acquire land for a ROW parallel to PNR ROW from Solis Station to Sta. Mesa Station with a total length of about 10.9 km up to Zobel Roxas Street.

1764. This new segment will displace further families and demolish properties, businesses and commercial establishments. Approximately 22 ha of agricultural land is required for the SC Depot site in Banlic, Laguna. Only a small number of dwellings are required to be purchased to enable these works.

1765. The results of Socio Economic Survey conducted for the RAP showed that the majority or 9,714 (83%) of the affected households expressed concern over their houses being demolished or that they will be relocated to another area, 348 or 3% are worried that their businesses/livelihood will be negatively affected , 255 or 2% are concerned that the living environment in the area might be worse because of the noise and vibration that the project will cause, 121 or 1.% are worried that their shops will be relocated, while 547 or 5% raised “other” concerns such as relocation site not good enough, no livelihood opportunities at relocation site, no assurance of good housing at relocation site with access to water and electricity, project funds being corrupted, etc. The other 617 or 5% did not respond to the question.

1766. For the project affected families (PAF), business, landowners, the RAP has been developed which describes specific details for the Project (separate document). The RAP is being prepared to ensure that affected households and establishments will be provided with resettlement sites and/or just compensation in compliance to the JICA Guidelines for Environmental and Social Considerations (2010) and Asian Development Bank (ADB) Safeguard Policy Statement (2009), the Republic Act No. 10752, and other applicable Philippine Laws and Regulations. Compensation will be paid in full prior to any displacement activity. Once the updated RAP is approved by JICA and ADB, DOTr will implement accordingly. In addition, a Social Development Plan (SDP) Framework of this report this will also address, among others, the social issues of the PAFs. Land Acquisition

1767. Land acquisition of private owned land is an inevitable impact of the project. For sections where private lands are affected by the project alignment such as the 10.9 km ROW parallel to the PNR ROW from Solis Station to Sta. Mesa Station; 30-meter ROW extension at 20 stations, SC Depot area (Sucat Thermal Power Plant or Banlic, Laguna), land acquisition will take place

with just compensations. There will be minimal land acquisition in the areas of Makati, Taguig and Paranaque.

1768. To avoid conflict, RAP and Land Acquisition Plan (LAP) is being prepared, in accordance with ADB and JICA Guidelines and applicable Philippine Laws and Regulations, for this Project to address in detail the compensation for land and structures, resettlement of displaced persons (DPs), and loss of livelihood opportunities.

1769. DOTr will continue coordination with the DAR for the conversion of the irrigated agricultural land at Banlic to development land as depot.

1770. DOTr will enter into an agreement to purchase the land at Sucat Power Station from PSALM for the new station at Sucat. The additional land at Sucat to link the new station requires purchase of existing dwellings. The impact on the household concerned is mitigated under the RAP. DOTr will coordinate with DPWH, PSALM, LGUs, lot owners and other concerned stakeholders in acquiring the land and/or securing ROW.

Resettlement

1771. Relocation sites will be secured and developed in an urban location prior to displacement in coordination with LGUs, SHFC and other key shelter agencies. Dwellings will be provided with basic utilities such as power and water and social infrastructure such as health and educational facilities. A noted positive impact of the project is that the affected families (i.e. informal settler families) may eventually be provided with secured tenure through housing units with basic amenities. Resettlement sites being located in same city, will also enable PAFs to maintain their existing employment. DOTr will continue coordination with the recipient LGUs for the development of sites and provision of basic services and facilities, as well as for ensuring the integration of the PAPs into the host community. In the case that resettlement sites are not ready at the time of construction; rental subsidy will be provided so that PAPs are able stay in temporary accommodation.

Impact on Livelihood

1772. Livelihood of the local community from commercial establishments, small vendors, and farmers may experience temporary disturbance during construction of the Project. The Project may also lead to a change in the business market in affected areas. In consideration of affected groups, construction activities will be undertaken at the shortest possible time to restore normal business operations immediately. Alternative livelihood programs in coordination with the LGUs and other government agencies will include things such as vocational training for construction related works, employment in local communities, and soft loans to establish business etc. For business establishments that will be permanently removed, fair compensation measures will be provided to ensure continued economic activity and/or the restoration and/or improvement of livelihood.

Monitoring

1773. Internal monitoring will be conducted by DOTr whereas external monitoring will be conducted by a third party to ensure that the displacement activities are conducted in compliance to the RAP approved by JICA and ADB. The internal monitoring indicators are; 1) Budget and timeframe, 2) Delivery of Compensation and Entitlements, 3) Public Participation and Consultation, and 4) Benefit monitoring, whereas the external monitoring indicators will be; 1) Basic information on PAP households, 2) Restoration of living standards, 3) Restoration of Livelihoods, 4) Levels of PAP Satisfaction, 5) Effectiveness of Resettlement Planning, and Other Impacts.

1774. RAP Institutional arrangements for the implementation of the RAP will be in place prior to the commencement of the process, which will include the provision of adequate human resources for supervision, consultation, and monitoring of land acquisition and rehabilitation activities.

2) Impact on Public Access and Right of Way

1775. The project will have an impact on access in two ways: First, there are pathways and road accesses to some properties that are trespassing the ROW and have no alternative access. Second, there are routes across the ROW used by children going to school. The existing public roads that cross the ROW will be impacted very little because of the construction method that will be used. Pre-cast span sections will be installed across the roads at times of little traffic and disruption will limited to a few hours.

1776. In terms of the excavation works for the SCRP underground interconnecting line, the required area for moving construction yards may hamper public access to road lanes. Roadside lands shall be utilized for the temporary construction yards to retain the existing use of road lanes during construction works. Where applicable, alternative routes around the respective station areas shall be proposed and its corresponding/informational signage shall be provided.

1777. During the DD, the project studied the current access routes across the ROW by the local affected communities and designed the project to avoid closure of existing public access as much as possible. Construction operations will move constantly along the line and once construction work starts the ROW will be fenced either with the Contractor's temporary fence or the final ROW fence and no access across the line will be allowed. Excluding access will continue as DOTr plans a rail freight line at ground level. DOTr will also coordinate with PNR, LGUs, Barangay, government agencies and Contractors to mitigate the closure of existing access where this needs to take place. In the case where an existing access to a building becomes completely blocked due to unavoidable blocking by the Project, RAP will be also applied for land acquisition and resettlement. Further, should the construction works completely block access (without alternative access) to a business, then compensation for lost income for the period of disrupted access will be provided.

1778. The project affected communities and LGUs will also be informed on the project activities including construction schedule and possible impact to the existing public access (pedestrian, cyclist and vehicles) through IEC activities of the Contractor. As diversions and access closures will change location as the construction progresses, the Contractor is required to keep the public and LGUs informed on any changes in diversions and route closures through notices, posters, signage, consultations, etc. Traffic aides will also be assigned on site to guide road users ensuring their safety and to monitor the site condition. DOTr will also coordinate with the DepEd and the host LGUs for the schedule of construction activities to ensure that the disruption to access for students is minimized.

3) Impact on Vulnerable Groups

1779. PAPS who are also part of vulnerable groups which include indigenous communities, people under poverty line, solo parents, women, children, elderly and persons with disabilities.

1780. Among the PAFs, there are members of households who are below the poverty line or who may be elderly, persons with disabilities and/or needing special assistance, and solo parents. Based on the SES, the majority of those vulnerable people affected by the Project are babies/toddlers (87.2%), whereas as families affected, elderly lead families (31.6 %), single parents (36.5 %), and below poverty threshold (32%).

1781. Vulnerable Persons will benefit from the Livelihood and Income Restoration Program (LIRP), which specific details will be explained in the RAP for the Project. The Project was designed to (i) minimize the effects of displacement and (ii) help the PAFs immediately restore their living condition to pre-project condition. Some of the mechanisms that will be put in place to ensure that the PAFs will benefit, especially the vulnerable groups, are as follows:

1782. Resettlement sites will be developed through Community Based Initiative Approach which is an alternative shelter planning approach that demonstrates the consultative and participatory principle of development planning enshrined in the Urban Development and Housing Act of 1992.

PAFs, through community associations, are given the opportunity to identify their own preferred relocation sites. This will hopefully fill the gaps of affordability, sustainability and other resettlement issues.

1783. Aside from relocation sites and applicable compensation, the following additional assistance will be provided to vulnerable groups:

- Inconvenience allowance in the amount equivalent to Php 10,000 per household;
- For the families with persons who need special assistance and/or medical care, respective LGUs to provide nurses or social workers to help them before and during the resettlement activity;
- Inclusion in the Livelihood Restoration and Improvement Program as prescribed in the RAP; Rehabilitation assistance in the form of skills training and other development activities with the value of up to Php 15,000 will be provided in coordination with other government agencies;
- Support to access government welfare programs;
- Support case workers to assist transition process and monitor conditions;
- The case workers will identify other assistance required for specific cases;
- For PAPs opting for self-relocation, DOTr will establish and keep records of all PAPs, issue the necessary certifications to facilitate access to national government programs through the partner agency regional field offices (DTI, DOLE, TESDA etc.), and carry out per iodic monitoring and evaluation through DOTr regional field offices.

4) Impacts on Gender

1784. Further findings from the Gender Impact Assessment indicate a lack of awareness on the issue of gender and vulnerable groups among the infrastructure projects. Some identified issues among LGUs include: (1) lack of specialized gender-sensitive facilities. In addition, the absence of a GAD database sets limitations on the capacity of LGUs to plan for their needs.

1785. Gender-sensitive livelihood and skills training program will also be included in the Social Development Plan (SDP) Framework presented in Chapter 6 with due consideration to solo parents and women-headed families. Furthermore, DOTr will provide gender equal job opportunities in line with national laws and regulation during construction and operation.

1786. The Project's design of train system (stations and trains) will also account for the needs of the gender as well as vulnerable groups through the provision of gender-sensitive facilities for women, allocation of trains for women (especially those pregnant), including allocation of security officers for each station. In addition, the station design will ensure that the all users are provided with sufficient lighting to ensure their safety and security.

1787. The various programs and equality of employment consideration for all jobs ensure that there is no disproportionate impact on gender.

(2) Effects of In-Migration

1788. The impact of in-migration of workers on surrounding communities during construction has been reduced to a moderate level by the DOTr and its requirement that Contractors give priority employment to skilled and unskilled local residents for the Project. Workers who do arrive from outside the area will be housed in worker camps lessening negative impacts on local communities.

1789. Encroachment of informal settlers during pre-construction stage taking advantage of the relocation package for affected ISFs of the Project has been minimized through setting a cutoff day which was clearly communicated to the community when explaining who will benefit the project compensation. Moreover, the Project ROW will be fenced and guarded with security personnel to limit access or entry of unauthorized persons at the ROW. In addition, the time between the pre-construction and construction will be shortened as much as possible.

(3) Cultural/Lifestyle Change

1790. The construction of the railway will have negative and positive impacts on the lifestyle of people living at the host barangays particularly the PAPs. The PAPs that will be relocated may experience inconvenience because they will be displaced from their home and/or source of livelihoods. Through the above-mentioned RAP, the living conditions of the PAPs will be maintained or improved by ensuring they can remain in their city to allow them to maintain the existing livelihood, get secure tenure of housing units with basic amenities, and partake of the Livelihood Restoration and Improvement Program (LRIP). DOTr continues coordination with the receiving LGUs for the development of relocation sites and provision of basic services and facilities, LRIP as well as for ensuring the integration of the PAPs into the host community through SDP and public consultations with receiving communities.

1791. Residents are likely to change their economic and social lifestyle to keep up the demand of employment and livelihood opportunities created by the project. In general, the stations will become centers of further economic development and opportunity. This is considered a positive impact by the LGU and most residents.

(4) Impacts on Physical/Cultural Resources

1) Impacts on Old PNR Structures

1792. The Project viaduct will pass over the Old PNR buildings and structures, many of which are over 50 years old and receive statutory protection unless the National Museum allows it. Structures were surveyed and all buildings that the project needed to demolish were assessed for historic value by the cultural agencies (NCCA, National Museum, NHCP) and for value by PNR. All other buildings left in place will be protected under the Historic Building Protection procedure which is part of the Contractor specifications. An outline of the protection procedure is given below:

- Old PNR structures such as the remaining old bridge piers will be protected by fencing;
- A building condition survey (BCS) will be carried out for the old station structures. This will assess in detail the present condition of the protected building;
- Vibration monitoring will be implemented when construction work is in the vicinity of the buildings;
- Buildings will be monitored through the contract to ensure no deterioration takes place;
- At the end of construction, the BCS will be repeated for verification and approval of concerned parties and repairs made to any deterioration;
- Sufficient consultations to the historic building owners to be carried out prior and throughout construction period;
- Traffic management of large trucks and machines in the area of the buildings at risk in order not to exceed allowable vibration level at the building.
-

1793. DOTr had conducted series of meetings with cultural agencies (National Commission for Culture and the Arts (NCCA), NHCP and National Museum (NM)), otherwise known as Tripartite Technical Working Council (TWC) on Built Heritage Issues and Concerns, and PNR to consult with them on appropriate protection measures for the identified old PNR structures during construction; hence, the Matrix of Existing PNR Structures of Historical Importance was created. The proposal was submitted, which is aimed to avoid the direct impact to old PNR structures and buildings by avoiding any overlap of project structures and allowing sufficient buffer zone and applying technologies to minimize the vibration during the construction.

1794. As of July 2019, DOTr has submitted to PNR the revised proposal for their approval of each proposed action for every structure and for their decision on what preservation measures to be done for each structure. Once a decision is made by PNR, the approved matrix is to be turned over to cultural agencies for further action.

1795. One building, the Abad Santos Signal box, has been confirmed to be moved to avoid destruction when constructing one of the viaduct piers. The National Museum has requested that the structure be relocated nearby to maintain historical context. The work to do this is will be done by DOTr in the pre-construction phase.

2) Impacts on Historic or Archeological Sites

1796. No archeological sites were found on the project alignment and no Archeological Impact Assessment was required by the National Museum, except for the National Nutrition Council (NNC) of the Philippines which is potentially at risk of being affected by the underground tunnel (although the vibration impact assessment presented in Chapter 3.2 indicates that damages to the building are very unlikely given the depth of the tunnel). Because of its entry in the Philippine Registry of Cultural Properties, further consultations with concerned agencies including but not limited to DepEd (property owner of the NNC), NCCA and National Museum during detailed engineering design (DED) of the underground section in the Senate-FTI-Bicutan segment and prior to construction is strongly recommended.

1797. Identified historic sites and structures in close proximity to the project shall undergo necessary consultation and permitting processes to NHCP, in accordance to RA 10066. The Act prohibits any form of modification, alteration or destruction of the original features of or undertaking of any construction (or real estate development) in any national shrine, monument, landmark and other historic edifices and structures, declared, classified, and marked by the NHCP as such, without the prior written permission from the Commission. This includes the designated security or buffer zone, extending five (5) meters from the visible perimeter of the declared historic site.

1798. There are no available records of specific location of possible archaeological finds along the project alignment. Recorded sites are within the Fort McKinley, with reference to previous studies. There are also indications of discoveries of fossils of megafauna from the Pleistocene period in other areas of Taguig, but not within the alignment. In view thereof, the National Museum provided Guidelines on Heritage Accidental Finds attached hereto as **Annex 3-8.**

1799. In the event that an archaeological asset is discovered during the course of construction period, the following procedure shall also be implemented:

1. DOTr must preserve the potential archaeological finds and report it immediately to the National Museum;
2. Closely coordinate with the National Museum on the appropriate course of action in protecting the archaeological finds;
3. Cease immediately all construction activities in the vicinity of the find/feature/site;
4. Hire an archaeologist, recognized by the National Museum, to ensure the following are carried out:
    - Delineate the discovered find/feature/site;
    - Record the coordinates of the find location, and all remains are to be left in place;
    - Secure the area to prevent any damage or loss of removable objects;
    - Assess, record and photograph the find/feature/site;
    - Undertake the inspection process in accordance with all project health and safety protocols under direction of the Health and Safety Officer;
    - Conduct all investigation of archaeological soils by hand;
    - Keep all finds, osteological remains and samples and submit to the National Museum as required;
    - In the event that any artefacts need to be conserved, secure approval from the National Museum;
    - Provide an on-site office and finds storage area to allow storage of any artefacts or other archaeological material recovered during the monitoring process;
    - In the case of human remains, in addition to the above, contact the National Museum

and adhere to the guidelines for the treatment of human remains; and
- If skeletal remains are identified, consult an osteo-archaeologist to examine the remains.

5. The proponent will implement the following process for conservation of objects found:
    - Hire a conservator, if required;
    - The consulting archaeologist completes a report on the findings and submits to the National Museum; and
    - National Museum reviews the report and informs when works can resume.

(5) Threats to Delivery of Basic Services/Increase in Demand for Resources

1) Impact on Utility Services

1800. The project will have an impact on utilities supplying basic service to local communities such as those carried on poles and overhead wires, and submerged utilities (in the case of underground interconnection line alignment). Prior to the construction of the Project, some of the overhead high voltage cables, telephone and communication cables and underground water pipes, and so on located inside the ROW, need to be diverted or relocated to make way for the railway construction.

1801. Each utility company has its own procedures for maintaining supply and minimizing inconvenience during maintenance and switch over work. DOTr will coordinate with the relevant utility agencies for the formulation and implementation of measures to minimize the impact of the diversion of such utilities.

1802. The exiting oil pipeline not in use within ROW will be also removed.

2) Impact on Social and Institutional Facilities

1803. The project will have a direct impact on school facilities and will require relocation. This may disturb the school activities as well as resulting in some students having to travel longer distances to school. DOTr has ongoing consultation with the schools so that the relocation site will be close to the existing site and the schedule to relocate will be on school holidays to minimize disruption of school activities.

1804. Additional demands for schools, markets and community service facilities, etc. is expected in the area of resettlement areas. Provision of these resources will be included in the RAP. DOTr will coordinate with the receiving LGUs for the development of sites and provision of basic services and facilities, as well as for ensuring the integration of the PAPs into the host community.

1805. The Project will also affect public open spaces in the area. The relocation of such open spaces will be covered in the RAP. DOTr will coordinate with the respective LGUs regarding the possible measures for the transfer or relocation of the parks and the nursery.

3) Increase in Demand for Resources

Power supply

1806. The project will use significant amount of electricity in the construction, mainly in the pre-casting and concrete processes. The amount of 23,786,067 kWh is estimated by the design team. This figure has been shared with the regional electricity companies and is within their existing and planned capacity and the severity of impact on availability is low.

1807. Diesel fuel consumption is estimated to be 257,016,000 liters over the course of the construction period and this amount will be sourced on the open market, which is global, and need not have any effect on local supply.

Water supply

1808. During construction, the concreting works and workers use will increase water consumption. Based on the estimated water consumption of 3,149,498,000 liters (3,149,498m^3) during construction. Over 2.5 years of construction this is 3400 m^3 per day.

1809. Water supply is restricted at certain times of the year in Metro Manila when droughts occur. The water companies have various projects in the pipeline to increase supply. The construction companies have the opportunity to sink boreholes to obtain water and may do this to ensure supply. The impact is rated as low as the demand is within local water supplier capacity and will persist only during the construction period.

Solid waste

1810. Solid wastes will be handled and disposed in accordance with RA 9003. The project will generate significant solid waste at the pre-construction, construction and much smaller amounts at the operational stage. A detailed project Solid Waste Management plan was written for the project that outlines the final location of the waste and its potential impact on local waste disposal resources.

1811. Waste disposal and demolition at the pre-construction site for the railway of SCRP will all go to registered landfill sites and have low impact on the environment. Trees cut within project ROW will be delivered to DENR for market sale and smaller trees will be disposed of as the tree cutting Contractor decides. Most of this timber will find a ready market. About 2304m^3 of concrete is predicted to be removed from ISF housing and this can be recycled into aggregate if facilities are available.

1812. The final disposal option for spoil has been left to the Contractor and the amounts will either be used on land raising projects, to fill borrow pit areas or taken to sanitary landfill sites where it can be used for covering. Final details will be provided in the Contractors Solid Waste Management Plan.

1813. In the case of Senate-FTI-Bicutan Segment, two suitable spoil disposal sites have been identified, including in the Barangays of Muzon and Sta. Ana in Municipality of Taytay with land area of 13.5 has and 9 hectares, respectively. The Contractor shall be responsible for conducting and securing related studies and clearances such as ECC, LLDA Clearance, Shoreland Development Clearance, Locational Clearances, Traffic Clearances, among others.

1814. The Contractor's accommodation and commercial waste will be collected by the LGU waste transfer operator or a similar locally contracted operator who will dispose of the same to the accredited sanitary landfill.

(6) Threats to Public Health and Safety

1815. The potential air and water pollutants generated during pre-construction and construction works may have adverse impacts on the health and safety of the residents of nearby communities, specifically those along the project boundary. Local residents may also be exposed to higher levels of some diseases due to worker migration. Also, accidents involving vehicles associated with the project and impact residents. The following measures will be implemented to reduce risks of threats to people in contact or close to the project:

1816. The following measures will be implemented to reduce risks of threats to human health and safety:

- Formulation and implementation of IEC to inform the affected LGU and local communities and the general public about 1) the project, project activities, schedule and duration, possible project impacts and incorporate their comments and inputs in the design, 2) the potential impact of project activities to air quality, noise, vibration, and climate change and mitigation, and safety aspects like areas that are restricted for the public, and 3) the Grievance Redress Mechanism to handle complaint/s if any.

- Provide SDP on public health and safety including infectious diseases to raise the awareness of communities.
- Plan for construction yard and access route in consideration to health and safety of local communities particularly traffic. The Contractor is required to submit a traffic management plan.
- Close coordination with the nearest hospitals in the active construction site for immediate transfer and/or further evaluation and medical management of the patient.
- Fencing of the construction site, provision of signage, warning and posters, and guarding of the access point to ensure that the area is not accessible to the public.
- Ensure that the construction workers have regular health checks and are provided with proper training on health and safety procedures and emergency preparedness and response procedure.

(7) Threats to Occupational health and safety (Accidents and infectious disease)

1817. Workers will on occasion be exposed to increased levels of noise, dust, and heat, as well as physical hazards associated with the work during pre-construction and construction phases of the Project. At the same time, they may bring personal physical and mental health conditions to the work. The workers may be exposed to insect borne infectious diseases due to poor drainage conditions at the project area (such as the prevalence of dengue fever in some areas). These workforce (including the transients such as ambulant vendors, hangers-on, visitors, etc.) in construction sites of the project footprints could also pose potential threat to adjacent communities and establishments in terms of public health and sanitation.

1818. The risk assessment detailed in Chapter 5 of this report also identifies hazards associated with the underground interconnecting line during construction and operation phases. These include tunnel deformation and collapse, groundwater ingress, chemical and process hazards, fire, train derailment, structural failure, security threats, UXOs, exposure to hazardous substances, underground utility strikes, and natural disasters.

1819. The following are the project mitigation measures proposed for pre-construction and construction:

Pre-construction phase

- Prepare occupational Health and Safety Management Plan in compliance to OSH.
- Include medical certificate in the requirements for hiring of workers to ensure that they are fit to work.
- Ensure that the construction workers are provided with proper training on construction operating procedures, occupational health and safety procedures and emergency preparedness and response procedure. This shall also include the SOP should the workers encounter UXOs and/or other unidentified metallic objects during excavations and tunneling activities.
- Soil and groundwater investigation should be conducted to assess the soil and groundwater conditions in the project area prior to any excavation and tunneling activities.
- Prepare construction plan including storage of equipment and machinery, and access route of heavy vehicles considering health and safety of workers.
- Close coordination with the nearest hospitals in the active construction site for immediate transfer and/or further evaluation and medical management of the patient.

Construction phase

- Provision of safe and clean water for drinking, appropriate sanitary facilities such as portable toilets and waste bins.
- Provision of a health clinic for workers.
- Ensure that construction complies with the provisions of NFPA130 (**Annex 1-1**) and NFPA241.

- Provision of appropriate PPE to all construction workers, particularly to the personnel working on heights, heavy and electrical equipment, and tunneling activities.
- Provision of safety signage and warnings, adequate security force and safety units, security cameras and anti-derailing rail or guard at construction sites.
- Provision of medical/first aid kits at the construction area. Establishment of Health and Safety Desk or Medical Station at the active construction sites to safeguard the health of the workers and local residents and to provide immediate response during unexpected incidents/emergencies.
- Provision of training on construction operating procedures, occupational health and safety procedures and emergency preparedness and response procedure including security policies and procedures
- Ensure that all workers are well trained in managing situations and the proper operational procedure to follow should there be UXOs and other unidentified metallic objects identified during excavation activities.
- Access to construction sites will also be controlled and monitored.
- Avoidance of unnecessary excavation shall also be observed to minimize ground disturbance.
- Tunneling shield designed in accordance with “Design Standards for Railway Structures and Commentary (Shield Tunnel)” shall be implemented to prevent groundwater ingress.
- Conduct geophysical investigations using underground utility scanning technologies such as Ground Penetrating Radar (GPR) to mitigate utility strikes.

(8) Generation of Local Benefits

1820. The direct benefits resulting from the Project during pre-construction and construction include the creation of temporary employment for both local and non-local manpower, as well as increase in demand of local service businesses.

1) Employment

1821. During pre-construction of the Project, DOTr will require about 200 staff in their management unit while approximately 26,680 workers will be required by Contractors during construction. All manpower requirements during pre-construction phase will be hired directly by the DOTr. During construction, the general consultant will employ mostly international experts since the technology and construction methods being used are new to the Philippines. For the construction works, manpower will be hired through the local construction company.

1822. DOTr is committed to provide equal opportunities for employment to everyone, in compliance with the Labor Codes of the Philippines, Republic Act No. 10911 known as the Anti-Age Discrimination in Employment Act, and RA 7277 known as the Magna Carta for Disabled Person. DOTr will also provide equal opportunities for employment of men and women, on the basis of their abilities, knowledge, skills and qualifications rather than on age or disability. In compliance to RA 6685, DOTr will hire at least 50% of unskilled workers and 30% of the skilled labor requirement from the unemployed, bona fide and actual residents of the host LGUs in Laguna and NCR with priority on the host barangays provided that these are qualified. The policy on hiring including the treatment of statutory benefits of the workers will be stipulated in the TORs and contracts with the local Contractors to ensure compliance.

1823. To enhance the employment opportunities brought by the Project, DOTr will regularly coordinate with the host LGUs and barangays regarding the hiring of temporary workers to ensure that the workers being considered are legitimate residents in the area. Moreover, by hiring local residents, some social conflicts associated with uncontrolled in-migration may be minimized. The priority of employment will be provided to project affected people and gender equality will be also well considered. Through livelihood and income generation program prepared under RAP, the skill training will be provided to those PAFs underprivileged in consideration so that they have sufficient skills to work at construction phase.

1824. The respective Contractor will be responsible to provide accommodation for their workers and equipped with the necessary social infrastructure such as potable drinking water, portable toilets, waste bins, first aid kits, etc. Non-local skilled and non-skilled workers will stay in temporary accommodation inside the ROW. The temporary accommodation will also be provided with security guards for safety and security purpose. After construction activities, the Contractor will ensure that workers leave the area to prevent the formation of informal settlements.

2) Local business

1825. Potential positive effects of the manpower influx will include demand for retail and other services. This will increase economic activities and benefits for some local businesses including food suppliers and other retailers. It is expected also to increase business opportunities in terms of the project needs for construction materials, general supplies, concrete aggregates, and social services.

(9) Traffic Congestion

1826. During FS stage, a Traffic Impact Assessment (TIA) was prepared. Based on its findings, a Traffic Management Plan (TMP) that details the activities to adequately manage traffic is recommended to be prepared in the DD Phase, to be based on the TMP prepared for the SCRP RAP. The development of TMP will be coordinated with the LGUs and relevant GAs prior to construction.

1827. The railway will cross existing major roads; thus, it is expected that negative impacts would arise from reduced road capacities. Moreover, the construction and operation of the railway will not only affect the surrounding areas but will have long term consequences and could cover road tributaries wider in scope. Traffic capacity analyses on the 45 intersections around the railway project were surveyed. There will be two (2) study periods, namely construction stage set as year 2020 for the Solis to Blumentritt section and year 2025 for the rest of the alignment, and operation stage set as year 2025 and 2030 respectively. The intersections are assessed based on their capacity to carry the future general traffic and the traffic volumes generated during the railway construction and operation.

1828. Tunneling activities and staging of construction works, restriction on some roadways and sidewalks will be unavoidable due to mobilization of heavy vehicles such as the TBM and equipment leading to increased traffic congestion and changes in traffic patterns during construction. Nonetheless, an optimized traffic routing and scheduling plan for the construction and logistics vehicles will reduce traffic burden and should be implemented with proper stakeholder consultation.

1829. Future general traffic is expected to rise due to increase in population, increase in car ownership and development of new offices, commercial facilities and housing, among others. During the construction period, many construction vehicles will be travelling to and from the railway's construction yards. Moreover, the addition of feeder transportation and the modal shift from current public and private modes to rail mode will alter the traffic conditions during the operation period.

1) Increase of Traffic by other project(s)

1830. In addition to a simple growth of future traffic volume, the traffic volume along the north south commuter railway will increase associated with the surrounding development projects and will increase in relation to the railway line development itself. It was investigated the development plan along the alignment, as a result large-scale project is not being planned at this time.

2) Increase of Traffic by the Project

1831. The year of analysis for the construction stage within the vicinity of Solis to Blumentritt will undergo a rapid construction at 2020. During the construction stage of Blumentritt to Calamba (2025), the highest increase in growth rate can be seen in Area 4[10]. This consist of the cities of Sta. Rosa, Cabuyao and Calamba in Laguna. The regional center of Region 4A is located at Calamba City which explains why several manufacturing industries such as Asia Brewery Inc, Laguna Industrial Park, etc. and commercial establishments such as SM Sta. Rosa and SM Calamba are already located in this area.

1832. Moreover, the railway construction will bring about additional traffic volume in the form of trucks carrying soil fills, facilities, construction wastes among others; concrete mixers, coasters for workers and others. These construction-related vehicles will be plying to and from the construction yards that are located along the railway alignment. The viability of these locations to be opened as construction yards will be influenced by the capacity of the surrounding roads to carry the additional construction vehicle volumes.

1833. Furthermore, these additional vehicle volumes are anticipated to cause traffic flow delays along narrow road sections and further exacerbate existing traffic bottlenecks. Detour policies are recommended to be planned to separate large vehicle and small car traffic in order to facilitate stable flow in consultation with LGU and relevant stakeholders.

3) Analysis and Prediction

1834. Result of current Level of Service (LOS) [11] shows 21 out of the 45 intersections are already beyond their capacities. Traffic volumes were projected to 2020 or 2025 using the regional growth rate factor from 2018 to 2020 or 2025. During this period, construction vehicles will be added to the regional traffic growth brought about by the construction of the railway project.

Capacity Analysis for Un-optimized Conditions

- Solis to Blumentritt Section: Only two (2) survey locations have acceptable levels of service for all three horizon years. On the other hand, the remaining survey locations remains at LOS E or F.
- Blumentritt to Calamba: Fourteen (14) survey locations have acceptable levels of service for all three horizon years. On the other hand, eighteen (18) intersections remain LOS F from 2018 to 2025.

Capacity Analysis for Optimized conditions

- Solis to Blumentritt Section: Five (5) survey locations have acceptable levels of service for 2018, 2025. Meanwhile, Survey Location W4 remains at a LOS F for 2018 and LOS E for the horizon years of 2020.
- Blumentritt to Calamba: Eighteen (18) survey locations have acceptable levels of service for 2018 and 2025. Meanwhile, only ten intersections remain to be LOS F for all horizon years.

[10] Area 1: Manila, Quezon; Area 2: Manila Makati, Pasay, Taguig, Muntinlupa; Area 3: Muntinlupa, San Pedro, Biñan, Santa Rosa; Area 4: Santa Rosa, Cabuyao, Calamba, Los Baños

[11] LOS Criteria: A- Progression is very favorable; most vehicles arrive during green signal; most vehicles do not stop. Short cycle lengths may also contribute to low delay.B- Progression is good and/or cycle lengths are short. More vehicles stop than for LOS A, causing higher levels of average delay, C- Progression is fair and/or cycle lengths are longer. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant, though many vehicles still pass through without stopping., D- Progression is unfavorable, cycle lengths are long, or has a high flow rate to capacity ratio. Many vehicles stop, and the proportion of vehicles not stopping diminishes. Individual cycle failures are obvious. E- Progression is unfavorable, cycle lengths are long, or has a high flow rate to capacity ratio. Many vehicles stop, and the proportion of vehicles not stopping diminishes. Individual cycle failures are obvious.F- Progression is very poor, cycle lengths are long. Many individual cycle failures. Arrival flow rates exceed the capacity of the intersection. This level is considered unacceptable to most drivers.

4) Mitigation Measures

1835. There will be additional disruption in the flow of vehicular traffic in the study areas once the construction of the railway project proceeds. Effective traffic management measures are needed to minimize these major disruptions.

1836. Based on findings of TIA, a Traffic Management Plan (TMP) that details the activities to adequately manage traffic flow will be prepared and strictly implemented. The TMP will be properly coordinated with concerned LGUs, transport operators and approved by the LGUs concerned and strictly implemented.

1837. Some measures that will be included in the plan are as follows:

- A traffic enforcer should be hired to man each of the critical signalized intersections. This is to prevent vehicles from blocking the intersection that causes other vehicles to also stop and whose queues would sometimes cascade to other intersections causing blockages and would result to traffic jams. Optimized traffic signal operation will also help improve traffic flow.
- Causes of roadside friction should be removed such as parked cars, ambulant vendors and improper loading / unloading of public utility vehicles at different locations. Clearing of the sidewalk also contributes to reducing side friction.
- Contain the movement of pedestrians by properly designating and marking pedestrian crossing and improving pedestrian facilities. This includes the clearing of sidewalks from parked vehicles and vendors.
- Provision of traffic signs and information guide that are properly located along affected streets in order to help motorist navigate the area without getting lost and that would also result to smoother traffic flow.
- Construction vehicles should be deployed from 10 PM to 6 AM when the intersections can accommodate more vehicles without experiencing congestion.

1838. Also, the general public, host barangays and LGUs are well informed on the potential impact of the project to the exiting access and can provide local mitigating measures. A Public Relations strategy is being defined for the project to inform the public of the project, and the traffic delays in order for them to make other arrangement where possible.

3.4.10.2. Operation Phase

(1) Displacement of Settlers

1839. No further displacement of households and business establishment is expected during operation of the proposed project.

(2) In-Migration

1840. If the local economy and improves, the Transit Oriented Development proposals will help guide the development of the areas around the stations. An influx of migrant workers is expected as economic activity increases both locally and via the ease of transport to other locations. This may intensify the competition for jobs of locals and also widen the numbers of jobs available. The LGU and operator will continue to prioritize local people for jobs in the station operations where possible. Informal settlers will be discouraged from occupying the ROW by the new fencing and security arrangements. The local housing market will adapt to the needs of the local job market naturally. Any in-migration is thus an inevitable part the economic growth stimulated by the project and the overall impact is balanced between negative and positive.

(3) Cultural/Lifestyle Change

1841. With the operation of the proposed project, it is anticipated that the host barangays, the surrounding barangays and the entire cities will be undergoing transformation bringing about by the influx of new industries and expansion of existing industries, which will further increase opportunities for local employment, increase in-migration and the need of increasing goods, commodities and social services. Moreover, the shorter travel time from Metro Manila to the host cities in Laguna will also give convenience to the commuters. Some residents may increase the pace of their lifestyle to keep up with development in the area and the convenience of the mass transport may improve their living as well as their perception on values of these conveniences.

(4) Impacts on Physical/Cultural Resources and Common Property Resources

1842. Old PNR Stations that have been preserved will still be seeking alternative uses after the railway become operational. PNR may decide to restore them and repurpose them as their proximity to the new stations may make them economically advantageous. PNR has plans to relocate stations and these do not have a final location agreed yet. Part of the area under the Solis – Blumentritt section is being designed as a park to provide open space in an area currently underserved with open space.

1843. In addition, the Project may have a positive impact on access to tourist destinations in the host LGUs because of shorter travel time and the easier access.

(5) Threat to Delivery of Basic Services/Increase in Demand for Resources

1844. The operation of the proposed project is not expected to have significant impact on the basic services of the host cities. DOTr instructed affected utility companies that there should be no service interruption during their relocation activities because of the Project Solid Waste

1845. Operational waste will be handled according to Philippine law. The operator will generate normal commercial waste from stations, trains and SCRP Depot offices and will employ the LGU or Private waste Contractors to dispose of waste to landfill via the solid waste disposal system in operation locally. The operator will also generate hazardous waste during maintenance operations. This will be disposed of through contracted hazardous waste Contractors to the appropriate waste disposal site by separation and using the hazardous waste manifest system under Philippine Law. The operator is required to submit a waste management plan for approval by the EMB and this will ensure a minimal impact. No residual impacts are expected.

(6) Threat to Public and Occupational Health and Safety

1846. Mass transport by their character and purpose transport large numbers of people of diverse backgrounds. The sheer amount and diversity of passengers using the Entrance / Exit Points suggest that some of them could intrude into the vicinities and areas beyond with no legitimate purpose and even engage in anti-social activities thereby posing a risk to legitimate residents, passengers and workers. This threat is addressed by installing security cameras at strategic places and instituting visible security presence.

1847. Health and safety of workers and passengers at the stations and SC Depot is managed by the Occupational Health and Safety Management Plan and the Emergency Preparedness and Response Plan. The Occupational Health and Safety Management Plan will be approved by the DOTr and will be aligned with their policy of mandating the strict implementation of precautionary, safety and security measures to ensure safe, fast, efficient, and reliable transportation services. The plan will cover the PPE required for all personnel undertaking maintenance work, the security and screening arrangements that will be implemented in all stations to ensure safety.

1848. Sanitary and comfort facilities are designed into the all stations and SC Depot for staff and passengers.

1849. The Emergency Preparedness and Response Plan has been outlined at the DD stage and will be further developed at the Operational phase. It will define actions in preventing the occurrence of accidents and the response procedure in case of accidents, fire and natural hazards.

1850. Similarly, Emergency Response Plan (ERP) shall also be established specific for the operation phase of the underground interconnecting line (Senate-FTI-Bicutan Segment) in line with NFPA130 requirements. Scenarios that shall be considered while crafting the ERP will be but not limited to the following:

- Derailment
- Fire
- Typhoon
- Floods
- Earthquake Ground Setting and Liquefaction
- Failure of Structure
- Transport of Dangerous Goods
- Medical attention required by passengers
- Criminal Acts

1851. Specific preventive measures for the above-mentioned emergency situations is explicitly discussed in Chapter 5 of this report (Environmental Risk Management).

(7) Generation of Local Benefits

1852. Operation of the railway will generate employment for skilled personnel to operate and maintain the railway system as well as managerial and lower skilled positions. It is estimated that the operation of the Project will provide employment to approximately 1,400 employees for manning the stations, operations and maintenance of trains at the SC Depot.

1853. Similar with the preconstruction and construction phase, all manpower requirements during operation phase will be hired directly by the DOTr/Operator following the compliance with the Labor Code of the Philippines, Republic Act No. 10911 known as the Anti-Age Discrimination in Employment Act, and RA 7277 known as the Magna Carta for Disabled Persons. DOTr will provide equal opportunities for employment of men and women, on the basis of their abilities, knowledge, skills and qualifications rather than on age or disability. Manpower will be sourced as much as possible from affected LGUs in NCR and Laguna, while priority will be given to hiring employees from the host LGUs. The policy on hiring including the treatment of statutory benefits of the workers will be stipulated in the TORs and contracts with the local Contractors to ensure compliance.

1854. DOTr (or its franchisee) will coordinate with the host LGUs, specifically at the barangay level regarding the hiring of regular workers to ensure that the workers being considered are legitimate residents in the area and similar coordination with respect to gender equality objectives to ensure equality of opportunity.

1855. The Project will boost regional economic activities along the route through provision of an efficient mass transit system and promotes urban and economic development by enhancing workforce mobility between the industrial zones. This fast and continuous means of transportation gives the labor force in Central Luzon more chances of getting available jobs without having to consider the distance between their home and their place of work. Shorter and more comfortable travel time will also bring workers better physical and psychological state resulting in higher productivity. The presence of the stations as nodes of foot traffic and transport and will also attract future commercial development around the area.

(8) Traffic Congestion

1856. Traffic volumes were projected to 2025 using the regional growth rate factor from JICA Design Team. Aside from the growth of general traffic, the traffic conditions during this period will also be affected by the generation of feeder transportation to/from the railway stations and the shift in mode usage from existing public and private modes to the rail mode.

1857. The SCRP Project will generally improve the traffic situation within the project area due to expected shift of commuters from road-based vehicular transport to rail-based mass transit system.

1) Traffic raised by Operation

1858. The traffic conditions during the operation period will be affected by the generation of feeder transportation to/from the railway stations and the shift in mode usage from existing public and private modes to the rail mode.

1859. The year of analysis for the area within Solis-Blumentritt is set earlier at 2025 due to the construction stage being earlier at 2020. The year of analysis for the remaining area is set at 2030. Likewise, the growth rate per area was estimated using the forecasted PCU for 2030. Traffic conditions during this period will also be affected by the generation of feeder transportation to/from the railway stations and the shift in mode usage from existing public and private modes to the rail mode.

2) Traffic raised by Other Projects

1860. In addition to a simple growth of future traffic volume, the traffic volume along the North-South commuter railway will increase associated with the surrounding development projects and will increase in relation to the railway line development itself. It was investigated the development plan along the alignment, as a result large-scale project is not being planned at this time.

3) Traffic raised by this Project

1861. The highest growth rate will be observed in Area 4 while Area 2 has the lowest growth. By this period, it is assumed that all travelers in the area are already aware of the presence of the project operating in the corridor. Feeder transportations will be generated, such that there may also be a need to realign or introduce new fixed route public transport to and from the rail stations. Mode of feeder transportation is expected to cover all available modes currently present in the area, such as PUB, PUJ, UV Express, tricycles, motorcycles, bicycles, private car, courtesy bus or walking.

1862. Moreover, it is expected that there will be modal shift not only from other public modes but also from private cars to the use of rail especially among those living along the catchment area of the rail line. It is then important that the access/egress or feeder modes to/from the rail station be taken into consideration.

1863. Noting that currently along Manila South Road, several road tributaries to the highway have tricycle terminals, it is expected that some of these terminals may need to be moved near the rail station. Linkages with LRT and MRT railway lines, bus, jeepney, and AUV stations will be considered for efficient and seamless passenger flow transferring to other modes of transportation. In addition, provision of park and ride facilities for bike, motorcycle, and private users can enhance patronage of rail system. It is also important to inventory all these feeder modes so that a properly designed feeder terminal for them can be incorporated in the station plans of the rail line. Furthermore, anticipating the shift from private cars to rail, there may be a need to provide parking facilities at the rail stations for owner-driven vehicles.

4) Analysis and results

1864. Result of current capacity analysis shows 21 out of the 45 intersections are already beyond their capacities. Traffic volumes were projected to 2020 or 2025 using the regional growth rate factor from 2018 to 2025. During this period, construction vehicles will be added to the regional traffic growth brought about by the construction of the railway project.

Capacity Analysis for Un-optimized Conditions

- Solis to Blumentritt Section: Only two (2) survey locations have acceptable levels of service for all three horizon years. On the other hand, the remaining survey locations remains at LOS E or F.
- Blumentritt to Calamba: Fourteen (14) survey locations have acceptable levels of service for all three horizon years. On the other hand, eighteen (18) intersections remain LOS F from 2018 to 2030.

Capacity Analysis for Optimized conditions

- Solis to Blumentritt Section: Five (5) survey locations have acceptable levels of service for 2018, 2025 and 2030. Meanwhile, Survey Location W4 remains at a LOS F for 2018 and LOS E for the horizon years of 2020 and 2025.
- Blumentritt to Calamba: Eighteen (18) survey locations have acceptable levels of service for 2018, 2025 and 2030. Meanwhile, only ten intersections remain to be LOS F for all horizon years.

5) Mitigation Measures

1865. The following specific recommendations are made for the operations phase.

- It would be advantageous if traffic signals are synchronized and centrally controlled by an improved centralized traffic monitoring system.
- Provision of traffic signs and information guide that are properly located along affected streets in order to help motorist navigate the area without getting lost.
- Installation of optimized traffic signals especially at the access intersections to the railway stations. Greater vehicle volume is expected to be generated due to addition of feeder modes. Optimizing the traffic signals would minimize delay at intersections and likewise increases the safety of pedestrians and vehicles.
- Plan routes for high-occupancy public utility vehicles as feeder mode to the railway stations to minimize the number of private cars plying major roads. Provision of proper loading/unloading area near or within the railway station is recommended to provide seamless connection of feeder modes to railway stations and to minimize road friction created by feeder modes.
- Define bus and jeepney stops. Jeepneys and buses can only drop off or pick up passengers on these designated stops. This is to minimize disruption of the stop and go movement of buses and jeepneys that disrupts the flow of other vehicles on the road.
- Transit Oriented Development (TOD) surrounding the stations should be considered from planning to operational stage to encourage the use of low carbon transport (e.g. walking, cycling, personal mobility devices (PMDs)) to/from railway stations.

1866. Traffic congestion has already occurred on the proposed railway alignment, and the reasons for the congestion are clearly defined. It is also important to get the cooperation of administrative agencies and the full support of the local leaders in the area in order to implement these traffic flow and demand management measures, and for railway operators to grasp the development of the region in the future and to take part in the role of reducing the influence on the traffic along railroads.

3.5. CUMULATIVE IMPACT

3.5.1. Cumulative Impact Assessment

1867. Cumulative impacts pertain to impacts from further planned development of the project, other sources of similar impacts in the geographical area, any existing project or condition, and other project-related developments that are realistically defined at the time of the assessment.

1868. Along these areas, including the existing PNR regular routes that runs from Tutuban to Alabang and vice versa, the Mamatid-Tutuban and Calamba-Tutuban, the Project is expected to contribute to positive long-term benefits in urban air quality and travel time savings. The Project will provide fast and convenient rapid transit service and an added transportation alternative that will enhance connectivity to the wider transit network for residents and businesses facilitating economic growth of municipalities along the railway corridor. The Project will reduce the use of personal vehicles, increase the transit mode share and will contribute to community re-development through the stimulation of future concentrated and mixed land use, as well as a positive business environment. It will contribute to environmental sustainability initiatives by reducing regional car trips, enhance community livability and reducing greenhouse gas (GHG) emissions. Project operation is expected to have a positive effect on air quality since the Project will use an EMU train which is exhaust-free and quieter compared to diesel and locomotive-drawn multiple units. As such, the Project's contribution to the cumulative impacts particularly during the operation would be positive. Project operation is expected to have a positive effect on air quality and specifically, GHG emissions based on the anticipated reduction in future vehicle use.

1869. During project operations, due to existing high background noise levels along portions of the alignment caused by the existing volume of road traffic in the area and vicinities, receptors may experience a low to moderate noise impact close to the proposed stations and maintenance depot. This will be mitigated by an operating schedule of 6:00 AM to 11:00 PM for the main SCRP line and 4:20 AM to 11:00 PM for the Senate-FTI-Bicutan Segment, and erection of site-specific noise attenuation panels at the stations and at locations along the railway line where noise levels are projected to increase more than 3dB as compared to the baseline levels such that the Project's contribution to cumulative impact on noise is considered not significant. Moreover, impacts will be addressed by the regular inspection, proper maintenance and reconditioning of trains and tracks such as rail grinding, slip-slide detectors and maintenance or replacement of suspension system, brakes and wheels. Vibration levels associated with project operations (i.e., train passing by) will be largely imperceptible.

1870. The communities along the alignment will benefit from the improved travel time, less road congestion and enhanced developments at the station nodes. This is considered a long-term positive cumulative impact.

1871. Based on the foregoing, the Project along with related infrastructure development projects within the area will result in positive long-term benefits in air quality, public health, safety, travel time savings and connectivity. No adverse residual effects to human health will occur as a result of project construction or operation. While exposure to elevated noise levels, fugitive dust and gaseous emissions will occur in proximity to project work sites during construction, due to their short-term, localized nature, these effects are expected to be minor. Project operations will benefit the general public by contributing to the long-term improvement of air quality in the locality. By providing a viable alternative to the use of private vehicles, it will also reduce traffic volumes, relieve traffic congestion, and improve community livability.

Table 3.5.1 Summary of Impact Identification, Prediction, Assessment, and Mitigation for People

Environmental Aspect	Environmental Component	Potential Impact	Level of Significance	Prevention/Mitigation/ Enhancement Measures
GENERAL				
Pre-construction, Construction and Operation activities	Land, Water, Air and People			• Comply with the relevant laws: o RA 6969: storage, transport, handling, treatment and disposal of hazardous waste o RA 9003: management and disposal of solid wastes o RA 8749: comprehensive air pollution control policy o RA 9275: comprehensive water quality management and for other purpose o PD 442: Labor Code of the Philippines, as amended (including Occupational Safety and Health standards) o PD 856: Sanitation Code of the Philippines o RA 8504: Philippine AIDS Prevention and Control Act of 1998 • Implementation of Emergency Response Plan and Health and Safety Management Plan to include but not limited to: o Distribution of manual/guideline for workers/employee on health and safety, environment management. o Orientation and continuous training of qualified workers/ employee/ operator on Environment Management, Basic and Construction Occupational Safety and Health, Scaffolding Safety, Fire Safety and Safe Use of Chemicals at Work. o Establish SOP, and provide training and orientation on the proper operational proceedure in accidental finds of archaeological items and UXOs o Provision of earthquake, fire drills for workers o Provision of appropriate PPE for workers o Provision of security personnel. o Regular monitoring of site condition
PRE-CONSTRUCTION/CONSTRUCTION				
Disclosure of project information and public consultation	Public involvement and support	• Communities and stakeholders not being provided with the appropriate information on the implementation of the Project. • Complaints from the communities	B-	[Pre-Construction/ Construction] • Prior to start of construction works, local establishments, local authorities and other stakeholders who are likely to be affected by the Project shall be informed about the construction schedule and activities, potential environmental impacts, mitigation measures and grievance redress procedure through public meetings. • During pre-construction and construction, public involvement activities will continue based on the framework for public involvement and disclosure.

Environmental Aspect	Environmental Component	Potential Impact	Level of Significance	Prevention/Mitigation/ Enhancement Measures
		and stakeholders.		• Regular consultations with affected people and relevant offices/agencies will be conducted by the Contractor during the construction phase and by the DOTr during operation phase to ensure adequate and timely mitigation of project adverse environmental impacts. • Prior to commencement of site works, the DOTr in coordination with the Contractors will established the approved grievance redress mechanism that will allow for the following: o Receiving/recording and immediate response (within 24 hours) by the Contractors of any construction-related complaints. o Report issues to DOTr-PMOs through GC by the Contractor within 24 hours. o Complaints reported by the affected person(s) to DOTr-PMO are recorded and relayed to the Contractor within 24 hours for immediate resolution. o Installation of notice boards at the construction sites that indicate the name and telephone numbers (hotline) of Contractors who are tasked to receive and document complaints.
Land acquisition for ROW and involuntary resettlement for PAFs	• Informal Settler Families (ISFs) • Vulnerable persons (Women-headed households, elderly, persons with disabilities and the poor)	• Displacement of ISFs • Disturbance of livelihood • Loss of income	A-	[Pre-Construction] • Design train system of the main SCRP railway maximizing the existing PNR ROW and minimizing additional land acquisition. • Design the undergrond section to minimize the ROW. • Prepare and implement RAP to ensure that PAFs are provided with proper relocation area and/or justly compensated. The RAP will include the following: o Provision of relocation sites for ISFs. o Livelihood and income restoration for head-of-household PAPs of ISFs and vulnerable persons. o Prior to displacement, secure and/or develop relocation sites in coordination with the concerned LGUs, Key Shelter Agencies, and other concerned stakeholders with conducive living condition and basic utilities, services and amenities. [Pre-Construction/ Construction] • Conduct external and internal monitoring to ensure that displacement activities are conducted in compliance to the RAP. • If PAFs raise an issue, ensure prompt response and resolution per established GRM.
	Legal PAFs	• Displacement/ Disturbance of Properties	A-	[Pre-Construction] o Prepare and implement RAP to ensure that PAFs are justly compensated for the loss of income by the Project. o Payment of compensation prior to displacement.

Environmental Aspect	Environmental Component	Potential Impact	Level of Significance	Prevention/Mitigation/ Enhancement Measures
		• Change/Conflict in Land Ownership • Impact on Livelihood and Income (i.e. farming, business)		o If the project involves underground works within a depth of 50 m from the surface, the implementing agency shall negotiate with the property owner a perpetual easement of ROW for the subterranean portions of the property and offer to acquire from the property owner the affected portion of the land, including affected structures, improvements, crops and trees. o Coordination with the LGUs, land owners and other concerned stakeholders in acquiring the land and/or securing ROW. [Pre-Construction/ Construction] o Prepare and implement livelihood and income restoration for PAFs whose present means of livelihood is no longer viable and will have to engage in new income activity. o Prepare and implement SDP including livelihood training for business owners, vendors, employers and agricultural landowners affected by Project. o Involve external and internal monitoring agencies to ensure that displacement activities are conducted in compliance to the RAP. o If PAFs raise an issue, ensure prompt response and resolution per established GRM
	Social aspect (Gender Equality and Vulnerable Groups)	• Generation of employment and livelihood opportunities and improvement of safety	C-	[Pre-Construction/ Construction] • Prepare and implement RAP to ensure that gender equality and needs of vulnerable groups are addressed including livelihood and skills training program • Design and install train system in consideration of universal design and strategic placement of security and lighting within the vicinity of the stations; • Employ workers in consideration to gender equality. Include gender-sensitive livelihood and skills training program in the SDP with due consideration to vulnerable groups. • Include gender-sensitive livelihood and skills training program in the SDP with due consideration to vulnerable groups
Demolition of buildings	Social component	• Temporary disruption of regular activities of sensitive receptors	C-	[Pre-Construction] • Consult affected household/ land owner prior to demolition of the structure/ building
	Solid waste management	• Generation of solid wastes and demolition debris	C-	[Pre-Construction] • Identify a site for the disposal of demolition wastes away from sensitive receptors as much as possible

Environmental Aspect	Environmental Component	Potential Impact	Level of Significance	Prevention/Mitigation/ Enhancement Measures
		• Scavenging of demolition wastes		• Provide barriers/ security measures on temporary storage areas of demolition wastes to prevent scavenging activities which may compromise the safety of scavengers
Clearing of the proposed project area Resettlement	In-migration	• In-migration to the project area	C-	[Pre-Construction / Construction] • Plan and implement construction schedule to shorten time between the pre-construction and construction as much as possible. • Install fencing and guarding of the proposed Project to restrict the public from entering the ROW.
		• Conflict between existing residents and new relocatees	C-	[Pre-Construction / Construction] • Prepare and implement SDP in coordination to host LGU's to align projects/programs to their development plans.
Pre-construction and construction activities (site preparations, mobilization, etc.)	Social component	• Damage or loss caused by Contractors on privately-owned property outside the scope of land acquired under the RAP	C-	[Pre-Construction/ Construction] • Compensation to property owner commensurate with rates set out in the RAP.
In migration to new relocation site	Basic services/ resources	• Increased demand on public infrastructure • Livelihood impacts	C-	[Pre-Construction / Construction] • Prepare and implement RAP in consideration of relocation site to sufficiently cover the expected demand of basic services, resource and social programs at relocation sites in coordination with LGUs. • Prepare and implement SDP in coordination to the host LGUs to align projects or programs to their development plans.
		• Loss of outdoor spaces	C-	[Pre-Construction / Construction] • Coordinate with respective LGU's and PNR regarding the possible measures for the transfer/provision or relocation of public parks and other recreational facilities.
Establishment of construction camps and other construction facilities (casting yard, laydown/ storage areas, concrete batching plants)	Public activities	• Temporary disruption of normal activities of sensitive receptors • Temporary loss of private lands	C-	[Pre-Construction] • Contractor to secure the necessary approvals and permits prior to establishment and operation of construction-related facilities. • Coordination with LGUs to identify minimization options, including identification of available public land where possible for access roads, material storage areas, construction yards, etc. • Negotiation for temporary land use with landowners and payment of rent commensurate with market rates and restoration of land to pre-use conditions within 3 months of discontinuation of use.

Environmental Aspect	Environmental Component	Potential Impact	Level of Significance	Prevention/Mitigation/ Enhancement Measures
				• Select construction camps and other construction facilities at least 300m from sensitive receptors such as residential housing areas, hospitals, schools, religious and cultural sites.
Disruption to community services due to relocation of utilities such as water supply, electric distribution poles, and communication lines.	Public services	• Disruption of public services • Damage to buried cables / pipelines due to boring activities	C-	[Pre-Construction] • Coordinate with the utility companies prior to relocation of utilities. • Issue notices or announcements in advance regarding temporary disruption of services. • Observe due diligence and conduct pre-construction utilities survey. • Minimize unnecessary excavation activities
Encroachment of the proposed Project to historical sites, tourist spots, etc. Excavation activities Construction of the proposed project	Historical sites, artefacts, ecofacts and archaeological remains	• Impacts on cultural/ historical resources	B-	[Pre-Construction] • Conduct literature review and site validation of the potential historic structures in coordination with PNR and Cultural Agencies (NCCA, National Museum and NHCP); • Perform measured survey of the identified historic structures including its foundation and building condition. • Coordinate closely with the Cultural Agencies, concerned LGUs, PNR, and DepEd (for the Nutrition Center of the Philippines) for verifying the qualification of those structures and provide necessary protection measures. • Prepare a protection plan for those identified PNR structures and other cultural structures (such as the Nutrition Center of the Philippines) which will be maintained in accordance to the agreed procedure. • Identified historic sites and structures in close proximity to the project shall undergo necessary consultation and permitting processes to NHCP, in accordance to RA 10066. • Consultations with concerned agencies including but not limited to DepEd (property owner of the NNC), NCCA and National Museum during detailed engineering design (DED) of the Senate-FTI-Bicutan underground segment [Construction] • Implement the approved protection plan • Close coordination with the National Museum on the appropriate course of action in case of any archaeological and related military material finds based on the guidelines on heritage accidental finds.. • Observe adherence of buffer zones as mandated by RA 10066 (Conservation of the National Cultural Heritage) • Implement the Guidelines on Heritage Accidental Finds of the National Museum along with the following procedures in the event that a potential archaeological asset is discovered during the course of construction:

Environmental Aspect	Environmental Component	Potential Impact	Level of Significance	Prevention/Mitigation/ Enhancement Measures
				- Immediately cease all construction activities in the vicinity of the find/feature/site - Preserve the potential archaeologic find and report it immediately to the National Museum - Coordinate with the National Museum on the appropriate course of action in protecting the archaeological finds - Hire an archaeologist, recognized by the National Museum, to ensure the following are carried out: o Delineate the discovered find/feature/site o Record the coordinates of the find location, an all remains are to be left in place o Secure the area to prevent any damage or loss of removable objects o Assess, record, and photograph the find/feature/site o Undertake the inspection process in accordance with all project health and safety protocols under direction of the Health and Safety Officer o Conduct all investigation of archaeological soils by hand • Keep all finds, osteological remains and samples and submit to the National Museum as required o In the event that any artefacts need to be conserved, secure approval from the National Museum; o Provide an on-site office and finds storage area to allow storage of any artefacts or other archaeological material recovered during the monitoring process; o In the case of human remains, in addition to the above, contact the National Museum and adhere to the guidelines for the treatment of human remains; and o If skeletal remains are identified, consult an osteo-archaeologist to examine the remains. - The following procedures will be implemented for conservation of objects found: o Hire a conservator, if required; o The consulting archaeologist completes a report on the findings and submits to the National Museum; and o National Museum reviews the report and informs when works can resume.
	Local conflicts of interest	• Potential conflict among PAFs and other government infrastructure projects	B-	[Pre-Construction] • Close coordination with BCDA, DPWH, and other relevant agencies • Prepare and implement RAP to ensure that PAFs are justly compensated for the loss of income by the project prior to displacement.

Environmental Aspect	Environmental Component	Potential Impact	Level of Significance	Prevention/Mitigation/ Enhancement Measures
				• Conduct external and internal monitoring agencies to ensure that displacement activities are conducted in compliance to the RAP. • Prepare and implement arrangement on financial assistant to the receiving of PAFs. [Construction] • If PAFs raise an issue, ensure prompt response and resolution per established GRM • Conduct external and internal monitoring agencies to ensure that displacement activities are conducted in compliance to the RAP.
Generation of solid waste, excavated soil and hazardous material	Basic services/ resources	• Increased demand on waste disposal	B-	[Pre-Construction / Construction] o Identification of final disposal site for solid waste, excavated soil, hazardous waste at each LGUs. o Conduct regular monitoring of disposal status in compliance to RA 9003 and RA 6969 o Registration of the proponent as a hazardous waste generator. o Collection of hazardous wastes in proper receptacle. o Storage of fuel and chemicals in appropriate storage area provided with secondary containment in case of spills. o Collection of hazardous waste by a DENR accredited hauler. o Treatment of hazardous waste by a DENR accredited treater. o Compliance to necessary permits and clearances for identified disposal sites (ECC, LLDA Clearance, Shoreland Development Clearance, Locational Clearances, Traffic Clearances)
Generation of potential air and water pollutants due to: Heavy lifting and movement of heavy equipment Construction of the proposed project	Public health and safety	• Degradation of public health • Increase in accident involving local communities	B-	[Pre-Construction / Construction] • Formulation and implementation of IEC Plan to inform the affected LGU and local communities and the general public about 1) the Project, Project activities, duration, possible Project impacts and incorporate their comments and inputs in the design, 2) the potential impact of Project activities to air quality, noise, vibration, and climate change, and corresponding health and safety mitigation measures, and 3) the GRM to handle complaint/s if any. • Plan for construction sites/facilities/yard and access route in consideration to health and safety to local communities. • Plan and implement SDP including health and safety of local community [Construction] • Provide safety officers to monitor the health and safety of the local community. If any complaints arise, immediately identify the causes and evaluate built-in measures.

Environmental Aspect	Environmental Component	Potential Impact	Level of Significance	Prevention/Mitigation/ Enhancement Measures
				• Install fencing of the construction site, provide signage and posters, and guard access point to ensure that the area is not accessible to the public. • Implement Emergency Response Plan and Health and Safety Management Plan.
Risks to workers	Occupational health and safety	• Increased risk of accidents at construction sites • Spread of infectious disease among workers	B-	[Pre-Construction/Construction] o Prepare and implement Occupational and Community Health and Safety Plan and Emergency Response Plan including security policies and procedures based on the WB-IFC EHS Guidelines and NFPA130. o Include medical certificate in the requirements for hiring of workers to ensure that they are fit to work. Ensure that they are provided with proper training on construction, occupational health and safety, and emergency response procedure. o Plan construction details such as storage of equipment and machinery and access route of heavy vehicle considering health and safety of workers. o Provide appropriate personal protective equipment **(PPE**) to all construction workers, particularly to the personnel working on heights, heavy and electrical equipment. o Establish Health and Safety Desk or Medical Station at the active construction sites to monitor and safeguard the health of the workers and local residents and to provide immediate response during unexpected incidents/emergencies. o Provide fire-fighting equipment at work areas and construction camps. o Close coordination with the nearest hospitals in the active construction site for immediate transfer and/or further evaluation and medical management of the patient. o Require the Contractors to appoint an environment, health and safety officer to supervise the implementation of environmental mitigation measures and to ensure that health and safety measures are strictly implemented at the construction site and immediate vicinity. o Proper management of identified unexploded ordnances (UXOs) such as: o -Preparation of protocol and orientation to workers on the proper handling of situation where there is suspected presence of UXOs o -Proper coordination with the Philippine National Police (PNP) in the event of a suspected presence o -Clear and accurate marking of all cleared areas

Environmental Aspect	Environmental Component	Potential Impact	Level of Significance	Prevention/Mitigation/ Enhancement Measures
				o -Confirmation from exploded ordnances disposal (EOD) expert that sites are safe for construction activities to proceed o Soil and groundwater investigation should be conducted to assess the soil and groundwater conditions in the project area prior to any excavation and tunneling activities. o Provide adequate drainage in construction camps to prevent water logging and formation of breeding sites for mosquitoes. o Provide potable water, hygienic sanitation facilities/toilets with sufficient water supply. o Ensure that all wastewater emanating from construction camps are treated and complies with the effluent standards. o Provide fence and anti-derailing rails or guards on all areas of excavation to avoid accidents. o Implement fall prevention and protection measures such as scaffoldings, wearing of safety belts by workers, etc. when working in high areas. o Provide sufficient lighting in tunnel areas and underground station excavation sites. o Provide emergency lighting system in case of power shutdown. o Ensure that sufficient fresh air is supplied at confined work spaces at the tunnel and underground station excavation sites. Ensure that air filters are kept clean. o Confined spaces such as tunnels shall be provided with safety measures such as venting, monitoring, and emergency rescue procedures. o Conduct orientation for construction workers regarding health and safety measures, emergency response in case of accidents, fire, etc. and prevention of HIV/AIDS, STIs and other diseases. o Tunneling shield designed in accordance with “Design Standards for Railway Structures and Commentary (Shield Tunnel)” shall be implemented to prevent groundwater ingress. o Conduct geophysical investigations using underground utility scanning technologies such as Ground Penetrating Radar (GPR) to mitigate utility strikes.

Environmental Aspect	Environmental Component	Potential Impact	Level of Significance	Prevention/Mitigation/ Enhancement Measures
Employment of workers	Local economy	• Generation of local employment • Hiring of workers from outside the community might create peace and order and social conflicts with local communities and increased HIV/AIDS risk.	B+	[Pre-Construction /Construction] • Close coordination with the host LGUs (barangay level) regarding the hiring of temporary workers to ensure that the workers being considered are legitimate residents in the area. Those affected by the Project will be prioritized for employment. • Provide skill trainings to PAFs under livelihood and income generation program developed by RAP • Provide HIV/STI awareness and prevention training to construction workers and Contractor's employees/staff
Traffic congestion and access problems	Mobility/ public transport	• Increase in traffic volume within the project area	B-	[Pre-Construction/Construction] • Conduct Traffic Impact Assessment (TIA) and based on its results, prepare a Traffic Management Plan (TMP) for approval. Implement the approved TMP. The plan shall be designed to ensure that traffic congestion due to construction activities and movement of construction vehicles, haulage trucks, and equipment is minimized. The plan shall be prepared in consultation with concerned traffic agencies, local officials and the general public. The plan shall identify traffic diversion and management, traffic schedules, traffic arrangements showing all detours, necessary barricades, warning/advisory signs, road signs, lighting, and other provisions to ensure that adequate and safe access is provided to motorists in the affected areas. • Coordinate with the traffic police for traffic management. • Provide traffic advisory signs for the public that construction is in progress and that road narrows in some sections. • Employ flag persons to control traffic at underground station sites. • Provide sufficient lighting at night within and in the vicinity of the construction sites. • Prohibit prolonged side street parking of construction trucks. • As much as possible, schedule delivery and transport of construction materials and spoils during non-peak hours.
Blocking of existing access roads	Public access	• Impact on public access • Impact to school access • Increase in accidents • Severance impacts and/or barrier effect	B-	[Pre-Construction/ Construction] • The Project will provide for temporary crossing and continued access to properties adjacent to construction site. • Based on the study on public access at affected barangay, maintain the existing public access as much as possible. • In case of any temporary closure during construction, minimize the impact to the daily life of affected communities such as access to school infrastructure in coordination with the DepEd and host LGUs for the schedule of construction activities.

Environmental Aspect	Environmental Component	Potential Impact	Level of Significance	Prevention/Mitigation/ Enhancement Measures
		during construction disrupting lateral movement (access) or access to property.		• In case of permanent loss of public access, RAP will be applied. • In case of complete block of access due to construction works (without alternative access) to a business, then compensation for lost income for the period of disrupted access will be provided. • Disseminate information to the public, barangay, and LGUs on the potential impact to the existing public access and mitigation measure through the project activities. • Provision of diversion route with appropriate health and safety measures. In case of any changes, prompt update on the diverted routes to the concerned communities and LGUs, • Assignment of traffic guide to provide assistance to the road users.
o Movement of construction equipment o Delivery of construction materials o Additional commuters due to construction workforce o Blocking of access roads o Transportation of excavated soil/muck from tunneling work	Traffic management	• Traffic Congestion	B-	[Pre-Construction/ Construction] • Conduct TIA and based on the results of TIA, prepare and implement TMP, coordinate to the concerned LGUs and transport operator/s and get their inputs and approval. • Schedule transport of heavy structures during period when there are fewer vehicles on the road and posting of appropriate traffic signage and warnings. • Disseminate information to the general public, host barangays, and LGUs on the potential impact of the project to the existing access and provide mitigating measures. • Identify the muck transportation hauling routes to the disposal sites. • Preparation of traffic management plan for hauling of excavated soil/muck from the tunneling work for the underground section.
OPERATION				
Hiring of workers	Local economy	• Generation of local benefits • Business opportunities	C+	• Coordinate closely with the host LGUs, specifically at the barangay level regarding the hiring of regular workers to ensure that the workers being considered are legitimate residents in the area in consideration to gender equality.
Operation of train	In-migration	• Influx of ISFs	C-	• Install fencing and provide guards to prevent the settlement of ISFs along the ROW
	Physical/ cultural resource	• Conservation of old PNR structure and parks and other culturally significant structures	C+	• Continuous conservation activities of old PNR structures in coordination with PNR and LGUs. • Monitoring of cultural structures (such as the Nutrition Center of the Philippines) to ensure that the construction does not affect its structure.
o Operation of train and station	Public health and safety	• Increased risk of accidents	B-	• Design underground facilities (tunnel) and stations in accordance with NFPA 130

Environmental Aspect	Environmental Component	Potential Impact	Level of Significance	Prevention/Mitigation/ Enhancement Measures
o Maintenance work at SC Depot				• Provide security guards in all stations to direct passengers on the safe zone. • Installation of security cameras at strategic places and instituting visible police presence. • Provision of safety signage and warnings, adequate security force and safety units, security cameras and anti-derailing rail or guard for the udergrund interconnecting line.
	Occupational health and safety	• Increased risk of accidents and infectious disease of employee	B-	• Implement the Occupational Health and Safety Management Plan. • Provide appropriate PPE to all personnel undertaking maintenance work. • Implement the Emergency Response Plan (ERP) • Establish ERP specific to the underground interconecting line considering the following scenarios: derailment, fire, typhoon, floods,earthquake,failure of structure, transport of dangerous goods, medical attention required by passengers and ciminal acts. • Provide sanitary facilities or utilities in all stations and SC Depot.
Public Involvement	Public consultation	• Immediate response to address adverse impacts during train operation	B+	• Regular consultations with affected people and relevant offices/agencies will be conducted by the DOTr during the operations phase to ensure adequate and timely mitigation of Project adverse environmental impacts.
Train Operation	Traffic conditions	• Traffic congestion may occur in the areas adjacent to the proposed stations due to pick-up and drop off of passengers by transport vehicles	B-	• Establish a traffic management committee, which will be composed of the Traffic Management of LGUs, Planning Office, PNR, DPWH, and DOTr to plan and implement TOD in consideration to the loading and unloading area and the circulation of the traffic as well as the integration of transport facility within the station. • Traffic signaling on railway stations must be carefully studied and optimized to minimize delays at intersections and improve safety of pedestrians and vehicles. • Plan for the seamless connection of SCRP stations to feeder modes to minimize road friction created by feeder modes.
Generation of solid waste from office and service areas	Community and workers' health and safety	• Indiscriminate waste disposal may pose risks to the health and safety of the surrounding communities	B-	• Provide solid waste segregation bins at each office area and at train stations. • Coordinate with the concerned LGUs in the collection and disposal of segregated solid wastes. • Maintain daily record of solid wastes generated and collected.

Environmental Aspect	Environmental Component	Potential Impact	Level of Significance	Prevention/Mitigation/ Enhancement Measures
Generation of hazardous waste from maintenance area at SC Depot and related facilities	Community and workers' health and safety	• Indiscriminate disposal of toxic and hazardous wastes may pose risks on the health and safety of surrounding communities	B-	• Provide hazardous waste bins at the stabling yard. • Record quantities of hazardous wastes generated. • Commission the services of a Government-recognized hazardous waste transporter and treater.
Railway operation	Community/ public and workers' health and safety	• Risk of accidents from railway operation and maintenance	B-	• Prepare the train safety operations plan before operation of the Project • Train workers and staff on implementation of the operations plan and the emergency response plan • Conduct drills on emergency situations at least once a year through professional experts • Conduct internal safety audits at least every six months. • Conduct full audit of the fire protection system every month and conduct daily random checks • Implement the grievance redress mechanism (complaints management system) with complaint desks at all stations • Prepare and implement Emergency Response/Evaluation Plan for underground interconnection section.

Note:
A+/-: Significant positive/negative impact is expected.
B+/-: Moderate positive/negative impact is expected to some extent.
C+/-: Minor / Negligible positive/negative impact is expected to some extent.
D: Extent of impact is unknown.

4. ENVIRONMENTAL MANAGEMENT PLAN

1872. The DOTr is committed to avoid, minimize, mitigate, or offset any potential adverse impacts that may arise from the construction, operation, and abandonment of the proposed Project. It will do so by implementing an Environmental Management Plan (EMP) to manage the Project's potential impacts and risks, adopt the best available proven control technologies and procedures, and undergo a continuing process of review and positive action in light of available monitoring results and continuing consultation with the local communities. Regular consultation with affected peoples and relevant offices/agencies will be conducted by the Contractor during the construction phase and by the DOTr during the operation phase to ensure adequate and timely mitigation of adverse environmental impacts associated with the Project. The DOTr will provide notification to DENR-EMB, ADB and JICA on any unanticipated environmental risks or impacts that arise during construction, implementation and/or operation of the Project that were not considered in the EIA and EMP.

1873. The EMP summarizes the identified potential impacts of the Project and their proposed mitigation measures per project phase. The EMP is a live document that will be constantly updated depending on project operations, changes in technology, changes in legislation, and current needs. The following policies, plans, and programs will be implemented as part of the overall EMP for the Project:

- Environmental Policy;
- Application of Mitigation/Management Measures;
- Environmental Monitoring Program;
- Resettlement Action Plan (under separate cover);
- Social Development Program;
- Emergency and Contingency Plan;
- Information, Education and Communication (IEC) Plan;
- Construction Contractor's Program; and
- Institutional Plan and Hiring of an Environmental/ Safety Officer.

1874. Overall, the DOTr will be the Implementing Agency of the Project. The Project Management Office (NSCR Ex PMO) of the DOTr will be the primary point of contact with EMB, ADB and JICA with regards to environmental management of the Project. The following chapters of the EIS will be included in the bid documents: Chapter 4 (Environmental Management Plan), Chapter 8 (Environmental Compliance Monitoring), and Chapter 10 (Institutional Arrangements for EMP Implementation), to ensure that the mitigation measures will be integrated and properly implemented and monitored during all phases of the Project. The Project will hire a General Consultant (GC) which will have International Environment Specialists and a National Environment Specialists that will assist the DOTr in the monitoring of compliance of the Project with the EMP. During the operation phase, the DOTr-PMO will be assisted by third-party environmental consultants/auditors in the monitoring of environmental parameters of the Project. In compliance with the ADB SPS requirements, DOTr will hire an external environment monitoring agent to verify the monitoring results and compliance with the EMP.

1875. **Table 4.1** presents the EMP for the Project.

Table 4.1 Environment Management Plan for the Project

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
GENERAL								
• Pre-construction, construction and operation activities	Land, Water, Air and People			Comply with the relevant laws: RA 6969: Storage, Transport, Handling, Treatment and Disposal of Hazardous Waste • Secure hazardous waste generator's ID from DENR-EMB; • Provision of hazardous materials storage area; • Hazardous materials/wastes will be stored in appropriate containers properly sealed and labelled; • Hazardous wastes will be hauled by an accredited waste transporter; • Hazardous waste will be treated by a registered waste treater (TSD Facility). RA 9003: Management and Disposal of Solid Wastes • Waste segregation, recycling, provision of waste color coded bins, etc.; • Provision of Material Recovery Facility (MRF); • Regular hauling of solid wastes through the LGU or private contractor. RA 8749: Comprehensive Air Pollution Control Policy • Secure permit to operate for all air pollution source installations (i.e genset); • Regular inspection and preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standards; • Regular cleaning and clearing of construction access/ site surfaces of spoils and debris from construction equipment and vehicles and wetting of ground soil in the construction site when necessary; • Control vehicle movement maintaining the speed limit within the construction site to <10kph and provide cover to loaded trucks. RA 9275: Comprehensive Water Quality Management and for Other Purposes • Secure discharge permit;	Implement: • Contractor • Operators Monitor: • PMO • GC • LGUs • MMT/TPA • DENR-EMB	Contractor and **operator's service** fee on health, safety and environmental management: • RA 6969: PhP 100,000 per year • RA 9003: PhP 400,000 per year • RA 8749: PhP 400,000 per year • RA 9275: PhP 400,000 per year • PD 442: PhP 6,000 per worker • PD 856: PhP 50,000 per year • Sanitary facility: PhP 200,000 per site • Emergency Response Plan and Health and Safety Management Plan: PhP 300,000 • Health and Safety Desk or Medical	EGF/ Bid Documents/ Contract Agreement	3rd Quarter of 2018 onwards

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
				• Provision of Wastewater Treatment Facility at the SCRP Depot; • Provision of three-chambered septic tank at each station. PD 442: Labor Code of the Philippines, as amended (including Occupational Safety and Health Standards) • Gender equality will be considered in hiring of workers; • Include medical certificate in the requirements for hiring of workers to ensure that they are fit to work. Ensure that they are provided with proper training on construction, occupational health and safety, and emergency response procedure; • Provide appropriate personal protective equipment (PPE) to all construction workers, particularly to the personnel working on heights, heavy and electrical equipment; • Establish Health and Safety Desk or Medical Station at the active construction sites to monitor and safeguard the health of the workers and local residents and to provide immediate response during unexpected incidents/emergencies; • Close coordination with the nearest hospitals in the active construction site for immediate transfer and/or further evaluation and medical management of the patient. RA 8504: Philippine AIDS Prevention and Control Act of 1998 • Education of employees on standardized basic HIV/AIDS information and instruction PD 856: Sanitation Code of the Philippines • Provide safe and clean water for drinking; • Provision of appropriate sanitary facilities such as portable toilets and waste bins.		Station: PhP 200,000 per site • PhP 1,500 per man-hour		

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
				Implementation of Emergency Response Plan and Health and Safety Management Plan to include but not limited to: • Distribution of manual/ guideline for workers/ employee on health, safety and environmental management; • Orientation and continuous training of qualified workers/ employee/ operator on Environment Management, Basic and Construction Occupational Safety and Health, Scaffolding Safety, Fire Safety and Safe Use of Chemicals at Work; • Provision of earthquake, fire drills for workers; • Provision of appropriate PPE for workers; • Provision of security personnel. Comply with relevant Codes and Standards: NFPA130 (further summary of applicable regulations included as Annex 1-1): • Construction and design requirements for stations, including capacity and location of means of egress, fire suppression systems and emergency power; • Design and construction requirements for trainways, including occupancy, emergency egress, emergency lighting and access, fire safety and emergency power; • Design of Emergency Ventiltion Systems; and • Emergency Communications.				
PRE-CONSTRUCTION/CONSTRUCTION								
BASELINE ENVIRONMENTAL QUALITY MEASUREMENTS								
Environmental Quality	• Air Quality • Noise • Vibration • Surface Water Quality			Baseline sampling at the SCRP Depot site and other locations where necessary as indicated in the Environmental Monitoring Plan (Table 8.1.1).	Implement: • Contractor Monitor • GC • PMO • MMT/TPA	**Contract's service** cost • PhP 30,000 to 80,000 per air quality sampling station	Contract Agreement	Before any activities are started on the sites

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
	• Ground water Quality • Soil Contami-nation				• Third Party Monitoring Contractor • DENR-EMB	• PhP 25,000 per noise monitoring station • PhP 80,000 per vibration monitoring station • PhP 25,000 per water quality sampling station • PhP 25,000 per soil sample • PhP 1,500 per man-hour		
Detailed Engineering Design	• Terrestrial Ecology • Comprehensive risk assessment for the underground section • Historic or Archeological Sites • Ground water • Tunnel safety			• Complete census and inventory of flora • Geotechnical investigation • Liquefaction potential analysis • Comprehensive study on West Valley Fault • Detailed hydrogeological studies including three-dimensional groundwater modeling • Tunnel safety assessment in complliance with NFPA 130 other relevant national and internation standards, including third-party audit • Further consultations with concerned agencies including but not limited to DepEd (property owner of the NNC), NCCA and National Museum	Implement: • GC Monitor • PMO • MMT/TPA • Third Party Monitoring Contractor	**GC's contract**	Contract Agreement	During DED

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
CONTRACTOR'S ENVIRONMENTAL MANAGEMENT PLAN (CEMP)								
Contractor's EMP	EMP Implementation			[Pre-Construction] • Prior to start of site works and within 60 days upon receipt of the notice to proceed, the Contractors shall prepare a site-specific Contractor's Environmental Management Plan (CEMP) based on the EMP in the EIS. The CEMP will describe the scope of works and schedule, construction methodology, facilities and site conditions, including sensitive receptors in the contract area. The CEMP should include the detailed operational plan for the implementation of the EMP/CEMP with targets/ indicators over a specific timeline that would be monitored for milestone highlights. The CEMP will be submitted to the project supervision consultants for approval with copies provided for review by DOTr and ADB. The following specific management plans shall be included in the CEMP: • Dust and Emission Control Plan. The plan shall provide details of mitigation measures, specific location and schedule where such measures shall be implemented to minimize impacts to sensitive receptors (residential areas, schools, hospitals, etc.) due to construction works, sourcing and transport of construction materials, operation of construction equipment and other project-related activities. • Noise Control Plan. The plan shall provide details of mitigation measures, specific location and schedule where such measures shall be implemented to minimize impacts to sensitive receptors (residential areas, schools, hospitals, etc.) due to construction works, sourcing and transport of construction materials, and other project-related activities. • Vibration Management Protocol. The protocol shall specify how to pace the piling and other heavy machinery operation as well as the scheduling of tunneling works to avoid vibration impacts. • Construction Camp and Worker Camp Lay-out and Management Plan	Implement: • Contractor • GC to assist Monitor: • PMO • GC • MMT/TPA • DENR-EMB	**Contract's service** cost: • PhP 1,500 per man-hour	Contract Agreement	CEMPs will be submitted and cleared no later than one month before site activities are started.

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				• Quarry and Construction Layout and Management Plan • Spoils Management and Disposal Plan • Erosion and Sediment Control Plan • Solid and Liquid Wastes Management Plan • Hazardous Materials and Wastes Management – includes measures to address spills of hazardous substances • Water Availability and Pollution Control • Construction and Decommissioning Plan of Worker Camps and other Construction Facilities – includes workshops, fabrication yards, warehouses, quarries, etc. The plan shall also confirm that necessary ECC for such temporary facilities have been secured from the relevant DENR-EMB. Where these temporary facilities are located in public or private lands, the Contractors shall enter into Lease Agreements and should there be a need for temporary displacement or compensation for affected structures and improvements, the Contractors shall demonstrate compliance with the provisions of R.A. 10752, the RAP and its Entitlement Matrix. • Vegetation Clearing, Landscaping and Revegetation Plan • Damage to Properties and Facilities Prevention and Management Plan • Traffic Management and Community Access Plan. The plan shall be designed to ensure that traffic congestion due to construction activities and movement of construction vehicles, haulage trucks, and equipment is minimized. The plan shall be prepared in consultation with concerned traffic agencies, LGUs and the general public. The plan shall identify traffic diversion and management, traffic schedules, traffic arrangements showing all detours, necessary barricades, warning/ advisory signs, road signs, lighting, and other provisions to ensure that adequate and safe access is provided to motorists and the public in the affected areas. The plan shall also ensure that severance impacts and/or barrier				

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				effect during construction disrupting lateral movement (access) or access to property is avoided or mitigated. • Occupational Safety and Project Personnel Health Program consistent with the Labor Code of the Philippines and international standards (e.g., the World Bank Group's Environment, Health and Safety Guidelines of 2012 and NFPA130). The plan shall address health and safety hazards associated with construction activities (e.g., excavations, working at heights, etc.), establishment and operation of construction/ worker's camps, use of heavy equipment, transport of materials and other hazards associated with various construction activities; includes HIV/AIDS awareness and prevention. • Community and Public Health and Safety Plan • Emergency Preparedness and Response Plan to prevent, mitigate, respond to and recover from emergency events that could occur due to project activities such as accidents, spills of hazardous substances, fire, extreme weather events, and other crises. The Plan shall include the provisions of NFPA130. • Cultural Resources Protection and Preservation Plan • Personnel Training and Awareness Program • Decommissioning Plan. The plan shall define contractor's commitment to restoration of land and compensation for non-land assets in case of damage. The decommissioning plan shall ensure that all site are fully restored within 3 months of completion of use, or as defined in the Lease Agreement.				
LAND								
Land acquisition for the Project ROW	Land use and classifica-tion	Incompatibili ty with the existing land use	C-	[Pre-Construction/ Construction] • Maximize the use of existing PNR ROW from Blumentritt to Calamba. • Information sharing with the affected LGU to align and ensure that proposed Project will be accommodated in their future land use plan. • Identification of future land use of surrounding areas that will result to a significant increase of transportation-oriented developments in cooperation	[Pre-Construction] Implement: • PMO • DED Consultant • GC	DED Cost/GC cost, DOTr IEC cost • PhP 1,500 per man-hour	Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2019

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
				with urban planners of LGUs to adopt in the future developments.	[Construction] Implement: • PMO • GC Monitor: • PMO • GC • MMT/TPA • DENR-EMB			
• Construction activities at the following: • Areas with the existing old PNR structures • Areas with high risk to typhoon passage, high susceptibility to flooding • Prime agricultural areas in the SCRP Depot	ECA	Incompatibility with classification as an ECA	B-	[Pre-Construction/ Construction] • Plan and design the site, structure foundation, and structure including construction activities in consideration of the ECAs. • Coordinate with relevant government agencies and stakeholders as required.	[Pre-Construction] Implement: • PMO • DED Consultant • GC [Construction] Implement: • PMO • GC Monitor: • LGUs • MMT/TPA • DENR-EMB	DED Cost/ GC cost, DOTr IEC cost • PhP 1,500 per man-hour	Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2019
Land acquisition for the Project ROW	Land tenure	Involuntary resettlement of informal settlers who had encroached portions of the existing PNR ROW; settlements outside the existing PNR ROW between Solis to Sta.	B-	[Pre-Construction] • Implement Resettlement Action Plan in coordination with KSAs/ NHA, LGUs, lot owners and other concerned stakeholders and agencies to address the issue on land acquisition and relocation of informal settlers.	Implement: • PMO • KSA • LGUs • GC Monitor: • PMO (Internal Monitoring) • External Monitoring Agents	As per RAP Budget	Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2019

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
		Mesa; agricultural area at SCRP Depot; and other government project sites						
		Potential conflict with other government infrastructur e projects	B-	[Pre-Construction] • Coordinate with DPWH and other relevant agencies.	Implement: • PMO • DED Consultant • GC	DED / GC cost, DOTr IEC cost • PhP 1,500 per man-hour	N/A	3rd Quarter of 2018 to 2nd Quarter of 2019
Construction activities	Visual aesthetic and land use	Visual impacts	B-	[Pre-Construction/ Construction] • Design and install facilities to harmonise with the surrounding environments (shape, colour, size, etc.). • Identify planting area within the ROW that will not be covered by development to act as buffer zone, green corridor and to lessen visual impacts brought by construction and railway structures, and plant trees. • Adequately record the condition of roads, agricultural land and other infrastructure prior to starting to transport materials and construction. [Construction] • Maintain the construction site/yards tidy and clean and rehabilitate after construction. Reinstatement of land after completion of Project. • Provision of temporary screens/ walls to minimize visual impacts. • Fully reinstate pathways, other local infrastructure, and agricultural land to at least their pre-project condition upon the completion of construction.	[Pre-Construction] Implement: • PMO • DED Consultant • GC [Construction] Implement: • Contractors Monitor: • PMO • GC • MMT/TPA	DED/GC cost, Construction cost • PhP 1,500 per man-hour	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023
Generation and improper handling and disposal of domestic and	Land value	Lowering of land values as a result of improper	B-	[Pre-Construction] • Prepare a Waste Management Plan (WMP)	[Pre-Construction] Implement: • Contractors	**Contractor's** service cost/ DOTr SDP cost	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
hazardous solid waste.		solid waste management		[Construction] • Implement WMP including strict implementation of solid waste manangement plan and proper disposal by Contractors in accordance with RA 9003, hazardous waste disposal in accordance with RA 6969. • Include waste management in communities in Social Development Plan (SDP).	Monitor: • PMO • GC • LGUs • MMT/TPA • DENR-EMB [Construction] Implement: • Contractors Monitor: • GC • PMO • MMT/TPA • DENR-EMB	• PhP 1,500 per man-hour • PhP 50,000 per activity		
Generation and improper handling and disposal of excavated soil, leftover concrete by excavation activities	Land value	• Lowering of land values as a result of improper handling of excavated soil • Generation of surplus soil	B-	[Pre-Construction/Construction] • Plan and implement the spoils management and disposal plan. • Preparation of traffic plan to manage the ingress and egress of soil/rock hauling machines • Plan and implement recycling and reuse of excavated soil to be utilized for the Project/other projects as much as possible. In case of excessive soil to be generated, identify the final spoil disposal site. [Construction] • Regular hauling of excavated materials and storage in pads with appropriate soil protection facilities or management systems • Disposal of excavated materials in appropriate and licensed dump sites or spoils area and with adequate containment. • Prepare and implement Construction Waste Management Plan/Muck Disposal Plan for the project in order to appropriately handle and dispose excavated materials (including muck generated from tunneling work) and demolition debris) • Comply with environmental permitting requirements for solid waste/soil management plan, which includes minimization of waste/soil generation, segregation,	Implement: • Contractors Monitor: • PMO • GC • MMT/TPA • DENR-EMB	• Construction cost • PhP 1,500 per man-hour	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023

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				and proper disposal (including the temporary storage) by Contractors in accordance with RA 9003. • Require vehicles transporting excavated soils to follow traffic rules strictly and limit speed not to exceed 30 kph and the load shall not exceed 25 tonnes if passing communities or commercial or sensitive areas (e.g. health premises, schools, educational institutions or religious institutions such as temples, mosques and churches).				
Construction of embankment/slope protection/ tunnel/ stations	Topography	Permanent and major modification of the terrain and alteration of landform may cause ground failure	C-	[Pre-Construction /Construction] • Formulate and implement appropriate design measures for the protection of slopes and banks, soil improvement/ground reinforcement to minimize ground failure during construction based on the results of the geological survey and geotechnical investigations. • Minimize ground disturbance through avoidance of unnecessary excavations. • Ensure that roads repaired after surface works would follow the same slope conditions prior to construction	[Pre-Construction] Implement: • DED Consultant • PMO • GC [Construction] Implement: • Contractors • Monitor: • PMO • GC • MMT/TPA • DENR-EMB	DED/GC cost, Construction cost • PhP 1,500 per man-hour • Soil Improvement: PhP 30,000 per m^3	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023
Earthworks, (excavation, backfilling, stockpiling, tunneling/ underground, elevated tracks/ platforms) and natural hazards	Geology/ Geomorpho-logy	• Ground subsidence liquefaction landslide, mud/debris flow, etc. • Foundation of piers of elevated structures may	B-	[Pre-Construction/Construction] • Design and implement appropriate foundation and structures based on combination of geotechnical, geodetic and hydrologic study, and seismicity studies, and in compliance with the National Building Code and the Structural Code of the Philippines and internationally accepted guideline. • Design and install emergency escape route, early warning (alarm) system, emergency power supplies in the design of the structure particularly in the viaduct. • Perform tunnel deformation analysis to determine how the hollowing of ground will affect under ground stress regimes. • Install piezometers to monitor groundwater pressure around the tunnel.	[Pre-Construction] Implement: • PMO • DED Consultant • GC [Construction] Implement: • Contractors • Monitor: • PMO • GC • MMT/TPA • DENR-EMB	DED/GC cost, Construction cost • PhP 1,500 per man-hour • Soil Improvement: PhP 30,000 per m^3	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
		cause unequal settlement of road surfaces. • Alteration of underground stress distribution • Tunnel deformation/ failure (for underground section) • Ground movement		• Plan and implement appropriate construction method, schedule, and activities based on combination of geotechnical and geological investigations, and seismicity studies in coordination with the PHIVOLCS. • Design and construct facilities according to geomechanical properties of the rock/soil. • Properly line tunnel wall with water-proof material. • Conduct regular leveling surveys, deformational studies, visual monitoring and level survey to detect sinking of ground. [Construction] • Install sufficient protection measure such as soil improvements during excavation activities and implement appropriate materials handling program or a site protection and rehabilitation program. • Proper inspection of all installed and constructed/ ongoing construction structures and facilities. • Coordinate with the PHIVOLCS during earthquake and volcanic events to adjust construction schedule. • Conduct earthquake drills for workers. • Use earth pressure balance (EPB) technique with the Tunnel Boring Machine (TBM) to prevent collapse of soil. • Construct diaphragm wall using polymer and bentonite. • Avoid simultaneous excavation in areas near waterways. • Monitor land subsidence. • Compact soil in excavation area. • The Contractors will be required to implement construction methods through underpinning of the existing structures to control vertical and horizontal settlement of road, bridges and other existing buildings. • Install seismometers/accelographs • Real-time and continuous measurement of ground movement				

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Clearing and removal of vegetation, stripping of soil cover, excavation of underlying rock, grading or construction of embankments and works in the SCRP Depot.	Pedology	Soil erosion/ loss of top soil	B-	[Pre-Construction/ Construction] • Design and install slope protection/soil erosion control to prevent or minimize slope failure during construction based on the results of the geo-hazard assessment and geotechnical investigations. [Construction] • Minimize the removal of vegetation cover as much as possible, provision of slope stabilization measure/s, when necessary. • Install surface water runoff drainage systems, protection of slope and bank as required. • Provide drainage system with sedimentation pond and temporary ditches to collect runoff and settle sediments before discharge to the public drainage system. • Clean and de-clog drainage canals surrounding the work sites and the SCRP Depot regularly. • Implement appropriate materials handling program or a site protection and rehabilitation program including but not limited to the following: - Schedule clearing and excavation activities in a speedy manner during dry season, if possible. - Installation of temporary erosion ponds or silt traps around the major work areas. - Placement of excavated materials on appropriate staging site or spoils area and with adequate containment. Limit stock pile height up to 2 m high only. Cover stockpile of excavated soil. In addition, install silt traps, deviation channels, mounting, barriers or trenches around the stockpiles. - Installation of fence at the stockpiles of sand and gravel to reduce sediment transport during heavy rains including reduction of storage time in the work areas. - For bored pile construction, use of bentonite or polymer slurry to stabilize uncased borings in loose soils is highly recommended. • Utilize heavy equipment for transporting, hauling and excavating material from one area to another so as to avoid spills into drainage system.	[Pre-Construction] Implement: • DED Consultant [Construction] Implement: • Contractors Monitor: • PMO • GC • MMT/TPA • DENR-EMB	DED /GC cost, Construction cost • Soil Erosion Control: PhP 30,000 per m^2 • Drainage System: PhP 15,000 per meter	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023

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				• Place construction materials in suitable areas, away from surface waters, canals and drains. • Schedule excavation works, levelling of area, removal of public utilities, e.g. water pipes, drain pipes, electric poles, etc. during the dry season to avoid soil erosion problems. • The Contractors will designate sufficient number of workers to be in-charge of cleaning the site and clearing the construction materials scraps such as soil, rock, sand, and lime that are scattered onto the construction areas and road surfaces every day or within 24 hours to avoid the obstruction of natural flow, especially during the wet season. • For the underground structures, double steel sheet piles will be driven in the construction area near soil surface water sources to prevent soil erosion or soft soil displacement. • Polymer solutions mixed with bentonite shall be used in holes to prevent soil erosion and to stabilize the soil, reduce seepage into sand layers and help in soil cohesion.				
Accidental spills of fuels/lubricants from construction vehicles & machineries/ hazardous chemicals. Generation and improper handling/ disposal of construction/ domestic/ hazardous wastes.	Pedology	Degradation of soil quality as a result of soil contaminatio n	B-	[Construction] • Proper inspection and maintenance of machines and equipment. • Strict implementation of solid waste management plan and proper disposal by Contractors in accordance with RA 9003, hazardous waste disposal in accordance with RA 6969. • Use of strong and durable materials for pipes to prevent leakage. • Use of non-reactive materials for pipes and other buried components to ensure that soil contamination is prevented • Conduct soil quality monitoring in case of any possible contamination events occur.	Implement: • Contractors Monitor: • PMO • GC • MMT/TPA • DENR-EMB	**Contractor's** Service Cost: • RA 9003: PhP 400,000 per year • RA 6969: PhP 100,000 per year • PhP 25,000 per soil sample	Bid Documents/ Contract Agreement	3rd Quarter of 2019 to 2nd Quarter of 2023
Drilling and excavation at previously contaminated sites	Pedology	Exposure to contaminate d soil	C	[Pre-Construction/ Construction] • Identify potentially contaminated sites and conduct soil sampling survey, if necessary.	[Pre-Construction] Implement: • PMO	DED /GC cost, **Contractor's** Service cost	EGF/Bid Documents/ Contract /Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023

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(e.g. Sucat Thermal Power Plant).				• Conduct Environmental Site Assessment if there is suspected contamination on the proposed location of facilities. In case toxic substances are found within the project area and/or adjacent sites, prepare contaminated soil management plan and implement necessary remediation measures. • Storage, handling, transport, treatment and disposal of contaminated soil will be in accordance with RA 6969. [Construction] • Conduct continuous monitoring of concentrations of contaminants to ensure that contaminants will not pose hazards. In case traces of contaminants are detected in concentrations that will pose health and environmental hazards, construction activities in affected site will be suspended until a soil management plan is developed and implemented in consultation with the DENR – EMB.	• DED Consultant • GC [Construction] Implement: • Contractors Monitor: • PMO • GC • LGUs • MMT/TPA • DENR-EMB	• PhP 1,500 per man-hour • PhP 25,000 per soil sample • ESA Phase I: PhP 150,000 per site • ESA Phase II: PhP 1,000,000 per site • ESA Phase III: depends on the extent of contamination		
• Removal of vegetation along the proposed Project alignment particularly the trees at some areas along the ROW and at the SCRP Depot • Generation of dust during construction	Terrestrial Ecology (Flora)	• Loss of habitat • Threat to existence and/or loss of important local species • threat to abundance, frequency and distribution of important species • Hindrance to wildlife access	B-	[Pre-Construction] • Design, plan and implement the Project in such a way that will minimize vegetation clearing, alteration of landform, generation of noise, vibration, illumination, and vehicular movement particularly in areas adjacent to flora of higher conservation significance (i.e. Antipolo, Is-is, Narra) and in the vicinity of ecologically significant areas. • Conduct 100% inventory of the affected trees along the alignment to determine the total number, species, endemicity and conservation status of affected trees and minimize removal particularly in areas adjacent to vegetation communities of higher conservation significance as much as possible. Native/endemic species of trees, shrubs and grasses will be identified. • Wildlings of threatened species, if any, will be collected before construction, placed in the nursery, and given priority during nursery operation to be used for rehabilitation of areas that will be affected by Project. • For tree replanting, areas not part of the development within the ROW, around the stations and the SCRP	[Pre-Construction] Implement: • PMO • DED Consultant • GC • Tree Contractors [Construction] Implement: • Tree Contractors Monitor: • PMO • GC • LGUs • MMT/TPA • DENR-EMB	DEC/GC Cost, **Contractor's** Service cost • PhP 1,000,000 for the 100% tree inventory • PhP 1,500 per man-hour • PhP 100 per sapling	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023

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		• Accumulation of dust on leaf laminae		Depot will be prioritized for replanting activities to create buffer zones and to improve habitats for wildlife. Other offset sites will be identified in coordination with DENR and the relevant LGUs. • Earth balling of trees (if any) will be coordinated with the DENR and LGUs including the site where the balled trees will be transplanted. • Secure tree cutting permit in compliance with DENR Memorandum Order No. 2012-02. [Construction] • Prior to any clearing activity, clearly mark the ROW to avoid the unnecessary vegetation clearing • Conduct tree planting activities to compensate site clearing activities. Conduct regular monitoring on survival of replanted trees and replant if necessary. • Regular water sprinkling (especially during the dry season) along dusty areas				
• Earthworks and vehicle movement. • Generation of dust and noise, vibration, and illumination pollution.	• Terrestrial Ecology (Fauna)	• Loss of habitat • Threat to existence and/or loss of important local species • Threat to abundance, frequency and distribution of important species • Hindrance to wildlife access	B-	[Construction] • Minimize vegetation clearing, alteration of landform, generation of noise, vibration, illumination, and vehicular movement particularly in areas adjacent to flora of higher conservation significance (i.e. Antipolo, Is-is, Narra) and in the vicinity of ecological significant areas if any. • Prepare and implement a tree and vegetation management plan as part of the construction plan considering fauna species (local bird species) such as creating buffer zones, and minimising the use of herbicide and machinery as much as possible. • Coordinate with EMB-DENR and the Society for the Conservation of Philippine Wetlands (SCPW) for the conservation of migratory birds if required. • Use of light source with directional lighting and screens to concentrate light on operations.	Implement: • Contractors Monitor: • PMO • GC • LGUs • MMT/TPA • DENR-EMB	Construction cost • PhP 1,500 per man-hour	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023

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WATER								
• Site preparation, land clearing, removal of vegetation • Excavation • Construction activities	• Hydrology	• Flooding and inundation by sediment run off, siltation, drainage overflow, clogging •	B-	[Pre-Construction/ Construction] • Design and install sufficient drainage system including temporary drainage systems during construction to accommodate the surface water runoff from the Project and avoid any flooding in the area caused by the project, in consideration to the existing drainage system and flood storage capacity. • Based on the hydrological, geological study and local climate change data from PAGASA, design and install train system insusceptible to flood and related extreme events including temporary construction drainage, SCRP train structure to be above the flood level, installation of drainage pumping system, slope protection, etc. • Based on the result of hydrological study, design and install viaduct piers, tunnels and stations considering the potential impacts on flood levels upstream and downstream of the waterway • FTI underground stationswill be provided with permanent bund walls • Coordinate with DPWH and LGUs on the integration of proposed drainage plan to the project area. [Construction] • Minimize the removal of vegetation and alteration of topography as much as possible. • Install soil erosion control such as protection of slope and bank silt traps to minimize siltation of waterways as required. • Strictly implement construction plan, operating instructions and solid waste/ soil management plan, which include minimization of waste/ soil generation, segregation, and proper disposal by contractor in accordance to RA 9003. • FTI Station be provided with permanent bund walls along with water-sealed panels, tempered glass and waterproof iron doors, and drainage pumping station. • Applicable dewatering technique may be considered to address this concern such as well point method,	[Pre-Construction] Implement: • PMO • DED Consultant • GC [Construction] Implement: • Contractors Monitor: • PMO • GC • LGUs • MMT/TPA • DENR-EMB	DED/GC cost, construction cost: • PhP 1,500 per man-hour • Soil Erosion Control: PhP 30,000 per m^2 • RA 9003: PhP 400,000 per year	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023

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				educator wells, open sump pumping and deepwell point method. • Regular inspection and prompt maintenance of the drainage system, all installed structures and facilities and improve/ enhance capacity when possible. • Conduct of construction activities along the waterways during the drier months of the year or during low flows whenever practicable. • Installation of diversion channels if appropriate.				
	Hydrogeology	• Depletion of water resource / competition in water use • Groundwater ingress • Groundwater drawdown	C-	[Pre-Construction/Construction] • Conduct hydraulic modelling to estimate the anticipated volume of groundwater inflow, drawdown, hydraulic radius of influence, and rate of groundwater depletion. Additional studies are needed to determine actual depths and extent of these groundwater aquifers and the potential interconnection that would be material information during the construction phase of the project. • A three-dimensional numerical groundwater model should be developed during Detailed Engineering Design (DED) to simulate existing groundwater conditions, proposed tunnel alignment and associated subsurface ancillary infrastructure. The groundwater model shall be used to predict future groundwater conditions and potential impacts related to the project. The groundwater model shall use internationally accepted modeling software. • Establish and operate suitable groundwater control strategies such as pre-drainage or cut-off methods whichever is applicable prior to construction. • Conduct regular monitoring of the ground water level and quality at nearby identified wells to ensure that the project is not causing any depletion of water supply. • A water conservation management plan will be implemented. This will include utilization of recycled water and rainwater. [Construction] • Utilize surface water from the local water service provider/s. • Conduct regular monitoring of water consumption.	Implement: • Contractors, DOTr • GC Monitor: • PMO • GC • LGUs • MMT/TPA • DENR-EMB	**Contractor's** Service Cost • Water conservation program: PhP 300,000 per site	Bid Documents/ Contract Agreement	3rd Quarter of 2019 to 2nd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
				• Implement water conservation program such as use of rain harvested/ recycled water at construction yard/ camp. • Install piezometers to monitor groundwater pressure around the tunnel. • Ensure that the tunnel is sufficiently supported and lined to prevent failure and ingress of groundwater. • Install dewatering pumps for the tunnel and cut-and-cover sections and secure necessary discharge permits. • Install monitoring wells for observation along the underground section and monitor change of the surrounding ground water levels. • If water supply of people relying on groundwater along the underground section decreases (due to groundwater drawdown), DOTr shall make arrangements to supply affected people with water. • DOTr will coordinate with NWRB regarding tunneling activities along the underground section and its potential effects on the water table. • A Dewatering Permit may have to be secured from NWRB prior to tunneling activities.				
Earthworks (excavation, backfilling, stockpiling, tunneling/ underground)	Water Quality	Degradation of groundwater quality	C-	[Pre-Construction/ Construction] • Plan and implement appropriate construction methods (i.e. excavation, backfilling, stockpiling) based on geological and geotechnical investigations. [Construction] • Install siltation/ filtration pond at tunnel construction area. • Comply with environmental permitting requirements for the storage, transport, handling, treatment, and disposal of hazardous material/ wastes and contaminated soil in accordance with RA 6969, and solid waste/soil management plan, in accordance to RA 9003.	[Pre-Construction] Implement: • DED Consultant • Contractors Monitor: • PMO • GC • LGUs • MMT/TPA [Construction] Implement: • Contractors Monitor: • PMO • GC • LGUs	DED /GC cost, Construction cost • PhP 1,500 per man-hour • Siltation pond: PhP 200,000	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
					• MMT/TPA			
Earthworks (excavation, backfilling, stockpiling)	Water Quality	• Disturbance on bottom sediment and degradation of surface water quality • Siltation / Inducement of turbidity	B-	[Pre-Construction] • Based on the hydrological and geodetic surveys, design bridge piers that will minimize installation within the rivers and select appropriate construction materials to be used. • Minimize the removal of vegetation cover, alteration of topography as much as possible. • Plan and implement construction activities in consideration of waterways, embankment, and weather conditions. • Coordinate with NWRB, DPWH and LGUs for necessary permit. [Construction] • Implement construction activities considering waterways, embankment, and weather conditions (for the underground section, designate buffer zones approximately 5 m from each bank of affected waterways) • Minimize the removal of vegetation cover, alteration of topography as much as possible. • Install slope protection to prevent soil erosion and bottom sediment around the bridge piers if necessary. • Place excavated material in temporary staging area with provision for silt traps/ siltation pond to avoid silt draining to waterways, degradation of surface water quality and clogging of waterways, if necessary. • Spoil and building material stockpiles will be provided with physical barriers and/or bunds to minimize silt-laden runoff. • Surplus soil from tunneling will be used as backfill; remaining surplus soil after construction shall be disposed of at pre-identified licenses sites. • Conduct regular surface water quality monitoring.	[Pre-Construction] Implement: • PMO • DED Consultant • GC [Construction] Implement: • Contractors Monitor: • PMO • GC • LGUs • MMT/TPA • Third Party Monitoring Contractor	DED/GC cost, construction cost: • PhP 1,500 per man-hour • Soil erosion control: PhP 30,000 per m² • PhP 25,000 per sampling station	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023
	Freshwater Ecology	Threat to abundance, frequency and distribution of species	C-					
• Discharge of wastewater, from construction	Water Quality	Degradation of surface water quality from	B-	[Pre-Construction/ Construction] • Design, and implement the temporary drainage of waste water from construction yard/other	[Pre-Construction] Implement: • PMO	DED/GC cost, construction cost (to include cost of Third-Party	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
sites/ yards / camps / slurry treatment plant / related facilities. • Accidental spills of fuels and lubricants from construction vehicles and machineries, as well as other hazardous chemicals like paints and solvents. • Generation and improper handling and disposal of construction, domestic wastes.		wastewater discharge, accidental spills and runoff of fuel, paints and solvents to water bodies near the construction sites		• facilities/camp, surface water runoff drainage systems to minimize discharge. • Design and install sewage treatment facility and separate non-sewage wastewater for stations and the SCRP Depot in compliance with the Sanitation Code of the Philippines. In addition, the SCRP Depot will have an interceptor tank to remove oil and fuel from surface water. • Compliance with RA 9275; secure discharge permit. [Construction] • Install wastewater treatment and portable sanitary facilities at the construction sites/yards. Toilets and lavatories to be provided at the construction camps should be at a ratio of 10 people per toilet. The mobile toilets with wastewater treatment system will be provided. • Conduct proper inspection and regular maintenance of construction machineries, equipment, vehicles and wastewater treatment equipment and facilities with appropriate measures to collect potential leaks • Control oil refuelling activities and provide oil bunds in oil storage areas. • Prohibit workers from dumping garbage into drains and canals. • Implement material handling program or a site protection program. • Prior to operation of the batching plant, construct settling/retention ponds with sufficient capacity for treatment of wastewater from washing of equipment such as mixer drums, trucks, and chutes. • Properly maintain settling/retention ponds to ensure compliance with the General Effluent Standards . • Comply with environmental permitting requirements for the storage, transport, handling, and treatment of hazardous material/ wastes and contaminated soil in accordance with RA 6969 and solid waste/soil management plan, which includes minimization of waste/soil generation, segregation, and proper disposal (including the temporary storage) by Contractors in accordance with RA 9003.	• DED Consultant • GC [Construction] Implement: • Contractors Monitor: • PMO • GC • LGUs • Third party monitoring contractor • MMT/TPA • DENR-EMB	Monitoring Contractor): • PhP 1,500 per man-hour • RA 9275: PhP 400,000 per year • RA 6969: PhP 100,000 per year • RA 9003: PhP 400,000.00 per year • PhP 25,000 per effluent sampling point		
	Freshwater Ecology	Threat to abundance, frequency and distribution of species	C-					

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
				• Conduct of effluent quality monitoring at discharge point. • Temporary installation of adequate hazardous waste facilities as needed.				
• Generation of hazardous wastes at construction sites	Water Quality	Potential contaminatio n of surface water	B-	[Pre-Construction/Construction] • Contractors will prepare a list of hazardous chemicals to be brought at the site including information on the quantity and hazard classification. • Minimize or avoid long storage of hazardous materials onsite. • Comply with the labelling and storage requirements of hazardous materials/ chemicals, including the provision of MSDS onsite. • Conduct refuelling and equipment servicing only in designated areas with impervious surface. • Temporary installation of adequate hazardous waste facilities and provision of oil and grease traps and other spill containment measures. • Collect hazardous materials including used fuel, lubricating oil and contaminated containers for proper disposal.	Implement: • Contractors Monitor: • PMO • GC • LGUs • MMT/TPA • Third Party Monitoring Contractor	Construction cost (to include cost of Third-Party Monitoring Contractor) • PhP 1,500 per man-hour • RA 9275: PhP 400,000 per year • RA 6969: PhP 100,000 per year • RA 9003: PhP 400,000.00 per year	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023
• Spillage of fuel and other hazardous substances			B-	[Pre-Construction/Construction] • Contractor to strictly prepare and implement the wastewater and spill management plan. • Store fuel and hazardous substances in paved areas with embankment. If spills or leaks do occur, undertake immediate clean up. • Ensure availability of spill clean-up materials (e.g. absorbent pads, etc.) specifically designed for petroleum products and other hazardous substances where such materials are being stored and used. • Train construction personnel in handling fuels and on spill control procedures. • Ensure all storage containers are in good condition with proper labelling. • Regularly check containers for leakage and undertake necessary repair or replacement. • Equipment maintenance areas shall be provided with drainage leading to an oil-water separator; oil will be				

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
				regularly skimmed to ensure efficiency. Discharge of contaminated water shall be prohibited. • Store waste oil, used lubricant and other hazardous wastes in tightly sealed containers to avoid contamination of soil and surface water. Transport and off-site disposal of such wastes shall be consistent with national regulations.				
Generation of solid waste	Water Quality	Solid wastes may pollute surface waters due to improper handling and disposal	C-	[Pre-Construction/Construction] • Comply with environmental permitting requirements for the storage, transport, handling, and treatment of hazardous material/ wastes and contaminated soil in accordance with RA 6969 and solid waste / soil management plan including minimization of waste/soil generation, segregation, temporary storage and proper disposal by Contractors in accordance with RA 9003. • Provide garbage bins and facilities within the project site for temporary storage of construction waste and domestic solid waste. • Separate solid wastes from hazardous waste and reusable wastes. • Store solid wastes temporarily on-site and secure facilities with weather-proof flooring and roofing. • Ensure that wastes are not haphazardly dumped within the project site and adjacent areas. • Undertake regular collection and disposal of solid wastes to sites approved by local authorities.	Implement: • Contractors Monitor: • PMO • GC • LGUs • MMT/TPA • Third Party Monitoring Contractor	Construction cost (to include cost of Third-Party Monitoring Contractor): • PhP 1,500 per man-hour • RA 6969: PhP 100,000 per year • RA 9003: PhP 400,000.00 per year	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023
AIR								
• Operation of construction machinery, equipment and vehicles • Removal of trees and other vegetation	Climate change	Exhaust emissions from movement of equipment and vehicles, excavated soil carried by vehicles and other	C-	[Pre-Construction] • Plan and design structures that will minimize the removal of vegetation and alteration of topography, if possible. • Plan and design structures considering climate-related risks [Construction] • Conduct proper inspection and preventive maintenance of heavy equipment, machineries and	[Pre-Construction] Implement: • PMO • DED Consultant • GC [Construction] Implement: • Contractors Monitor: • PMO	DED/GC cost, / Construction cost • PhP 1,500 per man-hour	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
		heavy loaders.		service vehicles to meet the DENR Emission Standards. • Use electric or fuel-efficient equipment, machineries and vehicles and maximize its operation, if possible. • .	• GC • MMT/TPA • DENR-EMB •			
Climate risk	Meteorology/ climatology	Restrictions/ disruption of construction due to soil erosion/ landslides/ and flooding.	A-	[Pre-Construction] • Take account of change in local micro climate such as rainfall, temperature pattern for 2020 and 2050 in project design criteria and schedule of construction works. • Integrate climate-related risks and mitigating measures in DED. • Ensure robust engineering design and construction standards for facilities • Based on the hydrological and geodetic study, design and install train system considering climate change and related extreme events including drainage, passenger facilities and structures (viaduct and embankment) i.e. train facilities to be above the flood level (except for underground section), installation of drainage pumping system. [Construction] • Adjust construction activities iconsidering local climate/extreme events such as extreme heat to avoid overheating of construction equipment and service vehicles and heat stress to workers. • Implement Emergency Response Plan.	[Pre-Construction] Implement: • PMO • DED Consultant • GC [Construction] Implement: • Contractors Monitor: • PMO • GC • MMT/TPA	DED/GC cost, construction cost • PhP 1,500 per man-hour	EGF/ Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023
		Slower drainage, soil erosion, disruption in construction by increased rainfall.	B-					
		Overheating of construction equipment, vehicles / heat stress by high temperature and heat waves.	C-					
• Earthworks including excavation activities • Site clearance including removal of topsoil at the SCRP Depot site	Air Quality	Degradation of air quality due to dust generation from transportatio n of excessive soil/ spoil to fill area	B-	[Pre-Construction] • Design to minimize alteration of topography and removal of vegetation. [Construction] • Minimize alteration of topography and removal of vegetation. • Adjust construction activities in consideration of weather conditions, identifying periods of high winds and drought that may aggravate dust transport.	Implement: • Contractors Monitor: • PMO • GC • MMT/TPA • DENR-EMB	Construction cost: • PhP 1,500 per man-hour • PhP 30,000 to 80,000 per ambient air sampling station depending on	Bid Documents/ Contract Agreement	3rd Quarter of 2019 to 2nd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
		construction activities.		• Conduct prompt inspection and regular maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standards • Check and maintain or monitor engine conditions and machines used in for construction at least once a week. • Conduct weekly maintenance of vehicles and equipment to ensure emissions comply with standards. • Conduct regular cleaning and clearing of construction access/sites surfaces of spoils and debris from construction equipment and vehicles. • Implement materials handling or a site protection and rehabilitation program. • Haul the excavated materials from the construction areas as soon as possible • Conduct water sprinkling in areas prone to dust emission such as at soil excavation areas or stockpile of aggregates and under the elevated stations. Keep excavated soil and stockpiles moist. • Control vehicle movement maintaining the speed limit within the construction site to <10kph and minimize vehicle transport by maximizing the use of site generated materials. • Equipment dispatching will be monitored closely in order to eliminate unnecessary use. • Impose speed limit of no more than 30kph on construction vehicles particularly when passing communities, residential or commercial areas or sensitive areas such as hospitals, schools or religious institutions such as temples, mosques and churches. • Require Contractors to wash wheels of vehicles before leaving the construction area particularly at the SCRP Depot and transition areas to avoid mud tracking on roads that cause dust emission later on. • Require materials delivery trucks to provide cover when transporting materials • Install board-ups or fence at the construction area not less than 2 meters high.		the parameter to be monitored		
Operation of construction machinery, equipment and vehicles	Air Quality	Degradation of air quality due to gaseous emissions from machineries and service vehicles.	C-					

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
				• In case of accidental spill of materials during transport, the Contractors will be required to immediately clean-up spilled materials. • Prohibit burning of waste materials in accordance to RA 9003. Unauthorized burning of construction materials and wastes shall be subject to penalties for the Contractors. • Ready mixed concrete produced and mixed outside the construction area shall be used to prevent and mitigate impacts on communities around the construction area.. • Designate at least 3-4 workers per construction area to clean the site after the completion of daily activities and arrange material piling in order to prevent dust diffusion. • For the elevated structures, provide nets and scaffoldings for falling debris from construction of elevated structures to avoid dust emission and hazards from falling debris. • Monitor air quality at identified nearby sensitive receptors regularly and evaluate effectiveness of the air pollution reduction measures provided. • Subcontractors' vehicles to undergo emission testing prior to contract award. • Fuel burning equipment will be managed through the utilization of low sulphur fuel, where possible. • Traffic management guidelines will be included in the induction seminar of workers.				
NOISE								
• Operation of construction machinery, equipment and vehicles • Earthworks • Construction of structures and facilities	Acoustic Noise	• Increase in ambient noise level	B-	[Pre-Construction /Construction] • Design to minimize alteration of topography and removal of vegetation • Position storage and other large equipment to function as noise barriers • Identify haul roads that minimizes noise impacts • Consider traffic re-routing • Maximize the use of existing structures like fences, walls, and other structures as noise barriers. • Select sites (i.e. construction yard, temporary facilities, access route) in consideration to sensitive	[Pre-Construction] Implement: • PMO • DED Consultant • GC • Contractors [Construction] Implement: • Contractors	DED/GC cost, / construction cost • PhP 1,500 per man-hour • PhP 8,000 per worker for PPE • PhP 25,000 per noise monitoring station	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
				receptors including ecologically significant areas (if any) likely to be affected. • Plan and implement construction activities in consideration to time, duration, and scale to optimize the use of construction equipment, machineries, and vehicles in accordance to the noise emission standard. • Design and install absorbers along the alignment during construction especially in areas with sensitive facilities. • Design and adopt long rails and ballast-less track with elastic and absorbent sleeper support to minimize noise generation from train operation. • Provision of effective noise barriers on each side of the track for the SCRP main railway. A continuous 1 m high concrete wall throughout alignment except 887m length in 3 sections all in Makati City i.e. from chainage 10+464 to 10+743, north bound; from chainage 12+557 to 12+970, north bound; and from chainage 13+093 to 13+288, south bound. A composite noise protection wall with a vertical element of 3.0 m, and on top two elements of 0.25 m and slope of 45 degree is provided at these three locations. • [Construction] • Sequence the construction operation: i) Schedule noisy activities at the same time since the combined noise levels may not be significantly higher that noise levels from individual equipment operation; ii) Install temporary noise barriers in the early stages of project construction • Use of alternative construction methods: i) Do not use pile driving. Only vibration, hydraulic insertion, or auger drill techniques shall be applied; ii) use of electric compressors which is quieter than gasoline or diesel-fed compressors. • Contract Specifications to include: i) Construction noise criteria limits as follows: Lmax in sensitive areas (residences, institutions, and hotels) <85dB(A) daytime and evening, and <80 dB(A) during nighttime;	Monitor: • PMO • GC • Third Party Monitoring Contractor • MMT/TPA • DENR-EMB	• PhP 30,000 per meter noise barrier		

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
				<140 dB(A) at any time; ii) Training for contractors to be administered by the construction supervision consultant on project specific noise requirement, project personnel in-charge with noise management, equipment noise level specifications, and personal protective equipment • Source Mitigation: i) use of less noisy equipment; ii) installation of mufflers on all internal combustion engines; iii) installation of noise shields to particular equipment; iv) dampeners through equipment modification; v) installation of aprons or curtains using absorptive mats; vi) enclosures; and vii) Equipment operating training • Consultations with affected community: Public involvement regarding noise impact and its mitigation is required under project during the noise assessment process and discuss the effectiveness of the mitigation measures. The need for coordination with the local officials to protect future development on areas identified to be exposed to elevated noises during construction and operation is an important input in the town and land use planning. The local government units can also assist in the dissemination of information to residents. • Implement construction activities in consideration of time, duration, and scale to optimize the use of construction equipment, machineries, and vehicles in accordance to the noise emission standard. • Minimize alteration of topography and removal of vegetation which generate noise. • Install noise control devices such as mufflers and noise suppressors to all construction equipment and machineries. Use of electric instead of diesel-powered equipment, hydraulic tools instead of pneumatic tools. • Conduct regular inspection and preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standards. • Monitor noise levels at identified nearby sensitive receptors (residential, school, places of worship and				

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
				hospital areas) including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the noise reduction measures provided. • Install 3-m temporary mobile noise barrier made of wood or metal at active construction sites. This will reduce construction noise to Ldn 60 dB(A) during footing construction activities resulting to no residual impacts. The same wall can reduce impacts during in-situ piling from moderate to no impact except for the houses located along the RoW that may be exposed to moderate impacts • For the underground section, install a 290 m long 3-m high peripheral temporary wall around construction site of the cut-and-cover section at FTI station. • Use noise barriers and sound absorption materials with no less than 70% and 80% of sound absorption coefficient at 1,000 and 500 hertz, respectively. • Noise levels from equipment and machinery shall conform to the noise standards and WB-IFC Environmental, Health and Safety Guidelines. • For construction works between nighttime hours of 10 pm to 6am, proper consultation will be conducted with the affected persons and local officials prior to construction activities, and all adverse environmental impacts are mitigated to acceptable levels. In case of activities that will cause noise exceeding the acceptable level, permission from DOTr-PMO and concerned LGU must be secured and advance notice to the public will be issued at least 24 hours before the start of construction activities. • Workers will be required to wear appropriate PPE including ear plugs or ear muffs in areas generating excessive noise. • Require drivers of construction vehicles to minimize blowing of horn and limit speed when passing through residential areas. • DOTr-PMO and Contractors to continuously operate Grievance Redress Mechanism (GRM) to urgently respond to the complaint and resolve the problem.				

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
VIBRATION								
• Conduct of geotechnical investigation • Operation of construction machinery, equipment and vehicles • Pile driving for piers • Tunneling works	Ground vibration	• Increase in ambient vibration level and threat to the health and safety of sensitive receptors • Threat to existence and/or loss of important local species and habitat • Threat to abundance, frequency and distribution of species	C-	[Pre-Construction / Construction] • Select sites in consideration to sensitive receptors including ecologically significant areas (if any) likely to be affected. • Plan and implement construction activities in consideration to time, duration, and scale to optimize the use construction equipment, machineries, and vehicles in accordance to the noise emission standard. • Conduct building condition survey of old PNR structures and buildings adjacent to the alignment to provide proper protection provision measures and continuous monitoring from the impact of vibration. • Review and amend, as needed, predicted vibration level study for the TBM and drilling during construction and tunnel operation. • Strategic scheduling of vibration-induced works. • Installation of vibration control measures such as i) vibration insulating sleeper; ii) sleeper with elastic layer directyl fastened track; and iii) secondary lining. • Prepare and submit work plan for building and structures of historic concerns and obtain approval from Cultural Agencies. [Construction] • Implement construction activities in consideration of time, duration, and scale of construction to optimize the use of construction equipment, machineries, and vehicles with minimal vibration generation. • Select construction equipment and machineries matching the scale of the construction and with minimal vibration generation, if possible. • Provide training on vibration mitigation and provide appropriate PPE to construction workers. • Monitor vibration levels including identified nearby sensitive receptors, old PNR structures including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the vibration reduction measures provided.	[Pre-Construction] Implement: • PMO • DED Consultant • GC • Contractors [Construction] Implement: • Contractors Monitor: • PMO • GC • Third Party Monitoring Contractor • MMT/TPA • DENR-EMB	GC Cost/ Construction cost: • PhP 1,500 per man-hour • PhP 80,000 per vibration monitoring station • PhP 15,000 per training	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
				• Coordinate with sensitive receptors prior to pile driving. • Strictly control construction activities close to historical/ archaeological sites. • If construction activities will cause continuous vibration, especially foundation excavation, it is necessary to reduce energy at each excavation. • Require vehicles transporting construction materials and equipment to follow traffic rules strictly and limit speed not to exceed 30 kph and the load shall not exceed 25 tonnes if passing communities or commercial or sensitive areas (e.g. health premises, schools, educational institutions or religious institutions such as temples, mosques and churches). • In case of vibration due to construction activities, the construction works will be carried out only in daytime from 8am to 6pm unless proper consultation has been conducted and agreement has been reached with the affected persons and local officials, and all adverse environmental impacts are mitigated to acceptable levels to minimize disturbance to people. • Monitor vibration level at the Philippine Airforce Villamor Air Base and Nutrition Center of the Philippines during tunneling works.				
PEOPLE								
Disclosure of project information and public consultation	Public Involvement and Support	• Communities and stakeholders not being provided with the appropriate information on the implementation	B-	[Pre-Construction/ Construction] • Prior to start of construction works, local establishments, local authorities and other stakeholders who are likely to be affected by the Project shall be informed about the construction schedule and activities, potential environmental impacts, mitigation measures and grievance redress procedure through public meetings. • During pre-construction and construction, public involvement activities will continue based on the framework for public involvement and disclosure. • Regular consultations with affected people and relevant offices/agencies will be conducted by the Contractors during the construction phase and by the DOTr during operation phase to ensure adequate and	Implement: • PMO • Contractors • GC Monitor: • PMO • (internal monitoring) • GC • MMT/TPA • Third Party Monitoring Agents	Part of DOTr project /IEC cost • PhP 1,500 per man-hour	Bid Documents/ Contract Agreement	Prior to start of construction

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
		of the Project. • Complaints from the communities and stakeholders.		timely mitigation of project adverse environmental impacts. • Prior to commencement of site works, the DOTr in coordination with the Contractors will establish the approved GRM that will allow for the following: - Receiving/recording and immediate response (within 24 hours) by the Contractor of any construction-related complaints. - Report issues to DOTr-PMO through GC by the Contractors within 24 hours. - Complaints reported by the affected person(s) to DOTr-PMO are recorded and relayed to the Contractors within 24 hours for immediate resolution. - Installation of notice boards at the construction sites that indicate the name and telephone numbers (hotline) of Contractors who are tasked to receive and document complaints.				
Land acquisition for ROW and involuntary Resettlement for Project Affected Families (PAFs)	• Informal Settler Families (ISFs) • Vulnerable persons (Women-headed households, elderly, persons with disabilities and the poor)	• Displacement of ISFs • Disturbance of livelihood • Loss of income	A-	[Pre-Construction] • Design train system maximising the existing PNR ROW and minimising additional land acquisition. • Prepare and implement RAP to ensure that PAFs are provided with proper relocation area and/or justly compensated. The RAP will include the following: - Provision of relocation sites for ISFs. - Livelihood and income restoration for head-of-household PAPs of ISFs and vulnerable persons. - Prior to displacement, secure and/or develop relocation sites in coordination with the concerned LGUs, Key Shelter Agencies, and other concerned stakeholders with conducive living condition and basic utilities, services and amenities. • Design the undergrond section to minimize the ROW. [Pre-Construction/ Construction] • Conduct external and internal monitoring to ensure that displacement activities are conducted in compliance to the RAP. • If PAFs raise an issue, ensure prompt response and resolution per established GRM.	Implement: • PMO • DED Consultant • GC • LGUs • KSAs Monitor • PMO (internal monitoring) • External Monitoring agents • MMT/TPA	DED /GC cost, RAP Budget • PhP 1,500 per man-hour	RAP Budget	3rd Quarter of 2018 to 2nd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
	Legal PAFs	• Displacement / Disturbance of Properties • Change/ Conflict in Land Ownership • Impact on Livelihood and Income (i.e. farming, business)	A-	[Pre-Construction] • Prepare and implement RAP to ensure that PAFs are justly compensated for the loss of income by the Project. • Payment of compensation prior to displacement. • If the project involves underground works within a depth of 50 m from the surface, DOTr shall negotiate with the property owner a perpetual easement of ROW for the subterranean portions of the property and offer to acquire from the property owner the affected portion of the land, including affected structures, improvements, crops and trees. • Coordination with the LGUs, land owners and other concerned stakeholders in acquiring the land and/or securing ROW. [Pre-Construction/ Construction] • Prepare and implement livelihood and income restoration for PAF's whose present means of livelihood is no longer viable and will have to engage in new income activity. • Prepare and implement Social Development Plan (SDP) including livelihood training for business owners, vendors, employers and agricultural landowners affected by the Project. • Involve external and internal monitoring agencies to ensure that displacement activities are conducted in compliance to the RAP. • If PAFs raise an issue, ensure prompt response and resolution per established GRM	[Pre-Construction] Implement: • PMO • DED Consultant • GC • LGUs • KSAs Monitor • PMO (internal monitoring • External Monitoring agents • MMT/ MMSP [Construction] • PMO • GC • LGUs • KSAs Monitor • PMO (internal monitoring • External Monitoring agents • MMT/TPA	DED /GC cost, RAP Budget/ DOTr IEC cost • PhP 1,500 per man-hour	RAP Budget	3rd Quarter of 2018 to 2nd Quarter of 2023
	Social Aspect (Gender Equality and Vulnerable Groups)	Generation of employment and livelihood opportunities and improvement of safety	C-	[Pre-Construction/ Construction] • Prepare and implement RAP to ensure that gender equality and needs of vulnerable groups are addressed including livelihood and skills training program • Design and install train system in consideration of universal design and strategic placement of security and lighting within the vicinity of the stations; • Employ workers in consideration of gender equality.	[Pre-Construction] Implement: • PMO • DED Consultant • Contractors • GC Monitor • PMO (internal monitoring)	DED/ GC cost, Construction Cost/ RAP cost: • PhP 1,500 per man-hour • PhP 15,000 per person per training	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
				• Include gender-sensitive livelihood and skills training program in the SDP with due consideration to vulnerable groups.	• GC • External Monitoring agents • MMT/TPA [Construction] Implement: • Contractors Monitor: • PMO (internal monitoring) • GC • LGUs • External Monitoring agents • MMT/TPA			
Demolition of Buildings	Social Component	• Temporary disruption of regular activities of sensitive receptors	C-	[Pre-Construction] • Consult affected households/land owners prior to demolition of the structure/ building	Implement: • Contractors • PMO • GC Monitor: • External monitoring agents • MMT/TPA	GC cost/ Costruction cost • PhP 1,500 per man-hour	Bid Documents/ Contract Agreement	Commencing on mobilization on site
	Solid waste management	• Generation of solid wastes and demolition debris • Scavenging of demolition wastes	C-	[Pre-Construction] • Identify a site for the disposal of demolition wastes away from sensitive receptors as much as possible • Provide barriers/ security measures on temporary storage areas of demolition wastes to prevent scavenging activities which may compromise the safety of scavengers	Implement: • Contractors Monitor: • PMO • GC • MMT/TPA • LGUs			

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
• Clearing of the proposed project area • Resettlement	In Migration	In-migration to the project area	C-	[Pre-Construction / Construction] • Plan and implement construction schedule to shorten time between the pre-construction and construction as much as possible. • Install fencing and guarding of the proposed Project to restrict the public from entering the ROW.	[Pre-Construction] Implement: • PMO • Contractors • LGUs Monitor: • PMO (internal monitoring) • MMT/TPA • External monitoring agents [Construction] Implement: • Contractors • PMO • LGUs Monitor: • GC • MMT/TPA • External monitoring agents	DOTr SDP cost/ **contractor's** Service Cost:/ RAP cost: • PhP 1,500 per man-hour • SDP: PhP 15,000 per person • PhP 10,000 per meter fence	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023
		Conflict between existing residents and new relocatees	C-	[Pre-Construction / Construction] • Prepare and implement SDP in coordination with host LGUs to align projects/programs with their development plans.				
Pre-construction and construction activities (Site preparations, mobilization, etc.)	Social Component	Damage or loss caused by Contractors on privately-owned property outside the scope of land acquired under the RAP	C-	[Pre-Construction/ Construction] • Compensation to property owner commensurate with rates set out in the RAP.				
In migration to new relocation site	Basic Services/ Resources	• Increased demand on public infrastructure • Livelihood impacts	C-	[Pre-Construction / Construction] • Prepare and implement RAP in consideration of relocation site to sufficiently cover the expected demand of basic services, resource and social programs at relocation sites in coordination with LGUs. • Prepare and implement SDP in coordination with the host LGUs to align projects or programs with their development plans.	[Pre-Construction] Implement: • PMO • DED Consultant • GC • LGUs • KSAs	DED/GC cost, RAP **Budget / the DOTr's** SDP cost • PhP 1,500 per man-hour • SDP: PhP 15,000 per person	RAP Budget	3rd Quarter of 2018 to 2nd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
		Loss of outdoor spaces	C-	[Pre-Construction / Construction] • Coordinate with respective LGUs and PNR regarding the possible measures for the transfer/provision or relocation of public parks and other recreational facilities.	Monitor: • PMO (internal monitoring) • External Monitoring Agents • MMT/TPA • [Construction] Implement: • PMO • GC • LGUs Monitor: • PMO (internal monitoring) • External Monitoring Agents • MMT/TPA			
Establishment of construction camps and other construction facilities (casting yard, laydown/ storage areas, concrete batching plants)	Public Activities	• Temporary disruption of normal activities of sensitive receptors • Temporary loss of private lands	C-	[Pre-Construction] • Contractor to secure the necessary approvals and permits prior to establishment and operation of construction-related facilities. • Coordination with LGUs to identify minimization options, including identification of available public land where possible for access roads, material storage areas, construction yards, etc. • Negotiation for temporary land use with land owners and payment of rent commensurate with market rates and restoration of land to pre-use conditions within 3 months of discontinuation of use. Rent will continue to be paid until the land is restored. • Select construction camps and other construction facilities at least 300m from sensitive receptors such as residential housing areas, hospitals, schools, religious and cultural sites.	Implement: • Contractor • PMO Monitor: • GC • External monitoring agents • MMT/TPA	Construction Cost • PhP 1,500 per man-hour	Bid Documents/ Contract Agreement	Commencing on mobilization on site.

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
Disruption to community services due to relocation of utilities such as water supply, electric distribution poles, and communication lines.	Public services	• Disruption of public services • Damage to buried cables / pipelines due to boring activities	C-	[Pre-Construction] • Coordinate with the utility companies prior to relocation of utilities. • Issue notices or announcements in advance regarding temporary disruption of services. • Observe due diligence and conduct pre-construction utilities survey • Minimize unnecessary excavation activities	Implement: • PMO • Contractor • GC • DED consultant Monitor: • MMT/TPA	DEC/GC Cost, construction cost: • PhP 1,500 per man-hour	Bid Documents/ Contract Agreement	Commencing on mobilization on site.
Encroachment of proposed Project to historical sites, tourist spots, etc. Excavation activities Construction of the proposed project	Historical sites, artefacts, ecofacts and archaeolo-gical remains	Impacts on cultural/ historical resources	B-	[Pre-Construction] • Conduct literature review and site validation of the potential historic structures in coordination with PNR and Cultural Agencies (NCCA, National Museum and NHCP); • Perform measured survey of the identified historic structures including its foundation and building condition. • Coordinate closely with the Cultural Agencies, concerned LGUs and PNR for verifying the qualification of those structures and provide necessary protection measures. • Prepare a protection plan for those identified PNR structures (such as the Nutrition Center of the Philippines) which will be maintained in accordance to the agreed procedure. • Identify historic sites and structures in close proximity to the project shall undergo necessary consultation and permitting processes to NHCP, in accordance to RA 10066 with concerned agencies including but not limited to DepEd (property owner of the NNC), NCCA and National Museum during detailed engineering design (DED) of the Senate-FTI underground section. [Construction] • Implement the approved protection plan • Implement the *Guidelines on Heritage Accidental Finds* of the National Museum along with the following procedures in the event that a potential	[Pre-Construction] Implement: • DED Consultant • GC • PMO • Contractors [Construction] Implement: • Contractors Monitor: • PMO • GC • LGUs • MMT/TPA	DED /GC cost, construction cost: • PhP 1,500 per man-hour • PhP 100,000 per m^2	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
				archaeological asset is discovered during the course of construction: - Immediately cease all construction activities in the vicinity of the find/feature/site - Preserve the potential archaeologic find and report it immediately to the National Museum - Coordinate with the National Museum on the appropriate course of action in protecting the archaeological finds - Hire an archaeologist, recognized by the National Museum, to ensure the following are carried out: o Delineate the discovered find/feature/site o Record the coordinates of the find location, an all remains are to be left in place o Secure the area to prevent any damage or loss of removable objects o Assess, record, and photograph the find/feature/site o Undertake the inspection process in accordance with all project health and safety protocols under direction of the Health and Safety Officer o Conduct all investigation of archaeological soils by hand • Keep all finds, osteological remains and samples and submit to the National Museum as required o In the event that any artefacts need to be conserved, secure approval from the National Museum; o Provide an on-site office and finds storage area to allow storage of any artefacts or other archaeological material recovered during the monitoring process; o In the case of human remains, in addition to the above, contact the National Museum and adhere to the				

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				guidelines for the treatment of human remains; and o If skeletal remains are identified, consult an osteo-archaeologist to examine the remains. - The following procedures will be implemented for conservation of objects found: o Hire a conservator, if required; o The consulting archaeologist completes a report on the findings and submits to the National Museum; and o National Museum reviews the report and informs when works can resume. • Close coordination with the National Museum on the appropriate course of action in case of any archaeological and related military material finds based on the guidelines on heritage accidental finds.. • Observe adherence of buffer zones as mandated by RA 10066 (Conservation of the National Cultural Heritage)				
	Local conflicts of interest	Potential conflict among PAFs and other government infrastructur e projects	B-	[Pre-Construction] • Close coordination with BCDA, DPWH, and other relevant agencies • Prepare and implement RAP to ensure that PAFs are justly compensated for the loss of income by the project prior to displacement. • Conduct external and internal monitoring agencies to ensure that displacement activities are conducted in compliance to the RAP. • Prepare and implement arrangement on financial assistant to the receiving of PAFs. [Construction] • If PAFs raise an issue, ensure prompt response and resolution per established GRM • Conduct external and internal monitoring agencies to ensure that displacement activities are conducted in compliance to the RAP.	[Pre-Construction] Implement: • DED Consultant • PMO • GC Monitor: • External Monitoring agents • MMT/TPA • [Construction] Implement: • PMO Monitor: • PMO (internal Monitoring) • LGUs	DED/GC cost, RAP cost/ construction cost/ DOTr IEC Cost • PhP 1,500 per man-hour		

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
					• External Monitoring agents • MMT/TPA			
Generation of solid waste, excavated soil and hazardous material	Basic Services/ Resources	Increased demand on waste disposal	B-	[Pre-Construction / Construction] • Identification of final disposal site for solid waste, excavated soil, hazardous waste at each LGUs. • Conduct regular monitoring of disposal status in compliance to RA 9003 and RA 6003. • Registration of the proponent as a hazardous waste generator. • Collection of hazardous wastes in proper receptacle. • Storage of fuel and chemicals in appropriate storage area provided with secondary containment in case of spills. • Collection of hazardous waste by a DENR accredited hauler. • Treatment of hazardous waste by a DENR accredited treater. • Compliance to necessary permits and clearances for identified disposal sites (ECC, LLDA Clearance, Shoreland Development Clearance, Locational Clearances, Traffic Clearances)	Implement: • Contractors Monitor: • PMO • GC • LGUs	Construction cost • RA 6969: PhP 100,000 per year • RA 9003: PhP 400,000 per year • PhP 1,500 per man-hour	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023
• Generation of potential air and water pollutants due to: • Heavy lifting and movement of heavy equipment • Construction of the proposed project	Public Health and Safety	• Degradation of public health • Increase in accident involving local communities	B-	[Pre-Construction / Construction] • Formulation and implementation of IEC Plan to inform the affected LGU and local communities and the general public about 1) the Project, Project activities, duration, possible Project impacts and incorporate their comments and inputs in the design, 2) the potential impact of Project activities to air quality, noise, vibration, and climate change, and corresponding health and safety mitigation measures, and 3) the GRM to handle complaint/s if any. • Plan for construction sites/facilities/yard and access route in consideration of health and safety of local communities. • Plan and implement SDP including health and safety of local community	[Pre-Construction] Implement: • PMO • GC • Contractors Monitor: • LGUs • External Monitoring agents • MMT/TPA [Construction] Implement: • Contractors Monitor: • PMO	DOTr IEC/SDP Cost, Construction cost • IEC: PhP 50,000 per activity per LGU • PhP 10,000 per meter fence • PhP 1,500 per man-hour	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
				[Construction] • Provide safety officers to monitor the health and safety of the local community. If any complaints arise, immediately identify the causes and evaluate built-in measures. • Install fencing of the construction site, provide signage and posters, and guard access point to ensure that the area is not accessible to the public. • Implement Emergency Response Plan and Health and Safety Management Plan.	• GC • LGUs • MMT/TPA			
Risks to Workers	Occupatio-nal Health and Safety	• Increase d risk of accident s at construct ion sites • Spread of infectiou s disease among workers	B-	[Pre-Construction/Construction] • Prepare and implement Occupational and Community Health and Safety Plan and Emergency Response Plan including security policies and procedures based on the WB-IFC EHS Guidelines. The Plan shall include the provisions of NFPA130. • Include medical certificate in the requirements for hiring of workers to ensure that they are fit to work. Ensure that they are provided with proper training on construction, occupational health and safety, and emergency response procedure. • Plan construction details such as storage of equipment and machinery and access route of heavy vehicle considering health and safety of workers. • Provide appropriate personal protective equipment (PPE) to all construction workers, particularly to the personnel working on heights, heavy and electrical equipment. • Establish Health and Safety Desk or Medical Station at the active construction sites to monitor and safeguard the health of the workers and local residents and to provide immediate response during unexpected incidents/emergencies. • Provide fire-fighting equipment at work areas and construction camps. • Close coordination with the nearest hospitals in the active construction site for immediate transfer and/or further evaluation and medical management of the patient.	Implement: • Contractors Monitor: • PMO • GC • LGUs • MMT/TPA	**Contractor's** service fee on health, safety and environmental management • PhP 1,500 per man-hour • PhP 8,000 per personnel for PPE • Health and Safety Desk or Medical Station: PhP 200,000 per site	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023

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				• Require the Contractors to appoint an environment, health and safety officer to supervise the implementation of environmental mitigation measures and to ensure that health and safety measures are strictly implemented at the construction site and immediate vicinity. • Proper management of identified unexploded ordnances (UXOs) such as: • -Preparation of protocol and orientation to workers on the proper handling of situation where there is suspected presence of UXOs • -Proper coordination with the Philippine National Police (PNP) in the event of a suspected presence • -Clear and accurate marking of all cleared areas • -Confirmation from exploded ordnances disposal (EOD) expert that sites are safe for construction activities to proceed • Soil and groundwater investigation will be conducted to assess the soil and groundwater conditions in the project area prior to any excavation and tunneling activities. • Provide adequate drainage in construction camps to prevent water logging and formation of breeding sites for mosquitoes. • Provide potable water, hygienic sanitation facilities/toilets with sufficient water supply. • Ensure that all wastewater emanating from construction camps are treated and complies with the effluent standards. • Provide fence and anti-derailing rails or guards on all areas of excavation to avoid accidents. • Implement fall prevention and protection measures such as scaffoldings, wearing of safety belts by workers, etc. when working in high areas. • Provide sufficient lighting in tunnel areas and underground station excavation sites. • Provide emergency lighting system in case of power shutdown.				

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
				• Ensure that sufficient fresh air is supplied at confined work spaces at the tunnel and underground station excavation sites. Ensure that air filters are kept clean. • Confined spaces such as tunnels shall be provided with safety measures such as venting, monitoring, and emergency rescue procedures. • Tunnel works, including stations and trainways shall follow the construction provisions outlined in NFPA130. • Conduct orientation for construction workers regarding health and safety measures, emergency response in case of accidents, fire, etc. and prevention of HIV/AIDS, STIs and other diseases. • Tunneling shield designed in accordance with "Design Standards for Railway Structures and Commentary (Shield Tunnel)" shall be implemented to prevent groundwater ingress. • Conduct geophysical investigations using underground utility scanning technologies such as Ground Penetrating Radar (GPR) to mitigate utility strikes.				
Employment of workers	Local Economy	• Generation of local employment • Hiring of workers from outside the community might create peace and order and social conflicts	B+	[Pre-Construction /Construction] • Close coordination with the host LGUs (barangay level) regarding the hiring of temporary workers to ensure that the workers being considered are legitimate residents in the area. Those affected by the Project will be prioritized for employment. • Provide skill trainings to PAFs under livelihood and income generation program developed by RAP • Provide HIV/STI awareness and prevention training to construction workers and contractor's employees/staff	Implement: • DED Consultant • GC • Contractors • PMO Monitor: • GC • LGUs • PMO • External Monitoring agents • MMT/TPA	DED/GC Cost, RAP cost/ DOTr IEC **cost/ Contactor's** Service Cost : • Skills Training: PhP 15,000 per person	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
		with local communities and increased HIV/AIDS risk.						
Traffic congestion and access problems	Mobility/ public transport	Increase in traffic volume within the project area	B-	[Pre-Construction/Construction] • Conduct Traffic Impact Assessment (TIA) and based on its results, prepare a Traffic Management Plan (TMP) for approval. Implement the approved TMP. The plan shall be designed to ensure that traffic congestion due to construction activities and movement of construction vehicles, haulage trucks, and equipment is minimized. The plan shall be prepared in consultation with concerned traffic agencies, local officials and the general public. The plan shall identify traffic diversion and management, traffic schedules, traffic arrangements showing all detours, necessary barricades, warning/advisory signs, road signs, lighting, and other provisions to ensure that adequate and safe access is provided to motorists in the affected areas. • Coordinate with the traffic police for traffic management. • Provide traffic advisory signs for the public that construction is in progress and that road narrows in some sections. • Employ flag persons to control traffic at underground station sites. • Provide sufficient lighting at night within and in the vicinity of the construction sites. • Prohibit prolonged side street parking of construction trucks. • As much as possible, schedule delivery and transport of construction materials and spoils during non-peak hours.	[Pre-Construction] Implement: • DED Consultant • GC • PMO [Construction] Implement: • Contractors Monitor: • PMO • GC • LGUs • MMT/TPA	DED / GC Cost, Construction cost: • PhP 1,500 per man-hour	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
Blocking of existing access roads	Public Access	• Impacts on public access • Impcts to school access • Increase in accidents • Severance impacts and/or barrier effect during construction disrupting lateral movement (access) or access to property.	B-	[Pre-Construction/ Construction] • The project will provide for temporary crossings and continued access to properties adjacent to construction sites. • Based on the study on public access at affected barangay, maintain the existing public access as much as possible. • In case of any temporary closure during construction, minimize the impact to the daily life of affected communities such as access to school infrastructure in coordination with the DepEd and host LGUs for the schedule of construction activities. • In case of permanent loss of public access, RAP will be applied. • In the event that construction works completely block access (without alternative access) to a business then compensation for lost income for the period of disrupted access will be provided. • Disseminate information to the public, barangay, and LGUs on the potential impact to the existing public access and mitigation measure through the project activities. • Provision of diversion route with appropriate health and safety measures. In case of any changes, prompt update on the diverted routes to the concerned communities and LGUs, • Assignment of traffic guide to provide assistance to the road users.	Implement: • Contractors • PMO • Contractor's cost for compensation for lost income due to blocked access to businesses. Monitor: • PMO (internal monitoring) • GC • LGUs • External monitoring agents • MMT/TPA	Construction Cost / DOTr IEC cost • PhP 50,000 per IEC activity per LGU • Calculation of lost income to be commensurate with procedures in RAP for determining loss of business income.	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023
• Movement of construction equipment • Delivery of construction materials • Additional commuters due to construction workforce • Blocking of access roads	Traffic Manage-ment	Traffic Congestion	B-	[Pre-Construction/ Construction] • Conduct Traffic Impact Assessment (TIA) and based on the results of TIA, prepare and implement Traffic Management Plan (TMP), coordinate to the concerned LGUs and transport operator/s and get their inputs and approval. • Schedule transport of heavy structures during period when there are fewer vehicles on the road and posting of appropriate traffic signage and warnings. • Disseminate information to the general public, host barangays, and LGUs on the potential impact of the	[Pre-Construction] Implement: • DED consultant • PMO • Contractors [Construction] Implement: • Contractors Monitor: • PMO • GC	DED cost/ DOTr IEC Cost/ Construction Cost • TIA: PhP 10,000,000 • IEC: PhP 50,000 per activity per LGU	Bid Documents/ Contract Agreement	3rd Quarter of 2018 to 2nd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
• Transportation of excavated soil/muck from tunneling work.				project to the existing access and provide mitigating measures. • Identify the muck transportation hauling routes to the disposal sites. • Preparation of traffic management plan for hauling of excavated soil/muck from the tunneling work for the underground section.	• LGUs • External Monitoring agents • MMT/TPA			
OPERATION								
LAND								
Operation and maintenance of the Project	ECA	Incompatibili ty with the area that will be affected by natural calamities.	B-	• Coordinate with PAGASA/PHIVOLCS and adjustment of train schedules. • Implement proper inspection and prompt maintenance of drainage systems.	Implement: • Operator Monitor • PMO • LGUs • Third Party Monitoring Contractor	Included in the operation and maintenance cost: • PhP 1,500 per man-hour	Operation and maintenance cost	From 3rd Quarter of 2023
Presence of the proposed project structures (railway, passenger facilities, SCRP Depot etc.)	Visual aesthetics	Impairment of visual aesthetic	C-	• Planting of trees to minimize the visual impact by the Project and harmonize with the surrounding environments in open areas within the ROW, SCRP Depot and around the stations, to create a green corridor.	Implement: • Operator Monitor • PMO • LGUs	Included in the operation and maintenance cost: • PhP 1,500 per man-hour	EGF	From 3rd Quarter of 2023
Generation of domestic and hazardous wastes including accidental oil and lubricant spills from passenger facilities (station), SCRP Depot.	Land value	Degradation of land value and soil quality due to improper handling of domestic and hazardous wastes	C-	• Conduct proper inspection and prompt maintenance of machines and equipment, and facilities. • Strictly implement solid waste management plan in accordance to RA 9003, and treatment of hazardous chemicals and contaminated soil in accordance with RA 6969. • Conduct of soil quality monitoring when necessary.	Implement: • Operator Monitor • PMO • LGUs	Included in the operation and maintenance cost: • PhP 1,500 per man-hour • RA 9003: PhP 400,000 per year • RA 6969: PhP 100,000 per year	Operation and maintenance cost/ EGF	From 3rd Quarter of 2023
Generation of solid waste from office and service areas	Solid waste management	Degradation of the area of the facilities and	B-	• Provide solid waste segregation bins at each office area and at train stations. • Coordinate with the concerned LGUs in the collection and disposal of segregated solid wastes.	Implement: • Operator Monitor • PMO	Included in the operation and maintenance cost • PhP 1,500 per man-hour	Contract agreement	From 3rd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
		surrounding communities		• Maintain daily record of solid wastes generated and collected.	• LGUs			
Generation of hazardous waste from maintenance area at SCRP Depot and related facilities.	Toxic and hazardous waste manage-ment	Degradation of the area of the facilities and surrounding communities	B-	• Provide hazardous waste bins at the stabling yard • Record quantities of hazardous wastes generated • Commission the services of a Government-recognized hazardous waste transporter and treater.	Implement: • Operator Monitor • PMO • LGUs	Included in the operation and maintenance cost • PhP 1,500 per man-hour	EGF/ Contract agreement	From 3rd Quarter of 2023
• Occurrence of landslides, volcanic hazards, ground shaking and liquefaction • Likely seismic events around the alignment	Subsidence, liquefaction, landslide, mud/debris flow, etc.	• Damage to tracks • Risk to the life of passengers and workers • Damage to passenger facilities • Failure of tunnel structure (for the subway).	B-	• Conduct inspection and leveling surveys in the event of natural hazard occurrence to assess damage of structures. • Regular coordination with the PHIVOLCS for earthquake and volcanic events to adjust the train schedule as necessary. • Conduct earthquake drills for train users are also advised. • Update tunnel deformation model to determine changes in underground stress regimes • Conduct proper inspection and prompt maintenance checks to every single installed structure and facility and improve/ enhance capacity when possible. • Real-time and continuous measurement of ground movement • Upgrades or install new technological advances when available are also encouraged for the continued operation of Project.	Implement: • Operator Monitor • PMO • LGUs	Included in the operation and maintenance cost: • PhP 1,500 per man-hour	Operation and maintenance cost/ EGF	From 3rd Quarter of 2023
• Operation of the proposed project and passenger facility, SCRP Depot, service vehicle • Passenger movement	Terrestrial ecology	• Threat to existence and/or loss of important local species • Hindrance to wildlife access	C-	• Minimize noise, vibration, illumination, and vehicular movement in significant fauna area. • Continuous planting of replacement trees, if needed. • Conduct monitoring of survival of replanted trees and replant, if necessary. • Implement vegetation management plan considering fauna species (local bird species) to minimize the use of herbicide and machinery as much as possible.	Implement: • Operator Monitor • PMO • LGUs	Included in the operation and maintenance cost: • PhP 1,500 per man-hour • PhP 100 per sapling	Operation and maintenance cost/ EGF	From 3rd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
WATER								
• Operation of passenger trains/facilities, SCRP Depot: • Discharge of wastewater from passenger facilities, stations, and the SCRP Depot. • Accidental spills of fuels and lubricants from service vehicles and machineries at the SCRP Depot • Generation and improper handling and disposal of domestic and hazardous wastes.	Hydrology/ Hydrogeo-logy	• Increase of flood intensity /occurrence • Groundwater ingress	C-	• Conduct proper inspection and prompt maintenance of the installed drainage system, and improve/ enhance capacity when possible. • Monitor groundwater pressure and levels along underground section • Update tunnel deformation model to determine changes in underground stress regimes. • Ensure dewatering pumps are working efficiently. • For the underground interconnection section, stations will be provided with permanent bund walls to mitigate potential flooding impacts to the stations	Implement: • Operator Monitor • PMO • LGUs	Included in the operation and maintenance cost: • PhP 1,500 per man-hour • RA 6969: PhP 100,000 per year • RA 9275: PhP 400,000 per year • PhP 25,000 per effluent sample	EGF/ Contract agreement	From 3rd Quarter of 2023
	Water quality	Degradation of groundwater quality	C-	• Comply with environmental permitting requirements for the storage, transport, handling, and treatment and disposal of hazardous material/ wastes and contaminated soil in accordance with RA 6969. • Compliance to RA 9275 including but not limited to securing of discharge permit. • Hygienic toilets will be provided at all stations and facilities. • Wastewater will be treated by a wastewater treatment system at each station before release of effluent into public waterways. • Recycle train washing to reduce volume of wastewater to be discharged daily. • Conduct proper inspection and prompt maintenance of the installed wastewater treatment facilities & drainage system and treatment facility. • Monitor effluent of the wastewater treatment system to ensure compliance with the effluent standards.				
	Freshwater ecology	Degradation of surface water quality	B-					
		Threat to abundance, frequency and distribution of species	C-					
AIR								
Climate change	Meteorology/ climatology	Restrictions/ disruption of railway operation due to soil erosion/ landslides/ flooding.	A-	• Regular inspection and preventive maintenance of railway structures and facilities to ensure optimum working condition; • When necessary, install improvement of railway system to make it more resilient to temperature and rainfall increase;	Implement: • Operator Monitor • PMO • LGUs	Included in the operation and maintenance cost: • PhP 1,500 per man-hour	EGF/ Contract Agreement	From 3rd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
		Slower drainage, soil erosion, disruption in construction by increased rainfall	B-	• Planting of vegetation as much as possible in open areas at the SCRP Depot, around the stations and along the railway track; • Implementation of an Emergency Response Plan.				
		Overheating of construction equipment and vehicles and track buckling and signalling problems	C-					
Operation of trains, SCRP Depot, passenger facilities (stations), service vehicles, etc.	Meteorology/ climatology	Reduction of Greenhouse Gases	B+	• Provide incentives and information dissemination activities to encourage commuters to use rail transit and its benefits over other modes of transport (Modal Shift). • Plant and manage vegetation as much as possible in open areas at the SCRP Depot, around the stations and along the railway track. • Conduct energy/water conservation program such as use energy efficient products (i.e. LED lights) and monitor carbon footprint monitoring. • Conduct regular inspection and proper maintenance of railway systems and facilities, and equipment and machinery.	Implement: • Operator Monitor • PMO • LGUs	Included in the operation and maintenance cost: • IEC: PhP 50,000 per activity per LGU • PhP 1,500 per man-hour	Contract Agreement	From 3rd Quarter of 2023
	Air Quality	• Degradation of air quality in the vicinity of the station and in the	C-	• Select appropriate operation and maintenance equipment that are fuel efficient to reduce emission. • Conduct regular inspection and maintenance of heavy equipment, machineries, service vehicles and facilities such as generator etc. to meet the DENR emission standards. • Regular cleaning and clearing of road from spoils and debris and wetting of ground in the periphery of the SCRP Depot when necessary.	Implement: • Operator Monitor • PMO • LGUs	Included in the operation and maintenance cost: • PhP 1,500 per man-hour • RA 6969: PhP 100,000 per year	EGF/ Contract Agreement	From 3rd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
		• SCRP Depot area • Increase in vehicle exhaust emission and entrained dust due to increased movement of people		• Comply with environmental permitting requirements for the storage, transport, handling, and treatment of hazardous material/ wastes and contaminated soil in accordance with RA 6969 at SCRP Depot area, and provide appropriate PPE for the concerned personnel. • Control service vehicle movement by maintaining the speed limit to <10kph within the construction site. Minimize vehicle transport by maximising the use of site generated materials. • Monitor air quality at the identified sampling stations		• PhP 8,000 per personnel for PPE • PhP 25,000 per ambient air station		
NOISE								
Operation of trains, SCRP Depot, passenger facilities (stations), service vehicles, etc.	Noise	Reduction of noise due to decrease in traffic volumes	B+	• Provide incentives and conduct information dissemination activities to encourage commuters to use rail transit over other modes of transport.	Implement: • Operator Monitor • PMO • LGUs	Included in the operation and maintenance cost: • PhP 1,500 per man-hour • PhP 30,000 per m² noise barrier • PhP 25,000 per noise monitoring station	Contract Agreement	
		Increase in ambient noise level	C-	• Optimize the number of train operation at night time to reduce generated noise. • Provision of effective height of noise barriers on each side of the track especially on areas with sensitive receptors such as school, hospital, residential area, including but not necessarily limited to: provide continuous 1 m high concrete wall throughout alignment except 887m length in 3 sections all in Makati City i.e. from chainage 10+464 to 10+743, north bound; from chainage 12+557 to 12+970, north bound; and from chainage 13+093 to 13+288, south bound. A composite noise protection wall with a vertical element of 3.0 m, and on top two elements of 0.25 m and slope of 45 degree is provided at these three locations. • Provision of noise control device such as muffler to all stationary sources (i.e. generator set).			EGF/ Contract Agreement	From 3rd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
				• Install traffic signs in the areas before and after passing all stations, e.g. directional signs, speed limit signs, no blowing of horn signs, etc. • Inspect the strength and efficiency of sound absorbing materials installed at the routes or areas under the stations at least once a month. Change the material in case these are damaged or their efficiency has decreased by more than 40%. • Regular inspection and proper maintenance of trains and tracks to ensure its optimal operation and functionality. • Monitor noise levels including identified nearby sensitive receptors such as ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the noise reduction measures provided.				
VIBRATION								
Operation of trains, SCRP Depot, passenger facilities (stations), service vehicles, etc.	Ground vibration	Increase in ground vibration level	C-	• Undertake regular inspection, proper maintenance and reconditioning of trains and tracks such as rail grinding, slip-slide detectors and maintenance or replacement of suspension system, brakes and wheels • Monitor vibration levels including identified nearby sensitive receptors, old PNR structures, historical heritages such as ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the vibration reduction measures provided. Monitor actions on complaints, if any, and attend to unresolved cases based on Grievance Redress Mechanism. • The strength and efficiency of rail pads at the train stations or hubs must be inspected at least once or twice a month. In case of damage or decrease in efficiency of the pads by more than 40%, these should be replaced.	Implement: • Operator Monitor • PMO • LGUs	Included in the operation and maintenance cost: • PhP 1,500 per man-hour • PhP 80,000 per vibration monitoring station	EGF/ Contract Agreement	From 3rd Quarter of 2023
PEOPLE								
Hiring of workers	Local economy	• Generation of local benefits	C+	• Coordinate closely with the host LGUs, specifically at the barangay level regarding the hiring of regular workers to ensure that the workers being considered	Implement: • Operator	Included in the maintenance cost	Contract Agreement	From 3rd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
		• Busness • opportun ities		are legitimate residents in the area in consideration to gender equality.	Monitor • PMO • LGUs	• PhP 1,500 per man-hour		
Operation of train	In-migration	Influx of ISFs	C-	• Install fencing and provide guards to prevent the settlement of ISFs along the ROW	Implement: • Operator Monitor: • PMO • LGUs	Included in the maintenance cost	Contract agreement	From 3rd Quarter of 2023
	Physical/ cultural resource	Conservation of old PNR structure and parks and other culturally signigicant structures	C+	• Continuous conservation activities of old PNR structures in coordination with PNR and LGUs. • PMO	Implement: • Operator Monitor • PMO • LGUs	Included in the budget of proponent	DOTr Budget	From 3rd Quarter of 2023
• Operation of train and station • Maintenance work at SCRP Depot	Public health and safety	Increased risk of accidents	B-	• Provide security guards in all stations to direct passengers on the safe zone. • Installation of security cameras at strategic places and instituting visible police presence. • Provision of safety signage and warnings, adequate security force and safety units, security cameras and anti-derailing rail or guard for the udergrounding interconnecting line.	Implement: • Operator Monitor • PMO • LGUs	Included in the health and safety and environmental management plan of proponent budget: • PhP 1,500 per man-hour • Occupational Health and Safety Management Plan: PhP 300,000	Contract Agreement/ Operation Cost	From 3rd Quarter of 2023
	Occupational health and safety	Increased risk of accidents and infectious disease of employee	B-	• Implement the Occupational Health and Safety Management Plan. • Provide appropriate PPE to all personnel undertaking maintenance work. • Implement the Emergency Response Plan • Provide sanitary facilities or utilities in all stations and the SCRP Depot. • Prepare and implement Emergency Response/Evaluation Plan for underground interconnection section in line with NFPA 130				From 3rd Quarter of 2023
Public Involvement	Public consultation	Immediate response to address adverse impacts	B+	• Regular consultations with affected people and relevant offices/agencies will be conducted by the DOTr during the operations phase to ensure adequate and timely mitigation of Project adverse environmental impacts.	Implement: • Operator • PMO Monitor: • MMT/ TPA	Included in the operation and maintenance cost	EGF/ Contract Agreement	From 3rd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
		during train operation			• LGUs			
Train Operation	Traffic conditions	Traffic congestion may occur in the areas adjacent to the proposed stations due to pick-up and drop off of passengers by transport vehicles	B-	• Establish a traffic management committee, which will be composed of the Traffic Management of LGUs, Planning Office, PNR, DPWH, and DOTr to plan and implement TOD in consideration to the loading and unloading area and the circulation of the traffic as well as the integration of transport facility within the station. • Traffic signaling on railway stations must be carefully studied and optimized to minimize delays at intersections and improve safety of pedestrians and vehicles. • Plan for the seamless connection of SCRP stations to feeder modes to minimize road friction created by feeder modes	Implement: • Operator Monitor: • PMO • LGUs	Included in the operation and maintenance cost • PhP 1,500 per man-hour	EGF/ Contract agreement	From 3rd Quarter of 2023
Generation of solid waste from office and service areas	Community **and workers'** health and safety	Indiscriminat e waste disposal may pose risks to the health and safety of the surrounding communities	B-	• Provide solid waste segregation bins at each office area and at train stations. • Coordinate with the concerned LGUs in the collection and disposal of segregated solid wastes. • Maintain daily record of solid wastes generated and collected.	Implement: • Operator Monitor: • PMO • LGUs	Included in the operation and maintenance cost • PhP 1,500 per man-hour	EGF/ Contract agreement	From 3rd Quarter of 2023
Generation of hazardous waste from maintenance area at SCRP Depot and related facilities	Community **and workers'** health and safety	Indiscriminat e disposal of toxic and hazardous wastes may pose risks on the health and safety of surrounding communities	B-	• Provide hazardous waste bins at the stabling yard. • Record quantities of hazardous wastes generated. • Commission the services of a Government-recognized hazardous waste transporter and treater.	Implement: • Operator Monitor • PMO • LGUs	Included in the operation and maintenance cost • PhP 1,500 per man-hour	EGF/ Contract agreement	From 3rd Quarter of 2023
Railway operation	Community/ public and **workers'**	Risk of accidents from railway operation	B-	• Prepare the train safety operations plan before operation of the Project, in compliance with NFPA130 standards	Implement: • Operator Monitor • PMO	Included in the operation and maintenance cost	EGF/ Contract agreement	From 3rd Quarter of 2023

Environmental Aspect	Environ-mental Compo-nent	Potential Impact	Level of Signifi-cance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Indicative Imple-mentation Schedule*
	health and safety	and maintenance		• Train workers and staff on implementation of the operations • Prepare and implement Emergency Response/Evaluation Plan for underground interconnection section in compliance with NFPA 130 • Conduct drills on emergency situations at least once a year through professional experts • Conduct internal safety audits at least every six months. • Conduct full audit of the fire protection system every month and conduct daily random checks • Implement the grievance redress mechanism (complaints management system) with complaint desks at all stations	• LGUs	• PhP 1,500 per man-hour		

- Note:
- Conduct drills on emergency situations at least once a year through professional experts
- Conduct internal safety audits at least every six months.
- Conduct full audit of the fire protection system every month and conduct daily random checks
- Implement the grievance redress mechanism (complaints management system) with complaint desks at all stations

A+/-: Significant positive/negative impact is expected
B+/-: Moderate positive/negative impact is expected to some extent
C+/-: Minor/Negligible positive/negative impact is expected to some extent
D+/-: Extent of impact is unknown

- *The actual implementation schedule of some of the activities will be dependent on the onboarding date of the contractors

5. ENVIRONMENTAL RISK MANAGEMENT

5.1. OBJECTIVES

1876. The Environmental Risk Assessment (ERA) has been prepared under the framework set forth in the Philippine Environmental Impact Statement System (PEISS) to identify the risks to the environment, as well as health and safety risks associated with project activities. The ERA aims to determine the environmental and human health risk posed by the project and to develop mitigation measures of the risks identified. It aims to provide information for making informed decisions and mechanisms to communicate forecasted risks such that stakeholders and the public are informed of the implications of identified risks.

5.2. METHODOLOGY

1877. The risk assessments for the SCRP main line (elevated and at grade) and interconnecting line (Senate-FTI-Bicutan segment) were done separately. The assessment for the SCRP main line was prepared by the Geosphere while AECOM prepared the assessment for the SCRP interconnecting line.

1878. Based on Annex 2-7e of the Revised Procedural Manual (RPM) of DAO No. 2003-30 or the Procedural Guidelines for Scoping of ERA, the level of assessment required for a project will be based on the quantity of hazardous substances or hazardous wastes produced or stored by a project. Three levels of coverage and scoping requirements are stipulated in Procedural Guidelines for Scoping of ERA and are listed below.

- **Level 2** – Required to prepare a Quantitative Risk Assessment (QRA) and an Emergency/Contingency Plan;
- **Level 1** – Required to prepare an Emergency/Contingency Plan only; and
- **Risk Screening Level** – Required to conduct a risk screening study.

1879. Based on assessment, the level of hazardous materials that will be used or stored at the project is not expected to exceed Level 1 threshold; hence only risk screening or qualitative risk assessment is required to be conducted.

5.2.1. Terminologies Used

1880. For the purpose of levelling off, **Table 5.2.1** defines the different terms used in this section.

Table 5.2.1 Terminology for the Environmental Risk Assessment

Term	Definition
Hazard	A hazard is a physical situation with a potential for human injury, damage to the environment or property, or a combination of these. It is the potential for an agent or process to cause harm.
Risk	Risk is the possibility that a harmful event (death, injury or loss) arising from exposure to a chemical or physical agent may occur under specific conditions; or alternatively, the expected frequency of occurrence of a harmful event (death, injury or loss) arising from exposure to a chemical or physical agent under specific conditions (WHO/IPCS, 2004).
Hazard Identification	Hazard identification is the determination of all possible events or processes that could lead to disastrous or fatal incidents, defining inherent and potential hazards of the substances/materials used, as well as the process hazards with potential to adversely affect project personnel, the public and the environment.
Risk Assessment	Risk assessment is the identification and quantification of the risk resulting from a specific use or occurrence of a chemical or physical agent, considering possible harmful effects on individual people or society of using the chemical or physical agent in the amount and manner proposed and all the possible routes of exposure. Quantification ideally requires the establishment of dose-effect and dose-response relationships in likely target individuals and populations (WHO/IPCS, 2004).
Risk Estimation	Risk estimation is the determination of the outcome of an activity taking into account the

Term	Definition
	probability of occurrence. To obtain risk, the product function of the frequency and consequence analyses must be determined.
Risk Management	Risk management is the logical and systematic method of identifying, analyzing, assessing, mitigating, monitoring and communicating risks associated with any activity, function or process in a manner that would enable the proponent to minimize losses and maximize opportunities.

5.2.2. Conceptual Framework

1881. Risk assessment is the scientific determination of the levels of risk related to situations and recognized threats inherent to a project, with the ultimate objective of proposing management solutions to bring risk exposure to acceptable and manageable levels. It involves three basic steps:

- Identification of hazards such as substances, activities, processes and natural phenomena that may cause harm or deterioration of safety;
- Evaluation of the incidence and severity of the hazards, and their possible consequences to the environment;
- Determination of appropriate measures to eliminate or control the hazards.

1882. A conceptual flow diagram for ERA is shown in Figure 5.2.1 Conceptual flow diagram for qualitative risk assessment.

Figure 5.2.1 Conceptual flow diagram for qualitative risk assessment

1883. The risk analyses and assessments can be done using either a qualitative or quantitative approach. Quantitative risk assessment uses all available data to calculate and predict the probability and hence, acceptability of outcomes of a risk event. On the other hand, qualitative risk assessment utilizes subjective assessment of a likelihood of the risks to occur against the potential severity of the risk outcomes to determine the overall severity of the risks. As identified above, only risk screening or qualitative risk assessment was conducted for the project.

5.2.3. Qualitative Risk Assessment Approach

1884. Descriptive assessments and systematic characterization form the basis of the qualitative assessment. This is best applied to accidents or events with little or no data pertaining to frequencies of occurrence or ecosystem and health impacts. There are limited data available for the Philippines that can be used for statistical analysis

1885. The assessment method used is generally defined as an engineering reliability method known as Failure Modes and Effects Analysis (FMEA). This approach is a systematic characterization and evaluation of sources of risks to the environment. It can be considered as a qualitative approach based on expert opinions. The primary objective of this approach is to identify the risks, prioritize those risks, identify risk tradeoffs, and identify means and methods to reduce the risks. Four questions must generally be answered to fully satisfy the process:

- What can go wrong?
- What is the range of severity of the adverse consequences?
- How likely are those adverse consequences to occur?
- What can be done to reduce risks that are unacceptable?

1886. The assessment is conducted through following steps:

- Hazard identification: Identification of materials to be stored and used within the site
- Environmental Pathway Identification: Cataloguing pathways and migration routes for transport of chemical or biological agents, and the spread of physical stressors
- Accident Scenario: Identification of scenario that allow the introduction of materials to the environment, focusing on the scenarios of "what can go wrong" that have the potential to adversely affect the environment and human health so that the full range of potential consequences must be considered at this stage
- Risk Characterization and Assessment: Estimation of the incidence and severity of the effects likelihood to occur in an environmental compartment due to actual or predicted exposure to a hazard

5.2.3.1. Likelihood and Consequence Rating

1887. The identified hazards will be assessed in terms of the relationship between the level of likelihood to exposure and the severity of effect/consequence of losses to the people, financial, public and environment. Ratings or categories of likelihood and consequences of various events are presented in **Table 5.2.2** while the relationship of exposure and severity of effects are shown in **Table 5.2.3**.

Table 5.2.2 Likelihood Categories for Risk Assessment

Subjective Category	Likelihood Occurrence	Likelihood Occurrence
Negligible	<10-6	Less than 1:1,000,000
Very low	10-6 to 10-4	1:1,000,000 to 1:10,000
Low	10-4 to 10-2	1:10,000 to 1:100
Moderate	10-2 to 10-1	1:100 to 1:10
Significant	>10-1	Greater than 1:10

Source: JICA Study Team

Table 5.2.3 Environmental and Health Consequence Categories for Risk Assessment

Subjective Category	Environmental and Health Consequences
Safe	Negligible effect on environment and human health
Marginal	Failure will cause some environmental degradation but no major or long term damage. Minor injury or illness.
Moderate	Failure will cause significant environmental degradation but no long term damage. Major injury or illness.
Critical	Failure will degrade environment, and if not mitigated will cause significant and permanent damage. Permanent disability.
Severe	Failure will cause major and irrevocable environmental damage. Fatalities

Source: JICA Study Team

1888. Using the risk matrix shown in **Table 5.2.4**, the risks posed by the identified hazards for the project will be assessed qualitatively and will be classified as either Minor, Low, Moderate, High, or Extreme.

Table 5.2.4 Risk Matrix for SCRP interconnecting line

		IMPACT				
		Negligible	Minor	Moderate	Significant	Severe
PROBABILITY	Very low	Minor Risk	Minor Risk	Low Risk	Moderate Risk	High Risk
	Low	Minor Risk	Low Risk	Low Risk	Moderate Risk	High Risk
	Medium	Minor Risk	Low Risk	Moderate Risk	High Risk	High Risk
	High	Minor Risk	Low Risk	Moderate Risk	High Risk	Extreme Risk
	Very High	Low Risk	Moderate Risk	High Risk	Extreme Risk	Extreme Risk

5.3. HAZARD IDENTIFICATION

5.3.1. Hazard Identification for SCRP main line (Solis-Calamba)

1889. Hazards associated with SCRP main railway line during construction and operation phases were identified under the 11 categories below. It should be noted that hazards caused by noise and vibration are not included in this section as these are already discussed in the previous sections. Hazards identified below are focused more on the health and safety impacts to the people.

- Rail system failure
- Structural failure
- Construction related accidents
- Exposure to the toxic chemicals / hazardous substances at contaminated site during construction and operation
- A breach or release of toxic chemicals / hazardous substances at maintenance depot
- A breach or release of toxic chemicals / hazardous substances during transport
- Fire
- Natural Disasters (Earthquake, Flood etc.)
- Terrorism attacks
- Security and violent incidents
- Transmission of infectious diseases

1890. Additional information relative to the specific hazards and risks associated with those hazards is presented below:

5.3.1.1. Railway System Failure

1891. This includes failure of rail equipment particularly rail track, signaling/ communication systems and rolling stock. Failure of these devices due to natural hazards (flood, earthquake, volcanic eruption and the like), natural wear and tear of rail parts, terrorist attacks or other forms of accidents may result to derailment.

5.3.1.2. Structural Failure

1892. Structural failure as a hazard is related to buildings at the Depot and stations as well as all infrastructures where the rail tracks are laid. Failure of these structures due to natural or man-made hazards may result to damage of property and/or loss of human life.

1893. DOTr and the Contractor will comply with the necessary codes and standards (i.e. the Philippine National Structural Code and National Building Code) in order to obtain the required permits. This will serve as an assurance that the facilities are structurally sound.

5.3.1.3. Exposure to the Toxic Chemicals / Hazardous Substances at Previous Contaminated Site

1894. In case contaminated sites exist in the project area, exposure to the toxic substance may occur during the detoxification process, excavation of the site during the construction, and to the neighboring communities. DOTr and the Contractor will ensure that site remediation and/or clean-up, if appropriate, follows national government regulations and procedures on health, safety and environment.

5.3.1.4. A Breach or Release of Toxic Chemicals / Hazardous Substances at Maintenance Depot

1895. The chemicals used for maintenance activities at depot are not harmful when handled properly. However, if accidental spills during their usage or a breach in containment unit occur, these chemicals may cause hazard to air and surface water. Even on storage, breach in containment unit may accidentally happen allowing the chemicals to diffuse into the air or be spilled on soil and surface/ groundwater.

1896. The fuel/ chemical containers will be properly designed to ensure its safety and durability during storage. Personnel will be assigned at the depot will be trained on occupational safety and health standards to ensure safety during handling of chemicals and other hazardous substances for maintenance activities.

5.3.1.5. A Breach or Release of Toxic Chemicals / Hazardous Substances during Transport

1897. This can be due to accidental spills or breach in containment unit of toxic chemicals and hazardous substances while in transport.

1898. Freight service will be introduced into the rail system or when the system has been developed to warrant the introduction of this service. However, since this Project is a transportation facility, some passengers may opt to carry with them “dangerous” goods that they need to transport. These goods may be accidentally spilled or released from its containers during transport and may cause fire, damage to property and / or loss of human life.

1899. The design of rail facilities to handle storage of toxic chemicals / hazardous substances during freight service will be in accordance with applicable local and international codes and standards. Inspection of containment units of toxic chemicals / hazardous substances for transport will be handled by qualified DOTr personnel and/or the railway operator.

5.3.1.6. Fire

1900. Fire may occur due to excessive heat, failure of equipment and other accidents. Fire may result to damage of property and/or loss of human life.

1901. DOTr will comply with the Bureau of Fire Protection requirements as part of its application for building permits. Firefighting equipment (fire hydrants, fire extinguishers) will be placed at strategic locations within the project site. The emergency response plans will ensure timely and proper response to emergency situations caused by fire.

5.3.1.7. Natural Disaster (Earthquake, Flood, Landslides, Cyclones, etc.)

1902. Some part of project area is prone to the natural disaster such as flood and earthquake. The railway structures are designed taking into account those events; however, there might be extreme cases beyond prediction which will cause damage to railway facilities and system, human injuries and accidents.

1903. The DOTr/ Contractor will ensure adequate coordination with Disaster and Risk Reduction Management agencies, (Philippine National Red Cross, etc.) on appropriate protocols to address such incidents including the response mechanism.

5.3.1.8. Terrorism Attack

1904. Terrorism attacks are prevalent in mass transport systems these days. Tight security measures (including coordination with law enforcement agencies) will be implemented during construction and operation phases to avoid occurrence of this risk.

5.3.1.9. Security and Violent Incidents

1905. The structural environment of railway systems may present opportunities for security incidents, crime and violence to occur. These include numerous unobserved niches and empty spaces, poorly lit stations, constricted platforms and crowded facilities.

5.3.1.10. Transmission of Infectious Diseases

1906. Transmission of infectious diseases through close person-to-person contact or indirect contact is a potential health hazard specially in confined spaces. Rodents may also be a problem in underground sections/stations. Hence, it is important to consider diseases that maybe spread by these rodents and their health awareness measures.

5.3.1.11. Construction Related Accident

1907. During construction, all personnel assigned at the Project site may be subject to accidents if Health and Safety Management Plans are not properly carried out. Similar to other construction activities, risk may occur due to construction related accidents such as: (1) Collapse of scaffolding; (2) Falling of construction materials while being lifted by a crane boom; (3) Fire or electrocution from welding and use of other electrical equipment; (4) Personnel being run over by heavy equipment; (5) Accidental fall of workers while in elevated location; and (6) Injury from construction debris and materials.

1908. Health and safety management plans required for the Works will be set up by the Contractor. As a matter of policy, Occupational Safety and Health regulations should be followed by all personnel.

5.3.2. Hazard Identification for SCRP Interconnecting Line (Senate-FTI-Bicutan Segment)

1909. Hazards associated with SCRP interconnecting line during construction and operation phases were identified under the 12 categories below.

- Natural disasters including earthquakes/ground shaking, liquefaction, flooding, and volcanic events
- Tunnel deformation and collapse
- Groundwater ingress
- Chemical and process hazards
- Fire
- Train derailment
- Structural failure
- Security threats such as terrorism attacks or bomb threats
- Exposure to toxic chemicals or hazardous substances at previous contaminated site
- Underground utility strikes
- Unexploded ordnance (UXOs)
- Occupational hazards during construction including confined space, mechanical, electrical, pressure, temperature, illumination, biological, noise, gravity, and motion hazards

1910. Additional information relative to the specific hazards and risks associated with those hazards is presented below.

5.3.2.1. Natural Disasters

1) Earthquakes and Ground Shaking

1911. Ground shaking is the hazard most commonly associated with seismic events. The vertical and horizontal movement of the ground following a seismic event is a manifestation of the propagation of waves emanating from the epicenter. The heaving and lurching of the ground causes foundations and structures to shift and settle from a previously static state. Buildings can lean or tip over. Foundations can subside or be thrust upward. The ground can liquefy or rupture. Ground shaking itself can be a trigger for these other hazards.

1912. A study conducted by Thenhaus, Hanson, and Algermissen of the United States of Geological Survey and the Philippine Institute of Volcanology and Seismology (1995) estimated peak ground horizontal accelerations (PGA) for rock conditions, medium soil, and soft soil conditions in the Philippines. The PGA values have a 10% probability of exceedance in 50 years.

1913. The SCRP interconnecting line underlain by weathered pyroclastic deposits fall under the medium soil category and have a PGA value of 0.4 *g*.

1914. The interconnecting line shall be designed to take into consideration the earthquake effect and in accordance with “Design Standards for Railway Structures and Commentary (Seismic Design)” and “Technical Regulatory Standards on Japanese Railways”. Moreover, emergency procedures shall be implemented and appropriate measures such as temporary suspension of operations shall be taken to prevent any dangers.

2) Liquefaction

1915. Under static conditions, the water pressure of saturated soils—soils in which the space between individual particles is filled with water—is relatively low, so that the individual grains that comprise the soil rest on the framework of the grain contacts (Pacific Northwest Seismic Network, 2019). The soil is solid and can support structures above it. When rapid loading occurs, such as during earthquake shaking, the pore water pressure in the saturated substrates builds up and the effective stress of grains may be exceeded, resulting in the grains becoming buoyant and floating in water. At this point, the soil completely loses its strength and begins to act like a liquid. The bearing strength of the soil is drastically reduced, and it can no longer support the same amount of weight as it did when it is a solid (BRANZ, 2019).

1916. The SCRP interconnecting line is located within areas underlain by Recent Deposits where groundwater is shallow with groundwater table ranging between 5 m to 15 m below ground surface and are potentially susceptible to liquefaction in the occurrence of a major earthquake. Ongoing geotechnical testing may yield properties indicative of liquefiable soils, in which case, additional liquefaction tests are recommended.

1917. Tunneling shield method shall be implemented for the Senate-FTI underground section to mitigate potential liquefaction hazards and ensure safety during construction phase. The shield tunnel shall be in accordance with “Design Standards for Railway Structures and Commentary (Shield Tunnel)”.

3) Heavy Rainfall and Flooding

1918. Intense precipitation brought forth by monsoons and tropical cyclones often bring other destructive events like flooding and storm surges which could affect project operations, facilities, staff and the surrounding community.

1919. The total monthly rainfall at the PAGASA synoptic weather station in NAIA Terminal 3 which is 970 m from the Senate station ranges from 4 mm (March) to 418.4 mm (August). The total annual rainfall amounts into 1,767.90 mm with an annual number of rainy days of 105

days or approximately 29% of the year. The highest daily rainfall recorded at the NAIA Terminal 3 was 472.4 mm on July 20, 1972.

1920. Flooding is one of the costliest natural disasters in the Philippines, causing displacement of people, and partial to complete damage to structures and properties. Aside from inundation by high water, flooding can also bring about torrential flows that collide with objects, erode riverbeds and riverbanks, and deposit large amounts of debris. It is common in low-lying floodplains or along river channels following intense precipitation brought by typhoon or monsoon rains.

1921. Metropolitan Manila falls under the Type I Climate based on the Modified Coronas Classification, having two pronounced seasons, dry from November to April, and wet during the rest of the year, with maximum rains falling from June to September. An average of two storms pass through the general area of Metropolitan Manila every year. In the Science Garden station, the mean annual rainfall from 1981 to 2010 is 2,574.4 mm (PAGASA & Geoscience Australia). Climatological normals for Metropolitan Manila indicate a peak rainfall period from June to August, with 1170.2 mm of rain (PAGASA, 2018). Historical records of climatological extremes of rainfall from 1961 to 2010 from the Science Garden station show that the greatest rainfall in Metropolitan Manila occurred on August 6-8, 2012 during the onslaught of monsoon rains enhanced by Typhoon Haikui (locally dubbed Habagat 2012), with a measured accumulated rainfall of 1007.4 mm (Rappler.com, 2013).

1922. Based on the UP NOAH (2019) data, the areas within the Senate Station have a medium-high flood susceptibility rating while the areas within FTI to Bicutan Stations have a low-medium susceptibility rating under a 100-year flood event.

1923. To mitigate the risks associated with heavy rainfall and flooding, the Senate-FTI underground section shall be equipped with flood control system which may include flood doors and automated or remote-operated pumping and dewatering systems designed to prevent inundation. The tunnel shall be designed to prevent flotation in case of water inrush due to heavy rainfalls. Tunnel design as well as the flood control system shall be in accordance with “Design Standards for Railway Structures and Commentary (Urban Mountain Tunnel)”.

4) Volcanic Hazards

1924. Volcanic processes prior, during, and succeeding eruptions give rise to numerous volcanic hazards that can have different types and magnitudes of impacts on people and property. Commonly known volcanic hazards such as lava flows, pyroclastic flows, lahars, ground rumbling, ashfalls and volcanic landslides typically affect areas immediately surrounding active volcanoes where these originate. In some instances, the effects of a volcanic eruption may reach great distances, especially if the eruption is powerfully explosive, and physical conditions are optimal. Volcanic quakes are just like tectonically-caused earthquakes that could cause destruction of structures resulting from strong ground movement and instability. Ashfalls, especially when mixed with water, can cause structural failure due to excess loading.

1925. The nearest active volcano from the Project is Taal Volcano. Recent depositions of eruptive products by active volcanoes have been recorded in Metropolitan Manila, such as those from the 2020 eruption of Taal Volcano and the 1991 eruption of Mt. Pinatubo.

1926. Metropolitan Manila had also been affected by strong ground shaking resulting from the explosive eruption of active volcanoes. Taal Volcano, with its frequent Plinian activity, has been known to occasionally cause strong ground shaking in Manila, such as during its 1716, 1749 and 1754 eruptions that shook the city and caused significant damage to property (Masó, 1910). There is a high probability that future eruptions of Taal Volcano may similarly affect Metropolitan Manila.

5.3.2.2. Tunnel Deformation and Collapse

1927. The greatest impact of tunneling is the creation of a void that would greatly alter the distribution of underground pressure. The loss of voluminous amounts of rock and soil material would greatly reduce the bearing capacity of the rock and soil material that would be left to shoulder additional stresses. Although initial drilling information reveals the occurrence of competent rock through which the tunnel will run, the volcanic deposits underlying Metropolitan Manila are not homogeneous—structural deformities such as joints, bedding planes, crushed and fracture zones were identified in borehole scanning surveys performed along the proposed alignment. As such, the bearing capacities of the sandstone that the tunnel will bore through, greatly differ. When a rock unit is adjusting to the underground pressures acted upon it, tunnel deformation can occur, resulting in misaligned tracks or uneven tunnel walls. In extreme cases, total failure can occur when the pressure limits are crossed, leading to total collapse of the tunnel walls.

1928. Temporary and permanent ground support shall be specified in the tunnel design. Structural design of tunnel ground support shall take into consideration geotechnical data, including soil and rock mechanics, and seismic data. Engineering control measures such as shoring support structures shall be designed in accordance with “Design Standards for Railway Structures and Commentary (Urban Mountain Tunnel)” and “Technical Regulatory Standards on Japanese Railways”. Supplementary assessments of ground conditions by geologists and engineers during actual excavation may provide additional relevant information to ensure that tunnel and ground support are designed appropriately. Moreover, emergency procedures and rescue protocols should be in place in case of tunnel collapse both during construction and operation phase.

5.3.2.3. Groundwater Ingress

1929. The Senate-FTI underground section will be at approximately 26 m depth to avoid disruption and disturbance of surface activities and structures. Initial borehole results indicate the presence of groundwater at depths ranging from 5 m to 15 m from the surface. Groundwater is found in the interstices between individual grains of sandstone. It can also accumulate and pass through planes of structural deformities, such as beds, joints and fractures. As the TBM burrows through the substrate, groundwater is expected to seep through the tunnel wall and into the created void, especially if the water table is above the level of the track tunnel. When water buried beneath tons of overlying mass experiences high pressure, the sudden lowering of pressure caused by tunneling can result in forceful entry of water into the void. If not managed properly, this can lead to underground flooding and possibly, tunnel collapse.

1930. During construction phase, tunneling shield designed in accordance with “Design Standards for Railway Structures and Commentary (Shield Tunnel)” shall be implemented to prevent groundwater ingress. Moreover, a quality assurance program shall ensure proper lining and annulus void filling or grouting during tunneling process.

1931. To mitigate groundwater ingress during operation phase, the tunnel wall shall be properly lined with waterproofing material. A monitoring, inspection, and maintenance program shall ensure the integrity of the tunnel during operations. Moreover, an emergency response procedure should be in place to activate measures in case groundwater ingress occurs.

5.3.2.4. Chemical and Process Hazards / Industrial Hazards

1932. The identification of chemical hazards associated with the SCRP interconnecting line is based on the physicochemical properties of the hazardous chemicals, substances and wastes that will be stored, handled, or generated during the operation of the project. Since the construction and operation of all the stations and tunnel alignment will essentially be similar to

each other the expected chemicals stored and hazardous wastes generated are lumped and are shown in **Table 5.3.1**.

Table 5.3.1 List of Chemicals Used and/or Wastes to be Generated

Chemical	Category	Storage	Generator	Method of disposal
Waste Oil	Flammable/ Toxic, Low	Steel drums	Operation and Maintenance	Hazardous Waste Treater
Oil Contaminated Debris	Flammable/ Toxic, Low	Steel drums	Operation and Maintenance	Hazardous Waste Treater
Oil Contaminated Water	Flammable/ Toxic, Low	Steel drums	Operation and Maintenance	Hazardous Waste Treater

1933. During the tunneling process, a clay and water mixture is pumped to the TBM cutterhead where it helps maintain hydrostatic pressure. Bentonite and other types clay material, carboxymethyl cellulose and dispersants will be stockpiled during the tunneling process. Carboxymethyl cellulose is a chemical generally recognized as safe (GRAS) by the United States Food and Drug Administration (US FDA). Also, the other identified substances are not considered hazardous. As the slurry/soil mixture returns from the cutterhead, it goes to the treatment plant where the muck is dewatered. The muck removal, storage and treatment facilities and its transport route can be found in Chapter 1.4.2 of the Project Description. The recovered water is recycled back into the slurry circuit of the TBM and the wastewater is treated prior to disposal.

(1) Flammable Substances

1934. Flammables substances are chemicals having a flashpoint of less than or equal to 55˚C (DAO 2003 - 30). Flammable liquids are categorized into three classes in DAO 2003-30: (1) flammable, (2) highly flammable and (3) extremely flammable. The flammability of a liquid can be determined flash point using either the closed-cup or open-cup method. The criterion for degree of flammability that is used to categorize flammable substances is in Annex 2.7e of DAO 2003-30.

1935. To maintain train services during power outages and/or emergencies, the stations will be equipped with generator sets. These generators will likely run on diesel and are expected to have ample diesel storage to operate the station for an extended amount of time (i.e., 12 hrs. or 24 hrs.). No estimates yet are available on the volume of fuel to be stored at the stations.

(2) Toxic / Hazardous Substances

1936. A waste may be considered hazardous if it exhibits certain hazardous properties such as ignitability, reactivity, corrosivity and toxicity (EPA, 2009). These may be toxic chemicals used by a project or toxic wastes generated by the project. Toxic substances are divided into five classifications based on the level of its toxicity in DAO 2003-30: (1) low toxicity, (2) medium toxicity, (3) high toxicity, (4) very high toxicity and (5) extreme toxicity. Toxicity level of a substance is dictated by its chemical state, vapor pressure, boiling point and the lethal concentration 50 (LC50). The LC50 is the standard measure of the toxicity of the surrounding medium that will kill half of the sample population of a specific test-animal in a specified period through exposure via inhalation (DAO 2003-30).

1937. Toxicity is defined through a laboratory procedure called the Toxicity Characteristic Leaching Procedure (TCLP) (Method 1311). The TCLP helps identify wastes likely to leach concentrations of contaminants that may be harmful to human health or the environment (EPA, 2009).

(3) Emissions

1938. Combustion products are emitted by project's stationary and mobile sources. Combustion products like CO, NO_x, So_x and VOCs may be considered hazardous to health. During the construction phase, generator sets, and mobile equipment will be used for the Senate-FTI underground section which will likely be stationed at the TBM launching site (refer to **Chapter 1.4.2**).

5.3.2.5. Fire

1939. Fire is the physical manifestation of combustion or the chemical reaction between oxygen and a fuel source such as flammable substances and combustible materials. An ignition source or heat source is required to start a fire. Ignition sources that may be present at the project site include open flames and sparks (during construction) and faulty electrical equipment or buildup of static electricity (during operation). A potential risk for fire exists at the project site which could lead to catastrophic events involving major injuries, fatalities, and damage to properties.

1940. In case of fire events during tunnel construction, fire underground will rapidly deplete oxygen producing noxious fumes within a confined space which may reduce, or in some cases, eliminate visibility causing additional hazards. The risks of fire in tunneling works shall be eliminated or minimized to the extent practicable. All construction activities shall be compliant with the Fire Code of the Philippines, DOLE OSH Standards, and NFPA130 in relation to fire prevention and firefighting programs. At the minimum, the following considerations will be taken into account in implementing fire control measures:

- **Combustible/flammable materials and ignition sources** – Identify all fuel sources in the workplace as well as the ignition sources such as naked flames, hot work activities (welding, grinding, and cutting), electrical equipment, and smoking people.
- **Hot work procedures** – Implement permit-to-work system for hot works that may cause fire and endanger a tunnel entrance or exit to ensure that all mitigation measures in relation to fire are in place before proceeding to work. Hot work activities are expected to produce ignition source, hence should be performed away from combustible or flammable materials.
- **Firefighting equipment** – Provision of the required firefighting facilities in strategic locations not vulnerable to fire emergencies
- **Air monitoring and ventilation requirements** – Training of personnel on basic recognition of fire hazards and prevention as well as emergency response and rescue procedures.

1941. All design aspect of the SCRP interconnecting line including stations, trainways and railway tracks, ventilation systems, vehicles, communications, control systems, escalators and elevators, egress routes, and alarm systems shall adhere to the relevant international design standards such as NFPA130, Japan Fire Prevention Standards for Underground Stations, Technical Regulatory Standards on Japanese Railways.

1942. Fire prevention and mitigation programs shall be implemented during operation phase in accordance with the Fire Code of the Philippines and NFPA130.

1943. Handling and storage of hazardous substances including flammable and combustible materials shall comply with Republic Act 6969 or the Toxic Substances and Nuclear Wastes Control Act 1990.

1944. Periodic maintenance of all electrical equipment should be carried out to ensure that these will not generate sparks that may ignite flammable gases or liquids which may come in contact with such equipment.

1945. Firefighting equipment and fire suppression system which are compliant with the abovementioned codes and standards should be available and installed within the facilities. Regular inspection and maintenance of these equipment should be conducted to ensure reliability and good working conditions.

5.3.2.6. Train Derailment

1946. Train derailment can be caused by a number of factors or events such as mechanical failure of track components or train running gears, operational errors such as improper operation of points or improper observance of signals, and collision with another object. Derailments result in temporary disruption of operations. This event can be potentially hazardous as it can also result in property damage, serious injuries to people, or even death.

1947. Protective devices, such as anti-derailing rail or anti-derailing guard, shall be installed to prevent derailment as well as to minimize any consequences of derailment in accordance with “Technical Regulatory Standards on Japanese Railways” and “Design Standards for Railway Structures and Commentary (Urban Mountain Tunnel)”. Vertical curve shall be introduced in sections where the grade changes to prevent derailing of rolling stock. A device to control the distance between trains shall be installed to reduce train speed and prevent potential train collisions.

5.3.2.7. Structural Failure

1948. Structural failure of train infrastructures including buildings, stations, and rail tracks may result to serious injuries, fatalities, or property damage.

1949. Construction of all infrastructures associated with the SCRP interconnecting line shall comply with relevant codes and standards such as Philippine National Structural Code and National Building Code. Regular inspection and appropriate maintenance shall be conducted to ensure integrity of the infrastructures.

5.3.2.8. Security Threats

1950. The structural environment of railway systems may present opportunities for security incidents to occur. Security incidents may include violence and aggression, terrorist attacks, bomb threats, and other crimes.

1951. Security policies and procedures should be implemented in order to prevent security incidents in the project. Moreover, an Emergency Preparedness and Management Plan should be established to provide detailed actions and responses to emergencies related to security threats in order to reduce the impact on human life, properties, and surrounding communities.

5.3.2.9. Exposure to the Toxic Chemicals / Hazardous Substances at Previous Contaminated Site

1952. In case contaminated sites exist in the project area, exposure to the toxic substance may occur during tunneling and excavation of the site for the construction of the Senate-FTI underground section. Potentially contaminated soils and groundwater may be generated during excavation; improper management and disposal of such materials may impact the soil, surface water, and groundwater in the disposal sites, as well as the health of the neighboring communities who may be exposed to such contaminated materials.

1953. Soil and groundwater investigation should be conducted to assess the soil and groundwater conditions in the project area prior to any excavation and tunneling activities. The assessment results will provide information for the proper management of soils that will be excavated and water that will be generated during the dewatering activities.

5.3.2.10. Underground Utility Strikes

1954. Excavation activities pose risks of striking underground utilities such as water pipelines, communication lines, electrical cables, and gas lines. Underground utility strikes are very costly and can be extremely dangerous particularly if electrical or gas lines are damaged during the excavation process.

1955. Mapping of nearby utility lines within the vicinity of the proposed SCRP interconnecting line is essential in mitigating utility strikes. This may be done using geophysical investigations using underground utility scanning technologies such as Ground Penetrating Radar (GPR). Alternatively, coordination with utility service provides can be done in order to identify any buried utility lines within the vicinity of the project site. An emergency response plan should be in place in case utility strikes occur during the course of the excavation.

5.3.2.11. Unexploded Ordnance (UXOs)

1956. As the Metro Manila was historically part of the World War II and received a number of bombs during that time, it is expected that there are still buried unexploded ordnance (UXOs) within the area that should be confirmed. There is currently no database on the locations of these UXO as there is no metro-wide scanning done.

1957. During the tunneling and excavation activities for SCRP interconnecting line, there is a possibility that the workforce will be exposed to the risk of finding and explosion of UXOs. To manage this, training and policy on the proper operational procedures (e.g., reporting to authorities including Philippine National Police) should be done to all the workforce and management in order to lessen the degree of risk in case of encountering UXOs during construction.

5.3.2.12. Occupational Hazards During Construction

1958. During construction, all personnel assigned at the project site may be subject to accidents if Health and Safety Management Plan is not properly carried out. Occupational hazards identified specific for tunneling activities include: 1) Confined space; (2) Mechanical hazards from mechanical equipment; (3) Hazards due to reduced ventilation; (4) Hazards due to reduced illumination; (5) Engulfment due to collapse of excavation which has been discussed in Section 5.3.2.2; and, (6) Fire which has been discussed in Section 5.3.2.5.

1959. Health and safety management plans required for the works will be set up by the Contractor. As a matter of policy, Occupational Safety and Health regulations should be followed by all personnel.

(1) Confined Space

1960. Confined spaces are enclosed or partially enclosed spaces that (1) is large enough that a worker can bodily enter and perform an assigned work; (2) is not designed for human occupancy; (3) have limited or restricted means for entry or exit; and, (4) have potentially hazardous atmosphere such as low oxygen level or toxic vapors.

1961. A tunnel can be considered a confined space hence construction activities within a tunnel pose great risk to workers as they may be exposed to toxic gases or oxygen deficiency leading to asphyxiation.

1962. In order to mitigate the risks associated with confined space works, all workers to be involved during construction should undergo training for recognizing and responding these hazards and risks. Site control protocols should be established and communicated to all workers. These procedures should, at the minimum, include the following:

- **Communication and notification process** – Lines of communication with employees

should be maintained during underground construction activities. These should be tested daily upon initial entry of each shift to ensure effective communications are always available and are in good working condition.

- **Permit-to-work requirements** – In order to control all confined space entry works, a permit to work system must be strictly implemented. This will prevent anyone from entering a confined space except when all the required permits have been approved and issued by an authorized person.
- **Check-in and check-out procedures** – Check-in/check-out procedures will ensure that an accurate accounting of the number of personnel working underground is maintained. This will also prevent any unauthorized entry into the working area.
- **Air monitoring and ventilation requirements** – Prior to entering the confined space, gas testing must be carried out by a competent person to ensure that the atmospheric conditions are within the safe limits for personnel. The gases that need to be monitored should include at least the following: oxygen, flammable gases such as methane, and toxic gases such as hydrogen sulfide and carbon monoxide. Mechanical ventilation may be required to supply fresh air into the work areas.
- **Emergency response plan** – A rescue plan in case of emergency should be established. Rescue team members must be trained in rescue procedures, the use and limitations of breathing apparatus, and the use of firefighting equipment.

(2) Mechanical Hazards

1963. Mechanical hazards are hazards encountered during the operation of an apparatus or tool of a mechanical nature. A multitude of hazardous mechanical hazards may be present during the project especially in the labor-intensive construction phases including manual handling of air tools, drill rods, and supports, and operating mechanical equipment such as tunnel boring machine. Direct contact between the personnel and the running equipment may result in entanglement of body parts causing injuries such as crushed hands and arms, severed fingers, lacerations, cuts, and even blindness.

1964. Effective and proper machine guarding can help reduce or even eliminate mechanical injuries. Machine guarding is a covering for the hazardous areas of a machine to prevent contact with body parts or to control projectile hazards exiting the machine. Some of the guard types that can be used are: fixed guards, interlocked guards, presence sensing device, automatic guards, adjustable guards, self-adjusting guards, distance guards and partial guard. Training of personnel regarding handling and operation of the equipment should be provided to mitigate the risks of mechanical hazards.

(3) Electrical Hazards

1965. Electrical hazards are hazards brought forth by working closely with sources of electrical power. Electrical hazards present in the underground section include power lines, generators, energized equipment, wiring and batteries. The severity of electrical injury ranges from just a faint shock to severe burns or even cardiac arrest and possibly even death. The most common electricity related injuries are burns suffered in electrical accidents which may be classified into three types: electrical burns, arc burns, and thermal contact burns. All three types of burns could possibly occur simultaneously.

1966. In electrical burns, tissue damage is caused by the heat generated by the current flow through the body. Arc or flash burns, on the other hand, are the result of high temperatures occurring near exposed tissues and are produced by an electric arc or explosion. Finally, thermal contact burns (related to temperature hazards) are those normally experienced when the skin comes in contact with hot surfaces of overheated electric conductors, conduits, or other energized equipment (OSHA, 2008).

1967. There is a multitude of method for protecting people from the hazards brought about by electricity. These include insulation, guarding, grounding, wearing electrical protective equipment and safe work practices.

(4) Pressure Hazard

1968. Pressure hazards include pipes, pressurized vessels, heated vessels, hoses, pumps, explosives and pneumatic and hydraulic equipment. Potential sources of pressure hazards in the project are pumps, pipes, slurry plant and storage vessels. These hazards can be minimized by wearing the proper personal protective equipment and employing safe work practices.

(5) Temperature Hazard

1969. Working outside in the heat especially in the summer can bring about hazards related to temperature. Personnel working in enclosed spaces with running machinery may also be vulnerable to temperature related hazards. The four environmental factors which determine heat stress are temperature, humidity, ventilation and radiant heat. In many operations, combinations of these factors may result in serious heat stress to the workers, who may be performing heavy work, and producing large amounts of body heat, thus also exacerbating the heat stress problem.

1970. Fresh air will be supplied to all underground work areas in sufficient amounts via mechanical ventilation to prevent any dangerous or harmful accumulation of dusts, fumes, mists, vapors, or gases. OSHA Part 1926, section 800 of Title 29 of the Code of Federal Regulations (OSHA 29 CFR 1926.800) requires 5.7 cubic meters of fresh air per minute to be supplied during tunneling works.

(6) Illumination Hazards

1971. Underground constructions entail reduced or limited illumination which can be both a safety hazard and a health hazard. Poor lighting can cause misjudgment while carrying out tasks leading to accidents and injuries. At the same time, poor lighting can strain eyes and may cause eye discomfort and headaches.

1972. Adequate lighting should be provided during underground construction activities. OSHA 29 CFR 1926.800 and DOLE OSH Standards require 100 lux or 10 foot candles as minimum illumination level for tunneling activities.

(7) Biological Hazards

1973. Biological hazards are hazards that arise from contact with animals, insects, plants, bacteria, viruses, etc. Trees that will removed may secrete allergenic sap or may host insects that sting or bite. Communicable diseases or sickness can be brought about by bacteria, viruses or their carriers such as certain insects, animals, ill individuals and unsanitary conditions.

1974. To mitigate such hazards, workers assigned to clearing or excavation, for example, should wear appropriate personal protective equipment. The wearing of insect or animal repellent should also help minimize such hazards. In terms of communicable diseases or sickness, the construction area should maintain good sanitary conditions to help reduce bacteria, viruses and their carriers. Workers should vacate blasting area to an appropriate distance prior to blasting. Workers who are ill should also be advised not to come to work until they are well to minimize the transmission of the contagion to healthy workers.

(8) Noise and Vibration Hazards

1975. Hazards brought about by noise or sound includes equipment noise, impact noise, vibration, high-pressure release, etc. Continuous exposure to intense noise may cause hearing loss, whether temporary or irreversible. Ear protection, such as ear plugs, should be provided to all employees who work in any situation where high noise levels may be encountered.

1976. Vibration hazards may be encountered in excavation operations during the use of hand pneumatic tools. Localized vibrations may lead to neurovascular alterations in the hands, bone alterations, including formation of cysts on some of the bones of the hand, weakness and atrophy, etc.

1977. Vibration hazards may be minimized by regular breaks and shift change.

(9) Gravity Hazards

1978. Gravity hazards are a group of hazards that occur when gravity acts upon an unstable or an unsecured object. These include trips: when a foot or leg is caught on an object or surface; slips: when grip between the foot and the ground surface is lost; and, falls: when a person moves from a higher level to a lower level without control or when an object moves from a higher level to a lower level causing injury or damage to anything it hits.

1979. The best way to control these hazards is to eliminate these hazards to prevent any injuries such as removing all tripping objects in the workplace, maintaining clean and dry ground surfaces, and working at elevated levels with the proper PPE such as fall arrest system or full body harness.

(10) Motion Hazards

1980. Motion hazards include vehicles, moving equipment, flowing water, wind, and poor work ergonomics. To avoid vehicular accidents, dedicated and well-marked crosswalks should be installed for pedestrians, vehicular speed should be reduced, traffic signs should be installed, driving should be prohibited under the influence of alcohol and other mind-altering substances, headlights should be used during the dark or during rain and workers should be required to wear reflector vests. Moving equipment should be clearly marked so that worker will know to avoid the area. The shafts and tunnels that could potentially become conduits for moving water should be installed with alarms to warn worker of approaching danger. As for work ergonomics, training for proper lifting, pulling, lifting postures and other working procedures should be implemented and reaffirmed regularly.

5.4. ENVIRONMENTAL PATHWAYS

1981. Ground can be considered as an environmental pathway when liquid substances travel through it by seepage or surface runoff.

1982. Water is one of the fastest and the most short-term pathway for potential pollutant impact. In many cases, this pathway is also a combination of surface water runoff and groundwater. The physical and chemical processes that affect migration of contaminants with both surface water and groundwater pathways are similar. Additionally, topographic and geomorphologic conditions also influence this pathway.

1983. Air can only become an environmental pathway when substances are in gaseous state. Vapors from hazardous chemicals and other substances are volatile. If these substances are released, they may diffuse into the air.

1984. To avoid deleterious effects of the various potential contaminants/pollutants on humans via the enumerated pathways all possible mitigating measures will be made available by the Proponent/Contractor.

5.5. RISK ASSESSMENT AND ANALYSIS

1985. Based on the previous discussions of hazard identification, environmental pathways and accident scenarios, FMEA was performed for the SCRP main line (Solis-Calamba) and SCRP interconnecting line (Senate-FTI-Bicutan segment). This is primarily a qualitative assessment approach but does provide a systematic characterization and evaluation of the risks. The analyses combine subjective ratings or categories of likelihood and consequences of various events

1986. As indicated in the FMEA analysis, a number of individual events would need to occur in near simultaneous fashion to result in potential occurrence of these risks. Individually, each event has a low probability of occurrence. When taken as a joint occurrence the probabilities are even lower. As such, only a catastrophic event would present a potential environmental hazard.

1987. A summary of these analyses using these categories as applied to the identified accident scenarios is presented in **Table 5.5.1** (SCRP main line) and in **Table 5.5.2** (SCRP interconnecting line).

Table 5.5.1 Qualitative Risk Assessment for SCRP main line (Solis-Calamba)

	Description of Failure Mode	Project Phase	Effects	Consequences		Likelihood		Preventive measure
				Category	Confidence	Category	Confidence	
1.	Failure of rail component may result to derailment	Operational phase	Possible damage to property and injury/loss of human life	Minimal to moderate (environmental degradation)	High	Very low	High	Design of rail system should conform with known standards
2.	Structural failure of encapsulation facility by seismic events	Construction and operational phase	Possible damage to property and injury/loss of human life	Minimal to marginal (environmental degradation)	High	Very low	High	Structural design follows or exceeds Code requirements
3.	Exposure to the toxic chemicals and hazardous substances at previous contaminated site	Construction phase	Possible damage to property and injury/loss to human life	Minimal to marginal (environmental degradation)	High	Very Low	High	Adherence and training on Occupational Safety and Health Environmental guidelines/ procedures
4.	Release of toxic chemicals and hazardous substances during maintenance activities	Operational phase	Possible damage to property and injury/loss of human life	Minimal to moderate (environmental degradation)	High	Very low	High	Safety training for depot personnel and proper design of depot facilities
5.	Release of toxic chemicals and hazardous substances during transport of dangerous goods	Operational phase	Possible damage to property and injury/loss of human life	Minimal to moderate (environmental degradation)	High	Very low	High	Inspection of goods for transport by qualified personnel and design of rail facility to handle transport of dangerous goods
6.	Fire	Construction and operational phase	Possible damage to property and injury/loss of human life	Minimal to moderate (environmental degradation)	High	Very low	High	Installation of firefighting facilities; design to comply with NFPA130
7.	Natural Disaster	Construction and Operational Phase	Possible damage to property and injury/loss to human life	Minimal to moderate (Environmental degradation)	High	Very low	High	Design of rail structure/system should conform to international standards. Adequate response mechanism
8.	Terrorist attacks	Construction and operational phase	Possible damage to property and injury/loss of human life	Minimal to moderate (environmental degradation)	High	Very low	High	Tight security measures within the project site

	Description of Failure Mode	Project Phase	Effects	Consequences		Likelihood		Preventive measure
				Category	Confidence	Category	Confidence	
9.	Construction related accidents	Construction phase	Possible damage to property and injury/loss of human life	Minimal to moderate (environmental degradation)	High	Very low	High	Follow Occupational Safety and Health regulations
10.	Security and violent incidents	Operational phase	Possible damage to property and injury/loss to human life	Minimal to marginal (environmental degradation)	High	Very low	High	Tight security measures at the Railway facilities (Station, Sub-station, Depot)
11.	Transmission of infectious diseases	Construction and operational phase	Possible injury/loss to human life	Minimal to marginal (Health consequences)	High	Low	High	Health awareness measures and sanitary practices.

Source: JICA Study Team

Table 5.5.2 Qualitative Risk Assessment for the SCRP interconnecting line (Senate-FTI-Bicutan Segment)

	Description of Failure Mode	Project Phase	Effects	Consequences		Likelihood		Safety measure
				Category	Confidence	Category	Confidence	
1.	Earthquakes and ground shaking	Construction and operational phase	Possible damage to property; injury/loss of human life	Minimal (environmental degradation) to severe (human health consequence)	High	Very low	High	Design and construct facilities according to acceptable standards based on realistic earthquake scenarios and establish an Earthquake Emergency Response Plan
2.	Liquefaction	Construction and operational phase	Possible damage to property; injury/loss of human life	Minimal (environmental degradation) to severe (human health consequence)	High	Very low	High	Design and construct facilities according to acceptable standards based on realistic earthquake scenarios and establish an Earthquake Emergency Response Plan
3.	Heavy rainfall and flooding	Construction and operational phase	Possible damage to property; injury/loss of human life	Minimal (environmental degradation) to critical (human health consequence)	High	Low	High	Construct flood control system and install early warning system for floods; design facilities including tunneling shield according to relevant technical standards
4.	Volcanic hazards	Construction and operational phase	Possible damage to property; respiratory ilness	Minimal (environmental degradation) to moderate (human health consequence)	High	Very low	High	Establish an Emergency Response Plan for volcanic eruptions
5.	Tunnel deformation and collapse	Construction and operational phase	Possible damage to property; injury/loss of human life	Minimal (environmental degradation) to severe (human health consequence)	High	Very low	High	Conduct detailed geomechanical investigation prior to construction; design and construct facilities in accordance with applicable technical standards; and establish emergency response

	Description of Failure Mode	Project Phase	Effects	Consequences		Likelihood		Safety measure
				Category	Confidence	Category	Confidence	
								procedures in case of tunnel collapse
6.	Groundwater ingress	Construction and operational phase	Possible damage to property; injury/loss of human life	Minimal (environmental degradation) to moderate (human health consequence)	High	Very low	High	Properly line the tunnel with waterproofing material; implementation of tunneling shield in accordance with relevant technical standards
7.	Chemical and process hazards	Construction and operational phase	Injury/loss of human life; damage to environment due to potential contamination	Moderate (environmental degradation) to moderate (human health consequence)	High	Low	High	Provide proper containment for fuels and hazardous chemicals; regular disposal of flammable wastes to DENR accredited hauler/treater; and regular maintenance of containment
8.	Fire	Operational phase	Possible damage to property; injury/loss of human life	Minimal (environmental degradation) to severe (human health consequence)	High	Very low	High	Design considerations will comply with Fire Code of the Philippines and NFPA130; implementation of fire prevention and mitigation programs in accordance with relevant standards and regulations
9.	Train derailment	Operational phase	Possible damage to property; injury/loss of human life	Minimal (environmental degradation) to severe (human health consequence)	High	Very low	High	Design of rail system and protective devices should conform with applicable technical standards and regular inspection and maintenance of railway system
10.	Structural failure	Operational phase	Possible damage to property; injury/loss of human life	Minimal (environmental degradation) to severe (human health consequence)	High	Very low	High	Construction of all infrastructures shall adhere to relevant codes and standards; inspection and maintenance of infrastructures to be conducted to ensure

	Description of Failure Mode	Project Phase	Effects	Consequences		Likelihood		Safety measure
				Category	Confidence	Category	Confidence	
								integrity of the infrastructures
11.	Security threats	Operational phase	Injury/loss to human life	Minimal (environmental degradation) to critical (human health consequence)	High	Low	High	Tight security measures and protocols and establish emergency response protocols in case of security threats
12.	Improper management and disposal of potentially contaminated soil and groundwater	Construction phase	Damage to environment due to potential contamination	Moderate (environmental degradation) to moderate (human health consequence)	High	Very low	High	Conduct subsurface sampling to assess for the soil and groundwater conditions within the proposed alignment; disposal of contaminated soil to accredited haulter/treater, as applicable; and, treatment of contaminated groundwater prior to disposal, as applicable
13.	Confined space	Construction phase	Injury/loss of human life	Minimal (environmental degradation) to severe (human health consequence)	High	Significant	High	Establish communication and notification process; establish permit-to-work system; conduct air monitoring; ensure proper ventilation of work area; training of workers on confined space works; establish emergency protocols and rescue procedures
14.	Underground utility strikes	Construction phase	Possible damage to property and injury/loss of human life	Minimal (environmental degradation) to severe (human health consequence)	High	Low	High	Mapping of underground utility lines via non-intrusive methodologies such as geophysical investigation and coordinate with utility providers to identify utility lines buried near the excavation areas

	Description of Failure Mode	Project Phase	Effects	Consequences		Likelihood		Safety measure
				Category	Confidence	Category	Confidence	
15.	Unexploded ordnance (UXO)	Construction phase	Possible damage to property and injury/loss to human life	Minimal (environmental degradation) to severe (human health consequence)	High	Very low	High	Establish procedures regarding UXOs including protocols on reporting to authorities
16.	Mechanical hazards	Construction phase	Injury/loss to human life	Minimal (environmental degradation) to moderate (human health consequence)	High	Low	High	Establish a Health and Safety Plan; regular inspection and maintenance of equipment; training of workers on handling and operation of equipment; and, provision of appropriate PPE to workers
17.	Electrical hazards	Construction phase	Injury/loss to human life	Minimal (environmental degradation) to moderate (human health consequence)	High	Low	High	Establish a Health and Safety Plan; establish lock-out/tag-out procedures; regular inspection and maintenance of equipment; training of workers on handling and operation of equipment; and, provision of appropriate PPE to workers
18.	Pressure hazards	Construction phase	Injury/loss to human life	Minimal (environmental degradation) to moderate (human health consequence)	High	Very low	High	Establish a Health and Safety Plan; regular inspection and maintenance of pressure equipment; training of workers on handling and operation of equipment; and, provision of appropriate PPE to workers
19.	Temperature hazards	Construction phase	Injury, illness, or loss to human life	Minimal (environmental degradation) to	High	Moderate	High	Establish a Health and Safety Plan; provision of mechanical ventilation in

	Description of Failure Mode	Project Phase	Effects	Consequences		Likelihood		Safety measure
				Category	Confidence	Category	Confidence	
				moderate (human health consequence)				the work area; implement shift rotation as required; and, enforce rest breaks.
20.	Illumination hazards	Construction phase	Injury, illness, or loss to human life	Minimal (environmental degradation) to moderate (human health consequence)	High	Moderate	High	Provision of sufficient lighting
21.	Biological hazards	Construction phase	Injury, illness, or loss to human life	Minimal (environmental degradation) to moderate (human health consequence)	High	Low	High	Establish a Health and Safety Plan; maintain personal hygiene; avoid contact with unfamiliar plants and potentially venomous animals; provide first aid and animal bite kits
22.	Noise and vibration hazards	Construction phase	Injury, illness, or loss to human life	Minimal (environmental degradation) to moderate (human health consequence)	High	Low	High	Conduct noise level monitoring to ensure that the noise levels are within the threshold values and provide ear plugs and ear mufflers for workers exposed to loud operational environments
23.	Gravity hazards	Construction phase	Injury/loss to human life	Minimal (environmental degradation) to moderate (human health consequence)	High	Moderate	High	Establish a Health and Safety Plan; employ good housekeeping to ensure workplace is free of slipping and tripping hazards; provide warning signs for slippery or wet surfaces; and provide appropriate PPE especially for working at elevated levels
24.	Motion hazards	Construction phase	Injury/loss to human life	Minimal (environmental degradation) to moderate (human	High	Low	High	Establish a Health and Safety Plan; provide signages and other early warning signs; provide

	Description of Failure Mode	Project Phase	Effects	Consequences		Likelihood		Safety measure
				Category	Confidence	Category	Confidence	
				health consequence)				sufficient illumination; and follow traffic rules

5.5.1.1. Risk Management

(1) Design Considerations for Physical Hazards of the SCRP

1988. Prior to construction of the SCRP main line and interconnecting line, the appropriate design criteria must be selected to assure structural soundness against realistic worst-case scenarios during the operational lifetime of the project. Being exposed to meteorological and seismic hazards, it is important that the proposed project be designed using parameters that reflect the actual hazard vulnerability of the area. Based on the geohazard assessment conducted for this project, the design criteria that will be adopted for the facilities is presented in **Table 5.5.3**.

Table 5.5.3 Codes and Standard to be used in the Construction of the SCRP Components

Subject	Philippine Codes and Standards	International Codes and Standards
Building and Space Planning / Barrier-Free Design (Accessibility)	• National Building Code of the Philippines (NBCP) (PD 1096) • National Structural Code of the Philippines (NSCP) by Association of Structural Engineers of the Philippines (ASEP) • Referral Codes of the NBCP (both laws and self -regulatory documents) such as: ➢ BP 344 - Accessibility Law; ➢ Philippine Electrical Code (PEC) ➢ Mechanical Code ➢ National Philippine Electrical Code ➢ Plumbing Code of the Philippines ➢ DPWH 2000 Architectural Code of the Philippines (ACP, as applicable) • DPWH DGCS Vol. 6 Public Buildings & Other Related Structures 2015 • DPWH-promulgated 2015 Philippine Green Building Code (PGBC) • Department of Energy (DoE) Guidelines on Energy Conserving • Design on Buildings, 2008 • RA 6716 - rainwater collection • 2016 NBCP: Illustrated data compact disc (CD) applicable standards by other infrastructure agencies such as the Department of Transportation (DOTr) • Applicable DOTr standards • RA 386, the 1949 New Civil Code of the Philippines • BP 344 - Accessibility Law and its IRR • RA7277, The Magna Carta for Disabled Persons	• The Building Standard Law of Japan, Ministerial Ordinance, Notification, MLIT-J. • Ordinance of the Building Standard Law of Japan • Guideline to Improve Barrier Free Access for Public Transport Passenger Facilities for the Enforcement of 2006 Law N.19. Edited by Ministerial ordinance MLITT of Japan • Technical Regulatory Standards on Japanese Railways • NFPA130 and related NFPA standards
Fire Protection and Safety Evacuation Design	• RA 9514 - Fire Code of the Philippines (FCP) and IRR of 2008 • Philippine Mechanical Engineering Code • Philippine Electrical Code • DPWH DGCS Vol. 6 Public Buildings & Other Rel. Structures 2015 • Illustrated FCP	• The Building Standard Law of Japan (Ministerial Ordinance, MLITT of Japan) • The Fire Law of Japan • Fire Prevention Standards for Underground Stations • Technical Regulatory Standards on Japanese Railways • NFPA130 and related NFPA standards
Building Materials	• 2013 DPWH Standard Specifications • DPWH Bureau of Research & Standards (BRS) certification, if applicable • Dept. of Trade & Industry (DTI) Bureau of Product Standards (BPS) product certification, if applicable	• Japanese Industrial Standards (JIS) • NFPA130 and related NFPA standards

Subject	Philippine Codes and Standards	International Codes and Standards
Urban Planning and Environment	• RA 7279 - Urban Development and Housing Act of 1992 • PD and IRRs (as applicable) such as: ➢ PD 1586 (Environmental Impact Statement System) ➢ PD 1216 (Open Spaces) ➢ PD 1151 (Environmental Policy) ➢ PD 1152 (Environmental Code) ➢ PD 1067 Water Code) ➢ PD 957 (Subdivisions and Condominiums) ➢ PD 953 (Tree Planting) ➢ PD 856 (Sanitation Code) ➢ PD 757 (Creation of the National Housing Authority) ➢ PD 296 (clearing of waterways) • Duly-approved LGU Zoning Ordinance (ZO), with official zoning map (i.e., based on the duly-approved CLUP) • Special development-related LGU ordinances, as applicable • Environmental laws and regulations such as: ➢ Clean Air Act (RA 8749) ➢ Clean Water Act (RA 9275) ➢ Ecological Solid Wate Management Act (RA 9003) ➢ Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990 (RA 6969) ➢ Climate Change Act of 2009 (RA 9729) ➢ Philippine Disaster Risk Reduction and Management Act of 2010 (RA 10121) ➢ National Heritage Act of 2009 (RA 10066) ➢ Indigenous Peoples' Rights Act of 1997 (RA 8371) ➢ Environmental Planning Act of 2013 (RA 10587) ➢ Resettlement and socialized housing (BP 220) ➢ DENR Administrative Orders ➢ HLURB issuance (e.g., guidebooks, guidelines, standards, manuals, etc.) • DPWH DGCS Vol. 6 Public Buildings and other Related Structures 2015 • DOTr transportation planning studies	
Others	• Other relevant Philippine Codes and standards	

Source: JICA Design Team

(2) Management of Chemical Hazards of Stations and Tunnel Alignment

1989. All hazardous substances to be used/generated by the project will be stored and handled in compliance with all applicable Philippine and international regulations. The DOTr is committed to preventing, to the greatest extent possible, both inadvertent release of these hazardous substances to the environment and accidents resulting from mishandling or mishap.

1990. To insure hazards or risks that may be posed by the project are further minimized, the following measures are recommended:

- Appoint a pollution control officer (PCO) to monitor the compliance to the ECC conditions and monitor the project impact.
- Institute programs for employee training, facility inspection, periodic drills to test systems, and procedural review to address deficiencies, accountability, and continuous improvement objectives.

- Actively work towards minimizing the generation of hazardous wastes by investigating alternatives to the use of hazardous materials, by recycling products and containers wherever feasible, and by treating wastes using state-of-the-art technologies before any release to the environment.
- All employees will be expected to comply with all applicable precautions and handling procedures about hazardous materials. Employees are also expected to report any concerns to their supervisors, the Health and Safety Committee, or senior site management. All staff is encouraged to bring forward suggestions for improvements that can be incorporated into procedure revisions as appropriate.
- Provide PPEs especially for working with any of the hazards discussed in the previous subsections
- Comply with all permitting requirements relating to generation, handling and disposal of hazardous substances such as the Hazardous Waste Generator's ID, Permit to Transport, Priority Chemical List, Chemical Control Order and other permitting that may be required

1991. There will be a detailed procedure on the management of hazardous substances/materials for the SCRP to ensure the safe use, storage of disposal of hazardous substance in the project. The following will be incorporated in the management procedure:

- Purchasing controls – control of shipping methods, appropriate packaging, shipping schedules, etc.;
- Inventory controls on site – periodic inventory of materials in storage on site to determine usage and to identify and manage any unexpected loss;
- Maintenance of current safe handling and storage procedures (i.e. Material Safety Data Sheet) and this will available to those in contact throughout the operational site;
- Characterization of potential environmental hazards posed by hazardous substances;
- Allocation of clear responsibility for managing shipment, storage, handling and use of potentially hazardous substances;
- Defined methods for transport, storage, handling, and use;
- Identification of disposal methods for hazardous waste generated from use of these products;
- Preparation of contingency and emergency response plans;
- Adequate type and delivery of training for management, workers, and Contractors whose responsibilities include handling potentially hazardous materials;
- Maintenance and review of records of hazardous material consumption and incidents in order to anticipate and avoid impacts on personal health and the environment; and
- Procedures to track and manage wastes generated through use of these products, including regular shipments of potentially hazardous waste to appropriate licensed disposal facilities following the provisions set forth by RA 6969.

5.6. EMERGENCY RESPONSE POLICY AND GENERIC GUIDELINES

5.6.1. Risk Assessment Conclusion

1992. The DOTr Project Management Office (SCRP PMO) will develop an Emergency Preparedness and Response Plan (EPRP) in order to define actions in preventing the occurrence of accidents and response procedure in case of accidents, fire and natural hazards. For the construction phase, each Contractor will be required to prepare the EPRP.

1993. During the operation phase, the DOTr railway operator of the will also prepare a specific EPRP for its operations.

1994. The EPRP will be aligned with the policy of the DOTr on the strict implementation of precautionary, safety and security measures to ensure safe, fast, efficient and reliable transportation services. The EPRP (both construction and operational phases) shall be compliant with the requirements of NFPA130 for emergency procedures (NFPA130, Chapter 9-10).

5.6.2. Construction Concept

1995. Possible causes of emergency situations due to man-made and natural hazards should be considered in the DED to reduce the chance of their occurrence. There are a number of design standards and codes that DOTr PMO will have to comply with and incorporate in its performance specifications. These standards are part of the requirements of the local agencies concerned in order to grant permits and licenses to DOTr.

1996. Procedures for each of several emergency categories will be established. The procedures will specify necessary actions to be performed by appropriate personnel within a time or event sequence. The emergency response plan will as a minimum address, but not limited to the following categories:

- Construction-related accidents (including spills, utility strikes, and UXOs during excavation and tunneling works)
- Fire or smoke conditions within the system structures, including stations, guideways (revenue or nonrevenue), and support facilities
- Explosions
- Flooding
- Structural collapse or imminent collapse
- Transport of Dangerous Goods
- Hazardous materials accidentally or intentionally released into the system
- Serious vandalism or criminal acts, including terrorism, e.g. bomb threat
- Extreme weather conditions, such as heavy snows, high or low temperatures, sleet, or ice
- Earthquake
- Chemical and process hazards
- Injuries or Fatalities
- Any other emergency as determined by the authority having jurisdiction

1997. The plan will establish what constitutes an emergency and the procedure will be developed for the following:

- Emergency Reporting
- Notification of Emergency Response Personnel
- Dispatching of Emergency Response Personnel and Equipment to the Site
- Coordination of all Emergency Response activities
- Protection of passengers/personnel, and equipment at the emergency site
- Evacuation of passengers/personnel
- Communication to all passengers, employees, emergency response personnel
- Restoration of normal operations
- Containment procedures for hazardous chemicals and dangerous goods

Training of Contractors staff and emergency response team will also be undertaken.

Training shall follow the requirements of NFPA130, including the following:

- Training shall cover all aspects of the emergency procedure plan.
- Exercises and drills shall be conducted at least twice per year to prepare the contractors personnel for emergencies.
- Critiques shall be held after the exercises, drills, and actual emergencies.
- Drills shall be conducted at various locations on the system as well as at various times of the day so as to prepare as many emergency response personnel as possible.

5.6.3. Emergency Response Program

1998. The proponent through its vision will adopt an active program of pursuing a healthy, safe and environment-friendly operation. DOTr/Operator guidelines on health and safety will be made clear to Contractors and all employees during construction and operations. An orientation briefing for Contractors and training for employees will be implemented.

5.6.3.1. Construction Phase

1999. Emergency situations that may occur during construction are construction-related accidents and fire. The Contractor will set up safety measures required for the Works as follows:

- Upon issuance of Notice of Award, prepare, as part of the Contractor's Environmental Management Plan (CEMMAP), an Emergency Response and Contingency Plan, as well as an Occupational Safety and Health Management Plan that illustrate measures to be undertaken during emergency cases including spills, fire, structural failure, and other construction-related accidents. As previously mentioned, approval of the CEMMAP (including plans mentioned above) will be a prerequisite for issuance of Notice to Proceed. All construction aspects of NFPA130 shall be included within the Emergency Response and Contingency Plan.
- Provide and enforce wearing of PPEs such as: efficient helmets, and where necessary, eye goggles, ear protection, safety harnesses, and other personal protection equipment for all the personnel.
- Submit for the approval of DOTr detailed proposals for safety regulations and emergency procedures.
- Approved copies of above plans, regulations and emergency procedures will be produced by the Contractor and distributed and displayed at each place of work, together with any other documents, posters, notices boards, or the like which are required by law. The Contractor will revise, replace, maintain, or remove the notices, regulations and the like as required by legislation.
- Provide adequate warning signs, barricades, and warning lights at all times during construction.
- Ensure that all equipment is in good working condition.
- Provide at designated stations within the site emergency telephones, suitable accommodation, and transport and first aid equipment including stretchers.
- Provide adequate service for the protection against fire at the site in accordance with the local fire regulations.

5.6.3.2. Operation Phase

2000. For the operation stage, emergency situations that could occur are as presented in **Table 5.6.1.**

Table 5.6.1 Preventive Maintenance during Emergency Situations

Emergency Situation	Preventive Measures
Derailment	• Railway Operator will procure emergency re-railing and rescue equipment. These should be part of the depot equipment. • Railway Operator will inspect, maintain adjust and replace defective, excessively worn or broken running rails, cross ties, special track work components, ballast, direct fixation fasteners, and other track materials, related hardware and support equipment. • Railway Operator will also inspect and adjust the smoothness of the alignment and levels of the track geometry. There will be inspections for: • Track geometry and ride quality • Turnouts (which may be combined with regular lubrication and cleaning) • Ultra-sonic testing of rail joints and turnout components. These tests will be based on an annual test in each of the first two years and then scheduled as necessary according to the initial results.
Fire	The Fire Safety Enforcement Manual of the Bureau of Fire Protection Philippine Standards, NFPA130 and relevant Japanese standards such as the Fire Prevention Standard for Underground Stations will be principally used as the design criteria of this project. The following presents the key aspects of NFPA130 requirements (excluding items on train movements in tunnels) that are presented in more detail in Annex 1-1. [Tunnel] **Tunnel Stations** • During the course of construction, provisions of NFPA 241 shall apply except as modified by NFPA130. • There shall be sufficient egress capacity to evacuate the platform occupant load in 4 minutes or less. The station shall be designed to permit evacuation from the most remote point on the platform to a point of safety in 6 minutes or less. • The maximum travel distance on the platform to a point at which a means of egress route leaves the platform shall not exceed 100 m. • At least two means of egress remote from each other shall be provided from each station platform. • Illumination of the means of egress in stations, including escalators that are considered a means of egress, shall be in accordance with NFPA 101. • Enclosed stations shall be provided with a fire command center in accordance with NFPA 72. • Where required, sprinkler systems shall be designed and installed in accordance with NFPA 13. • Portable fire extinguishers in such number, size, type, and location as determined by the authority having jurisdiction shall be provided. • Emergency power in accordance with Article 700 of NFPA 70 and Chapter 4 of NFPA 110 shall be provided for enclosed stations. **Tunnel Trainways** • The system shall be designed to deter passenger entry to the trainway except during an event that requires evacuation of a train. • The system shall include provisions for giving guidance to passengers who may be required to evacuate from a train to a trainway. • Where trainway sections are to be constructed by a tunnelling method through earth, unprotected steel liners, reinforced concrete, shotcrete, or equivalent shall be used. • The system shall incorporate a walk surface or other approved means for passengers to evacuate a train at any point along the trainway so that they can proceed to the nearest station or other point of safety. • Emergency exits or cross-passageways shall be provided in accordance with NFPA130. • Warning signs posted on entrances to the trainway and on fences or barriers adjacent to the trainway shall clearly state the hazard. • Lighting systems for enclosed trainways shall be installed in accordance with NFPA 101. • Blue light stations shall be provided. • Portable fire extinguishers shall be provided in such numbers, sizes, and types and at such locations in enclosed trainways as determined by the authority having jurisdiction. **Tunnel Emergency Ventilation Systems** • A mechanical emergency ventilation system shall be provided in the following locations: (1) In an enclosed station, (2) In an enclosed trainway that is greater in length than 305 m.

Emergency Situation	Preventive Measures
	• The emergency ventilation system shall be designed to do the following: 1) Provide a tenable environment along the path of egress from a fire incident in enclosed stations and enclosed trainways, 2) Produce sufficient airflow rates within enclosed trainways to meet critical velocity, 3) Be capable of reaching full operational mode within 180 seconds, 4) Accommodate the maximum number of trains that could be between ventilation shafts during an emergency, and 5) Maintain the required airflow rates for a minimum of 1 hour but not less than the required time of tenability. **Emergency Procedures** • The authority responsible for the safe and efficient operation of a fixed guideway transit or passenger rail system shall anticipate and plan for emergencies that could involve the system. • Participating agencies shall be invited to assist with the preparations of the emergency procedure plan. • Emergency procedures shall be developed to specifically address the various types of emergencies that might be experienced on the system. • The authority shall operate an OCC for the operation and supervision of the system. • The authority and participating agency personnel shall be trained to function during an emergency. **Emergency Communications** • Emergency voice/alarm communications systems (EVACS) shall be designed, installed, inspected, tested, and maintained in accordance with NFPA 72. Railway Operator shall conduct regular inspections of mechanical systems in tunnels including, but not limited to, tunnel ventilation, air conditioning, control units, emergency generators, fire protection and suppression system. Electrical systems including power distribution, lighting, air-quality monitoring, cameras and safety system, and communications system will also be inspected.
Typhoon	Regulations to follow for each typhoon signal no.: 1 – speed restriction for trains (60 kph max) 2 – speed restriction for trains (30 kph max) 3 – speed restriction for trains (30 kph max) 4 – suspend operation
Flood	[Elevated and at-grade segments] The bridge design will be carried out for a 50 and/or 100 yr return period high water level with a minimum safety margin clearance of 1 m and/or 0.5 m, respectively whichever is the greater. In addition, all drainage will be replaced, and in most cases by a better system. Railway Operator will conduct periodic maintenance or when necessary for its drainage and water systems. [Tunnel] Railway Operator shall conduct regular inspections of mechanical systems in tunnels including, but not limited to, plumbing, tunnel drainage systems, pumping systems, and flood gates.
Earthquake, Ground Setting and Liquefaction	[Guideway Structures] • Railway Operator will perform regular inspections by routine patrol of all structures including underground and depot structures and perform maintenance and repairs. A detailed structure inspection will be performed at least once per year. • The general condition of the structure as viewed from the track will be included in the item list of all route patrols, which are carried out on a regular basis. • All structures will be catalogued and numbered in a register of structures that records the conditions, inspection requirements, results and any corrective actions. • Main structures will be the subject to periodic structural inspections. These inspections will be designed and performed according to general practice according to the structure types, materials (steel or concrete), foundations, and any specific examination of components such as bearing and expansion joints. • Stations and Depot buildings will also be inspected using route patrolling and general route inspections. The inspections will be supplemented with fault reports made by the operational staff. • Should periodic inspection detect signs of ground movement, services will be suspended or be run at reduced speed. If services are allowed to continue, detailed monitoring of the site would be instigated. If services will be suspended, passengers would be de-trained at the next available station stop. Detailed investigation into the improvements required would be undertaken before services are recommenced or speed restrictions be lifted and such works would be put in hand as soon as reasonably. [Tracks]

Emergency Situation	Preventive Measures
	• Railway Operator will inspect, maintain adjust and replace defective, excessively worn or broken running rails, cross ties, special track work components, ballast, direct fixation fasteners, and other track materials, related hardware and support equipment. • Railway Operator will also inspect and adjust the smoothness of the alignment and levels of the track geometry. • In addition to the patrols described above, there will be inspections for: -Track geometry and ride quality -Turnouts (which may be combined with regular lubrication and cleaning) -Ultra-sonic testing of rail joints and turnout components. These tests will be based on an annual test in each of the first two years and then scheduled as necessary according to the initial results. • Should periodic inspection detect signs of ground movement, services will be suspended or be run at reduced speed. If services are allowed to continue, detailed monitoring of the site would be instigated. If services will be suspended, passengers would be de-trained at the next available station stop. Detailed investigation into the improvements required would be undertaken before services are recommenced or speed restrictions be lifted and such works would be put in hand as soon as reasonably. [Tunnel] • The tunnel will be inspected using route patrolling and general route inspections. The inspections will be supplemented with fault reports made by the operational staff. Inspections shall cover columns/piles, cross passageways, interior walls, liners, ceiling and on-grade slabs, hangers and anchorages, wearing surfaces, and traffic barriers. An assessment of degree of deterioration of tunnel components including, but not limited to, concrete, steel and masonry shal also be conducted. • Should periodic inspection detect signs of ground movement, services will be suspended or be run at reduced speed. If services are allowed to continue, detailed monitoring of the site would be instigated. If services will be suspended, passengers would be de-trained at the next available station stop. Detailed investigation into the improvements required would be undertaken before services are recommenced or speed restrictions be lifted and such works would be put in hand as soon as reasonably.
Failure of Structure	DOTr PMO will comply with international and national standards to ensure that the structures are designed and built in accordance with these safety standards.
Transport of Dangerous Goods	DOTr PMO has no immediate plans for the transport of dangerous goods. However, DOTr PMO and Railway Operator train crew and emergency re-rail and rescue crews would receive specific training on emergency procedures associated with the specific types of goods carried.
Medical attention required by passengers	For every station, security guards will be equipped with first aid kits. During extreme emergency cases, medical services including ambulance would be summoned to the nearest station by the central supervising station.
Criminal Acts	Railway Operator will provide security services to ensure the safety of passengers, crew and office workers.

2001. DOTr PMO will produce an emergency procedural plan, which will include, but not limited to, the following:

- Policy, purpose, scope and definitions
- List of participating agencies and names of executives responsible for each agency
- Safety procedures during emergency situations
- Purpose and operation of Centralized Train Control (CTC) System and alternate CTC
- Purpose and operation of command post and auxiliary command post
- Communication facilities available for use during emergency cases
- Operating manuals of all specialized rescue equipment
- Maps and plans of complex areas of the system
- Any additional information and data that the particular agencies require to have in the plan.

Where relevant the EPRP shall also comprise the following elements that are consistent with NFPA130:

a. Identification of the type of emergency, name of authority, and the date the plan was adopted, reviewed, or revised, as applicable.
b. Consideration of background noise levels in tunnel facilities within the system resulting from the operation of emergency systems during various types of incidents, and specific guidance for emergency responders as to what noise levels to expect.
c. Consideration of the possibility of the need to use systems designed for a single event to address concurrent emergency events.
d. Fire and smoke emergency information and procedures, including the following:
    i. Location of fire in station or support facility
    ii. Location of train in enclosed trainway and fire location on train
    iii. Fire detection systems/zones in stations
    iv. Fire protection systems and devices and their locations/ points of initiating operation
    v. Locations of exits from and entrances to the incident site, including vehicular routes
    vi. Emergency ventilation system components and locations of equipment and local controls
    vii. Special equipment locations/cabinets
    viii. Agency(ies) to be notified and their phone numbers
    ix. Agency in command prior to and after the arrival of the local jurisdiction emergency response personnel
    x. The pre-planned mode of ventilation system operation (exhaust or supply)
    xi. Pre-planned passenger evacuation direction as coordinated with fan mode operation
    xii. Fire and emergency incidents on adjoining properties
e. Procedures typically implemented by responding jurisdictions for various types of emergencies as appropriate to site configuration.

The emergency response plan will as a minimum address, but not limited to the following categories:

f. Fire or smoke conditions within the system structures, including stations, guideways (revenue or nonrevenue), and support facilities
g. Explosions
h. Collision or derailment involving the following:
    i. Rail vehicles on the guideway
    ii. Rail vehicles with privately owned vehicles
    iii. Intrusion into the right-of-way from adjacent roads or properties
i. Loss of primary power source resulting in stalled trains, loss of illumination, and availability of emergency power
j. Evacuation of passengers from a train to all right-of-way configurations under circumstances where assistance is required

k. Bomb threat
l. Passenger panic
m. Disabled, stalled, or stopped trains due to adverse personnel/passenger emergency conditions
n. Flooding of enclosed trainways from internal or external sources
o. Disruption of service due to disasters or dangerous conditions adjacent to the system, such as hazardous spills on adjacent roads or police activities or pursuits dangerously close to the operational system
p. Structural collapse or imminent collapse of the authority property or adjacent property that threatens safe operations of the system
q. Transport of Dangerous Goods
r. Hazardous materials accidentally or intentionally released into the system
s. Serious vandalism or criminal acts, including terrorism
t. First aid or medical care for passengers on trains and in stations
u. Extreme weather conditions, such as heavy snows, high or low temperatures, sleet, or ice
v. Earthquake
w. Chemical and process hazards
x. Suicide/Railway Injuries or Fatalities
y. Criminal Acts
z. Any other emergency as determined by the authority having jurisdiction

2002. LGUs and other participating agencies within the locality will be coordinated with by DOTr PMO to cooperate and assist depending on the nature of an emergency, which will include the following:

- Medical services
- Building department
- Fire department
- Police department
- Utility companies
- Other transportation agencies

2003. Training for emergency response crew for the operation stage will be programmed to include the following:

- Sponsored by equipment suppliers for the rescue equipment, firefighting equipment and the like
- Courses being offered by some government agencies and entities such as DSWD, Bureau of Fire Protection Special Rescue Unit (BFP-SRU), Philippine National Red Cross, DENR-EMB, Disaster and Risk Reduction Management offices etc.
- Evacuation of passengers from train, to a point of safety along the guideway
- Evacuation of passengers from stations (surface and underground)

2004. Emergency procedures will be controlled from the CTC within the Depot control center, including coordination of participating agencies such as fire service, police, ambulance, public works and utility companies, etc.

6. SOCIAL DEVELOPMENT PLAN/FRAMEWORK AND INFORMATION, EDUCATION AND COMMUNICATION FRAMEWORK

6.1. SOCIAL DEVELOPMENT FRAMEWORK

2005. The Department of Transportation (DOTr) has formulated the Social Development Plan/Framework (SDP) covering its social development programs, projects and/or activities (PPAs) for cities and municipalities that will be traversed by the Project in coordination with the city and municipal planning and development officers of affected local government units (LGUs). This SDP will be aligned with the local SDP to incorporate programs and projects that prevent, mitigate or enhance the Project's negative and positive impacts, especially those relating to livelihoods, health, and the environment of the communities affected by the Project.

6.1.1. Objectives

2006. Through the identification of appropriate social development programs, projects and/or their relevant activities, the objectives of the SDP implementation for the Project are as follows:

- To mitigate adverse social impacts of the project primarily on people's livelihood and health and the environment;
- To sustain Project benefits and self-reliance of affected communities in the context of the proposed Project; and
- To align with the existing social development plans of LGUs affected by the Project.

6.1.2. Target Stakeholders

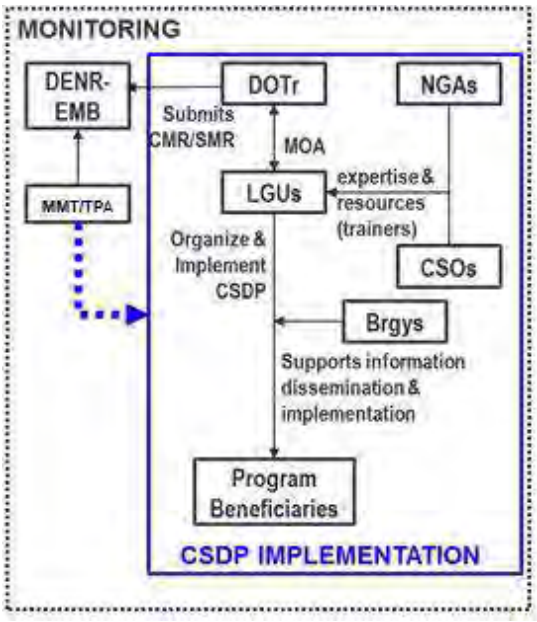
2007. The SDP is prepared in consideration of following stakeholders: (i) direct project-affected persons (PAPs) - persons living and working within a primary/direct impact area; (ii) indirect PAPs—persons living and working within a secondary/indirect impact area; and (iii) also vulnerable groups such as indigenous peoples (IPs), persons with disabilities (PWDs) and indigent families or barangays.

6.1.3. Responsible Parties

2008. LGUs, with funding support from the DOTr and implementation support from barangays, will be main SDP implementers for the identified PPAs relevant to the Project as stated in **Table 6.1.3**. The SDP formulation involves the participation of national government agencies (NGAs) in terms of providing technical expertise and resources to affected LGUs lacking capacity in certain social development sectors since they have mandates for the delivery of social services at the local level. Civil society organizations (CSOs), non-government organizations (NGOs) and people's organizations (POs), as representatives of the affected communities, also participate in the SDP implementation and ensure service delivery to program beneficiaries.

6.1.3.1. Institutional Arrangements

2009. Responsible parties involved in the SDP implementation and its arrangement are presented in **Figure 6.1.1**.



Source: JICA Design Team

Figure 6.1.1 SDP Implementation Structure

6.1.3.2. Roles and Responsibilities of Responsible Entities

2012. Based on the SDP implementation structure, identified key entities along with their roles and responsibilities are listed in **Table 6.1.1**.

Table 6.1.1 Roles and Responsibilities of Key Entities for the SDP Implementation

Key Entity	Responsibility
LGUs	• Assist DOTr in implementing the SDP with the support of barangays • Inform stakeholders of programs with support from barangays and match affected stakeholders with the appropriate SDP
DOTr	• Coordinate with LGUs in identifying and formulating the SDP • Work with LGUs in the implementation of the existing project-related social development programs by providing technical assistance and/or funding supports • Monitor and report the progress of the SDP implementation to the Environmental Management Bureau (EMB) through quarterly self-monitoring report (SMRs) and semi-annual compliance monitoring reports (CMRs)
NGAs	• Provide technical assistance, expertise and/or resources for their concerned social development sectors as part of the SDP implementation • NGAs may include but not be limited to the following: • Department of Health (DOH) – health • Department of Labor and Employment (DOLE) – occupational safety and health • Department of Education (DepEd)/ Commission oh Higher Education (CHED) - education • Department of Social Welfare and Development (DSWD) – social welfare and development • Philippine National Police (PNP) – peace and order • Department of Trade and Industry (DTI) • Technical Education and Skills Development Authority (TESDA) • Presidential Commission for the Urban Poor
Multipartite monitoring team (MMT)/Third-Party Auditory (TPA)	• Monitor project compliance • Validate the DOTr's conduct of self-monitoring through the compliance monitoring and validation report (CMVR) • Receive and validate complaints and transmit them to the DOTr and/or the EMB for recommended measures to address the complaints concerning social matters
DENR-EMB	• Validate and audit the SDP implementation during construction and operation
NGOs, CSOs and POs	• Provide technical assistance, expertise and/or resources to their concerned social development sectors as part of the SDP implementation

Source: JICA Design Team

6.1.4. Preparation of Comprehensive Social Development Plan

2013. The following activities were undertaken in the preparation of the comprehensive SDP. Social issues, concerns, or impacts of the Project as well as social development plans of each concerned LGU were considered in order to reflect the sentiments of affected localities.

6.1.4.1. Socio-economic Profile and Identification of Social Issues and Concerns of LGUs

2014. The SDP was prepared in consideration of the needs and aspirations of people in the affected locality as raised through various public participation activities such as information, education and communication (IEC), stakeholder consultations, focus group discussion (FGD) and public scoping and public hearings conducted during feasibility and detailed design studies. The information collected from perception surveys also formed a part of the SDP that mainly addresses perceived fears about environmental degradation caused by soil contamination, water and air pollution and health risks. Also, comprehensive development plans (CDPs) of respective LGUs with a focus on the social sector were studied. In the absence of CDPs, other local planning documents were examined such as comprehensive land use plans (CLUPs), local development investment programs (LDIPs) and/or annual investment plan (AIPs) to determine the existing PPAs relevant to the project.

6.1.4.2. Social Impact Assessment

2015. The study predicted the direct and indirect social impacts of the Project. This included assessing how the various stakeholder groups were likely to respond to these impacts. In order to determine perceived social impacts on direct project-affected people, socio-economic surveys were undertaken, targeting the affected LGUs since January 2018—which consist of (i) a census survey, (ii) an asset and land survey and (iii) a livelihood and living survey. The surveys were carried out for all PAPs, and their assets (land, structures, improvements, crops and trees) were inventoried and tagged.

2016. The cut-off date for the PAPs has been disclosed to each affected barangay by the relevant LGUs and their barangays. Presidents of Home Owners' Associations in respective barangays have been contacted to disseminate the information to the members that will be affected.

2017. The scope of resettlement impacts is being reviewed in line with the DED stage which has started in 2018 for the above ground main railway line. Therefore, outcomes of the census survey will be verified based on the final Detailed Design accordingly. In case there are no resettlement activities conducted after two years from the said cut-off dates, the census data shall be updated.

2018. At present, the RAP study for the feasibility stage of the SCRP project is under review and for finalization by DOTr, JICA Study Team and ADB.

6.1.4.3. Social Considerations Integrated into the Project Design

2019. **Table 6.1.2** presents the general social impacts and issues of the Project and concerns of project-affected stakeholders. The table also describes how the issues and concerns will be incorporated into Project planning and design.

Table 6.1.2 General Social Considerations Integrated into the Project Planning/Design

Category	Issue and Concern	Project Planning and Design
Public access	• Blocking and/or closure of access roads (major, barangay, private and farm-to-market roads) • Road space reduced • Pedestrian crossings and alleys affected • Heavy road traffic during railway construction and operation (e.g., transportation of construction materials)	• Preparation and implementation of traffic impact assessment (TIA)/traffic management plan (TMP) • Planning of transit-oriented development (TOD) plan for railway stations (e.g., provision of parking space and terminals for various modes of transportation) • Preparation and implementation of traffic management and community access plan
Hydrogeology	• Drainage systems affected • Water supply infrastructure affected • Damage to existing drainage systems due to construction • Flooding due to clogged drainage canals or low drainage capacity • Groundwater drawdown (for the underground section)	• Drainage and flooding designs in consideration of flood levels and existing drainage capacities • Construction of drainage facilities along the right-of-way (ROW) which have the same or larger capacity to the existing ones • Detailed hydrogeological/groundwater study in the detailed design stage for the Senate-FTI-Bicutan underground section.
Basic infrastructure and services	• Utilities and infrastructure affected, e.g., street lights, power lines, buried utitlity lines, oil/fuel line, and buildings	• Coordination with LGUs,utility companies, and owners of structures regarding compensation and replacement of affected utilities and infrastructure • Inventory of all directly affected utilities and infrastructure (e.g., electric posts, street lights and irrigation canals)
Public order	• Encroachment of the project site • Salvageable materials in affected properties	• Provision of safety and security measures (e.g., fencing of project ROW, designation of security guards around the ROW • Implementation of an agreement to demolish and remove improvements (ADRI) stating the details of demolition
Waste management	• Disposal of construction waste • Disposal of muck and spoil generated from tunneling work in underground section.	• Preparation and implementation of Solid Waste Management Plan for the Project • Preparation and implementation of Muck/Spoil Disposal Plan for the underground section • Spoils management and disposal • Solid and liquid waste management
Cultural heritage	• Old structures and stations located within the right-of-way • Old structures that will be affected by vibration caused by construction activities • National Nutrition Council of the Philippines at risk of being affected • Historial artifects may be found during underground tunneling works.	• Preparation and implementation of a preservation plan for historic structures • Conduct of archaeological impact assessment and prepare chance find procedures • Assessment of vibration vulnerability of structures and adaptation of low vibration technology for construction machinery and technique • Further consultations with concerned entities such as but not limited to the Department of Education (DepEd) (property owner), National Commission for Culture and the Arts (NCCA) and National Museum as part of Project's compliance
Gender and development	• Consideration of PWDs for the design of stations • Accessibility for senior citizens	• Consideration of the people needing special care (PWD, senior citizens) in station design and provision of facilities such as wheelchair ramps, railings, toilets, elevators, etc. • Prioritization on job employment
Children's rights	• Closure of access roads going to schools • Transfer of students to a different school from schools affected by the Project •	• Preparation and implementation of traffic impact assessment (TIA) • Coordination with concerned agency (DepEd, CHED) • Allocation of traffic enforcers
Health and safety	• Air pollution caused by construction activities • Degradation of water quality • Noise and vibration caused by construction activities and operation • Safety issues related to tunneling works and tunnel operation • Spread of infectious diseases, e.g., HIV, TB brought about by influx of external laborers	• Prepare implementation plans for the following based on WHO noise standards: • Dust and emission control plan • Noise control plan • Noise and vibration management protocols (scheduling of construction activities according to nearby sensitive receptors; construction of noise barriers; and, purchase/ maintenance of equipment to lower noise generation

Category	Issue and Concern	Project Planning and Design
	• Occupational hazards in railway industry	• Preparation and implementation of occupational safety and project personnel health program • Conduct of personnel training and awareness program • Standard occupational health and safety practices will be implemented pursuant to BWC-DOLE Occupational Safety and Health Standards (Department of Labor and Employment, 1989) • Tunnel safety management planning, demonstrating compliance with international good practice including NFPA 130
Employment	• Temporary/permanent loss of business/ employment/livelihood during construction and operation • Displacement of small-time vendors	• Prioritization of PAPs and the vulnerable for construction-related jobs • Preparation and implementation of livelihood and income restoration programs for direct PAPs
Grievance	• Environmental grievances/complaints on the project • Grievance due to risk of displacement	• Preparation and implementation of a grievance redress mechanism (GRM) for environmental concerns • Setup of the DOTr Helpdesks in affected LGUs • Grievance Handling Taskforce

Source: JICA Design Team Comprehensive Social Development Plan

2020. The Project's comprehensive Social Development Plan (SDP) shall be aligned and harmonized with the SDPs of the affected localities. Existing SDPs of LGUs were reviewed in order to identify which of these respond to priority social impacts expected by the Project. **Table 6.1.3** presents the SDP for the Project based on the affected LGUs' existing relevant PPAs. The relevance of PPAs was determined based on issues and concerns raised during public consultations as well as identified social impacts of the Project. Social issues and concerns of direct PAPs concerning livelihood and resettlement were covered in detail under the RAP prepared separately for the Project.

6.1.5. Estimated SDP Cost for Implementation

2021. The relevant PPAs are presented with their corresponding costs funded by local sources. Project briefs and/or detailed cost breakdown were obtained from the LGUs to determine specific activities and costs in order to enable the Project to attain a socially responsible implementation of the EMP. Costs for transport and food are not included in the total cost.

6.1.6. Continuous SDP Monitoring and Updating

2022. It is necessary that a re-assessment of the SDP be regularly carried out to identify and monitor the following:

- High investments which may have savings and incomes for the LGU(s) and DOTr;
- Overlapping social development projects for direct and indirect affected communities; and
- Needs for a unified grievance mechanism to address complaints effectively and timely.

2023. The implementation of this SDP will be monitored through the SCRP MMT/TPA and through the RAP monitoring.

Table 6.1.3 SDP Framework for the Proposed SCRP

LGU	Impact, Issue and Concern	Target Stakeholder	Program/Project/Activity to be Provided	Implementing Agency	Implementation Timeline	Fund Source	Cost Estimate (PhP '000)
Manila	Health and Safety	DPAP	Modernization, rehabilitation and development of hospitals	Engineering and City Health Office (CHO)	Year 1	LGU	To be confirmed with the LGU
Taguig	Health and Safety	DPAP	Mobile health clinics	CHO	Year 1	LGU	
	Landscape	DPAP and IPAP	Neighborhood parks	Engineering and City Planning and Development office (CPDO)	Year 1	LGU	To be confirmed with the LGU
Pasay*	Health and Safety	DPAP and IPAP	Modernization, rehabilitation and development of clinics and hospitals	Engineering and City Health Office (CHO)	Year 1	LGU	To be confirmed with the LGU
	Public Order	DPAP and IPAP	Crime prevention and control program	PNP	Year 1	LGU	To be confirmed with the LGU
Paranaque	Public Order	DPAP	Capacity building activities for disaster preparedness	Disaster Risk Reduction Management Officer (DRRMO)	Year 1	LGU	To be confirmed with the LGU
			DRRM program for 3 years	DRRMO	Year 1	LGU	To be confirmed with the LGU
		DPAP and IPAP	Crime prevention and control program	PNP	Year 1	LGU	To be confirmed with the LGU
	Health and Safety	DPAP and IPAP	Health Operatives programs for medical emergencies	DRRMO and CHO	Year 1	LGU	To be confirmed with the LGU
		DPAP and IPAP	Establishment of holding centers for HIV/AIDS awareness	CHO	Year 1	LGU	55 per program
		DPAP	Reproductive health program	CHO	Year 1	LGU	To be confirmed with the LGU
	Children's rights	DPAP	Paaralan sa Bawat Barangay program	Local School Board (LSB)	Year 1	LGU	500 per program
San Pedro	Public Access	DPAP and IPAP	• Capacity study of urban land for future land use • Feasibility study and master planning of urban land • Inventory of urban land utilization	CPDO	Year 1	LGU	To be confirmed with the LGU
Binan	Security through fencing of ROW to prevent proliferation of informal settler families (ISFs)	DPAP and IPAP	MASA MASID[1] CCTV installation	PNP and Barangay Anti-Drug Abuse Council (BADAC)	Year 1	LGU	To be confirmed with the LGU
		DPAP and IPAP	Ugnayan ng Barangay at mga Simbahan (UBAS)	UBAS	Year 1	LGU	To be confirmed with the LGU
		DPAP and IPAP	Police integrated patrol system	PNP	Year 1	LGU	To be confirmed with the LGU

[1] Mamamayang Ayaw sa Anomalya, Mamamayang Ayaw sa Iligal na Droga (MASA-MASID)

LGU	Impact, Issue and Concern	Target Stakeholder	Program/Project/Activity to be Provided	Implementing Agency	Implementation Timeline	Fund Source	Cost Estimate (PhP '000)
	Noise during construction	DPAP	Improvement of community health programs	CHO	Year 1	LGU	To be confirmed with the LGU
Sta. Rosa	Waste Management	DPAP and IPAP	Municipal solid waste management program	City Environment and Natural Resources Office (CENRO)	Year 1	LGU	294 per program
	Hydrogeology	DPAP and IPAP	Community sewerage system	Cabuyao-Biñan-Santa Rosa Waterworks System (CBSRWS)	Year 1	LGU	11.7 per program
		DPAP and IPAP	Level III water supply	CBSRWS	Year 1	LGU	180 per program
		DPAP and IPAP	Sanitation project	CBSRWS	Year 1	LGU	28 per program
		DPAP and IPAP	Stormwater drainage development/rehabilitation	CBSRWS	Year 1	LGU	6 per program
		DPAP and IPAP	Stormwater drainage master planning	CBSWRS	Year 1	LGU	75 per program
Cabuyao	Health and Safety	DPAP	• Construction of a new hospital (Cabuyao Medical Hospital) at Brgy. Banaybanay • Health on wheels-a government health vehicle (bus and van) equipped with mobile x-ray and minor maternal and surgical sets • Upgrading of Ospital Ng Cabuyao to Level III hospital provision of social hygiene clinics targeting STD, HIV and AIDS	Engineering and CHO	Year 1	LGU	To be confirmed with the LGU
Calamba	Railway operation safety	DPAP and IPAP	Upgrading and expansion of the Dr. J.P. Rizal Memorial District Hospital	Engineering and CHO	Year 1	LGU	To be confirmed with the LGU
	Noise during construction	DPAP and IPAP	Improvement of community health programs	CHO	Year 1	LGU	23.7 per program
	Children's rights	DPAP and IPAP	Elementary education facilities expansion and upgrading program	Engineering and DepEd	Year 1	LGU	16.4 per program

**Note: Programs are for confirmation with the LGUs*

Source: JICA Design Team.

6.2. INFORMATION, EDUCATION AND COMMUNICATION FRAMEWORK (CONSULTATION AND DISCLOSURE)

2024. Meaningful consultations paired with disclosure of information must be conducted with project stakeholders to guarantee their participation at all levels of project planning and implementation. Under PEISS DAO 2003-30, requirements of consultations and information disclosure are defined as the IEC. The proposed IEC framework for consultations and subsequent measures for information disclosure at different stages of the Project are described in this section.

2025. The IEC is undertaken to encourage participation and cooperation not only of the affected households but also of a broader range of stakeholders from different sectors and facilitate the establishment of support linkages in the implementation of the Project from the pre-construction stage through the completion stage. The IEC will also inform the stakeholders about the progress of the Project and provide feedback to DOTr regarding the concerns and issues raised by the stakeholders during the implementation of the Project. The DOTr discloses relevant information including potential impacts of the Project and its corresponding mitigating measures for stakeholders in line with the Philippine Environmental Impact Statement System (PEISS), Japan International Cooperation Agency (JICA) Guidelines (2010) and Asia Development Bank (ADB) Safeguard Policy Statement (SPS, 2009). **Table 6.2.4** IEC Framework for the Project presents the IEC framework for the Project.

6.2.1. Objectives

2026. The IEC for the Project is implemented to achieve the following objectives:

- Inform stakeholders on the progress of the Project and obtain issues and concerns through various social groups near the project area to determine their perception of the recent trends, existing problems, and potential solutions. This will determine potential social, health, economic and cultural impacts not always discovered through survey-based socioeconomic studies.
- Enhance sustainability of the Project by ensuring that interventions are relevant to the concerns of the stakeholders and seek understanding and cooperation in implementing the Project;
- Collect local knowledge, information, and ideas on technical impacts of the project design and apply the collected information in the formulation of mitigation measures against negative social and environmental impacts of the Project;
- Inform stakeholders of foreseeable health, natural, social, and economic environment risks and ensure that the mitigation measures will minimize negative impacts of the Project on surrounding social and natural environments on time; and
- Disseminate information and an action flow in a speedy manner in case of any outbreak of health/environment risks.

6.2.2. IEC Principles

2027. The DOTr carries out meaningful consultations with project stakeholders throughout the project cycle and ensure their participation. Meaningful consultations are a process containing the following elements:

- Begin early at the project preparation stage and be carried out on an ongoing basis throughout the project cycle;
- Provide timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people;
- Be undertaken free of intimidation or coercion;

- Be gender-inclusive and gender-responsive and tailored to the needs of disadvantaged and vulnerable groups; and
- Incorporate all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities and implementation issues.

6.2.3. Target Stakeholders

2028. Project stakeholders covered by the Project's IEC program include but are not be limited to the following:

- LGUs/barangays where the alignment traverses;
- Direct PAPs (persons living and working within a primary/direct impact area);
- Indirect PAPs (persons living and working within a secondary/indirect impact area);
- Affected vulnerable groups such as IPs, PWDs and indigent families or barangays;
- Private business owners/employees operating in the project area;
- Public social institutions such as schools as well as health and religious institutions;
- CSOs and NGOs operating in the project area such as the National Conservation of Philippine Wetland, the Association of Barangay Chairmen, the Senior Citizen's Association and the Historical Association;
- NGAs such as Key Shelter Agencies (KSAs), the Metro Manila Development Authority (MMDA), cultural agencies such as the National Museum (NM), the National Commission for the Culture and the Arts (NCCA) and the National Historical Commission of the Philippines (NHCP), the Department of Environment and Natural Resources (DENR), the Department of the Interior and Local Government (DILG), the Department of Trade and Industry (DTI), the Department of Labor and Employment (DOLE), the Department of Agrarian reform (DAR), the Department of Public Works and Highways (DPWH), the Department of Finance (DOF), the Department of Health (DOH), the Philippine Air Force (PAF), the Department of Social Welfare Development (DSWD), the Department of Education (DepEd), the Commission on Higher Education (CHED) and the National Commission on Indigenous Peoples (NCIP);
- Contractors and workers;
- Monitoring agents; and
- Authorities responsible for other projects traversed by the Project such as the North-South Commuter Railway (NSCR), the North Luzon Expressway-South Luzon Expressway Connector Road (NLEx-SLEx), the Metro Manila Skyway Project, the South-Long Haul Line, etc.

6.2.4. Responsible Parties

2029. The SCRP Project Management Office (PMO) through a delegated communication officer from their Environmental and Social Considerations Teams and ROW Acquisition (ROWA) Teams, are responsible for the IEC implementation in close coordination with stakeholders. Other IEC activities require the engagement of a contractor.

6.2.5. Main Information to be Delivered

2030. Based on the Environmental Compliance Certificates (ECC) of the SCRP, DOTr must disseminate the following information:

- Progress of the project including updates on project activities, schedules, etc.;
- Impacts of the Project and corresponding measures that are embodied in the EIS;
- Conditions stipulated in the ECC;
- Foreseeable environmental and human safety features of the Project; and

- Health consciousness alerts for any project-induced discomfort caused by dust, smell, noise and vibration as the Project progresses throughout the whole alignment.

2031. Sufficient information on the description of the proposed Project, the proponent, the environmental impact assessment (EIA) process and expected outputs will be disseminated. Information dissemination will also include an evaluation of impacts of the Project on public health, the environment, population, gender, socioeconomic and cultural elements and appropriate mitigation and enhancement measures.

6.2.6. IEC Methods and Information Medium

2032. IEC methods for the Project will include key informant interviews, focus group discussions, community open forum, and multi-media including print and social media. DOTr may use any or all kinds of information materials for conducting IEC campaigns. The materials may be prepared in print, (e.g. flyers, pamphlets, comics, posters, newspapers and banners) or in other forms such as videos, films, and sound slides. IEC materials will be prepared in a manner and a language that can be easily understood by stakeholders and will contain balanced and complete information. The information material on the EIA should, as much as practicable, be prepared in a local language or dialect. The IEC campaign will also involve informing community members of their responsibilities as stakeholders of the Project.

6.2.6.1. IEC Meetings for LGUs

2033. LGUs within the direct impact areas (DIAs), followed by localities within estimated indirect impact areas, are given priority in the IEC campaigns. The LGUs are required to be covered by the IEC at the pre-scoping stage as a requirement for preliminary identification of sectoral stakeholders who are invited to attend the public scoping proper (for projects which shall undergo public scoping). The IEC for LGUs is also intended to enable sectoral stakeholders such as representatives of LGUs, NGAs, PAPs, business establishments, and academe, to figure out preliminary key environmental issues from the perspective of LGUs participating in the IEC program. The information helps the DOTr appropriately prepare for public scoping.

6.2.6.2. Stakeholder Consultation Meetings

2034. After the conduct of IEC meetings for LGUs, a series of stakeholder consultation meetings (SCMs) are carried out. Stakeholders invited to these consultations are LGU representatives and potentially affected business owners, families and persons. The first round of SCMs primarily aimed at informing potential PAPs of the Project and explaining RAP activities that would be conducted during a feasibility study (FS) (i.e. a census survey and tagging, a socioeconomic survey, consultation meetings and FGD). The first SCM provided a venue to gather inputs of PAPs for the RAP and prepared the community for RAP activities, thereby minimizing resistance during surveys.

2035. The second round of SCMs was intended to inform PAPs of their rights under Philippine laws and international social safeguards policy, provided that they will be affected by the project. Hence, it also served as a venue to figure out possible impacts, policy gaps and unusual cases in which the project could affect PAPs. One example is the case of returnees who are not qualified to avail of socialized housing for the second time.

2036. Results of the Social Economic Surveys (SES) and inputs from the first and second SCMs were considered in the preparation of the compensation and entitlement matrix. Detailed provisions were presented and explained to PAPs during the third round of SCMs.

6.2.6.3. Focus Group Discussion

2037. FGD is conducted once in FS and detailed design (DD) phases as part of consultations with vulnerable sectors affected by the Project. The vulnerable sectors covered by FGD are confined to the poor, the underprivileged and the homeless including socialized housing beneficiaries. Separate FGD sessions have been designed and conducted for other vulnerable groups such as women, the elderly and children under gender impact assessment component of the RAP.

2038. Results from FGD sessions are consolidated to substantiate data gathered from a socioeconomic survey and analyzed as inputs in the preparation of the livelihood restoration and improvement program. Topics for FGDs focus mainly on livelihood and relocation with the following objectives:

- Obtain inputs directly from PAPs for the formulation of the livelihood restoration and improvement program;
- Discuss possible relocation options;
- Determine PAPs' apprehensions/concerns regarding displacement of communities in relation to their respective sources of livelihood;
- Understand PAPs' concept of livelihood restoration and improvement;
- Identify other possible entitlements that will be acceptable to PAPs;
- Identify relocation preferences among PAPs; and
- Include recommended mitigation measures in the compensation and entitlement matrix of the RAP based on outputs of FGD sessions.

6.2.6.4. Distribution of Printed Materials

2039. The DOTr conducts production and distribution of printed materials. The following materials will be distributed during consultations and will be made available at the Barangay hall and a Helpdesk of each LGU.

- Flowchart of the relocation and compensation procedure (for informal settler families);
- Flowchart of the land acquisition and compensation procedure (for legal land owners);
- Flowchart for the extra judicial settlement (EJS) process;
- Health and Safety related issues;
- Available livelihood and employment opportunities (i.e., civil works, overseas, etc.), skills required and the schedule of skills training/hiring per LGU; and
- Grievance redress hotlines and other contact information for grievance and complaints.

6.2.6.5. Online and Mass Media Information Disclosure

2040. Key project information and milestones are released through existing online channels and mass media in case that wider information disclosure is reckoned to be necessary. This may include the release of information through project websites and Facebook as well as in the form of news releases.

6.2.7. Timeframe and Frequency

2041. The schedule of activities varies per target sector. As shown in **Table 6.2.1**, the project cycle for the Project is divided into three stages: (i) planning and pre-project implementation stage; (ii) project implementation stage; and (iii) post-project implementation or project operation stage. The planning and pre-project implementation stage refers to the FS and DD stage.

Table 6.2.1 IEC Timeframe and Frequency

Stage of Project Cycle	Proposed Mechanism	Timing and Frequency	Status
A. Planning and Pre-Project Implementation			
FS stage	LGU meetings	Once per LGU, prior to all field activities	Completed
	NGA meetings	As required	Completed
	Stakeholder consultation	Three times per LGU, before, amid and after field surveys	Completed
	FGD	Once per LGU	Completed
	Public scoping	Once in two clusters prior to start an EIS study	Completed
	Public hearing	Once in three clusters after the draft EIS is compiled and the EMB review process started	Completed
Detailed design stage	LGU meetings	Once per LGU, prior to all field activities	On-going
	NGA meetings	As required	On-going/ Continuous coordination with NGAs
	1st SCM	Once per LGU, prior to a parcellary survey	On-going
	2nd SCM	Once per LGU, after updating census and tagging	To be conducted
	FGD	Once per LGU, between 1st and 2nd SCM	On-going
	Production and distribution of printed and other materials	Printed materials prepared to inform project stakeholders where to address their grievances and of the schedule of public consultations	To be conducted
	Online disclosure of project information	As needed, monthly at a minimum	On-going/ Continuous
	Media release/press briefing	As needed, press briefings meant to disclose key project information, key project highlights and risk mitigation measures	Completed
B. Project Implementation Phase			
Pre-construction phase	Group meeting	Monthly	Phase has not begun
	Stakeholder consultation	Monthly during land acquisition and resettlement activities	
	FGD	Quarterly during land acquisition and resettlement activities	
	Production and distribution of printed and other materials	As needed, printed materials prepared to inform PAPs where to go or who to contact for their grievance and complaints	
	Online disclosure of project information	As needed, monthly at a minimum	
	Media release/press briefing	As needed, press briefings meant to disclose key project information, key project highlights and risk mitigation measures	
Construction phase	Group meeting	Monthly	
	Stakeholder consultation	As required	
	FGD	As required	
	Production and distribution of printed and other materials	As needed, printed materials prepared to inform PAPs where to go or who to contact for their grievance and complaints	
	Online disclosure of project information	As needed, monthly at a minimum	
	Media release/press briefing	As needed, press briefings meant to disclose key project information, key project highlights and risk mitigation measures	
C. Post-Project Implementation			
Operation	Group meeting	As required	Phase has not begun
	Stakeholder consultation	As required	
	FGD	As required	
	Production and distribution of printed and other materials	As needed	
	Online disclosure of project information	As needed.	
	Media release/press briefing	As needed.	

Note: for further detail dates of activities conducted and content of activities, please refer to chapter 11.

Source: JICA Design Team.

6.2.8. Estimated Cost for Implementation

6.2.8.1. Cost for Meetings

2042. **Table 6.2.2** shows the estimated cost allotted by DOTr for meetings covering the pre-construction and construction phases.

Table 6.2.2 Cost for Meetings

Item	No. of LGUs	No. per Stage		Total No. of Meetings	Unit Price (PhP)	Total Cost (PhP)
		Pre-construction (6 months)	Construction (3 years)			
LGU meetings	11	6 times x 11 LGUs = 66	36 times x 11 LGUs = 396	462	20,000	9,240,000
SCM	11	6 times x 11 LGUs x 2 venues = 132	4 times/year x 3 years x 11 LGUs x 2 venues =264	396	35,000	13,860,000
FGD	11	2 times x 11 LGUs x 2 venues x 3 groups = 132	4 times x 11 LGUs X 3 groups x 2 venues =264	396	15,000	5,940,000
Public scoping		Publication = PhP 15,000 Van hire (PhP 7,000/van x 2 vans x 3 days) = PhP 42,000 Food (PhP 500/head x 10 heads x 3 days) = PhP 15,000 Food for participants (PhP 200/head x 300 heads) = PhP 60,000 DENR-EMB honorarium (PhP 2,000/head x 2 heads x 3 days) = PhP 12,000				144,000
Public hearing		Publication = PhP 15,000 Van hire (PhP 7,000/van x 2 vans x 3 days) = PhP 42,000 Food (PhP 500/head x 10 heads x 3 days) = PhP 15,000 Food for participants (PhP 200/head x 475 heads) = PhP 95,000 DENR-EMB honorarium (PhP 2,000/head x 5 heads x 3 days) = PhP 30,000				197,000
Total						29,381,00029,381,000

Source: JICA Design Team.

6.2.8.2. Cost for Printed Materials

2043. The DOTr allots a budget for production and distribution of tarpaulins and other printed materials as shown **Table 6.2.3**.

Table 6.2.3 Budget for Printing of Information Materials

Item	Posting/ Distribution	No. of LGUs	Total No. to be Printed	Frequency			Total No.	Unit Price (PhP)	Total Price (PhP)
				During DD	Pre / Cons-truction	Operation			
Tarpaulin for relocation	GRM/Help Desk	11	11	1	0	1	242	2,000*	484,00
Tarpaulin for land acquisition	GRM/Help Desk	11	11	1	0	1	242	2,000*	484,00
Tarpaulin for EJS flowchart	GRM/Help Desk	11	11	1	0	1	242	2,000*	484,00
Brochure/flyer for livelihood	Barangays	11	4,000	2	2 X 2 years	0	264,000	2.00**	528,000
Flyer for GRM	Barangays	11	4,000	2	2 X 2 years	0	264,000	2.00**	528,000
Total									2,508,000

* Php 50/square foot x 40 square feet (8 feet x 5 feet).
** based on 2018 Risograph printing cost.

Source: JICA Design Team.

6.2.9. Continuous Monitoring and Updating of the IEC Framework

2044. The IEC framework will be reviewed regularly as part of internal and external monitoring to assess the effectiveness of activities and make further improvements.

Table 6.2.4 IEC Framework for the Project

No.	Action	Description	Main Target	Information/Message	Frequency	Resource	Responsible Agency	Budget	Estimated Cost (PhP)
1	Group meeting	• Regular meetings that will be conducted to share details about the Project and the progress of activities as well as to obtain an understanding and cooperation of PAPs for project implementation, especially the resettlement process	LGUs and NGAs	[Pre-construction] • Project description/project updates • Negative and positive impacts on health and safety, society and the economy, and the natural environment and project mitigation measures including the RAP and the EIS • Health and environment alerts • Issues and concerns • Contact points and the grievance mechanism for the Project [Construction] • Project description/project updates • Health and environment alerts • Current pollution levels in the project area and the monitoring results • Issues and concerns	• Once during FS and DED • Monthly during land acquisition and resettlement and construction phase • As required during operations phase	• Venues, PPT, reports and handout materials	• PMO ESRL, DOTr's ROWA Team and PMO	• During FS and DD: JDT • After DD: DOTr	6,720,000
2	Stakeholder consultation	• Consultation meetings with stakeholders to provide details about the Project, the progress of activities, and measures to mitigate Project impacts to obtain their understanding and cooperation	Directly affected barangays, affected LGUs, NGOs and CNOs	[Pre-construction] • Project description/project updates • Negative and positive impacts on health and safety, society and the economy, and the natural environment and Project mitigation measures including the RAP, traffic management and alternative routes • Current pollution status and the monitoring results • Health and environment alerts • Contact points and the grievance mechanism for the Project [Construction] • Project updates • Mitigation measures of the Project • Current pollution status and the monitoring results • Health and environment alerts • Contact points and the grievance mechanism for the Project	• Quarterly (twice during DD) during pre-construction, • Monthly during land acquisition and resettlement, • As required during construction and operation	• Venues, PPT and leaflets	• DOTr's Communication Officer, PMO ESRL, DOTr's ROWA Team and PMO	• During DD: JDT • After DD: DOTr	10,080,000
3	FGD	• Face to face discussion with specific groups (approximately 15 people per discussion)	Project-affected families	[Pre-construction/Construction] • Project description/project updates • Negative and positive impacts on health and safety, society and the economy, and the natural environment and Project mitigation measures	• Twice during FS and DD • Quarterly during pre-construction	• Venues, PPT and leaflets	• DOTr's Communication Officer, PMO ESRL, and PMO	• During DD: JDT • After DD: DOTr	4,320,000

No.	Action	Description	Main Target	Information/Message	Frequency	Resource	Responsible Agency	Budget	Estimated Cost (PhP)
		to obtain their issues and concerns		including the RAP, traffic management and alternative routes • Health and environment alerts • Contact points	• As required during construction and operation				
4	Public scoping	• A large public meeting with stakeholders to present Project information to stakeholders and to provide a venue for an • open forum during scoping or before EIA preparation	Directly/ indirectly affected people and barangays, affected LGUs, NGOs and CNOs	[Pre-construction] • Project description • Project timeline • Possible impacts of the Project • Proposed mitigating measures	• Once during scoping (pre-ECC)	• Venues and PPT	• PMO, PMO ESRL, and the EMB	• JDT	99,800
5	Public hearing	• A large public meeting open to the general public to present Project information to stakeholders and to provide a venue for an open forum during scoping or before EIA preparation		[Pre-construction] • Project description • Project timeline • Possible impacts of the Project • Proposed mitigating measures	• Once after draft EIS summited to the EMB (pre-ECC)	• Venues and PPT	• PMO, PMO ESRL, and the EMB	• JDT	168,200
6	Online disclosure of Project information	• Project website that will include a webpage dedicated to environment / social considerations and will also include downloadable versions of Project-related reports • Use of existing social media networks (e.g. Facebook page of the DOTr) to release Project news and updates and knowledge-based information/data •	All stakeholders and the general public	[General page] • Project description/project updates • Project reports (RAP/EIA, FS/DD reports, monitoring reports, CMR) • Contact points (Q&A function) [ENV/SOC page] • Negative and positive impacts on health and safety, society and the economy, and the natural environment and Project mitigation measures • Compliance to national and international standards • Awareness on health and the environment • Health and environment alerts • Monitoring results • Resources: project reports, the EIS and the RAP • Contact points (Q&A function)	• Weekly updating • As required	• Web platform	• DOTr's Communication Officer, PMO and IEC contractor	• DOTr	-

No.	Action	Description	Main Target	Information/Message	Frequency	Resource	Responsible Agency	Budget	Estimated Cost (PhP)
7	Preparation and distribution of printed materials	• Project-related leaflets, posters, etc. that will be posted on barangay notice boards, and shopping malls, and that will be distributed during SCMs and at Helpdesks, etc.	All stakeholders	• Project description with compliance with national and international laws and regulations • Negative and positive impacts on health and safety, society and the economy, and the natural environment and Project mitigation measures including the RAP, traffic management and alternative routes • GRM procedure • Project-related events such as SCMs • Contact points	• During detailed engineering design stage, pre-construction and construction	• Leaflets, posters and tarps	• DOTr Communication Officer, PMO ESRL, and PMO	• DOTr	80,000
8	Press briefing and media release	• Information dissemination on the Project outline and major Project events to announce the progress of the Project	All stakeholders and the general public	• Project description and progress • Project updates on major events • Project compliance to national and international laws and regulations • Health and environment alerts	• Monthly during pre-construction and construction • As required	• Articles on newspaper, website, social media, radio, and TV clips	• DOTr 's Communication Officer, PMO and IEC contractor	• DOTr	
9	Multimedia	• Various multi-media materials to help disseminate information about the Project	General public	• Traffic management plan • Alternative routes around the station areas • Proper hygiene in all stations • Emergency response plans (e.g. fire, earthquake)	• Pre-construction and construction phase • Operations phase	• TV, Radio, Newspaper, Social Media (FB, Twitter) • Poster, leaflets, audio-visual presentation at the stations	• DOTr 's Communication Officer, PMO and IEC contractor	• DOTr	Cost of PR materials (for estimation

Source: JICA Design Team.

7. GRIEVANCE REDRESS MECHANISM

7.1 OBJECTIVES OF THE GRIEVANCE REDRESS MECHANISM

2043. A grievance redress mechanism (GRM) is an effective tool for early identification, assessment and resolution of complaints on a project. The GRM serves as a venue for receiving concerns of aggrieved stakeholders (AS) and acting on the concerns, but it does not hinder them from their right to judicial action if a decision by the GRM is unacceptable. The Department of Transportation (DOTr) has established the GRM for the Project in order to:

- Receive and facilitate the resolution of AS' concerns and grievances about physical and economic displacement and other project impacts with particular attention to impacts on vulnerable groups;
- Resolve AS' concerns and grievances which cannot be settled through collective platforms such as stakeholder consultations due to the complexity of the concerns or grievances and/or due to the absence of such platform at the time when a cause for grievances occurs; and
- Address AS' concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to the country's judicial or administrative remedies commensurate to risks and adverse impacts of the Project.

2044. **Table 7.1.1** lists the activities conducted in setting up the GRM for the Project.

Table 7.1.1 GRM-Related Activities Conducted

Activity	Details	Date	Involved Organizations
Gap Analysis	One proposed project policy to bridge gaps in establishing the GRM is its establishment under the PMO, RAP Implementation and Management Committee (RIMC) and Local Interagency Committee (LIAC), and representation of the AS in organizing the GRM	January 2018	DOTr, JICA, ADB, JDT
Meeting on RAP Concerns	ADB shared Terms of Reference for the GRM Workshop (Capacity Building Workshops on Grievance Redress Mechanism and Problem-Solving Tools for ADB-Assisted Projects)	07 March 2018	DOTr, JICA, ADB, JDT
GRM Workshop	Conducted for NSCR Clark Extension and SC	10-12 April 2018	DOTr, ADB, JICA, ADB, LGU representatives
EIS and RAP Preparation	Incorporated GRM procedures for RAP and Environmental Concerns in report preparation	July & October 2018	DOTr, JICA, ADB, JDT, Ecosys, GTI
Communication Strategy Meeting	Discussed the needs in setting up the GRM to be included in ADB communication plan for the Project including assessment of existing GRM of DOTr, conduct of GRM trainings for DOTr, monitoring of GRM process, involvement of LGUs	27 September 2018	ADB, JICA, DOTr, JDT
DD Meetings with LGUs	Requested from LGUs to physically allocate space for the help desk to be manned by DOTr Provided contact details of DOTr where grievances/ concerns related to environment may be raised while the GRM and physical help desk in LGUs are being set up	18 September to 02 October 2018	DOTr, JICA, ADB, JDT Ecosys, LGUs
Meeting on RAP Concerns	Discussed the need to set up the GRM and help desk before issuance of notice of taking	19 October 2018	DOTr, Ecosys, JDT
Meeting on RAP Concerns	Informed GRM workshops to start on February 2019 Required the preparation of Frequently Asked Questions (FAQ) Sheet to include RAP and environmental concerns	07 December 2018	DOTr, ADB, JDT, Ecosys

Activity	Details	Date	Involved Organizations
	Informed the release of draft GRM/ Communications Report by ADB on December 10-14, 2018		
Meeting on External Monitoring	Informed that external monitoring is a requirement for projects with significant involuntary resettlement impacts based on ADB Safeguard Policy Statement 2009 Requested data on any reports on institutional arrangement updates, GRM, increases in number of AS and/or grievances for external monitoring	13 December 2018	ADB, JICA, DOTr, JDT
Meeting on RAP Concerns	Discussed that workshops on GRM scheduled by January 2019 has to be participated in by designated GRM representatives from DOTr and LGUs	20 December 2018	DOTr, PNR, JDT, Ecosys
Livelihood Meetings with LGUs	Reiterated the request for space allocation and permanent staff of LGUs for the help desk	11 December 2018- 08 January 2019	DOTr, JDT, LGUs,
Help Desk Workshop	Discussed the following and incorporated practical applications in handling grievances through the help desk: Definition and importance of help desk and its legal basis GRM objectives, levels, process, and roles and responsibilities of involved government entities and stakeholders GRM for RAP and Environmental Concerns Sample grievance action form, FAQ sheet and reminders and conducted exercises on latest GRM incorporating new elements such as central/ local help desks, handling anonymous complaints and complaints filed on field, the resolve-together option, and monitoring - Next steps including capacity building and validation activities; materials and design production; communication and promotion of GRM to all stakeholders; pilot roll-out of help desk; and, monitoring activities	04-05 April 2019	DOTr, ADB, JICA, JDT, LGU GRM representatives
Iteration Session on SC: EIA, RAP, GRM and SCS	Discussed and iterated the design process, scope, purpose, objectives, key actors, levels, tasks, elements and progress of GRM for SC	17 June 2019	DOTr, ADB, JDT

7.2. PRINCIPLES GUIDING THE GRIEVANCE REDRESS MECHANISM

2045. The implementation of grievance redress must be anchored on several principles to guide the process and decision as follows:

- A complainant's details should be confidential.
- The grievance redress procedure must be explained, and cases must be presented and deliberated in a language understandable by project stakeholders; technical terms must be explained in layman's terms.
- The grievance redress procedure must be transparent, gender-responsive, and culturally appropriate.
- The grievance redress procedure must be readily accessible to affected persons at no cost such as administrative and legal fees without retribution. Incurred costs to achieve a resolution will be covered by the DOTr.
- A grievance is resolved expeditiously at all times at the lowest level if possible.

7.3. DOTr's GRIEVANCE REDRESS MECHANISM TEAM

2046. The DOTr has dedicated Grievance Redress (GR) Officers for the Project, whose tasks and responsibilities are focused entirely on the GRM. GR Officers are either assigned to the Local GRM Team of each local government unit (LGU) helpdesk or to the Central GRM Team of the PMO. The GRM will cover the whole SCRP including the Senate-FTI-Bicutan Segment. Roles and responsibilities as well as the composition of the team are described in the following sections.

7.3.1. Local Grievance Redress Mechanism Team

2047. The Local GRM Team is assigned to a specific city/municipality affected by the Project and is composed of trained officers who are 1) DOTr's dedicated staff and 2) an LGU representative. The officers serve as the first in-person contact point for legal AS and ISFs, and to receive their grievances filed in their city/municipality.

7.3.1.1. Roles and Responsibilities

- Receive, monitor, and track grievance cases across all levels raised in their assigned LGU, so that grievances are addressed in a timely manner;
- If the concern is beyond the Local GRM Team's capacity to decide, forward the complaint to a technical person or committee;
- Log-in all grievances raised in the assigned LGU to the Project Database and monitor the case throughout the process until the cases are closed;
- Provide updates using the AS' preferred communication tool on the status and resolution of grievance in a timely manner; and
- Provide information and support to AS on Project-related resettlement and land acquisition activities, including provision of assistance to AS to complete required documents and other required support.

7.3.1.2. Staff Composition

2048. The Local GRM Team will consist of DOTr and LGU representatives:

- DOTr Local GR Officer - responsible for answering and explaining issues related to the Project, and for tracking and keeping records of submitted and required/outstanding documents.
- An LGU representative - responsible for answering and explaining issues related to the Project. He/she will assist the AS to secure LGU related documents and access data from LGU offices when needed. He/she will also take note of urgent issues and concerns that may arise during the absence of DOTr Local GR Officer and report immediately to DOTr Central GR Officer for information and appropriate action.

7.3.2. Central Grievance Redress Mechanism Team

2049. The Central GRM Team is in charge of grievances channeled through the DOTr Central Office (Central Hotline, e-mail, SMS, and letters) and will be responsible for receipt and acknowledgement, registry, and eligibility assessment.

7.3.2.1. Roles and Responsibilities

- Overall monitoring and tracking of the grievance cases across all levels raised in the assigned Local and Central GRM, so that the grievance is addressed properly and promptly;
- Respond to all grievances received via the Central Hotline and Local GRM Team;

- Log in, manage, and maintain a database for all complaints and the corresponding actions and decisions on the complaints received raised in the Central GRM until they are closed;
- Act as Central Database Manager;
- Provide updates using the AS' preferred communication tool on the status and resolution of grievance in a timely manner;
- Provide information and support to AS on project related grievances, particularly issues on land acquisition and resettlement and livelihood improvement, and restoration programs;
- Prepare Quarterly Monitoring Reports on GRM with accomplishments and status of unresolved grievance to JICA and ADB;
- Conduct capacity building trainings for GR officers in order to improve, retain their skills, knowledge, tools, equipment, and other resources needed to implement the GRM; and
- Provide inputs as requested to internal and external monitoring activities.

7.3.2.2. Staff Composition

2050. The Central GRM Team will have 11 members and will be composed of the GRM Manager, Central GR Officers, DOTr Resettlement/Land Acquisition Expert and engineers. The role of the Central GRM Team members are described below.

- DOTr GRM Manager – responsible for managing the GRM Team and ensuring the GRM Team functions efficiently.
- DOTr Central GR Officers – responsible for all GRM operations, tracking and keeping records of submitted and required/outstanding documents, and GRM Monitoring and Evaluation (M&E).
- PMO Resettlement/Land Acquisition Expert – responsible for answering and explaining issues related to the contents of the RAP including questions on entitlement and legal procedure (i.e. EJS cases, mortgage property, land registration, etc.).
- PMO Land Acquisition/Engineers - responsible for answering/explaining issues related to the engineering design, the Project's ROW, the alignment, affected properties, the severity of impacts on properties, and all engineering-related concerns.
- PMO Environment Officer - responsible for answering and explaining issues related to health, safety and environment issues of the Project.

7.4. LEVELS OF GRIEVANCE REDRESS MECHANISM

2051. There are four levels of GRM for grievances on environmental, health and safety issues with an assigned GRM team at the PMO under the DOTr's Office of the Undersecretary for Railways, which serves as the first contact point for AS. **Table 7.4.1** summarizes the levels of grievances for environmental, health and safety issues.

Table 7.4.1 Levels of Grievance Redress Mechanism

Level	Environment Issue	Health and Safety Issue	Timeline
1st level	Helpdesk/Central Hotline (DOTr)		Same day
2nd level	2A: Health, Safety and Environment Officer (HSEO)		3 days
	2B: Health, Safety and Environment Committee (HSEC) Multi-partite Monitoring Team (MMT) for SCRP		10days/20 days for joint investigation
3rd level	Regional Director of Department of Environment and Natural Resources – Environmental Management Bureau (DENR-EMB)	DOTr's management level	15 days
4th level	Department of Environment and Natural Resources	Court of Justice	

Source: JICA Design Team

7.4.1. Level 1: Local/Central Help Desk (Local/Central GRM Team)

2052. There are two ways for legal AS and ISFs to raise grievances. These include help desks set up at each LGU, and the Central Hotline.

2053. The Helpdesk, which is a physical office, is the first contact point for legal AS and ISFs in the GRM and a venue for raising issues, concerns, and questions related to the Project. Helpdesks will be set up at each LGU, staffed with Local GR Officers. The Helpdesk will operate at least once a week. Depending on demand, it will operate more frequently, especially during the period of the issuance of Notice of Taking and during relocation. On days when the Local Helpdesk is not operating, AS may use the Central Hotline and e-mail DOTr.

2054. In addition to the Helpdesk, AS can also reach DOTr through its Central Hotline. Central GR Officers will answer calls and respond to text/SMS messages from 8AM to 5PM from Monday to Friday, as well as grievances and enquiries received by emails and letters.

2055. When receiving a grievance, the Local/Central GR Officers determine if: (a) the complaint is Project-related or not; (b) the complainant is a legal AS or ISF and; (c) if the nature of the issue is environmental or social. As part of basic policies for the GRM, the grievance will be resolved expeditiously at all times at the lowest level if possible. However, (a) if not settled at the lowest level, (b) if the complainants are not satisfied with the action taken, or (c) the case is not acted upon after 15 days, the issue or concern is elevated to the next level.

2056. The following are the processes of the Local/Central GRM Team of the Helpdesk/Central Hotline:

- Receive a written or verbal complaint via SMS, emails, letters, and phone calls from AS;
- Record the grievance into a grievance action form (GAF), provide the AS the control number. The control number enables the AS to track their complaint in the database and explain the process to the AS including who is responsible for acting on the complaint;
- Clarify whether the nature of the complaint is Project-related or not. If the complaint is not Project-related, assist him/her by forwarding the complaint to the appropriate agency or LGUs who could act on the complaint. If the concern is beyond the Helpdesk capacity to resolve, forward the complaint to 2nd level;
- Research Project-related issues, and promptly provide AS answers, clarifications, or solutions (if concerns need further action/solution);
- Monitor and follow-up on the action taken including site visits if applicable and/or needed; and
- Close out the case when the actions and resolutions to resolve the complaint have been completed.

7.4.2. Level 2: Health, Safety and Environment Officer and Health, Safety and Environment Committee

7.4.2.1. Level 2A: Health, Safety and Environment Officer

2057. The Local GRM Team sends grievances unresolved at the first level to the HSEO level (Level 2A). The HSEO is responsible for providing immediate resolution of urgent environmental grievances that, if not addressed immediately, may result to more adverse impacts. The HSEO will be part of the PMO for the Project.

2058. The following are roles and responsibilities of the HSEO:

- Address grievances related to formal AS which are unresolved at the local Helpdesk sent by the Local GRM Team;
- Act and decide on each complaint within 3 working days once the complaint has been filed by the Local GRM Team;
- Endorse the resolved case back to the Local GRM Team when the action to resolve the complaint has been completed; and
- Elevate unresolved, urgent or complex health, safety and environmental concerns to the HSEC.

7.4.2.2. Level 2B: Health, Safety and Environment Committee

2059. The Local GRM Team sends grievances unresolved at the HSEO level (Level2A) to the HSEC level (Level 2B). The HSEC will be under the PMO for the Project, and will consist of the HSEO, the General Consultant (GC), and the contractors. The HSEC will be responsible for receiving all environment-related complaints elevated by the Local GR Officers/Central GR Officers. In addition, AS are informed that they have an option to engage the HSEC for a "decide together" option. The following are the roles and responsibilities of the HSEC:

- Discuss forwarded grievances at a weekly meeting;
- Address grievances related to formal AS which are unresolved at the HSEO level sent by the Local GRM Team;
- Act and decide on each complaint within 10 working days once the complaint has been filed by the Local GRM Team;
- Hold public consultations within the scope of the complaint to consult with the community;
- Conduct an internal review on the grievance within seven (7) days upon receipt of the complaint from the Local GRM Team or within eight (8) days together with the AS in case that an AS opts for a joint approach for grievance redress, subsequently promoting a dialogue and a joint brainstorming meeting between the HSEC and the AS in order to formulate a solution or an action plan to address the grievance raised within five (5) days.
- Endorse the resolved case back to the Local GRM Team when the action to resolve the complaint has been completed; and
- Elevate unresolved, urgent, or complex health, safety and environmental concerns to the Regional Directors of DENR-EMB National Capital Region (NCR) and Region 4A (whichever is appropriate)/the PMO Board, which indicates the transition of grievance redress from the investigation and response phase to the appeal and/or final response phase.

2060. The PMO will initiate the formation of the Multi-partite Monitoring Team (MMT) compliant to Section 18 of DAO No. 2017-15. A Third-Party Auditor (TPA) may be engaged in lieu of an MMT based on discussions with the DENR-EMB Central Office. Both the MMT/TPA and the PMO Board will handle health, safety, and environment issues. Their roles and responsibilities pertaining to grievances are the following:

- Assign a focal to provide secretariat support such as coordination with the Central GRM Team, process documentation, and information updating on the Central Database;
- Receive endorsement from the Central GRM Team and update the status of the case as “undergoing final review and response” on the Central Database;
- Convene a meeting once a month but immediately once the grievance is elevated to their level by the Central GRM Team;
- Act and decide on each complaint filed to the MMT/TPA within 15 working days and then communicate and endorse a resolution to the Central GRM Team which will then deliver a decision to the complainant; and
- Officially communicate the decision through the Central GRM Team in writing to the AS in one day from the date of issuance of the decision.

2061. More complex legal matters are endorsed to the DOTr’s legal department. The department’s roles and responsibilities are as follows:

- Receive the endorsement from the Local GRM Team;
- Act and decide on each complaint within 15 working days once the complaint is filed by the Local GRM Team and inform the Local GRM Team of the recommended action/solution, which, in turn, allows the Local GRM Team to mark the status of the case in its local database as “action/resolution ongoing”; and
- Endorse the resolved case back to the Local GRM Team when the action to resolve the complaint is completed, which subsequently allows the team to update the local database and mark the status of the case as “action completed”.

7.4.3. Level 3: Regional DENR-EMB/DOTr’s PMO Board

2062. The Regional Offices of DENR-EMB (NCR and Region 4A Offices) are responsible for handling major issue/concerns raised that are within the scope of the Project, while the PMO is in charge of handling health and safety issues. Their roles and responsibilities pertaining to grievances are the following:

- Assign a focal to provide secretariat support such as coordination with the Central GRM Team, process documentation, and information updating on the Central Database;
- Receive the endorsement from the Central GRM Team and update the status of the case as “undergoing final review and response” on the Central Database;
- Convene regularly a once a month meeting but this will be held immediately once the grievance is elevated to their level by the Local GRM Team;
- Act and decide on each complaint filed to the MMT/DOTr’s PMO Boards within 15 working days and then communicate and endorse a resolution to the Central GRM Team which will then deliver a decision to the complainant; and
- Officially communicate the decision through the Central GRM Team in writing to the AS in one day from the date of issuance of the decision.

7.4.4. Level 4: DENR/Court of Justice

2063. Issues not addressed at the third level are elevated to the DENR-EMB for environmental issues and the Court of Justice for health and safety issues. The corresponding administrative and legal fees will be covered by the DOTr only if the AS sues a party other than the DOTr. If the AS sues the DOTr, the Public Attorney’s Office (PAO) can provide the AS with free legal assistance.

7.4.5. Other Grievance Procedures

7.4.5.1. Grievance Redress Procedure on Government Officials

2064. Some Project-related grievances related to the Project but pertaining to activities of other concerned stakeholders are handled as follows:

- Complaints against local government executives are filed with the Department of Interior and Local Government (DILG).
- Complaints against subordinate officials are filed with the office of the local chief executive concerned.
- Complaints against officials of other national agencies may be filed with the Office of the President of the Philippines or the Office of the Ombudsman.
- Aggrieved parties may also direct their complaints to and/or seek assistance of the Commission on Human Rights (CHR) or the Presidential Commission for the Urban Poor (PCUP).

7.4.5.2. Grievance Redress Procedure for Indigenous People

2065. According to the results of the feasibility study (FS) and the detailed design (DD) study, no indigenous people (IP) community is anticipated to be affected by the Project. In the event that an IP community is affected, grievances expressed by them and/or conflicts within the affected IP community are addressed within the community itself in the context of its customary law and customary dispute resolution process and mechanism. The relevant staff of the National Commission on Indigenous Peoples (NCIP) Office with jurisdiction over the area and if invited, project-related staff and other stakeholders, (e.g., formal local leaders in the barangay and/or the municipality) are enjoined to participate in the process.

2066. Likewise, inter-community conflicts are addressed between communities themselves according to their customary or agreed dispute resolution processes and mechanisms. If an external facilitator, mediator or arbiter is required or requested, the Resettlement Action Plan Team will seek the intervention of the NCIP to act as a facilitator, mediator or arbiter. This guideline will be applied to conflicts or disputes between IP communities and any of the Project units and implementers. If no satisfactory result is achieved, IP communities are allowed to elevate their complaints and grievances to the Provincial Inter Agency Committee (PIAC). The grievance procedure established herein in no way replaces the grievance procedure set forth in the Free and Prior Informed Consent (FPIC) Guidelines of 2012. At their disposal, IPs may avail of the grievance procedure and mechanism spelled out in the FPIC Guidelines of 2012.

7.4.5.3. ADB's Accountability Mechanism

2067. In addition to the Project's GRM, once all GRM measures have been exhausted, ADB's accountability mechanism is also applied to the Project. While the project-level GRM is the responsibility of the DOTr, the accountability mechanism is the responsibility of the ADB. The accountability mechanism provides opportunities for people, (i.e., two or more complainants who are adversely affected by ADB-financed projects) to express their grievances, seek solutions and report alleged violations against ADB's operational policies and procedures including safeguard policies. ADB's accountability mechanism is comprised of (i) consultations led by ADB's special project facilitator to assist people adversely affected by ADB-assisted projects in finding solutions for their concerns and (ii) a process through which those affected by projects can raise requests for compliance review by ADB's Compliance Review Panel. Details of the accountability mechanism can be found at the following link: https://www.adb.org/documents/accountability-mechanism-policy-2012.

7.4.5.4. JICA's Objection Procedure

2068. Alternatively, people, (i.e., two or more persons who suffer or are likely to suffer from substantial damages caused by JICA's non-compliance with its Guidelines for Environmental and Social Considerations regarding the Project) may submit an objection to JICA and request investigation. Details of JICA's objection procedure based on its guidelines can be found at the link: https://www.jica.go.jp/english/our_work/social_environmental/objection/index.html.

7.5. GRIEVANCE REDRESS MECHANISM PROCEDURE

2069. Grievances from the AS pertaining to environmental issues with regard to the Project will be handled free of monetary charge through negotiations aimed at reaching a consensus. The procedure is described in **Table 7.5.1** below.

Table 7.5.1 Grievance Redress Mechanism Procedure

<table>
<tr><th>No.</th><th>Actor</th><th colspan="3">Action</th></tr>
<tr><td>1</td><td>Aggrieved stakeholder</td><td colspan="3">An AS lodges the grievance in person to the local Helpdesk, or in writing, verbally or electronically transmitted to the Central GRM Team within the PMO for immediate action.</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">1st Level: Helpdesk/ Hotline</td><td colspan="2">[Helpdesk]

When the grievance is received, it may be written down in the Grievance Action Form GAF (Figure 7.7.1) by the staff of the Helpdesk on behalf of the AS who signs the written complaint for official submission.
A unique code for each AS is assigned
An acknowledgement slip is provided.
The AS gets explanation on the GRM process and is provided with contact details of the officer in charge of the complaint.
The complaint is reviewed to determine whether it is Project-related or not.
Documents presented by the AS are digitized (if any), and control numbers are assigned to the documents.
The GAF is encoded into the Central Database.</td><td>[Hotline]

When the grievance is received, it may be written down in the GAF by the Central GR Officer on behalf of the AS.
A unique code for each AS is assigned.
An acknowledgement slip is provided via phone call, email, SMS, and letter for each complaint for quick reference.
The AS gets an explanation on the GRM process and is provided with contact details of the officer in charge of the complaint.
The complaint is reviewed to determine whether it is Project-related or not.
Documents presented by the AS are digitized (if any), and control numbers are assigned to the documents.
The GAF is encoded into the Central Database.</td></tr>
<tr><td>2-a) If the complaint is Project-related, the Local/Central GR Officer resolves it on the spot (such as answer queries).</td><td>2-b) If it is not Project-related, the Local/Central GR Officer assists the AS by referring the complaint to appropriate agencies or LGUs which may be able to act on the complaint. The Local/Central GR Officer will issue an acknowledgement slip for the AS to fill and mark the status of the case as “closed/referred to the third party”.</td><td>2-c) If the complaint is Project-related, and beyond the Local/Central GR Officer’s capacity, the Local GR Officer will raise the case to the appropriate agency and next level.</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Aggrieved stakeholder</td><td colspan="3">The AS receives the action from the first level through the Local/Central GR Officer.</td></tr>
<tr><td>3-a) If the AS is satisfied with the decision, the complaint is resolved and recorded accordingly.</td><td>3-b) If the AS is not satisfied with the decision, the stakeholder may elevate his/her complaint to the second level.</td><td>3-c) If the complaint is beyond the Local/Central GR Officer’s capacity, he/she assists the AS by referring the complaint to the second level</td></tr>
<tr><td>4</td><td>Local/ Central GRM Team</td><td>In case of 3-a):
The Local/Central GR Officer will inform the AS that the case is closed via e-mail, SMS, letter and record the case as “closed” in an acknowledgement slip; the record in the database will also be updated as “closed”.</td><td>In case of 3-b):
Receive request from the AS to elevate his/her complaint to the HSEO.
Record the status of the AS complaint.
Forward the complaint to the 2nd level within one day or from receipt of complaint or by close of business.</td><td>In case of 3-c):
Receive request from the AS to elevate his/her complaint to the HSEO.
Record the status of the AS complaint.
Forward the complaint to the 2nd level within one day or from receipt of complaint or by close of business.</td></tr>
</table>

No.	Actor	Action		
5	Local/ Central GRM Team	In case of 3-a): The Local/Central GR Officer will inform the AS that the case is closed via e-mail, SMS, letter and record the case as "closed" in an acknowledgement slip; the record in the database will also be updated as "closed".	In case of 3-b): Receive request from the AS to elevate his/her complaint to the HSEO. Record the status of the AS complaint. Forward the complaint to the 2nd level within one day or from receipt of complaint or by close of business.	In case of 3-c): Receive request from the AS to elevate his/her complaint to the HSEO. Record the status of the AS complaint. Forward the complaint to the 2nd level within one day or from receipt of complaint or by close of business.
6	2nd LevelA: HSEO	The complaint from the Local GR Officer is received. The HSEO registers the case as "ongoing" at the Central Database. The action or resolution is drawn within only 3 working days once it is filed by the Local GR Officer. The Local GR Officer is informed about the action or decision on the AS' complaint.		
7	Local GRM Team	The decision from the HSEO is received and recorded. The Local GR Officer relays the decision to the AS.		
8	Aggrieved stakeholder	Receives action of the HSEO through the Local GR Officer		
		8- a) If satisfied, the complaint is resolved and recorded accordingly.	8- b) If not satisfied with the decision of the HSEO or if his/her complaint has not been acted upon within a period of one working day and has not received any response from HSEO decision maker, the AS can forward the complaint, or file an appeal, to the HSEC.	
9	Local GRM Team	In case of 8-a): The Local GR Officer will write down "case closed" on the acknowledgement slip and issue via e-mail, SMS, letter, or by hand to the AS and record as "closed" in the GAF and Central Database	In case of 8-b): Receive request from the AS to elevate his/her complaint to the HSEC Record the status of the AS' complaint. Forward the complaint to the HSEC via the Local GRM Team within one working day from receipt of complaint.	
10	2nd LevelB: HSEC	The complaint from the Local GR Officer is received. The HSEC registers the case as "ongoing" at the Central Database. More complex legal concerns are endorsed to the DOTr's Legal Department. The action or resolution is drawn within 10 working days once it is filed by the Local GR Officer. If the AS chooses a "decide together" option, the action or resolution is drawn within 20 working days once the complaint is filed by the Central GR Officer. The Local GR Officer is informed of the action or decision on the AS' complaint.		
11	Local GRM Team	The decision from the second level is received and recorded. The AS is informed of the decision.		

No.	Actor	Action	
12	Aggrieved Stakeholder	The action of the second level is delivered through the Local/Central GR Officer .	
		12- a) If the AS is satisfied with the decision, the complaint is resolved and recorded accordingly.	12- b) If the AS is not satisfied with the decision of the second level or if his/her complaint is not acted upon within 15 working days and he/she does not receive any response from the second-level decision maker, the AS can forward the complaint to or file an appeal with the MMT/ TPA/DOTr's PMO Board
13	Local GRM Team	In case of 12-a): The Local GR Officer writes down "case closed" on the acknowledgement slip which is given to the AS, and records the status of the case in the database as "closed". The Central GR Officer informs the AS that the case is closed via email, SMS, letter and records the status of the case as "closed".	In case of 12-b): The AS asks to elevate his/her complaint to the MMT/ TPA/DOTr's PMO Board The status of the AS' complaint is recorded, and the complaint is forwarded to the third level within 15 working days from receipt of the complaint.
14	3rd Level: MMT/TPA PMO Board	The complaint from the Local GR Officer is received. The complaint is endorsed to the MMT/TPA for handling environmental issues and the PMO Board for health and safety issues. The action or resolution is drawn within 15 working days, and the AS is informed of the final decision accordingly. The Local GR Officer is informed of the action or decision on the AS' complaint.	
15	Local GRM Team	The decision from the MMT/ TPA/PMO Board is received and recorded. The AS is informed of the decision.	
16	Aggrieved stakeholder	The action of the third level is delivered through the Local GR Officer.	
		15-a) If the AS is satisfied with the decision, the complaint is resolved and recorded accordingly.	15- b) If the AS is not satisfied with the decision of the third level or if his/her complaint is not acted upon within 15 working days and he/she does not receive any response from the third-level decision maker, the AS can forward the complaint to or file an appeal with the fourth level.
17	Local GRM Team	In case of 16-a): The Local GR Officer will write down "case closed" on the acknowledgement slip and issue it to the AS via e-mail, SMS, letter, or by hand; the case will also be recorded as "closed" in the GAF and Central Database	In case of 16-b): The AS asks to elevate his/her complaint to the fourth level. The status of the AS' complaint is recorded. The complaint is forwarded to the fourth level within one working day from receipt of the complaint.
18	4th level: Court of Justice/ DENR	The complaint from the AS is received. Once the complaint is filed with the Court of Justice or the DENR, the procedure on the case is followed.	

7.6. GRIEVANCE COMMUNICATION

2070. The Local/Central GRM Team will keep updating the AS on the status of their complaints and resolutions. The proposed communication method with the AS is presented in **Table 7.6.1**. The Grievance Action Form (GAF) is provided once the AS files grievances/concerns with the Helpdesk/Hotline. The form includes a section where the AS can select their preferred means of contact. The Helpdesk drop box will have a printed instruction indicating that all letters that will be submitted should contain at least the AS' name and/or contact details. Complaints will be handled on a case-to-case basis in accordance with the sensitivity of the case, and all communication related to the complaint will be made exclusively with the AS. Anonymous general complaints/queries will be posted in the public information board.

Table 7.6.1 Communication Methods with AS

Person in Charge	Grievance Received Through:	Immediate Actions Taken by the GRM Team	Acknowledge-ment of Receipt	Inform the Decision made at GRM	Agreement to Close the Issue	Communication Method with AS
Helpdesk (Local GR Officer)	Over the counter	AS will fill out the GAF with the assistance of the GR Officer.	An acknowledge-ment slip is provided with the control number.	AS is informed of the decision made in the GRM through the AS' preferred channels indicated on the GAF.	The GR Officer asks whether to close the case.	In person (at the Helpdesk) Emails Phone calls Text/SMS Response letters Posting on an information board (if anonymous)
	Drop box	The GR Officer fills out the GAF and provides a response as much as possible.	—	The GR Officer publishes the answer on the bulletin board and/or notifies the AS through his/her provided contact details.	When the answer is published on the bulletin board and is responded through the contact details, the grievance case is closed.	
Hotline (Central GR Officer)	Hotline (phone calls, text/SMS and emails)	The GR Officer fills out the GAF.	A control number is provided. If the AS uses SMS to communicate, the number is provided via SMS.	AS is informed of the decision made in the GRM through the AS' preferred channels indicated on the GAF.	The GR Officer asks whether to close the case.	Emails Phone calls Text/SMS Response letters
	Letters	The GR Officer fills out the GAF. If information is not sufficient, AS is contacted for further information.	The GR Officer sends a solution letter with an acknowledgement slip and a control number and will specify a deadline to respond. The letter will include the Central GR email address and text number. Or If AS mentions a specific contact number or an email address in the letter, the GR Officer provides a control number, and the same process for a Hotline is followed .		AS will respond to the acknowledge-ment slip attached to the letter to confirm whether the case is closed.	

Source: JICA Design Team.

7.7. TOOLS, MATERIALS AND EQUIPMENT REQUIRED FOR OPERATIONS OF LOCAL/CENTRAL GRM

2071. **Table 7.7.1** lists the tools, materials and equipment required for operations of the Helpdesk and the GRM Team. It also includes the responsible entities for each item along with the sources of funding. The various communication tools are further explained in the following sections.

Table 7.7.1 List of Required Tools, Materials and Equipment

Item		Local GRM	Central GRM	Responsible Entity	Fund
Staff	GRM Team	✓	✓	DOTr/LGU	DOTr
Office	Space, desk, and chairs	✓	✓	DOTr/LGU	DOTr/LGU
	Telephones	✓	✓	DOTr/LGU	DOTr/LGU
	Computers	✓	✓	DOTr/LGU	DOTr/LGU
	Internet access	✓	✓	DOTr/LGU	DOTr/LGU
	Letters/drop boxes	✓	✓	DOTr/LGU	DOTr
	Bulletin Board	✓	✓	DOTr/LGU	DOTr
	All in one printer (scanner, printer, photocopier) with supplies	✓	✓	DOTr/LGU	DOTr
Operation tool	Grievance Action Form (GAF)	✓	✓	DOTr / LGU	DOTr*
	Acknowledgement Slip (Receipt and Resolution)	✓	✓	DOTr/LGU	DOTr*
	Response letter format	✓	✓	DOTr/LGU	DOTr*
	Database	✓	✓	ADB/DOTr	DOTr
Supporting tool	GRM/Helpdesk Guideline	✓	✓	DOTr	DOTr*
	Directory for other agencies	✓	✓	DOTr	DOTr*
Communication tool	Maps showing the ROW within each LGU	✓		DOTr	DOTr*
	Project information booklets	✓	✓	DOTr	DOTr
	Leaflets on project information, land acquisition/resettlement and the GRM	✓		DOTr	DOTr*
Monitoring tool	Monitoring forms		✓	DOTr	DOTr*

Source: JICA Design Team.

7.7.1. Guideline on the Grievance Redress Mechanism

2072. The implementation of grievance redress must be anchored on several principles to guide the process, decisions, resolutions, and steps forward. The draft GRM Guideline for the Project is attached in **Annex 7.1**.

7.7.1.1. Continuous Update of the Guideline

2073. The GRM Guideline will be updated every six (6) months to correspond with the latest complaint process. Discussions and revisions will be made by the Central GR Team based on improvements proposed and complaints mentioned in a monthly report. If necessary, interviews will be conducted directly with local officers on site. The updated GRM Guideline will be promptly distributed to each local Helpdesk and Central GR Officer.

7.7.2. Grievance Action Form

2074. The Grievance Action Form (GAF) is a registry form of grievance and complaints received by the Helpdesk and Hotline. It is completed by the complainant or the GR Officer, and is registered into a centralized database. The form contain will contain fields that will provide sufficient information to understand/resolve the issue and contact details to

communicate with the AS (**Table 7.7.2**). The GAF will be accessible to the users, will be available in paper and online formats, and will be prepared in the local language (i.e. Filipino). A sample form is shown in **Figure 7.7.1**.

Table 7.7.2 Fields of the Grievance Action Form

<table>
<tr><th>No.</th><th>Item</th><th colspan="4">Detail</th></tr>
<tr><td>1</td><td>GAF control number</td><td colspan="4">Registration number to be provided in accordance with the pre-determined numbering system</td></tr>
<tr><td>2</td><td>Date and time</td><td colspan="4">Date and time when the complaint was first received</td></tr>
<tr><td>3</td><td>Basic information of AS</td><td colspan="4">Name, gender, address, date of birth, contact details and occupation
Name of spouse and date of birth of spouse</td></tr>
<tr><td>4</td><td>Category of filed grievances</td><td colspan="4">Environment Related
Health and safety Related
RAP Related
Non-environmental/RAP Related</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">Actions taken</td><td colspan="4">Date of actions resolved</td></tr>
<tr><td>RAP
Resolved at GR Officer level
Resolved at RIMC/ ROWSA Committee /Legal Department
Resolved at PIAC
Referred to Court</td><td>Environmental[1]
Resolved at HSE officer level
Resolved at HSEC level
Resolved at MMT/TPA level
Referred to DENR- EMB</td><td>Health and Safety Related
Resolved at HSE Officer level
Resolved at HSEC level
Resolved at PMO Board</td><td>Others</td></tr>
<tr><td>6</td><td>Referral details</td><td colspan="4">Name of authority
Office
Position
Date of meeting
Venue</td></tr>
<tr><td>7</td><td>Details of grievances</td><td colspan="4">Description of received complaints</td></tr>
<tr><td>8</td><td>Details of resolutions</td><td colspan="4">Description of provided resolutions</td></tr>
<tr><td>9</td><td>Preferred means of contact</td><td colspan="4">Over the counter
Letters
Phone calls
Emails
SMS/texts
Social media
Public information board</td></tr>
<tr><td>10</td><td>Remarks</td><td colspan="4"></td></tr>
</table>

Source: JICA Design Team.

[1] The Environment and Health and Safety GRM are modelled on the same principles and process of the Resettlement GRM. However, the agencies involved in resolving issues are different. Refer to the Project's Environment Impact Assessment Report for details of the Environment and Health and Safety GRM.

GRIEVANCE ACTION FORM

Paalala: Ang mga nakalimbag na porsyon ay pupunan lamang ng Grievance Officer.

GAF Control Number:

IMPORMASYON UKOL SA PROYEKTO

Pangalan: **North-South Commuter Railway-Extension (NSCR-Ex) Project**
Tagapagpatupad: **Department of Transportation**

Petsa kung kailan natanggap: _____

TUMANGGAP
(Lagda) _____
Pangalan: _____
Posisyon ng tumanggap: _____

PERSONAL NA IMPORMASYON NG NAGREKLAMO

Pangalan: _____ Kasarian: Lalaki / Babae Petsa ng Kapanganakan (MM-DD-YYYY) _____

Pangalan ng Asawa: _____ Kasarian: Lalaki / Babae Petsa ng Kapanganakan (MM-DD-YYYY) _____

Tirahan: _____
Trabaho: _____
Numero: _____

DETALYE NG REKLAMO NA IDINUDULOG

KATEGORYA (Bilugan ang nararapat na letra)

A Patungkol sa Pangkapaligiran
B Patungkol sa Kalusugan at Kaligtasayan
C Patungkol sa RAP (Resettlement Action Plan)
D Atbp.

URI NG AKSYON (Bilugan ang nararapat na letra)

PANGKAPALIGIRAN

A Naresolba sa antas ng HSE Officer
B Naresolba sa antas ng HSEC Level
C Naresolba sa antas ng MMT Level
D Naresolba sa antas ng DENR – EMB

RAP

A Naresolba sa antas ng Grievance Officer Level
B Naresolba sa antas ng LIAC / ROW PMO
C Naresolba sa antas ng PIAC
D Naresolba sa antas ng Court

DETALYE NG REKLAMO OR TANONG

Petsa: _____

Tala ng Reklamo o Tanong:

DETALYE NG NAGREKOMENDA

Pangalan: _____
Opisina: _____
Posisyon: _____
Petsa ng Pagpupulong: _____
Lugar: _____

DETALYE NG SAGOT SA REKLAMO O RESOLUSYON

NAIS NA PARAAN NG PAKIKIPAG-UGNAYAN

A Personal
B Liham
C Telepono
D E-mail
E Mensahe sa pamamagitan ng 'cellphone'
F 'Social Media'
G 'Public Information Board'

Inirekomenda ni : _____
(Pangalan at Signatura ng Grievance Officer)

Sinang-ayunan ni: _____
(Pangalan at Signatura ng PAP)

Petsa: _____

Source: JICA Design Team.

Figure 7.7.1 Grievance Action Form in Tagalog

7.7.3. Control Number of Grievance Action Form

2075. All complaints and grievances lodged at the Helpdesk and Hotline are given a control number. The control numbers will be assigned to the GAFs and will comprise of a coding system which allows easy identification of the date, the LGU where the grievance was raised, and the office managing the grievance (**Table 7.7.3**).

Table 7.7.3 Control Numbers of the Grievance Action Form

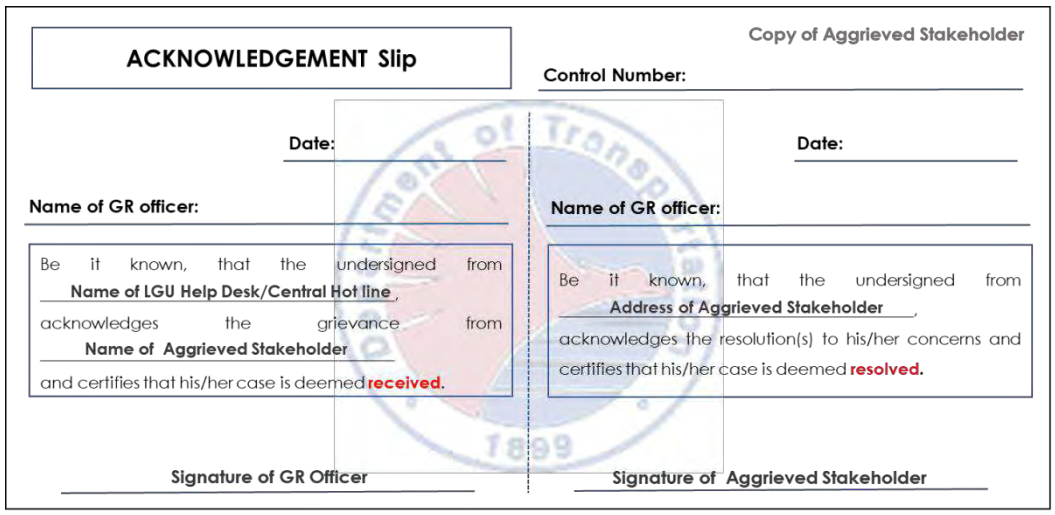
Date	Office Logged		GR Officer Number	GRM Channel	AS Number	Location of Affected Properties		Concerned Number
Possible values: Year 2018-2025 Possible values: Month 01-12	MNL	Manila City	S1	A: Personal B: Telephone C: Email D: Letter E: Text/SMS F: Social Media	Possible values: 0001-9999 Note: Each AS has a unique AS number.	MNL	Manila City	Possible values: 01-99
	MKT	Makati City	S2			MKT	Makati City	
	TAG	Taguig City	S3			TAG	Taguig City	
	PSY	Pasay City	S4			PSY	Pasay City	
	PRN	Paranaque City	S5			PRN	Paranaque City	
	MTN	Muntinlupa City	S6			MTN	Muntinlupa City	
	SPD	San Pedro City	S7			SPD	San Pedro City	
	BIN	Binan City	S8			BIN	Binan City	
	STR	Santa Rosa City	S9			STR	Santa Rosa City	
	CBY	Cabuyao City	S10			CBY	Cabuyao City	
	CMB	Calamba City	S11			CMB	Calamba City	
	CEN	Central GRM	C1-onwards					
SAMPLE CONTROL NUMBER: 201901- CEN- 01-B-0001- MNL-01								

Note: Table contains sample information only. Values for control numbers are yet to be finalized.

Source: JICA Design Team

7.7.4. Acknowledgement Slip for Receipt and Resolution

2076. Once the GR Officer receives a grievance from an AS, an “acknowledgement slip” in Tagalog format is issued to the AS within twenty-four (24) hours of receiving the grievance (example below is a copy in English format). When the AS contacts DOTr over the counter, drop box, or through a letter, the GR Officer provides a paper acknowledgement slip. The slip will serve as an acknowledgement of receipt and resolution. When a resolution satisfactory to both parties has been reached, the AS will sign on the right side of the slip to acknowledge the resolution of the grievance. The GR Officer will keep a copy of the slip. The acknowledgement slip format is shown in **Figure 7.7.2**. For other cases received via email or SMS, the acknowledgement slip is provided to the AS through the respective channel. When the complaint is received through a phone call, the GR Officer will ask the AS whether he/she prefers the acknowledgement slip to be delivered via email or SMS. The acknowledgement slip and the control number will make it possible to track the complaint, and thereby the AS should keep the number for reference.



Source: JICA Design Team

Figure 7.7.2 English Copy of Acknowledgment Slip for Aggrieved Stakeholders

7.7.5. Central Database

2077. The DOTr is planning to develop a software for the Central Database system for the sustainable operation of the GRM. Meanwhile, a temporary online Central Database has been developed using a spreadsheet. Although the software and the online system will have a different process in creating the Central Database, the basic function and contents are the same. Upon receiving grievance from the AS, the GR Officer will register the GAF information into the database. Data inputted at each LGU Helpdesk is uploaded online daily and are merged into the Central Database managed by the Database Manager of the Central GRM Team. The database is designed to accommodate manual inputs of GAFs by the Local and Central GRM Team who have access to the system.

7.7.6. Framework for the Temporary Online Central Database

2078. The temporary online Central Database will be operated until the software of the Central Database is developed. In instances where internet access is unavailable, each Helpdesk will have an Excel database (offline) to input the information. The Excel file with inputted information will then be transferred into the Central Database (online) by the Local GR Officer who is assigned to the Helpdesk from DOTr at the end of each Helpdesk operation day. Helpdesks with internet access can directly use the online GAF. Once the grievance is registered into the online GAF, the information is automatically registered to the Central Database.

2079. The data, once integrated and uploaded into the Central Database, will be accessible/viewable at any time to both the Central and Local GR Teams, including committee focal points, but editable only by the current assigned GR Officer. The Central GR Officer filters the Central Database for each LGU and shares it accordingly. The LGU Helpdesk cannot see the other LGU data to ensure the security of personal information.

2080. All the Central GR Officers will have access to the Central Database. When a grievance is received via phone call, e-mail, SMS, and letter, the Central GR Officer inputs information to the online GAF. The data inputted in the online GAF is automatically registered into the Central Database. Grievances raised to higher levels are managed in the same Central Database by the Local GR Officer.

Table 7.7.4 Operational Procedure for Online Central Database at 1st level

No.	Item	Description	Required Equipment	Responsible		Timeline
				Local GR Officer	Central GR Officer	
1	Register ID	Register login ID in the Central Database system and give appropriate access authority for each ID.	Online Central Database system Internet		✔	Before activating the Helpdesk
2	Distribution	Database in Excel and link of online GAF are distributed to each Helpdesk. Log in ID for accessing Central Database is distributed to each Helpdesk.	Registered ID Excel file database Link to online GAF		✔	Before activating the Helpdesk
3	Input	**No Internet at Helpdesk** Input information to the Excel file database along with the GAF written by AS.	GAF Database in Excel file	✔		As soon as complaint is received
		Internet Access at Helpdesk Input information heard from AS into the online GAF. Inputted information is automatically registered to the online Central Database.	Internet Online GAF	✔		
		Central Hotline Input information heard from AS who contacted the Hotline (phone call, e-mail, SMS, and letter) into the online GAF. Inputted information is automatically registered to the online Central Database.	Internet Online GAF		✔	
4	Integration	**No Internet** The Excel file database at each Helpdesk are collected and compiled into the Central Database. The Excel file database is collected through e-mail or hand delivered.	Excel file database Internet		✔	End of Helpdesk operation day
		Internet Access No need for integration				
5	Tracking	Follow up and clarify status of resolution for grievance at each level using status and deadline action date tab in Central Database.	Central Database	✔	✔	Everyday
6	Update	Once status of grievance is updated, reflect in database. The tab in the database for status of resolution is updated with the following items: a) Ongoing at the Helpdesk level b) Resolved at the Helpdesk and Endorsed to XX (responsible unit) for Implementation or Closed and Resolved c) Referred to RIMC/ ROWSA Committee /Legal Department/PIAC/Court (awaiting resolution) d) Resolved at the RIMC/ ROWSA Committee/Legal Department/PIAC/Court and Endorsed to AS	Central Database	✔	✔	Everyday
7	Feed back	**No Internet at Helpdesk** Updated information in Central Database is shared with Local Helpdesk in Excel file by Central GR Officers. Local Helpdesk can only have the copy of their own LGU database.	Database in Excel file		✔	At the latest one day before local Helpdesk resumes scheduled weekly operation

No.	Item	Description	Required Equipment	Responsible		Timeline
				Local GR Officer	Central GR Officer	
		Internet Access at Helpdesk Updated information in Central Database is shared to Local Helpdesk online by Central GR Officers. Each Local Helpdesk only can check its own LGU data.	Internet Access authority for updated database provided online		✔	
8	Browse Central Database	The Local GR Officer can access all inputs/cases relating to their specific LGU, but not everyone can edit. Only assigned complaint owner can edit at a given time.	Central Database Internet	✔	✔	Appropriately
9	Maintain	Conduct database health check following items once a month by person responsible Overlapped data Correct input style All items required for monitoring are filled in cell Information updated properly	Central Database		✔	Once a week
10	Backup	The copy of the Central Database is backed up daily to hard disk or online.	Central Database Hard disk Online server		✔	Once a month

Source: JICA Design Team.

2081. The role and responsibility of the GRM team for the Temporary Online Central Database is summarized in **Table 7.7.5**.

Table 7.7.5 Role and Responsibility of GR Team for Temporary Online Central Database

Responsibility	Local GR Officer	Central GR Officer	Database Manager
Generate user ID and password of spreadsheet database			✔
Create, update, and delete the spreadsheet format and online GAF			✔
Input the information of GAF written by AS to spreadsheet.	✔		
Collect the Excel file from each Local Helpdesk to integrate to the Central Database		✔	
Input the information heard from AS into the online GAF and register it in the Central Database.	✔	✔	
Browse data for the following up of grievance status in the Central Database	✔	✔	
Provide access (when immediately available) and copy of Central Database to each Local Helpdesk for browsing		✔	
Update status of grievance once information updated	✔	✔	
Record in database when the grievance is resolved	✔	✔	
Update the Central Database as necessary to respond to threats such as computer virus and attacks			✔
Maintains database performance by troubleshooting problems			✔
Back up data of the system or recovery files			✔

Source: JICA Design Team

7.8. INFORMATION DISSEMINATION

2082. The GRM is publicized and promoted at the local level, (i.e., communities and barangays) to ensure that project stakeholders are aware of the platform and actually use it as a trustworthy and effective means for feedback and grievance redress. As part of the Project's overall communication strategy, the PMO will prepare communication materials to

assist PMO officers including GR officers. The communication materials will include the GRM in text and visual forms, project details and maps, and frequently asked questions and procedures relating to land acquisition and resettlement. Proposed communication materials regarding the GRM are listed in **Table 7.8.1**.

2083. Project stakeholders have been informed about the GRM during stakeholder consultations. During the Feasibility Study Phase, a hotline was set up, and the hotline information was distributed to stakeholders. During the Detailed Design Phase, the hotline information was posted in each barangay's notice board and announced during stakeholder consultations.

2084. In addition, a GRM leaflet is being prepared for the Project. All concerned institutions including barangays, LGUs, and the PMO will use the same leaflet when explaining grievance redress procedures to AS who will raise their issues or concerns. Handouts are disseminated to LGUs, barangays, and the DOTr at the Helpdesk and barangay halls or during stakeholder consultations. The mechanism will also be posted on the websites of the DOTr and the LGUs.

Table 7.8.1 Dissemination Methodology of GRM Materials and Timeline

Activity	Contents	Dissemination Methodology	Responsibility	Timeline
DOTr Hotline	Phone Number Globe: 0927 450 6720 Smart: 0939 223 7993 Email Address: nscr.grm@dotr.gov.ph nsrcex.dotr@gmail.com	Stakeholder consultation meetings (SCM) Posting on barangay notice board Posting on Project website, Facebook, twitter	DOTr	Ongoing since December 2018
Map	Map showing the SCRP ROW within the LGU	Helpdesk	DOTr	June 2019
Project information booklet	Project description	SCM Helpdesk DOTr staff	DOTr	June 2019
Leaflet on GRM	Summary of Project Objective of GRM GRM process flow Information of Helpdesk opening time, location, how to consult complaint/ Issue Contact detail, Hotline, e-mail address	Helpdesk SCM DOTr staff During NHA community organizing Posting on Project website, Facebook twitter	DOTr	June 2019
Leaflet on Land acquisition	Project description Entitlement and schedule Land acquisition process Contact/opening time, location of Helpdesk/Hotlines		DOTr	June 2019
Leaflet on Resettlement	Project description Entitlement and schedule Resettlement site Contact/ opening time, location of Helpdesk/Hotlines		DOTr	June 2019
Leaflet on livelihood	Project description Entitlement and schedule Livelihood and income restoration program Contact/ opening time, location of Helpdesk/Hotlines		DOTr	June 2019

Source: JICA Design Team

7.9. CAPACITY BUILDING FOR GRIEVANCE OFFICERS

7.9.1. Objectives

2085. The objective of the capacity building activities is to help ensure that GR Officers who are assigned at the Local=/Central GRM Team have the proper skills and knowledge on all aspects of the Project including RAP, timelines for construction, Environmental Impact

Statement (EIS), health and safety measures, legal, and documentation processes. The capacity building activities will also be a means to obtain comments and suggestions from the GR Officers with regard to validating, improving and streamlining the GRM.

7.9.2. Training Program

2086. There are two types of training provided which are: 1) GRM and 2) Helpdesk training.

7.9.2.1. GRM Validation and Training

2087. During the Detailed Design Phase of the main railway line (Solis-Calamba), DOTr staff and Local GR Officers underwent a review of the GRM using Grievance Redress Principles and sound practices as guide and/or standards for human rights-based grievance redress. Participants provided inputs on the terms of reference governing the structure and system for implementing grievance redress, in particular the scope, objectives, structure, GR process flow, and system for implementation and monitoring. The assessment results of existing RAP GRM conducted by ADB was also presented.

Figure 7.9.1 Grievance Redress Mechanism Training

7.9.2.2. Continuous Capacity Building

2088. The PMO will undergo regular trainings and iteration sessions to ensure that staff have a sufficient understanding of the GRM, including update or changes in GRM procedure and system and project details.

2089. These trainings and iteration sessions may include but will not be limited to:

- GRM Validation Workshop – DOTr staff and Local GR Officers undergo a review of the GRM using GR Principles and sound practices as guide and/or standards for human rights-based grievance redress. Participants provide inputs on the terms of reference governing the structure and system for implementing grievance redress.
- GR Iteration Session – GR Officers from the PMO and local government units undergo a shorter but more intensive session going through the process flow and the specific roles of GR units or focal points at each level. This session is also merged with an orientation on the extra-judicial process as well as practical case studies.
- Training of DOTr Trainers – DOTr staff undergo a three-day coaching and facilitating session focusing on communication-based assessment and audience profiling, communication and listening skills, the grievance redress process, extra-judicial settlement process, and the provisions under the Project's Environment Compliance Certificates. At least one-half day is dedicated to case studies, presentations, and critiquing. The purpose of the Training of Trainers (TOT) is two-fold: i) to increase communication skills and knowledge in conducting the grievance redress process and ii) to improve coaching and facilitating skills in conducting the same type and content of training among Local GR Officers.

2090. On 3 June 2019, ADB and DOTr conducted an Iteration Session among Local GR Officers. The session lasted one-half day following the scope of training mentioned above. It also included a presentation on the requirements under the SC ECC and the role of the SC MMT, which is also a key factor in the GR process.

2091. On 16-17 September 2019, ADB conducted a TOT among DOTr staff comprised of the SC PMO's grievance redress team, environment team, and resettlement action plan (RAP) team. ADB conducted the TOT, with the scope of training covering the same topics mentioned above.

2092. Risk Communication and Grievance Redress Monitoring – DOTr staff and Local GR Officers will undergo a training on applied communication and GR skills. This is a two-day "special topics module" focusing on communication in the context of identifying and addressing potentially or ongoing public and corporate relations dilemmas. The module also includes monitoring on the field and reporting using indicators to be vetted or validated by DOTr during the training.

2093. A second stage training and mentoring will follow, covering field exercises using actual case situations. This will take five days, involving actual field work and data gathering in communities, data processing, and synthesis.

7.10. MONITORING REPORTS ON GRIEVANCE REDRESS

2094. The PMO monitors the status of Grievance Redress monthly and reports to JICA/ADB quarterly by submitting Monitoring Reports on Grievance Redress accomplishments and status of unresolved grievances. These reports form a part of the Internal/External Monitoring Report to be submitted to JICA/ADB. The details and proposed monitoring format are referred to in **Annex 7-2**.

7.10.1. Local Monitoring

2095. The Local GRM Team will undertake periodic rapid appraisals that measure the GRM's effectiveness and efficiency. The Local GRM Team monitors the types of grievances, status of resolutions and grievances forwarded to 3rd parties or next levels. The newly designed Central Database will have an integral program to enable the processing and generation of these types of information.

7.10.1.1. Monitoring Approaches

2096. Monitoring activities to generate data on the GRM's relevance, effectiveness and efficiency will range from simple tracking of the progress of cases using the Central Database management and tracking system, to site visits and interviews with local key players including officials. The results of local monitoring will be documented by the GR Officer and also uploaded on the Central Database management and tracking system under a monitoring tab that contains a specific monitoring template. The Local GRM Team undertakes the following:

- Once a month, the Local GRM Team visits barangays for ocular inspection of areas where grievances originate, which can be complemented by informal small group discussion with complainants or grievance owners or interviews with local or community leaders.
- The team attends stakeholder consultation meetings (SCMs) where communities give positive or negative feedback on the project. The SCMs are also utilized to report back, essentially updating the affected community on how the Project is addressing concerns and grievances in the barangay, what have been achieved and what are the challenges.
- The team gathers feedback through a "drop box" installed in every city hall.
- The results of local monitoring are documented by the GR Officer and uploaded on the Central Database management and tracking system under a monitoring tab that contains a specific monitoring template.

2097. The results of local monitoring are documented by the GR Officer and uploaded on the Central Database management and tracking system under a monitoring tab that contains a specific monitoring template.

(1) Monitoring Indicators

2098. Local monitoring indicators to measure the GRM's relevance, efficiency and effectiveness are shown in **Table 7.10.1**. The information can be used in two ways, i.e., as a way to report back to affected communities on resolutions made and as an input to the PMO through the Central GRM focal point for developing robust data that can help inform the PMO of other aspects of the Project, e.g., the effectiveness of environmental management plan and social development plan.

Table 7.10.1 Monitoring Indicators for Central Monitoring

No.	Monitoring Indicator	Basis for Indicator
1	Measure of relevance	[Use of the GRM by AS] Do the AS choose to use the local Helpdesk as a platform for grievance redress or do they choose other means, e.g., media and public service programs?
2	Measure of efficiency and effectiveness	[Information on Resolutions of Grievances] What are the monthly completion rate of grievances filed and types and/or complexity of grievances? What are the proportions of grievances resolved and grievances pending resolutions? What types of grievances are more likely resolved by the GRM and those less likely resolved?
3	Other descriptive data	Gender disaggregation in terms of complainant profiles and geographic locations.

Source: JICA Design Team.

(2) Reporting

2099. The results of local monitoring activities will be documented by the Local GR Officer and submitted to the GR Manager and the Central GR team once a month. The monitoring report includes: i) progress of addressing the grievances, ii) raised issues and concerns during SCMs and FGDs, iii) comment for improvement of GRM, and iv) inclusion of the monitoring sheet (e.g. determining the number of grievances received, grievance resolved, and category of complaints at the Helpdesk).

7.10.2. Central Monitoring

2100. Central Monitoring is an integration of all local-level monitoring using information from the Central Database and qualitative and/or quantitative information from the local monitoring reports, including information on progress of, and gaps in, grievance resolution. The DOTr GR Manager will prepare a formatted narrative report on a monthly basis.

7.10.2.1. Monitoring Approaches

2101. The central monitoring is conducted for all levels of the GRM based on the Central Database. This enables the GRM Team to get a picture of the progress of all grievances. It will help to verify if there are any abnormal number of complaints of the same nature. It will enable problem identification, such as if the rate of receiving grievances at the Central Hotline are irregular, then the GRM Team can analyze if there are any system errors. The GRM Team can also examine if there are consistent delays in reaching resolutions, and investigate the cause of these delays.

(1) Monitoring Indicators

2102. The central monitoring indicators are shown in **Table 7.10.2**.

Table 7.10.2 Monitoring Indicators for Central Monitoring

No.	Monitoring Indicator	Basis for Indicator
1	Rate of receipt	How many complaints are received as a whole? How many complaints are received by each channel at the Central Hotline? How many complaints are received at each level?
2	Rate of grievance category	Which grievance categories are the most frequent?
3	Rate of resolution	How many complaints are resolved as a whole? How many complaints are resolved at each level? How many complaints are forwarded to the third party? (irrelevant to the Project)
4	Response time	How many days does it take for complaints to be received by the Central Hotline and resolved on average? How many days does it take for complaints to be resolved on average at each level? If it takes longer, what is the reason?
5	Satisfaction	How satisfied are the AS with the GR Officer's response?

Source: JICA Design Team.

(2) Reporting

2103. The Central GR Officer monitors the type of grievance and the status of resolution using mainly the information from the database. The Monitoring Report that will be provided includes grievance received though the Central Hotline and grievance raised to other levels. The results of central monitoring will be documented by the GR Manager on a monthly basis. The Monitoring Report will include the following: i) progress of addressing the grievance, ii) summary of GRM activity such as meetings or capacity building training, iii) comment for improvement of GRM, iv) monitoring sheet e.g. number of grievances received, grievance resolved and category of complaints for each level, v) analysis of grievances according to common themes and areas for improvements, (vi) recommendations for further actions to reduce similar grievances in the future.

8. ENVIRONMENTAL COMPLIANCE MONITORING

2104. This section describes the framework for environmental compliance monitoring and environmental performance indicators that will be implemented for the Project as required by DENR Administrative Order 2003-30 (DAO 2003-30), *Implementing Rules and Regulations of Presidential Decree No. 1586, Establishing the Philippine Environmental Impact Statement System,* and DENR Administrative Order 2017-15 (DAO 2017-15), *Guidelines on Public Participation under the Philippine Environmental Impact Statement System.* The framework covers DOTr's Self-Monitoring Plan, the formation of a Multi-Partite Monitoring Team (MMT) or alternatively the engagement of a Third-Party Auditor (TPA), and DOTr's commitment to establish an Environmental Monitoring Fund (EMF) and Environmental Guarantee Fund (EGF).

2105. The objective of conducting environmental monitoring for the Project is to ascertain compliance with conditions in the Environmental Compliance Certificate (ECC), applicable environmental standards and policies, management plans, other commitments made in this EIS. The monitoring program will also determine any changes in the baseline data, and also serve as a feedback mechanism for mitigation measures which may require corrective actions if these are found inadequate or unsuitable based on the requirements of Philippines regulations and JICA and ADB safeguard policies. The institutional plan for the implementation of the Environmental Management Plan (EMP) and the Environmental Monitoring Plan (EMoP) of the Project are further discussed in Chapter 10. To ensure that the EMP and EMoP are fully integrated in the overall implementation of the Project, Chapter 4 (Environmental Management Plan), Chapter 8 (Environmental Compliance Monitoring), and Chapter 10 (Institutional Plan for EMP Implementation) of this EIS will be included in the bid documents.

8.1 SELF-MONITORING PLAN

2106. Compliance monitoring is a key component of Philippine environmental policy. It involves a range of inspection, sampling, and reporting activities, and enables the detection of environmental impacts of development projects and the assessment of compliance with regulatory requirements. Based on the assessment, specific actions may be implemented to enhance or augment mitigation measures as required.

2107. Compliance monitoring may be divided into three stages: program design, field investigation and validation, and evaluation and reporting of results. The monitoring design is proposed by the project proponent in the form of an EMoP as part of the EIS. The EMoP is divided into pre-construction, construction, operation, and abandonment phases. For each phase, key environmental aspects (e.g., earthworks) and the corresponding potential impacts (e.g., sedimentation) are identified. Each impact then determines the parameter to be monitored (e.g., total suspended solids), sampling method (e.g., grab sampling), sampling frequency (e.g., weekly), and sampling location (e.g., receiving river station immediately downslope of project's drainage channel).

2108. A key requirement in the design of the EMoP is the "Environmental Quality Performance Level" (EQPL) for each identified monitoring parameter. Three (3) levels need to be defined: the "Alert or Red flag" which is early warning; "Action level" which is the point at which management measures are needed to prevent escalation of impact to the regulated limit level; and "Limit level" which is the regulatory standard that must not be exceeded and for which emergency response measures must be employed.

2109. DOTr will conduct self-monitoring and will regularly submit its Self-Monitoring Report (SMR) to the DENR. The EMoP for the Project following Annex 2-20 of DAO 2003-30 is presented in **Table 8.1.1**. The plan is largely indicative and will be refined during project implementation. The proposed EMoP will involve all project phases. Areas for monitoring proposed as part of the EMoP include but are not limited to the inventory of opened up areas, removal of structures and vegetation, volume of spoils, spaces opened up, built up structures, influx of workers, water consumption, waste generation, disposal of hazardous wastes, operating and maintenance of equipment, fuel and chemical storage and dismantling and removal of facilities and removal and disposal of demolition wastes.

Table 8.1.1 Environment Monitoring Plan for the Proposed SCRP

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
PRE-CONSTRUCTION PHASE													
BASELINE ENVIRONMENTAL QUALITY MEASUREMENTS													
Surface Water and Ground Water Quality		BOD COD Color TSS Oil and grease Coliform pH Temperature Water table level	Grab sampling (In situ for pH and Temp using pH meter and temperature probe) In accordance to DAO 2016-08 approved methods	Once before construction	Depot site, surface water and groundwater established sampling stations near active construction and tunnelling sites, temporary facilities; other surface water locations within the contract package will be added as necessary.	Contractor/s with third party sampling firm in coordination with DOTr PMO, GC and MMT/TPA	Included in contract cost PhP 25,000 per station	Philippine National Guideline DAO 2016-08 Water Quality Guidelines for Class C waters: BOD: 7 mg/L Color: 75 TCU TSS: 80 mg/L Oil and grease: 2 mg/L Coliform (Fecal): 200MPN/100mL pH: 6.5-9.0 Temperature: 25-31°C					
Air Quality		TSP PM_{10} $PM_{2.5}$ SO_2 NO_2	24-hr continuous sampling for: TSP, PM_{10}: High Volume; Gravimetric method $PM_{2.5}$: e-sampler, gravimetric SO_2, NO_2: grab sampling; absorbing solution	Once during dry season and once during wet season or once before construction	Depot site and Established monitoring stations near active construction site, temporary facilities; other locations with sensitive receptors within the contract package will be added as necessary	Contractor/s with third party sampling firm in coordination with DOTr PMO, GC and MMT/TPA	Included in contract cost PhP 30,000 to 80,000 per sampling station	Philippine National Standard (DAO 2000-81, DAO 2013-13) TSP: 230 ug/NCM; PM_{10}: 150 ug/NCM; $PM_{2.5}$: 50 ug/NCM; SO_2: 180 ug/NCM; NO_2: 150 ug/NCM					

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
Noise		Noise Level (dBA)	24-hr continuous sampling Direct Reading/ Sound Level Meter	Once before construction	Depot site and established monitoring stations; other locations with sensitive receptors within the contract package will be added as necessary	Contractor/s with third party sampling firm in coordination with DOTr PMO, GC and MMT/TPA	Included in contract cost PhP 25,000 per station	WBG EHS Guidelines 2007 on Noise Management[1]					
Vibration			Building condition survey to supplement survey of DED	Once before construction	Depot site and Old PNR structures and buildings adjacent to the alignment and above tunnel alignment	Contractor/s with third party sampling firm in coordination with DOTr PMO, GC and MMT/TPA	Included in contract cost PhP 25,000 per station	U.S. Federal Transit Administration Guidelines, 2006					
Soil Contamination		pH, As, Ba, Cu, Zn, Fe, Cd, Cr, Pb, Mn, Hg, Se, Ni, O&G, Cn, PCBs	Composite sampling	Once before construction	Sucat Thermal Power Plant; Area where the alignment will pass through; Tunnel section	Contractor/s with third party sampling firm in coordination with DOTr PMO, GC and MMT/TPA	Included in contract cost PhP 25,000 per station	Dutch Intervention Values					
PEOPLE													
Resettlement/ Land Acquisition	Involuntary resettlement	Progress of RAP	Site survey and meeting with PAPs	Monthly or as needed	Construction and relocation sites	DOTr PMO in coordination with LGUs	To be determined and finalized during the RAP updating in the Detailed	N/A	N/A	N/A	N/A	N/A	N/A

1 Refer to EMP Annex

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
							Engineering Design Phase						
Land Acquisition	Displacement of residents and few commercial establishments along the proposed alignment	Compensation for affected land, structures and improvements	Consultation meeting and survey with PAPs	Monthly until ROW is fully acquired	Affected barangays (including relocation sites)	DOTr PMO with GC	Included in the RAP cost PhP 50,000 per activity	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM	100% compensation prior to displacement
Involuntary Resettlement for PAPs	Improvement of living conditions through Relocation	Resettlement of PAPs to the relocation sites	Consultation meeting and/or survey with PAPs	Monthly until ISFs are all relocated	Affected barangays (including relocation sites)	DOTr PMO with GC, external monitoring agents, MMT/TPA	Included in the RAP cost PhP 50,000 per activity	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM Improvement of living conditions through relocation	100% Resettlement of PAPs to the relocation sites
		Livelihood program No. of Participants	Consultation meeting and/or survey with the PAPs Livelihood trainings and seminars	Quarterly until the end of livelihood restoration program	Affected barangays (including relocation sites)		Included in the RAP cost PhP 50,000 per activity Training: PhP 15,000 per person	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM	Livelihood trainings and programs will consider gender equality
CONSTRUCTION PHASE													
LAND													
Earthworks including excavation and tunnelling activities	Generation of excavated soil	Volume Disposal method and management of soil against soil	Ocular inspection Regular reporting, and	Daily visual inspection Monthly reporting and	Construction site and disposal site	Contractor/s in coordination with DOTr PMO, GC	To be included in the engineering cost	Post ECC Agreement between DOTr, Contractor/s, and DENR – EMB			Post ECC Agreement between DOTr, Contractor/s, and DENR – EMB		

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
		management plan	meeting with Contractor/s	meeting or as needed Immediately in case of spill			PhP 1,500 per man-hour						
		Heavy metal levels in surplus soil: Cd, Cr (VI), Hg, Se, Pb, As, F and B (for underground section only)	Toxicity Characteristic Leaching Procedure (TCLP)	5 samples /1km tunnel excavation for the undergruond section.	Construction site and disposal site	Tunnelling Contractor in coordination with DOTr PMO and GC	~ Php 50,000/ 5 samples	Post ECC Agreement between DOTr, Contractor, and DENR – EMB		Cd, Pb, Cr (VI), As: 5 mg/L; Hg: 0.2 mg/L; Se: 1 mg/L; F and B – no standard	Post ECC Agreement between DOTr, Contractor, and DENR – EMB		
	Ground subsidence	Level of ground subsidence/ change in ground level	Visual observation Level survey	Daily visual observation Weekly level survey or as needed	In and around the excavation and tunneling site and temporary facilities	Contractor in coordination with DOTr PMO and GC	To be included in the construction cost PhP 1,500 per man-hour	N/A	N/A	Visually observed subsidence, damage to above ground structures	N/A	N/A	Implement corrective actions as necessary if the observed subsidence will pose hazard to the workers and community
	Soil erosion	Occurrence of erosion	Ocular inspection	Daily	Construction site and temporary facilities	Contractor/s in coordination with DOTr PMO and GC	Included in the construction cost PhP 1,500 per man-hour	N/A	N/A	Visually observed erosion	N/A	N/A	Implement corrective actions as necessary if the observed erosion will pose hazard to the workers and community
Generation of solid waste by construction activities	Soil pollution and visual impacts (aesthetic)	Volume Disposal method and management of solid wastes	Ocular inspection Regular reporting, and	Daily visual inspection Monthly reporting and	Construction site, temporary facilities, and disposal site	Contractor/s in coordination with DOTr PMO and GC	To be included in the engineering cost PhP 1,500 per man-hour	Post ECC Agreement between DOTr, Contractor/s, and DENR – EMB			Post ECC Agreement between DOTr, Contractor/s, and DENR – EMB		

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
		against solid waste management plan	meeting with Contractor/s	meeting or as needed									
		Soil fertility level (if necessary)	Soil sampling and analyses for fertility	As required		Contractor/s in coordination with third - party sampling firm, DOTr PMO and GC	PhP 25,000 per sample	Post ECC Agreement between DOTr, Contractor/s, and DENR – EMB			Post ECC Agreement between DOTr, Contractor/s, and DENR – EMB		
Operation and maintenance of construction machineries, equipment, and vehicles	Generation and accidental spills of hazardous wastes (i.e. oil, grease, etc.)	Quantity Occurrence of accidental spills Condition of equipment and machinery, oil and fuel storage, and chemical injection method (for underground section only)	Ocular inspection Regular reporting and documentation, and meeting with Contractor/s	Daily visual inspection Monthly reporting and meeting or as needed	Construction site and temporary facilities	Contractor/s in coordination with DOTr PMO and GC	Included in the engineering cost PhP 1,500 per man-hour	Incidence of spills Complaints	Spill-related complaints persist/unresolved after three (3) months	Spill-related complaints persist/unresolved after six (6) months	Initiate Clean-up Resolve complaints based on GRM	Resolve complaints based on GRM Evaluate Waste Mgmt.Plan (WMP) implementation and revise as needed Implement more efficient system of hazardous waste handling and management	Resolve complaints based on GRM Evaluate WMP implementation and revise as needed Coordinate with LGU
		Substances that may spill (e.g. oil, diesel, grease)	Soil sampling and analyses for chemicals of potential concern based on the spilt substance. A	As needed	Construction site and temporary facilities	Contractor/s with third party sampling firm in coordination with DOTr-PMO, GC and MMT/TPA	Included in the EMF PhP 25,000 per sample	If purely soil-based contamination only, then compliance to RA 6969 for the treatment, storage and disposal of contaminated materials If groundwater has been contaminated as a result of leaching			If purely soil-based contamination only, then compliance to RA 6969 for the treatment, storage and disposal of contaminated materials If groundwater has been contaminated as a result of leaching through the soil		

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
			targeted sampling approach may be designed by the assessor on a case-by-case basis. Assess if groundwater has been impacted.					through the soil strata, then a holistic remediation approach should be assessed. Remediation clean-up goals may be agreed upon on a case-by-case basis.			strata, then a holistic remediation approach should be assessed. Remediation clean-up goals may be agreed upon on a case-by-case basis.		
Clearing operations and vegetation removal	Potential loss of ecologically important, endemic and threatened species	Transplanted tree individuals Number of trees replaced Survival rate Mortality rate Provision of corresponding number of tree seedlings	Ocular survey	Quarterly during construction or as required by DENR-EMB	Off-site area for the transplant of earth balled species and/or reforestation site for re-planting appropriate seedlings (in a 1:100 exchange ratio), recognized by the proponent or as identified by DENR-EMB	Contractor/s in coordination with DOTr PMO, GC and MMT/TPA	Included in the construction cost PhP 1,500 per man-hour PhP 100 per sapling	60% survival rate	50% survival rate	40% survival rate	Replacement of non-surviving tree/s	Replacement of non-surviving tree/s Assess soil quality of areas with low survival rate Identify if need to change species to increase rate of survival	Identify if there is a need to change species to increase rate of survival Identify potential causes of hindering tree survival
WATER													
Increase demand on drainage systems	Flooding (during rainy season)	Occurrence of flooding	Ocular inspection and observation	Daily during rainy season	Construction site and temporary facilities	Contractor/s in coordination with DOTr PMO and GC	Included in engineering cost	N/A	N/A	N/A	N/A	N/A	N/A

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
			Check PAGASA bulletin				PhP 1,500 per man-hour						
Clearing activities, excavation and piling work, and construction of piers in rivers	Increase in suspended sediments in receiving water body	DO TSS pH Turbidity	Ocular inspection Water sampling in accordance with DAO 2016-08	Daily inspection Quarterly sampling	Established surface water quality sampling stations	Contractor/s with third party sampling firm in coordination with DOTr PMO, GC and MMT/TPA	Included in the EMF PhP 1,500 per man-hour PhP 25,000 per sampling station	Post ECC Agreement between DOTr, Contractor/s, and DENR – EMB		Philippine National Guideline DAO 2016-08 Water Quality Guidelines DO: 5ppm TSS: 30 ppm pH: 6.5-8.5	Post ECC Agreement between DOTr, Contractor/s, and DENR – EMB		
Wastewater generation Fuel and oil leaks from construction equipment	Water pollution	BOD COD Color TSS Oil and grease Fecal/total Coliform pH DO	Grab sampling in accordance with DAO 2016-08 and EMB approved methods *In situ* measurement for pH, DO and temperature using portable water quality meters	Quarterly	Established surface water quality sampling stations near active construction sites, temporary facility and depot discharge points	Contractor/s with third party sampling firm in coordination with DOTr PMO, GC and MMT/TPA	Included in the EMF PhP 1,500 per man-hour PhP 25,000 per sampling station	75% of DENR limit BOD: 37.5ppm COD: 75ppm TSS: 75ppm Oil & Grease: 3.75ppm Fecal Coliform: 300 MPN/100 mL Total Coliform: 7,500MPN/ 100mL pH: Color: 112.5 TCU	85% of DENR limit BOD: 42.5ppm COD: 85ppm TSS: 85ppm Oil & Grease: 4.25ppm Fecal Coliform: 340 MPN/100 mL Total Coliform: 8,500MPN / 100mL pH: Color: 127.5TCU	For ambient water quality: Philippine National Guideline DAO 2016-08 Water Quality Guidelines for Class C waters: BOD: 7 mg/L Color: 75 TCU TSS: 80 mg/L O&G: 2 mg/L Coliform (fecal): 100 MPN/100mL pH: 6.5-9.0 DO: 5 mg/L For effluent: Philippine National Standard DAO 2016-08 General Effluent Standards for	Post ECC Agreement between DOTr, contractor, and DENR – EMB		

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
										Class C waters: BOD: 50 mg/L Color: 150 TCU TSS: 100 mg/L O&G: 5 mg/L Coliform (fecal): 400 MPN/100mL pH: 6.0-9.5			
Hydrology	Impact on existing nearby deepwell within the depot area	Water table level	Onsite	Quarterly	Depot area	Contractor/s in coordination with DOTr PMO, GC and MMT/TPA	Included in the construction cost PhP 1,500 per man-hour	Related complaints	Particular complaints persist after three (3) months	Particular complaints persist after six (6) months	Resolve complaints based on GRM	Implement corrective actions as necessary	Implement corrective actions as necessary Coordinate with LGU
	Lowering of groundwater level and pressure (for areas influenced by underground section only)	Groundwater level	Water level survey Installation of monitoring boreholes	Daily visual observation Daily or as needed water level and pressure monitoring	In and above construction site of the tunnels (for underground section only)	Contractor in coordination with DOTr PMO, GC and MMT/TPA	To be included in the engineering cost	N/A	N/A	N/A	N/A	N/A	N/A
	Flooding and inundation in the tunnel and station (for underground section only)	Water leakage	Visual observation and installation of dewatering pumps	Daily visual observation	In and above construction site of the tunnels (for underground section only)	Contractor/s in coordination with DOTr PMO, GC and MMT/TPA	To be included in the engineering cost	N/A	N/A	N/A	N/A	N/A	N/a
AIR													

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
Generation of dust and particulate matter from earthmoving and construction activities; Particulate matter (TSP, $PM_{2.5}$, and PM_{10}) and gaseous pollutants (SO_2 and NO_2) emission from vehicles and construction equipment	Air pollution	Dust level (qualitative)	Ocular observation Interview with residents of affected barangays and pedestrians	Daily observation Monthly interview or as needed	In and around construction sites, temporary facilities and affected barangays	Contractor/s in coordination with DOTr PMO, GC and MMT/TPA	Included in the construction cost PhP 1,500 per man-hour	Dust-related complaints	Particular complaints persist after three (3) months	Particular complaints persist after six (6) months	Resolve complaints based on GRM	Implement corrective actions as necessary	Implement corrective actions as necessary Coordinate with LGU in resolving dust-related issues
		TSP PM_{10} $PM_{2.5}$ SO_2 NO_2	TSP, PM_{10}: High Volume; Gravimetric $PM_{2.5}$: e-sampler, Gravimetric SO_2: Gas Bubbler, Pararosaniline Method NO_2: Gas Bubbler, Griess-Saltzman Method	24-hr ambient air quality sampling (Quarterly during construction or as required by DENR-EMB) For underground section: 1-hour ambient air quality sampling Immediately based on complaints	Established monitoring stations near active construction sites and temporary facilities	Contractor/s with third party sampling firm in coordination with DOTr PMO, GC and MMT/TPA	Included in the EMF PhP 1,500 per man-hour PhP 30,000 to 80,000 per sampling station depending on parameters	Post ECC Agreement between DOTr, Contractor/s, and DENR – EMB		Philippine National Standard (DAO 2000-81, DAO 2013-13) : TSP: 230 ug/NCM; PM_{10}: 150 ug/NCM; $PM_{2.5}$: 50 ug/NCM; SO_2: 180 ug/NCM; NO_2: 150 ug/NCM	Continue monitoring and investigate possible causes of increase of particulates and gaseous pollutants	Check efficiency of dust suppression systems and conduct routine preventive maintenance. Investigate cause of complaint and determine and address the root cause. Increase frequency of dust suppression	Consider modifications to dust suppression system (i.e. changes to spray nozzle type, upgrade to air-and-water dust suppression system, etc). Conduct smoke emission tests of vehicles and construction equipment, as necessary. Review traffic management guidelines
Earthmoving and movement and operation of construction machinery	Increase in ambient noise level due to earthmoving and operations	Noise level	Ocular observation Interview with residents of affected barangays	Daily observation Monthly interview or as needed	In and around construction sites, temporary facilities, affected barangays and	Contractor/s in coordination with DOTr PMO and GC	Included in the construction cost PhP 1,500 per man-hour	Noise-related complaints	Particular complaints persist after three (3) months	Particular complaints persist after six (6) months	Resolve complaints based on GRM	Implement corrective actions as necessary	Implement corrective actions as necessary Coordinate with LGU to

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
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			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
	from construction machinery		Noise meter	Weekly noise meter measurement	nearby sensitive receptors (residential, school, places of worship and hospital areas) including ecologically significant area/s (if any) likely to be affected		PhP50,000 (cost of noise meter)						resolve noise-related issues
	Increase in ambient noise level due to earthmoving and operations from construction machinery	Noise level (dBA)	Direct reading/ Sound level meter Approved method of Ambient Noise Level measurement (AS 1055.1-1998)	Monthly (morning, daytime, evening and nighttime when applicable) Immediately based on complaints	Established monitoring stations including sensitive receptors (within 50 m from alignment)	Contractor/s with third party sampling firm in coordination with DOTr PMO, GC and MMT/TPA	Included in the EMF PhP 1,500 per man-hour PhP 25,000 per monitoring station	Negative feedback reported from surround-ding communi-ties.	Complaints filed by surrounding communities, commercial areas, Contractor/ss, or employees. These include, but not limited to, health complaints or problems, and distur-bances, among others.	WBG EHS Guidelines on Noise Management[2] or multiple complaints filed by nearby residential and commercial areas, or by Contractor/s and employees.	Determine equipment, machines, and/or activities that caused the complaints	Determine cause and address the problem according to the feasible mitigation measures	Continuous ambient noise level monitoring Strategic scheduling of activities per period within a day to minimize effects of noise Using machines with lesser noise produced, or using equipment/ structures to minimize noise produced such

2 Noise impacts should not exceed the levels presented in the WBG EHS guidelines or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
													as noise barriers or mufflers
Earthmoving and operation of equipment and machinery	Increase in vibration levels	Vibration level	Ocular observation Interview with residents of affected barangays	Daily observation Monthly interview	In and around construction sites, temporary facilities, affected barangays including ecologically significant area/s (if any) and Philippine Airforce Villamor Base and Nutrition Council of the Philippines Building	Contractor/s in coordination with DOTr PMO, GC and MMT/TPA	Included in the construction cost PhP 1,500 per man-hour	Vibration-related complaints	Particular complaints persist after three (3) months	Particular complaints persist after six (6) months	Resolve complaints based on GRM	Implement corrective actions as necessary	Implement corrective actions as necessary Coordinate with LGU to resolve vibration-related issues
		Vibration Level (dBA)	Vibration survey using vibration level meter	Monthly	Established monitoring stations including sensitive receptor (within 50 m from alignment and temporary facilities) Old PNR structures/ NHCP accredited cultural/	Contractor/s with third party sampling firm in coordination with DOTr PMO, GC and MMT/TPA	Included in the EMF PhP 1,500 per man-hour PhP 25,000 per monitoring station	Post ECC Agreement between DOTr, Contractor/s, and DENR – EMB U.S. Federal Transit Administration (FTA) Guidelines, 2006			Post ECC Agreement between DOTr, Contractor/s, and DENR – EMB		

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
					historical structures (within 50m from alignment and temporary facilities) and other ecologically significant areas (if any) Philippine Airforce Villamor Base and Nutrition Council of the Philippines Building								
		Vibration Level (dBA)	Vibration survey using vibration level meter	Continuous during TBM operation	Sensitive receptors along TBM route	Contractor/s with third party sampling firm in coordination with DOTr PMO, GC and MMT/TPA	Included in the EMF PhP 1,500 per man-hour PhP 25,000 per monitoring station	Post ECC Agreement between DOTr, Contractor/s, and DENR – EMB U.S. Federal Transit Administration (FTA) Guidelines, 2006			Post ECC Agreement between DOTr, Contractor/s, and DENR – EMB		

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
PEOPLE													
Construction activities Vehicle access around construction site	Threat to health and safety of the community	Number of project construction/ operation-related accident involving communities	Survey occurrence of accidents with local communities Interview with affected communities	Regular monitoring throughout construction phase Immediately in case of accidents	Affected barangays	Contractor/s in coordination with DOTr and GC	Included in the construction cost: PhP 1,500 per man-hour	1 near miss incident per quarter	1 near miss incident per quarter	1 accident per quarter	Investigate incident and develop/ improve prevention plan	Investigate near miss incident and review effectiveness of prevention plan and revise as needed	Implement corrective actions as necessary Coordinate with LGU and relevant agencies to implement accident prevention plan
	Loss/ degradation of livelihood of affected communities	Change with respect to baseline livelihood conditions	Review of barangay records, complaints Social Survey	Quarterly Annual	Impact barangays and relocation sites	DOTr PMO	Included in the operation cost: PhP 1,500 per man-hour	10% reduction in livelihood/ decrease in income	20% reduction in livelihood/ decrease in income	30% loss of livelihood /decrease in income	Resolve complaints based on GRM Review implementation of SDP and revise as needed	Resolve complaints based on GRM Review implementation of SDP and revise as needed Re-conduct SDP workshop	Review implementation of livelihood assistance and revise as needed in coordination with LGU and relevant agencies Implement corrective actions as necessary

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
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Construction activities	Occupational health	Working Environment Measurement (WEM)	BWC-OSHC/ NIOSH method	Quarterly throughout construction phase	Project site	Contractor/s with third party sampling firm in coordination with DOTr PMO, GC and MMT/TPA	Part of construction cost PhP 1,500 per man-hour PhP 25,000 per monitoring station	Parameters for good working conditions are near DOLE OSH limits	Parameters for good working conditions are equal to or exceed DOLE OSH limits	Parameters for good working conditions exceed DOLE OSH limits for 2 consecutive quarters	Implement corrective actions Review maintenance and housekeeping activities and revise as needed	Implement corrective actions Conduct internal audit and monitoring after implementation	Conduct third-party (external) audit of working environments
		Infectious disease Degradation of health condition of workers	Survey trend of epidemic disease Health records of workers	Monthly throughout construction phase	Construction yard	DOTr PMO and GC	Included in the construction cost: PhP 1,500 per man-hour	5% of workers experience symptoms of disease	10% workers are infected with disease	15% of workers are infected with disease	Assess if illness is work-related; conduct interview of sick employees and assess health condition by medical health doctor	Implement site-wide investigation of cause IEC campaign for illness prevention Monitoring of health conditions by medical doctor	Implement site-wide investigation of cause, isolate cases and prevent spread of illness; IEC campaign for illness prevention Continue monitoring by health doctor
		Number of accidents	Occurrence of accidents related construction work Monitoring Documentation	Weekly Immediately in case of accidents	Project site	Contractor/s in coordination with DOTr PMO and GC	Included in the construction cost: PhP 1,500 per man-hour	1 near miss incident per semi-annual	1 near miss incident per quarter	1 accident per quarter	Safety re-training for workers involved in accident	Conduct departmental re-training of the workers on health safety rules and regulation Inspect the area where	Inspect the area where most accidents happen Hire a 3rd party safety practitioner to conduct safety audit and implement

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
												most accidents happen	recommendations
Construction activities	May cause hearing problems to workers who operate nearby machineries or equipment that produce extremely loud noises	Implementation and effectivity of PPE during workhours	Regular inspection, strict reinforcement and maintenance of PPE	Daily inspection of PPE	Within construction areas	GC and Contractor/s in coordination with DOTr PMO	Part of Contractor/s's cost	Noise-related health problem reported by employees and workers on- site, or reported damaged PPE	Verbal or non-verbal complaints filed by employees and/or workers	Multiple complaints filed by employees and workers on-site, and if the permissible noise levels, as suggested by DOLE, exceeded the limits.	Determine equipment, machines, or activities that caused the complaints	Coordinate with construction employees to address the root cause, or; coordinate with a health institution for necessary medical check-up	Maintenance of equipment or machineries used during construction or using equipment that produce lesser noise. Strategic scheduling of shifts to integrate the permissible noise level exposure in the safety of the workers. Inspection and maintenance of PPE, and repair of damages (if repairable). Strict implementation of PPE on-site. Recording equipment that produce harmful noise levels, and keeping its

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
													nearby area off-limits to workers
	May cause hearing problems to nearby residents who are part of vulnerable groups, and the general public	Public perception and complaints	Visual observation, survey of nearby residential areas, and survey of residents that are part of the vulnerable groups	Daily visual observation Survey once prior to the construction of the project	Communities/areas surrounding the construction sites	GC and Contractor/s in coordination with DOTr PMO	Part of the operations cost	Negative feedback from surrounding residential and commercial areas.	Formal complaints filed by surrounding residential and commercial areas	Multiple complaints filed by nearby residential and commercial areas, or by Contractor/ss and employees	Investigate the extent of the damages, and the root cause of the complaint Resolve complaints based on GRM.	Coordinate with the LGUs and relevant stakeholders to properly address the issue Implement corrective actions as necessary	Implement corrective actions as necessary Update the affected surrounding communities about the actions done to address their complaints through written statements and assemblies Conduct necessary health programs for vulnerable groups, and public information campaign about mitigation measures to avoid damages

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
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			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
													caused by elevated noise levels. Continuous monitoring and documentation of complaints from residents to assess extent and gravity of disturbance Continuous ambient noise level and vibration monitoring during operations.
Employment of PAFs and locals		Number of PAFs, locals, females hired	Survey status of employment	Quarterly	Project site	Contractor/s in coordination with DOTr PMO and GC	Included in the construction cost: PhP 1,500 per man-hour	70% of the employees are local residents (based on the skills and capacity)	60% of the employees are local residents (based on the skills and capacity)	50 % of the employees are local residents (based on the skills and capacity)	Increase employability of local residents by undertaking skills training prior to job hiring	Investigation of the reasons for not meeting the % local resident employment undertaking skills training prior to job hiring	Investigation of the reasons for not meeting the % local resident employment skills training prior to job hiring
Resettlement, Construction activities	Social conflicts Degradation of livelihood	SDP/RAP implementation record IEC implementation record	Interview with residents of affected barangays, relocatees	Quarterly	Affected barangays Barangay/s with relocation sites	Contractor/s in coordination with DOTr PMO and GC	Included in the construction cost PhP 1,500 per man-hour	Complaints on implementation of SDP	Particular complaints on implementation of SDP persist per quarter	Particular complaints on implementation of SDP persist for 2 quarters	Resolve complaints based on GRM	Resolve complaints based on GRM Coordinate with LGUs	Implement corrective actions as necessary Coordinate with LGUs and

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
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			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
		Participants list										Review SDP, IEC and revise as needed to be more effective	relevant government agencies Hire services of third-party consultant to audit implementation of SDP
Access obstruction, increase in construction vehicles	Increase in traffic volume	Traffic congestion Traffic volume	Survey traffic volume Actual traffic observation and documentation	Weekly monitoring of traffic condition	Main intersection near construction area and temporary facilities	Contractor/s in coordination with DOTr PMO and GC	Included in the construction cost PhP 1,500 per man-hour	N/A	N/A	N/A	Resolve complaints based on GRM	Resolve complaints based on GRM Review effectivity of Traffic Management Plan (TMP) and revise as needed Provision for traffic signage and personnel	Resolve complaints based on GRM Implement corrective actions as necessary Coordinate with LGU and other agencies to update TMP
OPERATIONAL PHASE													
LAND													
Train operation	Ground subsidence	Level of ground subsidence/ change of ground level	Visual observation Level measurement/ survey	Daily visual observation daily Monthly measurement or as needed	Project alignment	Operator in coordination with DOTr PMO	Included in the Operation & Maintenance cost: PhP 1,500 per man-hour	N/A	N/A	N/A	Resolve complaints based on GRM	Resolve complaints based on GRM	Implement corrective actions as necessary
Ground movement due to train operation	Developme nt of fractures	Ground acceleration	Vibration level meter	Real-time and continuous measurement	Per station/ and between stations	Structural or Operations Engineer	To be included in operation and	N/A	N/A	N/A	N/A	N/A	N/A

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
(for underground only)	Structural damage Disruption of operations						maintenance cost						
Train operation Depot Passenger facilities	Generation of domestic/ solid wastes by passengers and personnel	Volume Disposal method Management of solid wastes against solid waste management plan	Ocular inspection Regular reporting	Daily visual inspection Monthly reporting	Passenger facility depot	Operator in coordination with DOTr PMO	Included in the operation and Maintenance cost: PhP 1,500 per man-hour	Garbage-related complaints from passengers and residents nearby	Garbage-related complaints persist/unresolved after three (3) months	Garbage-related complaints persist/unresolved after six (6) months	Clean-up of litter Resolve complaints based on GRM	Resolve complaints based on GRM Evaluate SWMP implementation and revise as needed Implement more efficient system of garbage collection and handling	Resolve complaints based on GRM Evaluate SWMP implementation and revise as needed Coordinate with LGU
		Soil fertility level	Soil sampling and analyses	As necessary	Depot	Operator with third party sampling firm in coordination with DOTr PMO, and MMT/TPA	Included in the EMF PhP 1,500 per man-hour PhP 25,000 per sample	Post ECC Agreement between DOTr, Contractor/s, and DENR – EMB			Post ECC Agreement between DOTr, Contractor/s, and DENR – EMB		
Maintenance works Depot facility	Spill of oil and other similar substances	Trace metals (Pb, Hg, Cd, As, Cr+6) Oil diesel and Grease	Ocular inspection for surficial spills	Weekly ocular inspection or immediately in case of spill	Depot	Operator with third party sampling firm in coordination with DOTr	Included in the Operation & Maintenance cost:	Post ECC Agreement between DOTr, Contractor/s, and DENR – EMB		Dutch Intervention Values for soil remediation Pb: 530 mg/kg	Post ECC Agreement between DOTr, Contractor/s, and DENR – EMB Disposal of contaminated soil in accordance with RA 6969		

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
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			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
		pH	Inventory and record-keeping of stored hazardous substances Survey check against RA6969	Daily inventory and record keeping		PMO, and MMT/TPA	PhP 1,500 per man-hour PhP 25,000 per sample			Hg: 10 mg/kg Cd: 12 mg/kg As: 55 mg/kg Cr+6: 380 mg/kg Compliance with RA 6969			
Survival of transplanted trees/ vegetation	Survival rate of transplanted trees/ vegetation	Number of trees surviving	Ocular inspection	Quarterly	Transplanted areas	Operator in coordination with DOTr PMO	Included in the Operation & Maintenance cost: PhP 1,500 per man-hour	60% survival rate	50% survival rate	40% survival rate	Replacement of non-surviving tree/s	Replacement of non-surviving tree/s Assess soil quality of areas with low survival rate Identify if need to change species to increase rate of survival	Identify if there is a need to change species to increase the rate of survival Identify potential sources issues that hinders tree survival
WATER													
Increased demand on drainage systems	Flooding (during rainy season)	Occurrence of flooding Reports of complaints related to flooding from nearby communities	Ocular inspection and observation Records on help/ assistance desk	Daily during rainy season	Project alignment, particularly train stations and depot	Operator in coordination with DOTr PMO	Included in the Operation & Maintenance cost: PhP 1,500 per man-hour	N/A	N/A	Occurrence of flooding Complaints of flooding	Resolve flood-related complaints based on GRM Investigate source of flooding if caused by Project Implement corrective actions as necessary		

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
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			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
Wastewater generation Fuel and oil leaks from equipment	Water pollution of receiving water bodies	BOD COD Color TSS O&G Coliform pH	Grab sampling in accordance with DAO 2016-08 and EMB approved methods *In situ* measurement for pH, DO and temperature using portable water quality meters	Quarterly	Discharge points	Operator with third party sampling firm in coordination with DOTr PMO, and MMT/TPA	Included in the EMF PhP 1,500 per man-hour PhP 25,000 per station	75% of DENR limit BOD: 37.5ppm COD: 75ppm TSS: 75ppm Oil & Grease: 3.75ppm Fecal Coliform: 300 MPN/100 mL Total Coliform: 7,500MPN/ 100mL pH: Color: 112.5 TCU	85% of DENR limit BOD: 42.5ppm COD: 85ppm TSS: 85ppm Oil & Grease: 4.25ppm Fecal Coliform: 340 MPN/100 mL Total Coliform: 8,500MPN / 100mL pH: Color: 127.5TCU	For ambient water quality: Philippine National Guideline DAO 2016-08 Water Quality Guidelines for Class C waters: BOD: 7 mg/L Color: 75 TCU TSS: 80 mg/L O&G: 2 mg/L Coliform (fecal): 100 MPN/100mL pH: 6.5-9.0 DO: 5 mg/L For effluent: Philippine National Standard DAO 2016-08 General Effluent Standards for Class C waters: BOD: 50 mg/L Color: 150 TCU TSS: 100 mg/L O&G: 5 mg/L Coliform (fecal): 400 MPN/100mL pH: 6.0-9.5	Post ECC Agreement between DOTr, Contractor/s, and DENR – EMB Implement corrective actions as necessary		

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
Groundwater	Impact on existing nearby deep wells within the depot area and along undergroun dsection	Water table level	Onsite Water level survey	Quarterly 2 times per year for 2 years at 2 locations after completion (Total 20 times) (for underground section only)	Depot Area Around underground tunnel	Operator in coordination with DOTr PMO MMT/TPA	Included in the Operations & Maintenance cost PhP 1,500 per man-hour	Related complaint s	Particular complaints persist after three (3) months	Particular complaints persist after six (6) months	Resolve complaints based on GRM	Implement corrective actions as necessary	Implement corrective actions as necessary Coordinate with LGU in resolving water supply-related issues
AIR													
Train operation, Depot, passenger facilities, service vehicles Generator set operation (for the underground section)	Air pollution	TSP PM_{10} $PM_{2.5}$ SO_2 NO_2	TSP, PM_{10}: High Volume; Gravimetric method $PM_{2.5}$: e-sampler, gravimetric SO_2 – Gas Bubbler, Pararosaniline Method NO_2 – Gas Bubbler, Griess-Saltzman Method	24-hr Sampling, Annually, immediately based on the complaints, or as required by DENR-EMB For underground section: 1-hr ambient air quality monitoring	Station and Depot At the established ambient air quality monitoring stations for the underground section.	Operator with third party sampling firm in coordination with DOTr PMO, MMT/TPA	Included in the EMF PhP 1,500 per man-hour PhP 30,000 to 80,000 per sampling station depending on parameters	Post ECC Agreement between DOTr, Contractor/s, and DENR – EMB	TSP: 230 ug/NCM; PM_{10}: 150 ug/NCM; $PM_{2.5}$: 50 ug/NCM; SO_2: 180 ug/NCM; NO_2: 150 ug/NCM Implement corrective actions as necessary	Continue monitoring and investigate possible causes of increase of point source emissions	Check efficiency of pollution control devices and conduct routine preventive maintenance until pollutant concentratio ns are down to acceptable levels.	Check efficiency of pollution control devices and conduct routine preventive maintenance until pollutant concentrations are down to acceptable levels.
	Increase in noise levels	Noise level (decibel)	Direct reading using Sound Level Meter	Semi-annually (daytime and night time) Annual for the underground section	Established monitoring stations at sensitive receptors (within 50m from alignment: residential, school, places	Operator with third party sampling firm in coordination with DOTr PMO, MMT/TPA	Included in the EMF PhP 1,500 per man-hour PhP 25,000 per station	Post ECC Agreement between DOTr, Contractor/s, and DENR – EMB		NPCC Noise Standards	Post ECC Agreement between DOTr, Contractor/s, and DENR – EMB		

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
				Immediately based on the complaints	of worship and hospital areas) including ecologically significant area/s (if any) likely to be affected by the operation Ground above underground tunnel in selected stations								
	Increase in vibration levels	Vibration Level (dBA)	Vibration survey using vibration level meter	Semi - annually Immediately based on complaints	Established sampling stations at sensitive receptors (within 50m from alignment) Old PNR structure / NHCP accredited cultural/historical structures (within 50m from alignment)	Operator with third party sampling firm in coordination with DOTr PMO, and MMT/TPA	Included in the EMF PhP 1,500 per man-hour PhP 25,000 per station	Post ECC Agreement between DOTr, Contractor/s, and DENR – EMB		FTA standards	Post ECC Agreement between DOTr, Contractor/s, and DENR – EMB		
PEOPLE													
Operation of train	Unsafe working environments	Compliance with DOLE OSH Standards	Monitoring of working environments Regular meeting	Quarterly Internal Monitoring Monthly	Project Stations and Depot	Operator in coordination with DOTr PMO	Part of Operation & Maintenance cost PhP 1,500 per man-hour	Parameters for good working conditions are near DOLE	Parameters for good working conditions equal to or exceed DOLE	Parameters for good working conditions exceed DOLE OSH Limits for 2 consecutive quarters	Implement corrective actions Review maintenan	Implement corrective actions Conduct internal audit	Conduct third-party (external) audit of working environments

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
							PhP 10,000 per meeting	OSH Limits	OSH Limits		ce and housekeeping activities and revise as needed	and monitoring after implementation	
	Occurrence of accidents involving workers/employees	Number of accidents	Record of operation-related accidents (inc. incidents, near-misses)	Monthly Immediately, in case of accidents	Project Alignment	Operator in coordination with DOTr PMO	Part of Operation & Maintenance cost: PhP 1,500 per man-hour	1 near miss incident per quarter	1 near miss incident semi-annually	1 accident per quarter	Safety re-training for workers involved in accident	Conduct departmental re-training of the workers on health safety rules and regulation Inspect the area where most accidents happen	Inspect the area where most accidents happen Hire a 3rd party safety practitioner to conduct safety audit and implement recommendations
	Health and safety Risks to the community	Number of accidents involving passengers and residents at nearby communities	Record of operation-related accidents (inc. incidents, near-misses)	Quarterly Immediately, in case of accidents	Project Alignment	Operator in coordination with DOTr PMO	Part of Operation & Maintenance cost: PhP 1,500 per man-hour	1 near miss incident per quarter	1 near miss incident per quarter	1 accident per quarter	Investigate accident and prepare/ improve prevention plan	Investigate accident and review effectiveness of prevention plan and revise as needed	Implement corrective actions as necessary Coordinate with LGU and relevant agencies to implement accident prevention plan
	Loss/degradation of livelihood of affected communities	Change with respect to baseline livelihood conditions	Review of barangay records, complaints Social Survey	Quarterly Annual	Impact barangays and relocation sites	Operator in coordination with DOTr PMO	Included in the Operation cost: PhP 1,500 per man-hour	10% reduction in livelihood/ decrease in income	20% reduction in livelihood/ decrease in income	30% loss of livelihood /decrease in income	Resolve complaints based on GRM	Resolve complaints based on GRM	Review implementation of livelihood assistance and revise as needed in

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
											Review implementation of SDP and revise as needed	Review implementation of SDP and revise as needed Re-conduct SDP workshop	coordination with LGU and relevant agencies Implement corrective actions as necessary
	Increase in local employment	Composition of workforce	Review or record of employment	Semi-annual	N/A	Operator in coordination with DOTr PMO	N/A	60% of the employees are local residents (based on the skills and capacity)	55% of the employees are local residents (based on the skills and capacity)	50 % of the employees are local residents (based on the skills and capacity)	Increase employability of local residents by undertaking skills training prior to job hiring	Investigation of the reasons for not meeting the % local resident employment undertaking skills training prior to job hiring	Investigation of the reasons for not meeting the % local resident employment skills training prior to job hiring
Traffic Management	Traffic congestion	Number of traffic-related complaints	Record of traffic-related complaints against the project (physical or online feedback/ help desk)	Monthly	Stations and retained road crossings	Operator in coordination with DOTr PMO	Included in the Operation cost: PhP 1,500 per man-hour	Five (5) valid complaints per month	Ten (10) valid complaints per month	Fifteen (15) valid complaints per month	Resolve complaints based on GRM	Resolve complaints based on GRM Review effectivity of Traffic Management Plan (TMP) and revise as needed Provision for traffic signage and personnel	Resolve complaints based on GRM Implement corrective actions as necessary Coordinate with LGU and other agencies to update TMP
Structure-borne vibrations and noise during	May inadvertently cause	Ambient Noise level (decibel)	Approved method of	Quarterly or as required by EMB	Co-located with air quality	Operator in coordination	Part of the operations cost	Negative feedback	Formal complaints filed by	Multiple complains filed by nearby	Investigate the extent	Coordinate with the	Update the affected

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
operations (for underground only)	mental stress to residents near the project location	monitoring during operations	Ambient Noise Level measurement (AS 1055.1-1998)		monitoring stations.	with DOTr PMO		from surrounding residential and commercial areas.	surrounding residential and commercial areas.	residential and commercial areas, or by Contractor/ss and employees.	of the damages, and the root cause of the complaint.	LGUs and relevant stakeholders to properly address the issue.	surrounding communities about the actions done to address their complaints through written statements and assemblies. Conduct necessary health programs for vulnerable groups, and massive public information about mitigation measures to avoid damages caused by elevated noise levels. Continuous monitoring and documentation of complaints from residents to assess extent and gravity of

Key Environmen-tal Aspect	Potential Impacts	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
													disturbance. Continuous ambient noise level and vibration monitoring during operations.

8.2. MULTI-PARTITE MONITORING TEAM / THIRD PARTY AUDITOR

2110. DAO 2003-30 and subsequent guidelines provided in DAO 2017-15 require that a Multi-Partite Monitoring Team (MMT) be formed for Environmentally Critical Projects (ECPs). The MMT is a community-based multi-sectoral team which is organized to monitor compliance of a project to conditions stipulated in the ECC, the implementation of the EMP, and general adherence to other applicable environmental laws and regulations as a third-party entity. As per the DAO 2017-15, "the MMT scheme is intended to enhance participation and transparency at the post-ECC issuance stage of the EIA Process." Its formation is initiated by the project proponent after the issuance of the ECC. In lieu of the MMT, and based on approval by DENR-EMB Central Office, a TPA may be engaged. The TPA will be a qualified environmental/EMS auditor. The functions of the TPA are discussed in Section 10.1.7 in Chapter 10 of this report.

2111. Specific functions of the MMT as per DAO 2017-15 will include:

- Conducting quarterly ocular site visits to validate the project proponent's compliance with the ECC, EMP, and EMoP including the requirement to conduct self-monitoring and submit corresponding reports regularly;
- Preparing and submitting reports to EMB at least semi-annually; and
- Instituting an environmental emergency and complaints receiving and management mechanism which shall include systems for transmitting recommendations for necessary regulatory action to EMB in a timely manner to prevent adverse environmental impacts.

2112. The DENR-EMB will provide oversight guidance to the SCRP MMT and consider its reports and recommendations in its impact and compliance evaluation. The composition of the SCRP MMT should be representative of relevant stakeholder groups and will include the following as required in DAO 2017-15:

- Representative from the following LGUs along the Project alignment:
    - Manila City
    - Makati City
    - Taguig City
    - Parañaque City
    - Muntinlupa City
    - San Pedro City
    - Biñan City
    - Santa Rosa City
    - Cabuyao City
    - Calamba City
- Representative from the LGU-accredited local NGOs with mission/s specifically related to environmental management. Representative from an academic institution may be included in absence of a local NGO
- Representative from locally recognized community leaders who can represent vulnerable sectors such as women and senior citizen
- Concerned Government Agencies
    - Department of Public Works and Highways (DPWH)
    - Metro Manila Development Authority (MMDA)

2113. The members of the MMT will elect among themselves the Chairman and Vice Chairman.

8.3. EXTERNAL ENVIRONMENT MONITORING AGENT (EMA)

2114. In addition to the MMT/TPA, and in compliance with the requirements of the ADB SPS 2009, an external environment monitoring agent (EMA) will be engaged for compliance monitoring of the SCRP. The EMA will be a qualified environmental/EMS auditor and will be engaged for the construction and operations phase of the SCRP. The specific functions of the EMA will include:

- Validating compliance with the conditions stipulated in the ECC, EMP, and the EMoP of the SCRP along with JICA's Environmental Guidelines (2010) and ADB's SPS (2009) (e.g. auditing CMRs, SMRs, environmental sampling results, etc.);
- Validating the DOTr's conduct of self-monitoring for the SCRP;
- Overseeing implementation of the EMP and EMoP of the DOTr, GC and the Contractors;
- Coordinating with the SCRP Contractor's Pollution Control Officer (PCO) to ensure timely gathering of monitoring data for environmental parameters, and subsequent monitoring of such;
- Compiling monitoring data gathered by the SCRP Contractors and ensure timely submission of the Contractor's Self-Monitoring Report to DOTr;
- Notifying DOTr and the General Consultant about any act or activity by the Contractors that are deemed as violations to the stipulations in the ECC, EMP or EMoP including any amendment issued, and recommend immediate courses of action to avoid or mitigate any violation to the relevant stipulations; and
- Gathering relevant information to facilitate determination of validity of complaints or concerns about the SCRP and recommend measures to the DOTr and the General Contsultant to address the complaints.

2115. The EMA will serve as the project's External Monitoring Agent and will be hired and funded through the General Consultant.

8.4. ENVIRONMENTAL MONITORING AND GUARANTEE FUND COMMITMENT

8.4.1. Purpose of an Environmental Monitoring Fund and Environmental Guarantee Fund

2116. The DOTr commits to establish an Environmental Monitoring Fund (EMF) and Environmental Guarantee Fund (EGF) for the Project in accordance with the requirements of DAO 2003-30. The EMF will be used exclusively to support the activities of the SCRP MMT for compliance monitoring. A Memorandum of Agreement (MOA) will be entered into by DENR-EMB and DOTr, with conformity of the SCRP MMT members, to establish the EMF. The EMF will be immediately accessible and easily disbursable.

2117. The EGF will be used exclusively for the following purposes:

- Immediate rehabilitation of areas affected by damages to the environment and the resulting deterioration of environmental quality as a direct consequence of the Project's construction, operation, and abandonment;
- Just compensation of parties and communities affected by the negative impacts of the proposed Project;
- Conduct of scientific or research studies related to the proposed Project that will aid in the prevention or rehabilitation of accidents and/or environmental damages; and
- For contingency and clean-up activities, environmental enhancement measures, damage prevention programs and social equity measures including the necessary IEC and capability building activities related to the Project.

8.4.2. Basis of the Cost

2118. The indicative amounts of the EMF, EGF Trust Fund, and EGF Cash Fund are presented in **Table 8.4.1** Estimated EMF, EGF Trust Fund and EGF Cash Fund for the Project. The actual amounts that will be allocated for these funds will be finalized in the Memorandum of Agreement on the Creation of the SCRP MMT, EMF and EGF.

Table 8.4.1 Estimated EMF, EGF Trust Fund and EGF Cash Fund for the Project

Type of Fund	Amount (PhP)
EMF (PhP)	400,000.00
EGF Trust Fund (PhP)	5,000,000.00
EGF Cash Fund (PhP)	3,000,000.00

2119. The EGF Trust Fund and EGF Cash Fund will be replenished to its original amount annually or whenever the amount goes below 50% of the original amount. The EGF Trust Fund will be renewed upon every expiration.

2120. At the end of the project life, a sufficient amount will be reserved from the EGF to ensure that rehabilitation, restoration, decommissioning, or abandonment will be adequately financed. Such amount may be increased during the project life span to ensure that the balance will be sufficient for the abandonment phase. In such case, the EGF Committee may require an adjustment of such amount to cover inflation and other factors. The required submission to the DENR-EMB of the Abandonment/ Decommissioning Plan for the proposed Project will have a corresponding fund commitment subject to the approval of the DENR or the lead government agency with direct approving authority on the Abandonment/Decommissioning Plan.

9. DECOMMISSIONING/ ABANDONMENT/ REHABILITATION POLICY

9.1. POLICY

2121. Upon completion of construction, Contractors will undertake and comply with the following decommissioning/demobilization activities:

- Complete restoration of affected social service utilities (i.e., power and water supply, and telecommunication lines) to their normal functions;
- Complete closure and dismantling of the workers' camps, field offices, and temporary construction facilities;
- Complete dismantling of the temporary sanitation facilities, particularly the portable toilets;
- Clean-up and sterilization of the worker's camps and field offices to ensure that no wastes are abandoned in the sites;
- Hauling and disposal of remaining muck soils, construction spoils and debris to sites duly-approved by the LGUs; and
- Complete restoration/reconstruction of affected public and cultural and historical structures, if any.

2122. All parties concerned, such as the DOTr, DENR, the GC and the LGUs will inspect the area for compliance to the above activities.

2123. Project abandonment is not envisioned in the near future since there is a pressing need for an efficient public transport system in the country. In the unlikely event that the proposed Project becomes economically unviable or if by force majeure or acts of God it will have to be terminated and/or decommissioned, a detailed Abandonment and Decommissioning Plan will be developed prior to the closure of the facilities and within the timeframe that will be specified in the ECCs. The Abandonment and Decommissioning Plan will be prepared in accordance with DENR-EMB requirements and will address the following:

- Proposed abandonment/decommissioning measures for the Project facilities;
- Removal of any existing hazardous and non-hazardous waste;
- Site restoration where appropriate;
- Cost associated with the proposed abandonment/decommissioning activities and source of funds for the implementation of the activities; and
- Conformance to the requirements of the PNR (as owner of the ROW), the local government, the DENR and other relevant agencies.

2124. Parts that are determined to be serviceable will be salvaged for use in other railway infrastructures or other public facilities. The structures may be retrofitted, if adaptable, for use with newer technology. Otherwise, the major structures will be demolished/ dismantled. The area may be re-developed according to alternative land uses for the site as the government may see appropriate.

2125. Major activities that will be involved in the decommissioning and abandonment of the Project will include removal of all buildings, structures, and equipment, and other works. DOTr shall ensure minimal damage that may be caused by the removal of the facilities. An audit of hazardous wastes and an environmental site assessment (ESA) will be conducted to account for proper disposal and site treatment, if deemed necessary. DOTr will leave the project site in a secure, clean, and tidy condition and will ensure that the site is securely enclosed.

9.2. PROCEDURE AND RESPONSIBLE PARTIES

9.2.1 Pre-Abandonment/ Decommissioning Activities

2126. The SCRP PMO will further develop the appropriate protocols for inclusion in the Abandonment and Decommissioning Plan. The plan will be submitted to the DENR for review and approval prior to the commencement of abandonment/decommissioning activities. DOTr concerned staff workers will be informed six (6) months prior to abandonment/decommissioning of the Project. All affected communities and stakeholders will also be properly informed of the abandonment/decommissioning activities.

9.2.2 Abandonment/ Decommissioning Activities

2127. The SCRP PMO will oversee the performance of identified activities in the Abandonment and Decommissioning Plan by their Contractors for all temporary structures and work areas related to the Project. In the case of the railway and subway operation, the PMO will oversee the performance of all appropriate activities by the Railway Operator, as contained in the Abandonment and Decommissioning Plan, including the provision of security within the premises. Appropriate documentation will be conducted during the abandonment procedures including photographs of the work areas/operational areas, by the DOTr. This documentation will be made available to the proper agencies, upon request and for monitoring purposes.

9.2.3 Post-Abandonment/ Decommissioning Activities

2128. Upon review of the submitted Abandonment and Decommissioning Plan, the DENR-EMB will notify the DOTr of its findings and may, as a consequence of the review process, conduct inspections, other related activities, and actual site observations. Should inspections be necessary, the DENR-EMB will form a team composed of, among others, DOTr, PNR, EMB, concerned LGUs, and such other entities who are affected by the abandonment procedures.

2129. If during site inspection irreversible damages to the environment are discovered, the extent of such damage will be investigated and reported to the DENR-EMB. If the findings show that said damages were caused by construction-related activities, the Contractor's All Risk Insurance (CARI) will be tapped for compensation of damages. In the event such findings show that the damages were caused by train maintenance and operations procedures, the EGF will be tapped.

10. INSTITUTIONAL PLAN FOR THE IMPLEMENTATION OF THE ENVIRONMENTAL MANAGEMENT PLAN

2130. This section presents the institutional plan for the implementation of the proposed Environmental Management Plan (EMP) for the Project. It describes the organization structure for the implementation of the EMP and provides a mechanism that will reinforce the relationship of DOTr with the host communities, concerned government agencies, and other stakeholders.

2131. The Project component are covered under two separate Environmental Compliance Certificates (ECCs) that were issued by the Department of Environment and Natural Resources – Environmental Management Bureau (DENR-EMB) Central Office. The main SCRP alignment (Solis to Calamba) is covered under ECC-CO-1807-0018 issued last 13 August 2018 whereas the SCRP interconnecting line (Senate-FTI-Bicutan segment) is covered under ECC-CO-1708-0017 issued on 25 October 2017. ECC-CO-1708-0017 was amended last 22 November 2019 to reflect changes in the MMSP alignment and station locations.

2132. During the Detailed Design Phase for the main railway line, the Department of Transportation (DOTr) has started addressing the following conditions of ECC-CO-1807-0018 and ECC-CO-1708-0017: Establishment of the Environmental Guarantee Fund (EGF), Multi-partite Monitoring Team (MMT) and/or hiring of Third-Party Auditor, and Environmental Guarantee Fund (EGF) 60 days prior to construction); and Establishment of an Environmental Unit (EU) 60 days prior to construction. The formal establishment of the Project Management Office is currently being finalized by DOTr.

10.1 IMPLEMENTING STRUCTURE

10.1.1 The Department of Transportation

2133. The DOTr is the primary policy, planning, programming, coordinating, implementing and administrative entity of the executive branch of the Philippine government on the promotion, development, and regulation of a dependable and coordinated network of transportation system, and fast, safe, efficient, and reliable transportation in the country. The DOTr plays a crucial role in accelerating the country's economic development. It provides the backbone for growth and enhances the country's competitiveness by providing effective and efficient transportation infrastructure systems that narrow the geographical and physical divide through connecting the country, its islands, and its people to the rest of the world.

2134. As the executing agency (EA) for the Project, DOTr is responsible for ensuring compliance of the project with the conditions of the ECC and the EIS. DOTr will supervise and coordinate the implementation of all activities, monitor compliance with the Environmental Impact Statement (EIS) (which covers the EMP and Environmental Monitoring Plan (EMoP) for the Project), secure sufficient funding for all resettlement activities, allocate resources in a timely manner, set target outputs with corresponding timelines, monitor progress, consolidate reports from all sources, and document gaps and find appropriate solutions. The general roles of the DOTr as the IA will be largely carried out by the SCRP PMO. DOTr is responsible for adequately staffing the SCRP PMO, establishing the MMT, EGF and EMF for the project. DOTr will delegate EMP implementation responsibilities to the following entities: (i) The SCRP PMO and its Environment, Social, ROW and Legal Division (ESRL); (ii) the Health, Safety and Environment Committee (HSEC); (iii) the general consultant (GC); the contractors (including sub-contractors); and (iv) the EMA.

2135. The DOTr is headed by the Department Secretary who directly reports to the President of the Philippines. The Department Secretary is assisted by several undersecretaries that head their respective divisions. For this Project, the undersecretary for railways will directly

supervise the SCRP PMO and will make critical decisions regarding the implementation of the Project.

10.1.1.1 Vision

2136. By 2030, the DOTr is a world-class organization, providing integrated transport systems, connecting people, islands, families, communities and the nation with the rest of the world, constantly crafting environmentally sustainable solutions and globally building competitive transport systems.

10.1.1.2 Mission

2137. To provide the country with efficient, effective and secure transportation systems that is globally competitive, compliant with international standards and responsive to the changing times.

10.1.1.3 Sectoral and Attached Agencies

2138. The DOTr has four (4) sectoral offices and eighteen (18) attached agencies. The sectoral offices include the aviation and airports, railways, road transport and infrastructure and maritime offices.

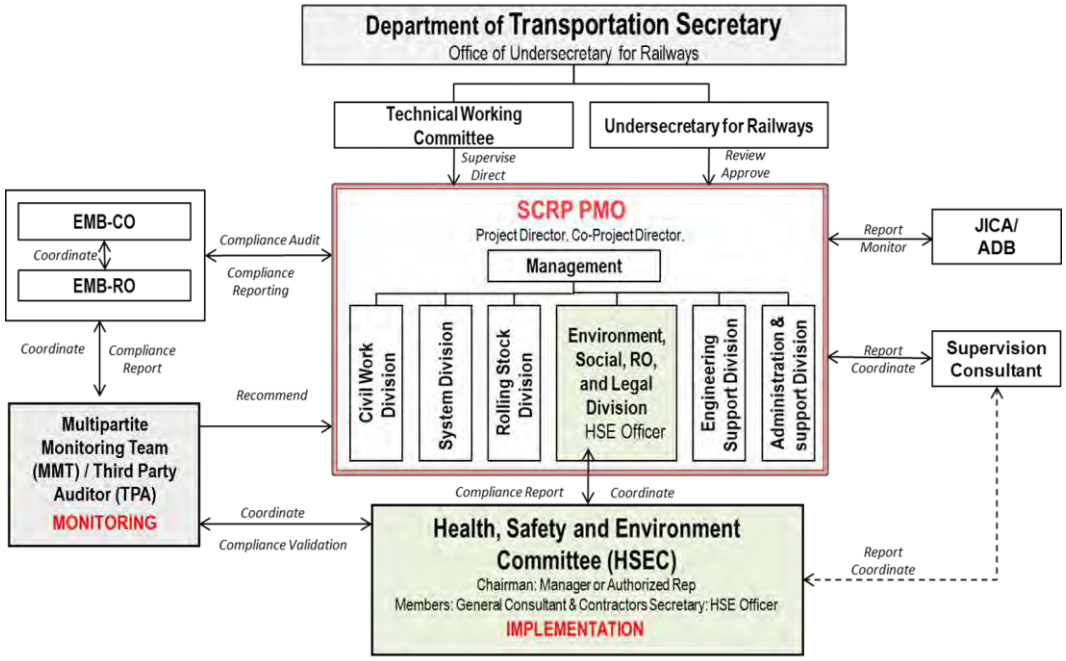
2139. As for the attached agencies, there are three (3) railway agencies, i.e., the Philippine National Railways (PNR), the Light Rail Transit Authority (LRTA) and the North Luzon Railways Corporation (NLRC or Northrail). Under the department, in addition, there is one (1) railway project management office for the Metro Rail Transit (MRT).

10.1.1.4 Roles for the EMP

2140. The DOTr is responsible for providing overall policies and guidance concerning the implementation of the Project. The Department is also responsible for monitoring the compliance of the Project with the conditions of the ECC as well as JICA and ADB safeguard policies. Further, the DOTr will also ensure that all the provisions necessary for implementing the EMP and the EMoP – including budgets and agreements with other concerned national and local government agencies – are included in all contracts in compliance with JICA Guidelines (2010) and ADB's Safeguard Policy Statement (SPS, 2009).

10.1.2 The Implementation of the Environmental Management Plan

2141. The organizational structure for the EMP implementation constitutes the SCRP PMO and its Environment, Social, ROW and Legal Division (ESRL); Health, Safety and Environment Committee (HSEC); the General Consultant (GC), and contractors (including sub-contractors). The Project will have an MMT (or alternatively a Third-Party Auditor (TPA) if approved by DENR-EMB) in order monitor and validate the implementation of the EMP. **Figure 10.1.1** presents the simplified institutional chart for the EMP implementation for the Project, showing the relationship among the entities.



Source: JICA Design Team

Figure 10.1.1 Institutional Plan for Implementing the EMP

2142. Independent environmental compliance verification during the construction and operational phases will be undertaken by the MMT (or alternatively the TPA) and the EMA, respectively. They will monitor the performance of the Contractors, the GC and the SCRP PMO in light of ECC conditions, the EMP and the EMoP, by evaluating compliance with the guidelines of DAO 2003-30, DAO 2017-15, JICA Guidelines (2010) and ADB's SPS (2009).

2143. The main roles and responsibilities of the EMP implementing entities are to ensure compliance with the EMP, the EMoP, and other conditions stipulated under the ECC and tackle with grievances if any arise during all phases of the Project. The assignments of the EMP implementing entities for the Project are presented in **Table 10.1.1**.

Table 10.1.1 Roles and Responsibilities for the EMP Implementation

Entity / Responsibility	DOTr	PMO	ESRL	HSEO	MMT/ TPA	Contractor	GC
Establish the PMO	◎						
Establish the ESRL	◎	○					
Appoint the Health, Safety and Environment Officer (HSEO)		◎	○				
Establish the MMT	◎	○	○				
Secure fund for the EMP implementation (for the operation of the EGF, the EMF and the ESRL)	◎	○	○	○	○		
Ensure the project's compliance to the ECC, the EMP and the EMoP		◎	○	○		○	○
Ensure the project's compliance to JICA and ADB safeguards requirements		◎	○	○			○

Entity / Responsibility	DOTr	PMO	ESRL	HSEO	MMT/ TPA	Contractor	GC
Handle grievances			◎	○	○	○	○
Implement mitigation measures in compliance with the EMP				○		◎	○
Implement the EMoP in compliance with the EMP				○		◎	○
Monitor and assess the effectiveness of mitigation measures			◎	○	○		○
Revise the EIS/EMP as necessary			◎	○			○
Audit compliance					◎		
Prepare and submit EMP progress reports			◎	○	○	◎	○

Note: ◎ = leading party, ○ = assisting party

Source: JICA Design Team

10.1.3 Technical Working Committee of the DOTr[1]

2144. DOTr Department Order No. 2013-05 stipulated the establishment of a Technical Working Committee (TWC) for the acquisition of sites/right-of-way (ROW) of infrastructure projects under the management of the DOTr. The Undersecretary for Legal and Procurement and the Undersecretary for Planning are members of the TWC. The TWC provides legal and technical support to all PMOs under the DOTr including the SCRP PMO.

10.1.3.1 Roles and Responsibilities of the TWC

2145. The roles and responsibilities of the TWC are summarized below:

- Audit disbursement of EMF and DGF as reported by the SCRP PMO;
- Review Work Financial Plan for MMT Operationalization prior to approval of DOTr and EMB;
- Assist in legal and financial aspects related to the disbursement of EMF and EGF.

10.1.3.2 Composition of the TWC

2146. The TWC is established under the Office of the Undersecretary for Legal and Procurement. Members of the TWC are presented in **Table 10.1.2**, as specified in DOTr Department Order No. 2013-05.

Table 10.1.2 Composition of the TWC

Position		Member
1	Leader	• Chairman: Director of the Legal Service • Vice-chairman: Director of the Planning Service

[1] It will be replaced by the DOTr's ROWSA Committee if once created.

Position		Member
2	Member	• Executive Director concerned • Chief of the Legal Affairs and Research Division • Project manager/engineer concerned • Representative of the Legal Service • Representative of the Planning Service • Representative of the Finance and Comptrollership Service • Representative of the Procurement Supply and Property • The Management Service
3	Observer	• Representative of the Commission on Audit (COA), resident auditor

Source: DOTr

10.1.4 SCRP Project Management Office

2147. The SCRP PMO is established as the representative of the DOTr and the PNR for all activities pertaining to the planning, design review and implementation of the Project.

2148. The Project Director, the Co-Project Director and the Management Director of the SCRP PMO are responsible for the decision-making, planning and implementation of the overall project activities, while the Project Manager and the Deputy Project Manager are in charge of the management of the Project (**Table 10.1.3**).

Table 10.1.3 Composition of the SCRP PMO (Provisional)

No.	Position	Member
1	Oversight functions	• Project Director: DOTr Undersecretary for Railways • Co-Project Director: PNR General Manager • Managing Director: Representative from the DOTr
2	Manager	• Project Manager: Representative from the DOTr • Deputy Project Manager: Representative from the DOTr
3	Division (a total of 450 staff)	Six (6) divisions headed by Division Chiefs: • Management • Civil Works Division • System Division • Rolling Stock Division (RS Division) • Engineering Support Division (ES Division) • Environment Social, ROW division and Legal Division (ESRL Division) • Administration and Support Division (PCS Division)

10.1.4.1 Environment, Social, ROW and Legal Division (ESRL)

2149. Under the SCRP PMO, the Environment, Social, RoW and Legal Division (ESRL) was created and is currently staffed with approximately 130 officers including the Health, Safety and Environment Officer (HSEO), accredited Pollution Control Officers (PCO), environmental engineers, project development officers, community development officers, attorneys, foresters, other specialists - who provide necessary guidance and technical assistance - and office staff in order to fulfill the ECC conditions and the activities laid out in the EMP, EMoP and SDP/IEC Framework which constitute an integral part of the EIS. The ESRL personnel directly handling the environment-related aspects of the Project will act as the EU as required by the ECC. The ESRL, through the EU, have the following tasks:

- Prepare the Environment Protection Clauses, which are based on the EMP and the ECC of the Project, and include these clauses in the bidding documents for all works contracts;
- Ensure that all engineering interventions and conditions prescribed in the approved EMP, EMoP and ECC and requirements of JICA guidelines (2010) and ADB's SPS (2009) are reflected in the bid docs and the works contracts, and implemented accordingly during pre-construction/construction and operation of the SCMP;

- Adequately staff and resource the ESRL, with qualified full-time environment and construction safety specialists;
- Maintain adequate construction supervision including environment and safety supervision at all times.
- Supervise the General Consultant in the conduct of EMP implementation coordination, safeguards monitoring and report preparation;
- Report periodically the status of compliance to the DENR-EMB following prescribed formats;
- Report periodically the status of compliance with the JICA Guidelines (2010) and ADB's SPS (2009) to JICA and ADB.

10.1.4.2 Health, Safety and Environment Officers (HSEO)

2150. The SCRP PMO ESRL Division will have HSEO. The HSEO will provide appropriate actions on complaints brought to the PMO-ESRL for resolution. Further, the HSEO will closely coordinate with the Health, Safety and Environment Unit of the Contractors regarding mutual concerns during construction.

2151. The HSEO may take the role of a Pollution Control Officer (PCO). The PCO serves as a technical person competent and qualified in pollution control and environmental management, performing duties and responsibilities in a particular establishment, and is officially accredited by EMB regional offices to assume such responsibilities. The HSEO is responsible for the following among others:

- To guide PMO-ESRL engineers and technical personnel in the implementation of the ECC conditions and other activities during pre-construction/construction and operation which are laid out in the EMP and the EMoP—both consisting of integral parts of the EIS—and requirements of JICA Guidelines (2010) and ADB's SPS (2009);
- To prepare environment monitoring reports including CMRs and submit them to the DENR-EMB, JICA and ADB;
- To prepare and include in the bidding documents the Environmental Protection Clauses;
- To discuss with bidders the Environmental Protection Clauses for their consideration and compliance;
- To handle grievances/complaints forwarded from the grievance team and respond to them within 15 days of receipt; and
- To represent the PMO for the HSEC.

2152. The HSEO is recommended to have an environmental management background or at least 5 to 10 years of experience in the environmental management field in accordance with the Revised Guidelines for PCO Accreditation (DAO 2014-02). In addition, the position requires the following qualifications:

- Per letter instruction (LOT) 588, LLDA BR 455, series of 2014 and DAO 2014-02 as amended by DAO 2018-07, the person is required to attend the basic PCO training course conducted by EMB-recognized training institutions[2]. It is a five-day course, which is conducted by EMB-recognized training institutions and costs around PhP 10,000.00. After successfully finishing the course, an attendee is given a certificate of training, which is one of the requirements for accreditation as a PCO.

[2] Training on environmental regulations, or the usual basic training course for PCOs deal with environmental regulations including the Clean Air Act, the Clean Water Act, the Toxic Substances and Hazardous Wastes Management Act, the Philippine EIS system, the Ecological Solid Waste Management Act and legal procedures on environmental cases.

- The person is required to attend an accredited eight-hour orientation training on environmental regulations for managing heads (required under LLDA BR 455, series of 2014, DAO 2014-02 and DAO 2018-07).
- The person is required to provide the accreditation certificate to the EMB Central Office (2M). After fulfilling the requirements for accreditation, the managing head shall submit required documents to the concerned EMB regional office and pay a processing fee. The regional director is obliged to respond within 15 days from receipt of application. The PCO accreditation shall be renewed every three (3) years, provided he/she has completed at least forty (40) hours of cumulative relevant training as a participant or twenty (20) hours as a trainer/subject matter expert within the three-year period and upon payment of a renewal fee.

10.1.5 Health, Safety and Environment Committee (HSEC)

2153. The HSEC will be established by SCRP PMO prior to works commencement, which will comprise representatives from the SCRP PMO, the GC and the works contractors. The HSEC's role and responsibilities are as follows:

- Hold bi-weekly meetings to discuss EMP-related matters (progress, issues) and complaints and resolve them;
- Support the GRM Help Desk in responding to grievances and complaints;
- Verify performance of the contractor in the EMP implementation and effectiveness of mitigating or enhancement measures;
- Set forth solutions or alternatives to enhance the EMP based on monitoring results;
- Coordinate with the DENR-EMB and other relevant oversight agencies and stakeholders;
- Submit self-monitoring reports (SMR), prepared and signed by the accredited works contractor's Pollution Control Officer (PCO), detailing the status of compliance with the ECC and other environmental regulations to the DENR-EMB, JICA and ADB on a quarterly basis.

10.1.6 Multi-partite Monitoring Team (MMT)

2154. The MMT is an independent third-party entity formed after the issuance of the ECC to encourage participation of the project's various stakeholders and monitor the project's compliance with the ECC conditions as well as the EMP and EMoP during pre-construction, construction and operation. The MMT's Compliance Validation Monitoring Reports (CMVRs) as prescribed in the Revised Procedural Manual for DAO 2003-30 will be submitted to the DENR-EMB. JICA and ADB may request for these reports for their reference.

2155. The formation of the MMT is initiated by the SCRP PMO through a Memorandum of Agreement (MOA) between the DENR-EMB Central Office and the PMO in conformity with identified MMT members. According to DAO No. 2017-15, the MMT is composed of representatives of relevant stakeholders. As such, the EMB and the DOTr, as principal project parties, will no longer be members of the MMT. Instead, the EMB will provide oversight guidance to the MMT and factor in its reports and recommendations for its impact and compliance evaluation. Further, DAO 2017-15 requires proponents such as the DOTr and/or the PNR to provide fund for the EMF or MMT activities based on the annual work and financial plan (WFP) approved by the DENR-EMB Central Office. Key stakeholder members of the MMT are enumerated below.

10.1.6.1 Composition of the MMT

10.1.6.1.1 Local Government Unit

- One (1) representative of the Provincial Environment and Natural Resources Office

(PENRO) from each affected province
- In case that there is no PENRO, one (1) representative from the Municipal/City Environmental and Natural Resources Office (M/CENRO) or the Municipal/City Planning and Development Office (M/CPDO) or the chairman of the Sangguniang Barangay (SB) Environment Committee Chairman
- Chiefs of rural health units (RHU)
- Concerned barangay captains

10.1.6.1.2 Non-government Organization/People's Organization

- One (1) representative from environmental non-government organizations (NGOs)
- In case there is no environmental NGO, one (1) representative from other NGOs
- Maximum of two (2) representatives from locally-recognized community leaders representing the vulnerable such as indigenous peoples (IPs), women, senior citizen, etc.

10.1.6.1.3 Academics

- Maximum of two (2) representatives from the academe

10.1.6.1.4 National Government Agencies

- Maximum of three (3) representatives with relevant mandates regarding the project
- Regarding special environmental concerns, e.g., biodiversity, DENR membership will be endorsed by the Director of the concerned bureau.

10.1.6.2 Roles and Responsibilities of the MMT

2156. The specific functions of the MMT include the following:

- Conduct a quarterly ocular site visit to validate the proponent's compliance with the ECC conditions and the environmental management and monitoring plan (EMMP) including requirements for self-monitoring and submit the corresponding reports regularly;
- Observe sampling activities conducted by the project proponent;
- Prepare and submit its report to the EMB-Central Office, the EMB-Region 4A, JICA and ADB using EMB-prescribed formats at least semi-annually, no later than July 30 for the first-term report and January 30 for the second-term report; and
- Institute an environmental emergency and grievance management mechanism which is expected to provide recommendations for necessary regulatory actions to the EMB in a timely manner to prevent adverse environmental impacts.

10.1.7 Third-Party Auditor (TPA)

2157. In lieu of an MMT, a TPA may be engaged for compliance monitoring if agreed upon with the DENR-EMB Central Office. The specific functions of the TPA would include:

- Validating compliance with the conditions stipulated in the ECC, EMP and the EMoP of the Project along with JICA's Environmental Guidelines (2010) and ADB's SPS (2009) (e.g. auditing CMRs, SMRs, environmental sampling results, etc);
- Validating the DOTr's conduct of self-monitoring for the Project;
- Overseeing implementation of the EMP and EMoP of DOTr and the Contractor;
- Coordinating with the Contractor's Pollution Control Officer (PCO) to ensure timely gathering of monitoring data for environmental parameters, and subsequent monitoring of such;

- Compiling monitoring data gathered by the Contractor and ensure timely submission of the Contractor's Self-Monitoring Report to DOTr;
- Notifying DOTr and the GC about any act or activity by the Contractors that are deemed as violations to the stipulations in the ECC, EMP or EMoP including any amendments issued, and recommend immediate courses of action to avoid or mitigate any violation to the relevant stipulations; and
- Gathering relevant information to facilitate determination of validity of complaints or concerns about the Project and recommend measures to the DOTr and the GC to address the complaints.

10.1.8 Contractors

2158. Contractors will be primarily responsible for implementing the EMP and complying with measures and requirements relevant to the contractor set forth in the EMP and any corrective or preventative actions set out in a safeguard monitoring report during the construction phase. The Contractor shall be liable to any penalty sanctioned to the SCRP PMO that are related to the non-compliance with the conditions in the ECCs. The Contractors will allocate funding for the successful implementation of the EMP as stated in the Environmental Protection Clauses. Along with the DOTr, the Contractors will be responsible for ensuring that all engineering interventions in the approved EMP, RAP, and ECCs are implemented and documenting and reporting them to the DENR-EMB, JICA and ADB. The Contractors will notify the SCRP PMO, JICA and ADB of any unanticipated environmental risks or impacts that arise during construction that were not considered in the EIS, the EMP and the RAP or the indigenous peoples plan (IPP). The following tasks are to be strictly observed by the Contractor:

- Provide sufficient funding and human resources for the proper and timely implementation of required mitigation and monitoring measures stipulated in the EMP and additional measures that may be required to address adverse environmental impacts generated by construction activities;
- Recruit a sufficient number of full-time, qualified and experienced environmental officers and safety officers before site works commence to ensure compliance with environmental statutory requirements, compliance with contractual obligations related to environmental management, timely and adequate compliance with provisions of the EMP and timely and adequate monitoring and reporting on the EMP implementation;
- Prioritize employment of project-affected persons for construction works as conditioned in the ECC and submit a monthly report on employment status;
- Conduct joint site investigation with the IA and the GC before site works commence, adequately record the conditions of roads, agricultural land and other structures/infrastructure along the project alignment and construction-related facilities that may be affected or damaged by civil works—such as damages due to vibration, operation of equipment, etc.—and ensure that those structures and assets are not removed until relevant permits from the PMO/GC for the pertinent area are obtained;
- Ensure that site clearing, and construction works are consistent with unexploded ordnance (UXO) protocols to avoid health and safety hazards at work and against the public;
- Prepare the Contractor's detailed design consistent with the EMP prior to the start of site works;
- Undertake ambient environmental baseline sampling prior to the start of site works and ambient environmental monitoring in compliance with EMoP and prepare corresponding monitoring reports;
- Prepare monthly monitoring reports on the EMP implementation, e.g., environmental mitigation measures for submission to the SCRP PMO and the GC;
- Undertake consultations with affected people and local officials prior to the start of

site works and throughout the duration of construction works to ensure that they are properly informed on the grievance redress mechanism and upcoming construction activities and that any environment-related concerns are adequately addressed;
- Provide the SCRP PMO with a written notice of any unanticipated environmental impacts that arise during construction that were not considered in the EMP and prepare and implement corrective action plan(s);
- Implement additional environmental mitigation measures, as necessary, to avoid, minimize and/or compensate for adverse impacts due to construction works and related activities;
- Fully reinstate pathways, other local infrastructure and agricultural land to their pre-project condition at least upon completion of construction; and
- Obtain the ECC necessary for temporary facilities and environment permits prior to construction.

10.1.9 General Consultant (GC)

2159. The DOTr hired the GC who will support the SCRP PMO for the project implementation. The GC will have overall responsibility for supervising, monitoring and reporting the EMP implementation. The GC will include international environmental specialists and local environmental specialists who are responsible for supporting the PMO-ESRL for the and providing training and capacity building programs as required. The GC is tasked to assist the PMO in the following main activities, but not limited to:

- update the EIA/EMP/EMoP or prepare new EIA/IEE, as appropriate, in accordance with the EARF, if any unanticipated environmental risks and impacts arise and/or there are any changes in the project design that would cause environmental risks or impacts beyond the scope of the EIA;
- fulfill the conditions stated in the ECC, JICA's Environmental Guidelines (2010), ADB's SPS and other environmental requirements regarding the project;
- supervise environmental management of the project during the contract process, pre-construction, construction, and post-construction;
- provide introductory training for contractors prior to the preparation and submission of their construction environmental management plan (CEMP);
- review and carry out clearance of the CEMPs;
- monitor compliance with the approved CEMP of each contract package;
- prepare, on behalf of HSEC (see below) quarterly monitoring online reports on the EMP implementation and semi-annual reports on environmental safeguards activities in the format required by DENR-EMB, ADB and JICA, respectively.

10.1.10 External Environmental Monitoring Agency (EMA)

2160. In accordance with ADB’s SPS (2009) requirement for environment category A projects, DOTr will hire an external monitoring agency (EMA) to conduct independent verification of the project’s compliance with the EIS and its EMP/EMoP, the ECC conditions and ADB’s SPS (2009). The specific functions of the EMA include the following:

- Verify results of internal monitoring and supervision undertaken by DOTr and assess adequacy of the process and suggest any improvement measures as required;
- Verify compliance of DOTr to the ECC conditions of the Project under the Philippine Environmental Impact Statement System (PEISS);
- Conduct site visits and assess works contractors’ compliance with the EMP/EMoP and their CEMP. Such assessment shall include environmental management as well as health and safety performance and compliance with the EMP/EMoP, and

the Philippines legal and regulatory framework;
- Assess the adequacy of EMP/EMoP implementation and identify necessary corrective actions, as needed;
- Review and assess adequacy of the institutional arrangements and capacities of the the PMO, the General Consultant, and the works contractors for EMP/EMoP implementation;
- Assess the extent to which consultation and information disclosure activities are inclusive, accessible, and effective in conveying key information from the EIA/EMP/EMoP as well as provide conditions for stakeholders to contribute to decision making which affects them such as pre-construction, construction and operational impacts;
- Assess the works contractor's construction safety performance, including safety provisions for workers and communities, construction safety procedures, protocols and record, and emergency preparedness and response procedures;
- Assess the effectiveness of the grievance redress mechanism (GRM) and its accessibility and responsiveness to resolving complaints;
- Conduct key stakeholder interviews, as required, to substantiate observations and identify meaningful corrective actions;
- Review contractor's system and performance with regard to core labor standards, the Philippines Labor Code, and other relevant laws and regulations;
- Recommend corrective actions required to resolve on-site environmental problems including proposed actions for inclusion in the Corrective Action Plan (CAP), if required;
- Prepare and submit to DOTr, JICA, and ADB for review the periodic EEMR for disclosure of the ADB project website.

10.1.11 Other government agencies

2161. DOTr and the SCRP PMO will implement the EMP in coordination with the following entities:

- The Environmental Management Bureau (EMB)-Central Office (CO) of the Department of Environment and Natural Resources (DENR);
- The regional offices of DENR-EMB, specifically the DENR-EMB NCR and Region 4-A;
- The Forest Management Bureau (FMB) and the Biodiversity Management Bureau (BMB) of the DENR;
- The DOTr's attached agencies – the Philippine National Railway (PNR)
- Other relevant national government agencies (NGAs) – the National Commission for Culture and Arts (NCCA), the National Historical Commission of the Philippines (NHCP), the National Museum (NM), Laguna Lake Development Authority (LLDA), the Department of Public Works and Highways (DPWH), the Department of Human Settlements and Urban Development (DHSUD), and the Social Housing Finance Corporation; and
- Local government units (LGUs) of Manila, Makati, Taguig, Parañaque, Muntinlupa, San Pedro, Biñan, Santa Rosa, Cabuyao, and Calamba.

10.2 INFORMATION DISCLOSURE

2162. Requirements of information disclosure, disclosure plans under the Project and actual disclosure implementation are detailed in Chapters 2, 6 and 11.

10.3 REPORTING REQUIREMENTS FOR MONITORING

2163. The SCRP PMO is required to submit internal and external environment monitoring reports to the DENR-EMB, JICA and ADB during pre-construction, construction and operation until the project completion report is issued. Further, the results of public consultation, SDP and IEC Framework implementation, and information disclosure are also submitted as attachments. The said reports are disclosed to the public.

2164. Each **works contractor** must submit monthly environmental compliance progress reports through the GC to the PMO throughout pre-construction and construction phases. Each works contractor must be able to highlight the summary of the pre-construction and construction progress and activities undertaken to implement measures outlined in the EMP and EMoP, recording any received community complaints and their resolution, as well as activities related to social protection, health and safety. All incidents and accidents involving construction workers and members of the community must be reported immediately (i.e. within 24h) to the GC and the PMO.

2165. **Internal monitoring reports.** The **GC** consolidates, on behalf of the PMO, the results of monthly environmental monitoring in quarterly self-monitoring reports (for online submission to DENR-EMB) and semi-annual environmental monitoring report (to attention of ADB). The significant findings and measures undertaken to address any adverse environmental impacts and safety risks during construction are summarized, and any unforeseen environmental impacts and suggested remedial actions for the next monitoring period are presented in the semi-annual report. The semi-annual environmental monitoring reports also report on status of SDP and IEC Framework implementation. The GC will also prepare a Project Completion Environmental Monitoring Report after completion of construction, detailing the status of EMP implementation, outstanding environmental issues and time-bound corrective action plan, as necessary.

2166. Once environmental monitoring reports are received by the **PMO**, the project's compliance with the ECC and EMP is reviewed by HSEC and the PMO. After thorough review and QA/QC, the reports are submitted to DENR-EMB (online submission of quarterly reports), and ADB and JICA (semi-annual reports). All semi-annual environmental monitoring reports are subject to disclosure on the website of ADB. During operation, EMP reporting is undertaken by the PMO on an annual basis.

2167. **External monitoring reports.** Semi-annual external monitoring reports are prepared by the EMA and are submitted by the PMO (through HSEC) to DENR-EMB, ADB and JICA. Further, semi-annual compliance monitoring and validation report (CMVR), otherwise known as the MMT report form, are also submitted by the MMT to the DENR-EMB.

2168. The monitoring reports to be prepared are summarized in **Table 10.3.1.**

Table 10.3.1 Types of Monitoring Reports

	Type of Report	Frequency	Responsible Party	Place of Submission
Pre-Construction and Construction Phase				
1	Monthly HSE compliance progress report	Monthly	Contractor	Contractor ⇒ GC ⇒ PMO
2	Semi-annual environmental monitoring report; Project completion environmental report	Semi-annual (no later than July 30 for the first term and January 30 for the second term)	GC, PMO (PCO)	GC ⇒ PMO ⇒ ADB/JICA
3	Self-monitoring report (SMR)	Quarterly online submission	GC, PMO (PCO)	PMO ⇒ EMB-Central Office, EMB-NCR, EMB-Region 4A

	Type of Report	Frequency	Responsible Party	Place of Submission
4	Compliance monitoring report (CMR)[3] on ECC conditions	Semi-annual using EMB-prescribed formats (no later than July 30 for the first term and January 30 for the second term)	PMO	PMO ⇒ EMB-Central Office, EMB-NCR, EMB-Region 4A
5	Compliance monitoring and validation report (CMVR)	Semi-annual using EMB-prescribed formats (MMT report form) as prescribed in the revised procedural manual for DAO 03-30	MMT	PMO ⇒ EMB-Central Office, EMB-NCR, EMB-Region 4A Optional: JICA and ADB
6	External Monitoring Report	Semi-annual using format acceptable to ADB	EMA	EMA ⇒ PMO, JICA and ADB
Operational Phase				
1	Self-monitoring report (SMR)	Quarterly using DENR-EMB prescribed format	PCO of SCRP operator	PCO ⇒ DENR-EMB, ADB/JICA

[3] The CMR can be based on semi-annual environmental monitoring report defined in item (2) but following EMB-prescribed template.

11. PUBLIC CONSULTATION DOCUMENTATION

2169. According to best practices worldwide, project-affected communities are to be fully informed, consulted and encouraged to participate in the decision-making process concerning the project that will affect their lives. Information dissemination and meaningful consultations at the early stage provide a good opportunity for the public to express their opinions, apprehensions and even objections. The information gained through public consultations on stakeholders' concerns, interests and ability to influence decision-making contributes to identifying key causes of environmental problems. The information can be used to evaluate direct and indirect environmental impacts and assess short- and long-term resource use implications. In addition, it allows the Proponent, the DOTr, to promptly address matters raised. After careful consideration, the information can be also helpful to evaluate alternatives and strengthen the environmental management plan (EMP) by incorporating local inputs and know-how and can be incorporated in project design and development as a way to improve environmental governance by providing a mechanism to influence decisions on the use and management of natural resources. Once the aim is achieved, delays in implementation due to unforeseen conflicts can be minimized, if inevitable. The DOTr pays particular attention to the needs of disadvantaged or vulnerable groups, especially those below the poverty line, the landless and the elderly, single-parent households, women and children and indigenous peoples.

2170. This chapter summarizes the results of all public consultation and information disclosure activities conducted during the feasibility study and detailed design stages of the SCRP main line and during the feasibility study of the SCRP interconnecting line in line with the detailed mechanism discussed in the Social and IEC Framework.

11.1 INFORMATION DISCLOSURE

2171. The documents prepared and disclosed for the SCRP main line and for the SCRP interconnecting line were done separately since the SCRP interconnecting line was originally part of the project scope of the Metro Manila Subway Project that underwent a separate Environmental Impact Assessment (EIA) process with the Department of Environment and Natural Resources-Environmental Management Bureau (DENR-EMB). The following documents will be disclosed on websites of the DOTr, ADB and JICA.

- Draft and Final Environmental Impact Statement (EIS) of the SCRP (on ADB and JICA websites);
- Final Environmental Performance Report and Management Plan (EPRMP) for the MMSP endorsed by the DOTr and concurred with by JICA (on JICA website);
- Corrective action plans prepared during project implementation (if any) on ADB and JICA websites);
- EIS and EPRMP-related due diligence reports (on ADB and JICA websites); and
- EIS and EPRMP implementation monitoring reports (on ADB and JICA websites).

11.1.1 Information Disclosure under the Philippine Environmental Impact Statement System (PEISS)

2172. Information about the Project was disclosed in compliance with the Philippine Environmental Impact Statement System (PEISS). The project concept and the proposed scope of the EIS were first disclosed to potentially affected people during compulsory information, education, and communication (IEC) campaigns and perception surveys. Relevant stakeholder engagement activities for the Project were conducted from late 2017 to early 2018 for the SCRP main line (from Solis to Calamba) and from 2017 to 2019 for the SCRP interconnecting line. During these consultation meetings, people were given the opportunity to raise their issues, questions, and concerns about the project components.

2173. Prior to Public Scoping activities, the DOTr prepared a comprehensive project description including the proof of the IEC implementation—such as attendance sheets, photos, received invitation letters and a list of issues raised by the participants—and initial environmental assessment[1] and submitted them to the EMB for disclosure. A summary of the draft EIS report for SC main railway line was disclosed on EMB's website[2] 20 days prior to public hearings conducted in June 2018 (Makati City on June 20, 2018; Taguig City on June 21, 2018; and Santa Rosa on June 22, 2018). Meanwhile, the summary of the draft EPRMP of the SCRP interconnecting line was disclosed on EMB's website[3] prior the public hearing conduced in 03 September 2019 in Taguig City. Copies of the Executive Summary for the Public was distributed to invited participants as an attachment of invitation letters. Hard copies of the final EPRMP for the SCRP interconnecting line was provided to relevant stakeholders including host LGUs including Taguig and Paranaque, as well as relevant Local Government Agencies.

11.1.2 Information Disclosure under ADB

2174. The first draft EIS was first disclosed on ADB's project website in November 2018. The updated draft EIS report was disclosed on ADB's project website[4] in February 2019. The EIS report was then updated to include the SCRP interconnecting line (i.e. this document). This updated version of the final EIS will also be posted and disclosed on ADB's project website.

11.1.3 Information Disclosure under JICA

2175. The main line's EIS, endorsed by the DOTr and concurred with by JICA, was disclosed on JICA's website on July 3, 2018 for 120 days prior to the loan agreements.

2176. The interconnecting line's final EPRMP on the other hand was disclosed on JICA's website on December 11, 2019 for 120 days prior to loan agreements.

11.2. CONSULTATION/PARTICIPATION DURING FEASIBILITY STUDY AND DETAILED DESIGN STAGES

2177. The following information was presented to the public during local government unit (LGU) meetings, stakeholder consultation meetings (SCMs), focus group discussion (FGD), public scoping and public hearings under the IEC:

- Project description;
- Project activities and schedule;
- Possible impacts of the proposed project; and
- Proposed mitigating measures.

2178. A summary of overall consultation/participation and disclosure conducted during the feasibility study (FS) and detailed design (DD) is presented in **Table 11.2.1**.

[1] https://eia.emb.gov.ph/wp-content/uploads/2018/01/PDS-PNR-Los-Ba%C3%B1os-NSRP-South-Line-Commuter.pdf for SC
[2] http://eia.emb.gov.ph/wp-content/uploads/2018/05/NSRP-ESP-English-DOTr-PNR-Los-Banos.pdf
[3] http://eia.emb.gov.ph/wp-content/uploads/2019/08/MMSP-EPRMP_-Executive-Summary_English.pdf
[4] https://www.adb.org/sites/default/files/project-documents/52083/52083-001-eia-en_13.pdf

Table 11.2.1 Summary of Consultation/Participation and Information Disclosure Conducted under the Project

No.	Proposed Mechanism	Dates	
		SCRP Main Line	SCRP Interconnecting Line*
Feasibility Study Stage			
1	LGU meetings	December 13, 2017–January 10, 2018	May 16 – June 3, 2019
2	NGA meetings DENR-EMB, HUDCC, NCCA, NHCP, PCUP, SHFC	November 22, 2017–September 25, 2018	January 2019 – December 2019
3	Perception survey	February 6–28, 2018	May 30-31 and June 3, 2019
4	Stakeholder consultation	January 18–August 28, 2018	August 14, 2019 (1st SCM under RAP study)
5	Focus group discussion	April 23–May 15, 2018	July 15, 2019
6	Public scoping	January 18–24, 2018	July 1, 2019
7	Public hearing	June 20–22, 2018	September 3, 2019
Detailed Design Stage			
1	LGU meetings	September 19–October 23, 2019	Not yet in DD stage
2	NGA meetings BIR, DA, DAR, DENR RO3, DENR RO-4A, DENR-FMB, DOLE, DSWD, DTI, HUDCC, LBP, NAPC, NCCA, NCIP, NHCP, NM, PAF, PAG-IBIG, TESDA	October 2018–March 2019	Not yet in DD stage
3	Stakeholder consultation	1st SCM: January 8-16 2019	Not yet in DD stage
4	Focus group discussion	November 7–September 18, 2019	Not yet in DD stage
5	Production and distribution of printed and other materials	Not yet	Not yet in DD stage
6	Online disclosure of project information	January 2018–present	Not yet in DD stage
7	Media releases/press briefings	November 2018	Not yet in DD stage

*Consultation activities done for the SCRP interconnecting line were conducted as part of the EPRMP preparation during its feasibility stage. Project layout presented to the stakeholders in Taguig and FTI includes the basic plan with worst case scenario which was subsequently revised and presented in this EIS.

BCDA = Bases Conversion Development Authority, BIR = Bureau of Internal Revenue, CDC = Clark Development Corporation, DA = Department of Agriculture, DAR = Department of Agrarian Reform, DENR-EMB = Environmental Management Bureau of the Department of Environment and Natural Resources, DENR-FMB = Forest Management Bureau of the DENR, DOLE = Department of Labor and Employment, DSWD = Department of Social Welfare and Development, DTI = Department of Trade and Industry, HUDCC = Housing and Urban Development Coordinating Council, LBP = Land Bank of the Philippines, NAPC = National Anti-Poverty Commission, NCCA = National Commission for the Culture and the Arts, NCIP = National Commission on Indigenous Peoples, NGA = National Government Agency, NHA = National Housing Authority, NHCP = National Historical Commission of the Philippines, NM = National Museum, PAF = Philippine Air Force, PCUP = Presidential Commission for the Urban Poor, SHFC = Social Housing Finance Corporation, TESDA = Technical Education and Skills Development Authority.

Source: JICA Design Team.

11.2.1. Consultation/Participation During Feasibility Study

11.2.1.1. Meetings with Local Government Units

2179. The IEC campaigns were conducted to provide updated information about the proposed Project and encourage concerned stakeholders, e.g., LGUs, provincial governments and land owners to participate in the course of the EIA study. The outline of the sessions held during the FS is shown in **Table 11.2.2**, and major issues and concerns discussed are summarized in **Table 11.2.3.**

Table 11.2.2 Outline of FS Meetings with Local Government Units

Target Affected LGU	Venue	Date and Time	Main Participants	Topic	No. of Participants		
					M	F	Total
SCRP Main Line							
Calamba	Provincial Government Extension Office, Calamba City	December 13, 2017	Officials from the Office of the Governor PUDHO	1st IEC	2	0	2
Muntinlupa	Office of the City Administrator, Conference Room, Muntinlupa City	December 18, 2017	Muntinlupa City LGUs (UPAO, CPDO, City Engineering, Records and Assets, Barangays)	1st IEC	2	7	9
Manila	Manila City Engineer's Office Conference Room, Manila City Hall	December 18, 2017	Manila City LGUs (the Office of the City Administrator, City Engineer's Office and DEPW)	1st IEC	5	8	13
Los Baños	The Workshop Room, 3rd Floor, Los Baños Municipal Hall	December 19, 2017	San Pedro City LGU Santa Rosa City LGU Mayor of Cabuyao City Los Baños LGU	1st IEC	20	4	24
Parañaque	Conference Room, Parañaque City Hall	December 20, 2017	Parañaque City LGU (City Planning, UMADO, City Assessor, City ENRO, City Engineering and LHDO)	1st IEC	3	6	9
Biñan	Biñan City Hall	December 22, 2017	Parañaque City LGU (City Mayor, City Councilor, City ENRO and CPIO)	1st IEC	3	6	9
Makati	Makati City Hall	December 22, 2017	Makati City Administrator's Office	1st IEC	4	1	5
Calamba	Calamba City Hall	December 22, 2017	Calamba City LGU	1st IEC	1	0	1
Makati	Makati City Hall	December 27, 2017	Makati City Administrator's Office	1st IEC	4	1	5
Taguig	Taguig City Hall	January 10, 2018	City Hall, Taguig City	1st IEC	6	1	7
SCRP Interconnecting Line							
Taguig	Taguig City Hall	11 April 2019	Representatives from the Taguig Planning and Development Office	Coordination and IEC	1	3	4
	Western Bicutan Barangay Hall	May 27, 2019	Officials from the Barangay Western Bicutan	Coordination and IEC	1	4	5
	Fort Bonifacio Satellite office, 2nd Fl., Market! Market!, McKinley Parkway	May 27, 2019	Barangay Chairperson of Fort Bonifacio	Coordination and IEC	1	0	1
Parañaque	Parañaque City Hall	May 23, 2019	Representatives from the Parañaque Planning and Development Office	Coordination and IEC	3	2	5
	San Martin de Porres Barangay Hall	June 03, 2019	Officials from the Barangay San Martin de Porres	Coordination and IEC	4	3	7
Pasay	Pasay City Hall	May 03, 2019	Representatives from the Pasay Planning and Development Office	Coordination and IEC	5	1	6
	Barangay 183 Hall	May10, 2019	Officials from the Barangay 183	Coordination and IEC	2	0	2

Source: JICA Design Team.

Table 11.2.3 Summary of Issues and Concerns Raised During Feasibility Study Meetings with Local Government Units

Stakeholder	Concern		Answer
	Environment	Resettlement Action Plan (RAP)	
SCRP Main Line			
Office of the Governor, Laguna	• Trees will need to be cut down during clearing of the right-of-way (ROW).		JICA Design Team will check for a cutting permission.
	• There is a fault line near the alignment.		Engineering geological and geohazard assessment (EGGA) will be carried out during DD.
	• Will old stations of the Philippine National Railways (PNR) be preserved?		JICA Design Team will discuss the preservation of PNR's stations with the NHCP and the Department of Tourism (DOT).
		• Convening of the Local Inter-Agency Committee (LIAC) at an early stage. • There are a large number of informal settler families (ISFs) at Calamba and Los Baños. • Where is the resettlement site for Los Baños? • Local elections might cause a delay in resettlement. LGU wants to implement resettlement after the elections.	JICA Design Team will organize a coordination meeting with the NHA.
			Public roads will not be blocked. If passing through a private road, a memorandum of agreement MOA will be concluded between the PNR and the LGU.
Muntinlupa City	• There is a local ordinance declaring areas along the fault line, i.e., West Valley Fault, a “no build zone”. This is supported by a zoning ordinance and also incorporated into the comprehensive land use plan (CLUP). Identified geohazards are flood, liquefaction and seismicity.		JICA Design Team will coordinate with the Philippine Institute of Volcanology and Seismology (PHIVOLCS) and gather information concerning procedures.
		• There is an ongoing construction of roads along the alignment which is a project of Congressman Biazon.	JICA Design Team requested the LGU to provide data on ongoing projects.
Los Baños, Laguna		• There are at least 3,500 ISFs along the PNR alignment.	The DOTr will write a letter of request to LGUs to halt issuance of a building permit within the 30-meter PNR's ROW.
Paranaque City		• A legal project-affected person (PAP) is set to construct an eight-level	JICA Design Team will prioritize some sections for a parcellary survey particularly in the proposed station location.

Stakeholder	Concern		Answer
	Environment	Resettlement Action Plan (RAP)	
		building near the alignment.	
Taguig City	• A fault line traverses the PNR alignment between Tanyag and Daang Hari.		JICA Design Team will coordinate with the PHIVOLCS and gather information concerning procedures.
		• Tanyag area has many ISFs.	Sub-contractors will meet with LGU officials prior to actual surveys and stakeholder consultation meetings. The DOTr will endorse sub-contractors to the LGU.
SCRP Interconnecting Line			
Taguig	• Inquired about the location where the excavated spoils will be disposed of. • Asked about the length of alignment which will pass through the city. • There may be underground tunnels within the proposed alignment locations. • They expressed concern regarding the name of the stations since the proposed FTI Station is part of Parañaque City already. • Clarified that both BGC and Lawton Stations are within Brgy. Fort Bonifacio and Senate Station is within Brgy. Western Bicutan. • Requested for a formal report regarding the selection of station locations in Taguig City as well as a traffic management plan during construction period. • Asked for the schedule of the start and finish of the construction within Fort Bonifacio. • Raised inquiry on the possible impact of the vibration in their area. Asked if connections to commercial buildings like malls is possible.	• No issues raised.	• The LGUs of Quezon City and Valenzuela City have already expressed their willingness to cater the excavated spoils from the Partial Operability (PO) Sections of MMSP. Further, based on the initial meeting with the LGU of Taguig City, they will only receive spoils that are excavated from their jurisdiction. • The approximate length of alignment that will fall in Taguig is 5 km with the Tunnel Boring Machine's (TBM) diameter of ~ 7 m. These alignments will not fall within any bodies of water. • DOTr assured that finding the said tunnels will be included in the EIA. • Explained that the schedule of construction is on 2020 or 2021 for the construction and operational by 2025 approximately. • Explained that based on the study made, there might be vibration during the actual construction but this is temporary as the operation is within the standard. • Explained that there will be multiple entrances and exits near the malls that are considered by the project.
Parañaque	• Clarified if the station still is in Brgy. San Martin De Porres.	• Asked why the project has to take private areas when the PNR right-of-way is already	• Confirmed and added that the change in the FTI station is its expansion.

Stakeholder	Concern		Answer
	Environment	Resettlement Action Plan (RAP)	
	• Asked if it is possible to construct without excavating the aboveground. • Asked why the change in the scope of the station increased greatly. • Asked how many meters deep are the tunnels. • Asked if the excavation has started already and if ever, when will it start. • Asked if there is a second option for the FTI Station area	taking up 30 m and the road have 20 m. • Asked for the basis of the compensation.	• Explained that the PNR project is separate from the Segment. • Explained that the NATM can only be used for narrow sections with very delicate excavation process. • Explained that one reason is the planned interconnection with PNR. Further, the tracks will not meet but it will be connected in other ways (ex. walkways), the subway track will be in the surface for said Bicutan station. • Depth varies but ranges from 7 to 30 m below, shallowing as the tunnel approach the stations. • Explained that excavation has not yet started and is target to commence within the year. • Said that as of now, it is still in concept stage but detailed design will follow for these changes in alignment once the loan agreement is signed, but prior to signing, JICA requires for the amended ECC that covers this area. • Said that the compensation will be based on the current market value.
Pasay	• Expressed that the condominium units are going to be affected and the dust may be a concern. • Informed DOTr and JDT that some of the condominiums have basements for parking as deep as 6 stories down and should be considered in the design.	• No issues raised.	• DOTr confirmed and noted the concerns. • No high rise condominium will be impacted by the SCRP Interconnecting Line

Source: JICA Design Team.

2180. IEC documents such as attendance sheets, issues raised, and photos taken during IEC sessions are presented **Annex 11-1**.

11.2.1.2. Meetings with National Government Agencies

2181. As part of consultation activities, meetings with NGAs such as the DENR-EMB, the BCDA, the NCIP, the CDC and the NHCP were held in order to effectively comply with each agency's requirements and regulations (**Table 11.2.4**).

Table 11.2.4 Outline of Feasibility Study Meetings with National Government Agencies

Date	Agency	Subject	Venue
November 22, 2017	DENR-EMB	EMB-Central Office discussion on EIA requirements	DENR EMB Central Office, Visayas Ave. Quezon City
December 5, 2017	DENR-EMB	Alignment coordination meeting–PNR North 2 Project	BCDA's board room, BCDA Corporate Office, Taguig City
December 7, 2017	DENR-EMB	Alignment coordination meeting–PNR North 2 Project	DOTr's Clark Office, Clark Freeport Zone, Angeles
December 20, 2017	Presidential Commission for the Urban Poor	SOCIO meeting with the DOTr and the PCUP	MRT 7 PMO building, Commonwealth Ave., Quezon City
December 29, 2017	Construction Industry Arbitration Commission	NCIP meeting on ancestral domain areas in Tarlac Province	NCIP Regional Office III, San Fernando City, Pampanga
April 13, 2018	NHCP	NHCP meeting	NHCP Main Office, T.M. Kalaw, Manila
April 18, 2018	NCIP	NCIP meeting prior to field based investigation (FBI)	NCIP Regional Office III, San Fernando City, Pampanga
June 7, 2018	DENR	1st EIA Review Committee (EIARC) meeting for the Malolos-Clark Railway Project (MCRP) and the North-South Railway Project (NSRP)	DENR-EMB Central Office, Visayas Ave. Quezon City
July 30, 2018	DENR	2nd EIARC Review Committee Meeting for MCRP and NSRP	DENR-EMB Central Office, Visayas Ave. Quezon City
July 16, 2018	SHFC and HUDCC	Meeting with ADB, JICA and SHFC on RAP	ADB Philippine Country Office, Pasig City
September 24, 2018	NHCP	Submission of updated project profile to NCIP Region 3	NCIP Regional Office III, San Fernando City, Pampanga
September 25, 2018	DENR-EMB	Meeting on the ECC, the Multi-partite Monitoring Team (MMT) and environmental standards	DENR-EMB Central Office, Visayas Ave., Quezon City
September 27, 2018	NCCA	PNR's old structures along the NSCR-Ex alignment	DOTr Office, Mandaluyong City
January 15, 2019	DepEd	Discussion on the SCRP interconnecting line	DepEd Complex, Meralco Avenue, Pasig city
May 15, 2019	Philippine Air Force	Basic details on construction and the effects on properties of the Department of National Defense	Villamor Airbase, Pasay City
June 4, 2019	DPWH-SMDEO	Creek-related matters at Villamor Airbase Golf Course	DPWH-SMDEO, Port Area, Manila
June 25, 2019	Philippine Air Force	Intermediate Shaft between LW and FTI Station	Villamor Airbase, Pasay City
July 11, 2019	Philippine Air Force	Intermediate Ventilation	MMSP GC Office,

Date	Agency	Subject	Venue
		Facility Between Lawton West and FTI Stations	Triumph Square Bldg., Quezon City
November 18, 2019	Cultural Agencies' (CA) Technical working committee (TWC)	National Nutrition Council (NNC) Building	National Commission for Culture & The Arts Office, General Luna St, Intramuros, Manila
November 22, 2019	DOTr Roads, TRB, and SMC	FTI Interface Issues	Columbia Tower, Ortigas
December 19, 2019	DPWH-MM2DEO	East Service Road Diversion Planning	DPWH-MMIIDEO Office, Dr. A. Santos Ave. corner West Service Access Road, Sucat Parañaque City

Source: JICA Design Team.

11.2.1.3. Perception Surveys

2182. Perception surveys were conducted for host and affected barangays of the SCRP. The survey covers respondents' demographic characteristics, sources of income, health conditions as well as their knowledge about and attitudes towards the project. The respondents include representatives of barangay councils, multi-sectors such as representatives of female groups and male groups, senior citizens and church groups and other figures from community authorities. **Table 11.2.5** shows the number of respondents for the perception surveys, disaggregated by each LGU.

Table 11.2.5 Perception Survey Respondents Disaggregated by LGU for the SCRP

LGU	Respondents				
	Male		Female		Total
	Sub-total	%	Sub-total	%	
SCRP Main Line					
Metro Manila					
Manila	486	52.31	443	47.69	929
Makati	15	41.67	21	58.33	36
Taguig	32	50.00	32	50.00	64
Parañaque	4	50.00	4	50.00	8
Muntinlupa	25	35.21	46	64.79	71
Laguna					
San Pedro	19	50.00	19	50.00	38
Biñan	23	56.10	18	43.90	41
Sta. Rosa	40	80.00	10	20.00	50
Cabuyao	59	65.56	31	34.44	90
Calamba	79	52.00	73	48.00	152
Total	**782**	**-**	**697**	**-**	**1,479**
SCRP Interconnecting Line					
Barangay 183, Pasay City	45	46	53	54	98
Barangay Fort Santiago, Taguig City	58	58	42	42	100
Barangay San Martin de Porres, Paranaque City	40	48	43	52	83
Total	**143**	**-**	**138**	**-**	**281**

Source: JICA Design Team.

11.2.1.4. Stakeholder Consultation Meetings

2183. The first, second and third rounds of SCMs for the SCRP main line were conducted in each LGU during the FS stage from January to August 2018 (**Table 11.2.6**). Further,

additional SCM was conducted for Parañaque City for the SCRP interconnecting line. Each round of SCMs had different agenda in order to orient stakeholders towards a project description, a resettlement plan, a legal framework and an entitlement matrix.

Table 11.2.6 Outline of Stakeholder Consultation Meetings During Feasibility Study

SCM	Date	Target Affected LGUs	Total No. of Participants
1st SCMs	January 18-February 2, 2018	Manila, Makati, Taguig, Parañaque, Muntinlupa, San Pedro, Biñan, Sta. Rosa, Cabuyao, Calamba and Los Baños, Bay	6,535
	August 14, 2019	Parañaque (for the SCRP interconnecting line)	416
2nd SCMs	April 25–June 8, 2018	Manila, Taguig, Parañaque, Muntinlupa, San Pedro, Biñan, Sta. Rosa, Cabuyao and Calamba	4,696
Additional round of 1st and 2nd SCMs	May 16–July 21, 2018	Manila, Makati, Taguig, Parañaque, Muntinlupa, San Pedro, Biñan, Sta. Rosa, Cabuyao, and Calamba	1,765
3rd SCM	August 18–28, 2018	Manila, Makati, Taguig, Parañaque, Muntinlupa, San Pedro, Biñan, Sta. Rosa, Cabuyao and Calamba	7,778

Source: JICA Design Team.

(1) First Round of Stakeholder Consultation Meetings During Feasibility Study

2184. The first round of SCMs was conducted in each LGU as shown in **Table 11.2.7**. The first SCM started with information disclosure regarding the project, e.g., areas that the project will traverse, project components such as stations and a depot and other features such as the ROW envisioned. In turn, the RAP study was described with a particular focus on the following topics: (i) basic principles of resettlement; (ii) socio-economic survey activities and (iii) the schedule of RAP activities. At the end of each meeting, invited project-affected persons (PAPs) were encouraged to participate in the open forum to express their views/opinions. A summary of main concerns/issues raised during the first SCM is presented in **Table 11.2.8**.

Table 11.2.7 Outline of the First Round of Stakeholder Consultation Meetings During Feasibility Study for the SCRP

LGU	Venue	Date and Time	Main Participant	No. of Participants		
				M	F	Total
Manila City	Dapitan Sports Complex	January 22, 2018 9:00 a.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	94	80	174
	Covered Court, Brgy. 811	January 22, 2018 2:00 p.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	114	208	322
	Sases Covered Court, Brgy. 803	February 2, 2018 8:30 a.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	125	268	393
	Sarmiento Community Center, Brgy. 592	February 2, 2018 8:30 a.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	62	96	152
	Jacinto Ciria Cruz Covered Court, Brgy. 860	February 2, 2018 2:00 p.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	189	374	563
	Basketball Court, Brgy. 511	February 2, 2018 2:00 p.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	97	214	311
	Basketball Court, Brgy. 503	February 3, 2018 8:30 a.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	21	38	59
	Barangay Hall, Brgy. 368	February 3, 2018 8:30 a.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	101	220	321

LGU	Venue	Date and Time	Main Participant	No. of Participants		
				M	F	Total
	Covered Court, Brgy. 224	February 3, 2018 2:00 p.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	13	12	25
	Domingo Santiago Covered Court, Brgy. 576	February 3, 2018 2:00 p.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	204	361	565
Makati City	Multi-Purpose Room, 7th Floor, Makati City Hall Building 2	December 18, 2017 9:00 a.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	4	2	6
Taguig City	Covered Court, Brgy. Fort Bonifacio	January 19, 2018 9:00 a.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	14	34	48
	Covered Court, Brgy. South Daang-Hari	January 19, 2018 2:00 p.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	39	52	91
Parañaque City	Brgy, Hall, San Martin De Porres	January 17, 2018 2:00 p.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	3	2	5
	United Hills Village Covered Court	August 14, 2019	PAPs, DOTr, JDT, LGU, Barangay	180	236	416
Muntinlupa City	Baywalk Covered Court, Brgy. Bayanan	January 18, 2018 2:00 p.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	39	81	120
	Barangay Hall, Brgy. Alabang	January 31, 2018 8:30 a.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	48	87	135
	Brgy. Hall Covered Court, Brgy. Poblacion	January 31, 2018 2:00 p.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	40	74	114
San Pedro City	Pavillion Hall, 5th Floor, San Pedro City Hall	January 18, 2018 8:30 a.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	28	66	94
Biñan City	Biñan People's Center	January 18, 2018 2:00 p.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	55	204	259
Sta. Rosa City	West Drive Covered Court, Brgy. Labas	January 19, 2018 8:30 a.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	44	97	141
Cabuyao City	AVR, Cabuyao City Hall	January 18, 2018 2:00 p.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	89	53	142
Calamba City	LLC Auditorium, Central 2	January 19, 2018 2:00 p.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	71	127	198
	Covered Court, Brgy. Pansol	February 1, 2018 9:00 a.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	57	152	209
	Covered Court, Brgy. Parian	February 1, 2018 2:00 p.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	13	61	74
Municipality of Los Baños	Covered Court, Old Municipal Hall Compund, Brgy. Baybayin	January 19, 2018 2:00 p.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	-	-	1,889
Municipality of Bay	Covered Court, Brgy. Paciano Rizal	January 22, 2018 9:00 a.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	51	74	125

Source: JICA Design Team.

Table 11.2.8 Summary of Issues and Concerns Raised at the First Round of Stakeholder Consultation Meetings During Feasibility Study for the SCRP Main Line

Query/Concern/Suggestion/Comment	Response to Query
Entitlements and Rights of ISFs	
Qualifications for the relocation program Whether unit owners of residential buildings within the PNR's ROW (Brgy. 811) are qualified in the relocation program for the project as they do not own the land.	• The law gives a priority to homeless and underprivileged citizens who cannot afford to have their own houses and lots. • Beneficiaries of previous relocation programs who sold their units and returned to informal settlings are not qualified to avail of or beneficiaries of any government housing project for 10 years. • Eligibility of PAPs to the relocation program for the project will be determined by the partner housing agency of the DOTr. • A more detailed explanation on qualifications of PAPs for the relocation program will be discussed in the 2nd SCM.
Entitlements of structure owners	• The type of land ownership must be established first to determine entitlements of the structure owner. • The owner will be compensated for the structure if the land is outside the PNR's ROW. • During tagging activities, the structure owner will be the one to be photographed, not the renter.
Whether awardees of previous NHA housing programs are still qualified to avail of another relocation program of the project. Whether recipients of a relocation program through a PNR project who sold their units and returned to informal settlings along the PNR track are beneficiaries of the housing program for this project. Whether awardees of a housing program who abandoned their units due to poor living conditions at the relocation site and returned to informal settlings along the track could still qualified to the relocation program for the project.	• A more detailed explanation regarding concerns will be discussed during the 2nd SCM. • Based on RA 7279, it depends on a reason of the awardee for leaving the unit. • It is specified in the law that awardees who sold their relocation units and returned to informal settlings are not qualified to avail of any NHA housing programs for 10 years. • All ISFs within the 30-meter PNR's ROW will be included in the survey even including returnees, but their qualifications for another relocation will be decided by the partner housing agency of the DOTr. • The survey result will show the length of stay of the awardee in the unit and if the unit was put up for rent or sale or just plainly abandoned. • If the case is abandonment, it will be very different from the case which the owner sold the unit. • Since availability of the relocation program has become a business, a stricter inquiry on the true reason for abandoning a housing unit is being carried out by the NHA. • If the awardee can prove through documentation that he/she is not a professional squatter based on NHA standards, then qualifications for another relocation program will be considered. • The people's plan (PP) will be based on the plan made by people, with assistance from the partner housing agency of the DOTr, in this case, the SHFC.
Whether all families living in one structure will be included in the relocation program.	• Relocation will be implemented per household. • One household is defined by a separate kitchen and a food budget.
Whether financial assistance will be accorded to PAPs unqualified for relocation	• The legal framework for the RAP will be discussed during the 2nd SCM.
Basis of compensation for structures	• Affected structures will be compensated at replacement costs without depreciation.
Entitlements and Rights of Renters	
Qualifications of renters for the relocation program	• Qualifications of renters for the relocation program are dependent on the current economic status. • A separate interview will be conducted for renters. If they turn out to be qualified, they will be included in the relocation program. • The consultant can only recommend who are qualified, but the partner housing agency of the DOTr will decide who are qualified and who are not.

Query/Concern/Suggestion/Comment	Response to Query
	• Renters may have a higher possibility to be beneficiaries of the relocation program.
Compensation for renters	• A renter has its own entitlements which are separated from the owner. • A detailed explanation on compensation for renters will be discussed during the 2nd SCM. • The compensation for the renter will not be subtracted from compensation for the structure owner.
Issues and Concerns on Tagging and Surveys	
Suggested that a coordination meeting with barangay units be carried out by the teams during the conduct of surveys and tagging to facilitate activities.	• Informed stakeholders that it was the standard operating the procedure of census and survey teams to coordinate with the office of barangay chairpersons. • Requested BLGUs to provide assistance during the conduct of the tagging, census and survey activities.
Structure owners may not be present during tagging, census and survey activities due to a work schedule, particularly during weekdays.	• Permission will be requested from the structure owners prior to tagging; • Suggested to the PAPs to authorize their neighbors to permit the tagging in case the owners are not present; • Schedule of the interview could be arranged with Team on weekends as the enumerators are staying in the area, to accommodate PAPs who are working during weekdays
Whether tagging of structures depends on the number of families living in the house.	• Clarified that the tagging would be implemented per structure, not per household or per family. • Explained that structures tagged at this stage were considered potentially affected only. • There may be additional structures to be tagged once a parcellary survey is completed. • After tagging activities, enumerators/interviewers will start survey and census activities.
Alternative Livelihood and Restoration Program	
If there will be alternative livelihood for PAPs who will lose their main sources of income including trolley operators.	• Informed PAPs that there would be a livelihood restoration and improvement program to be included in the RAP report in considerations of skills of every individual. • Urged PAPs to provide accurate and correct information, especially questions regarding their present livelihood for inputs since the information would be the basis of preparation for the livelihood restoration program. • Temporary employment during project implementation is also being considered as another livelihood program. Trainings will be conducted by construction engineers qualified for the job. • Informed PAPs that there was an existing law stating that a large percentage of the workforce should come from directly affected areas.
Issues on Relocation Sites	
Is there a possibility of intra-city relocation? The relocation site should not be far from present workplaces of PAPs to avoid returning to the track.	Intra-city relocation is the priority. • The option for intra-city relocation will be discussed with the concerned LGUs to determine the availability of potential relocation sites within the city/municipality. • If there is no available public land within the city/municipality, potential sites in neighboring areas will be considered. • Emphasized that the resettlement for the project is a PP, wherein a relocation plan will be presented to PAPs for discussion to ensure that the relocation site is acceptable to relocatees to achieve the “no worse-off” policy of JICA. • PAPs will be involved in the planning of the relocation program. • JICA will be monitoring living conditions of relocatees to ensure that the no-worse off policy is achieved.
Basic social service facilities such as water and power supply lines, health centers and educational and sanitation facilities must be provided at the relocation site.	• Explained that JICA was aware of circumstances surrounding the failure of some relocation programs and negative experiences of relocates. • Related that the DOTr has already coordinated with the SHFC, the housing agency that will partner with the DOTr

Query/Concern/Suggestion/Comment	Response to Query
	in the implementation of the relocation program for the project. • As stipulated in RA 7279, the relocation site must have water and power supply lines, educational facilities and access. • The RAP study as well as the agreement with the SHFC will include budgeting for utilities. • Explained that not only the Philippine laws would safeguard their rights but also JICA standards, which must be complied by the DOTr to secure the loan for the project. • Reiterated that JICA would conduct monitoring on living conditions of relocatees to ensure compliance with JICA Guidelines. • JICA will not allow PAPs to be relocated at a site where basic social service facilities are not provided. • JICA Guidelines will bridge the gap between the Philippine laws and international standards to ensure that PAPs' rights are protected during project implementation. • Explained JICA would not approve the loan if RAP guidelines of are not followed. • Assured that the DOTr would not relocate PAPs to an area where basic social service facilities are not provided.
Housing units in the relocation areas must be decent and not sub-standard.	• Emphasized that DOTr's direction was towards building a standard housing for PAPs. • Assured PAPs that a thorough study would be undertaken to ensure that all aspects are carefully considered. • Clarified that the primary objective of consultation meetings is to involve PAPs in the planning of the relocation program that will best correspond to their needs.
Whether compensation for structures is dependent on their size.	• Compensation for every structure varies depending on the size and type of structures. • A more detailed explanation regarding compensation of structures will be discussed during the 2nd SCM in March.
Whether the relocation unit is free or amortized by awardees.	• The Philippine laws and JICA and World Bank (WB) guidelines do not recommend providing the housing program for free to encourage beneficiaries to give a value to the relocation unit received. • The laws promote affordable housing, indicating that recipients will be asked to pay minimum monthly amortization that they can afford for a certain period.
ROW Issues	
Reckoning point of the 30-meter PNR's ROW	• Explained that surveyors were still locating the boundary of the 30-meter ROW, and it will be marked once a parcellary survey is completed by March. • Informed participants that there are areas where the track is not in the middle of the ROW. • In areas where the track is in the middle of the ROW, it will be 15 m to the left and 15 m to the right. • Clarified that measurement of the 30-meter ROW for tagging, census and survey activities will be from the central line of the existing track with a width of 15 m to the left and 15 m to the right
Basis of compensation for private land	• A more detailed explanation on compensation for private land will be discussed in the 2nd SCM. • The latest ROW law, R.A. 10752 will be implemented for compensation for affected private properties.
Residential buildings (with 50 units per building) in Brgy. 811, Manila City are located within the PNR's ROW.	• The 30-meter ROW of the PNR is still being established by JICA Design Team. • A coordination with the PNR and the SGC will be undertaken to determine the status of residential buildings.
Is there a possibility that areas below the elevated railway can be utilized as alternative roads?	• The matter will be referred to the DOTr as the agency may have other plans for the areas underneath the elevated guideway.

Query/Concern/Suggestion/Comment	Response to Query
Concerns on Access	
Raised concerns on the access of residents during construction	• Provision of alternative access to affected access roads and crossings are being considered in the design. • The PNR's ROW will be secured and fenced after clearing aimed at ensuring safety of the public.
Provision of access of residents crossing the tracks	• Clarified that unauthorized access to the public would no longer be allowed once operational. • The survey will include a questionnaire regarding the access to understand the needs of residents for access to cross over to the other side of the tracks and the importance of the access that will be lost. • The RAP preparer can recommend the provision of the access to the other side of the tracks if the purpose for crossover is valid such as going to a day care or a school.
Concerns on the possible closure of existing road crossings and public access points	• All existing legal roads crossed by the alignment such as national roads, city roads and barangay roads will be maintained and not closed/blocked. • Provision of alternative access to affected access roads and crossings is being considered in the design. • Assured that the concern was being carefully studied by the traffic engineering design team.
Timeline of the Project	
Timeline of the project	• Stressed that the timeline of the project was tentative. • The feasibility and basic design stages are simultaneously undertaken, beginning from last November 2017 and re-expecting to be completed by August 2018. • It is expected that the loan agreement will be signed by December 2018. • The DD phase will start from August 2018 until May 2019. • Construction is scheduled to start by 2019. • The target opening of the NSRP commuter is 2022. The project is expected to have the connection with the ongoing NCSR Project (Tutuban-Malolos) (a partial operation is expected).
Concerns relevant to the timing of the project's implementation, which might disrupt education of affected students	• The relocation timing will be part of the RAP report. • Students must be considered, and the relocation timing should not be scheduled in the middle of the school year. • If unavoidable, there should be an arrangement between the concerned school and the students that affected students can come in and go on with their studies. • The issue will be included as recommendations in the RAP study.
Certainty that the project will be implemented	• Explained that the President expects that the train is operational by 2020. • The government has already allotted fund and exerted efforts for the project, so its implementation is certain. • There will be no issue even if the administration changes as long as a new administration will pursue the implementation of the project.
A transition period allowed by the DOTr for PAPs to fully vacate their structures	• Assured PAPs that they would have enough time to prepare relocation before the actual relocation is implemented as they will be involved in the planning period.
The exact date that the affected area will be determined	• Based on the project's tentative timeline, the detailed engineering design (DED) will be undertaken by August 2018. • Specific areas to be affected will be determined during the DED stage.
Engineering Design	
Whether the 30-meter PNR's ROW is fenced once the railway is operational.	• Yes. The ROW will be fenced to limit access of the public to ensure safety. • Unauthorized access to the ROW will be limited.
Whether the railway project is elevated.	• Yes. There are also some sections on embankment.

Query/Concern/Suggestion/Comment	Response to Query
The height of the elevation	• The south line of the NSRP is still at the design stage, and the structure design has yet to be finalized, so the height of elevation is not yet determined.
Other Issues, Concerns and Suggestions	
A policy on salvaged materials	• Salvaged materials will be given to structure owners. • Further explanation regarding salvaged materials will be discussed in the next SCM.
Temporary shelters (tents) along the tracks should not be included in census and tagging activities.	• Clarified that there were different categories of PAPs such as land owners, structure owners, temporary shelter owners and terminals and that all these are classified as PAPs. • All PAPs will be interviewed. • Explained that PAPs would have different types of compensation and entitlements depending on their classification.
Concerns on a possible invasion of illegal settlers from neighboring areas due to speculation on potential relocation	• Explained that the RAP team would not undertake census and tagging activities without the permission of LGUs and BLGUs and without consultations with stakeholders first. • Urged stakeholders to be vigilant and discouraged settlers to construct new structures in the area. • Reminded stakeholders that the initial budget allotted for existing ISFs would be shared with new ISFs which were not included in an original financial plan if the number of ISFs increases.

Source: JICA Design Team.

(2) Second Round of Stakeholder Consultation Meetings During Feasibility Study for the SCRP Main Line

2185. The second round of SCMs started with a brief presentation on the project, i.e., areas that the project will traverse, project components such as stations and a depot and other features such as the envisioned ROW width. Subsequently, the legal framework for the RAP consisting of two (2) overarching guidelines, i.e., the international standards such as ADB and JICA guidelines and applicable Philippine legislations particularly R.A.10752 and R.A.7279.

2186. At the end of each meeting, invited PAPs were encouraged to participate in the open forum to express their views/opinions. A summary of the main concerns/issues raised during the second SCM is provided in **Table 11.2.9**.

Table 11.2.9 Outline of the Second Round of Stakeholder Consultation Meetings During Feasibility Study for the SCRP Main Line

LGU	Venue	Date and Time	Main Participant	No. of Participants		
				M	F	Total
Manila City	Brgy. 811 Covered Court	April 27, 2018 9:00 a.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team, EcosysCorp, Inc. and the PNR	228	556	784
	Brgy. 629 Covered Court	April 27, 2018 2:00 p.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team, EcosysCorp, Inc. and the PNR	39	93	132
	Brgy. 443, Algeciras cor. Firmeza Sts.	April 27, 2018 2:00 p.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team, EcosysCorp, Inc. and the PNR	34	68	102
	Aldana Elementary School, Brgy. 422	May 31, 2018 8:00 a.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team, EcosysCorp, Inc. and the SHFC	39	93	132

LGU	Venue	Date and Time	Main Participant	No. of Participants		
				M	F	Total
	484 Brgy. Hall, Algeciras St., Brgy. 484	April 30, 2018 3:00 p.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team, EcosysCorp, Inc.	71	232	303
	Brgy. 485, Algeciras St.	June 06, 2018 2:00 p.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team, EcosysCorp, Inc.	34	56	90
	Brgy. 224 Covered Court	May 31, 2018 8:00 a.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team, EcosysCorp, Inc.	15	7	22
	Brgy. 348, Old Antipolo cor. Oroquieta Sts. (Blumentritt Station)	June 07, 2018 2:00 p.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team, EcosysCorp, Inc.	66	140	206
Taguig City	Brgy. Fort Bonifacio Covered Court	May 31, 2018 2:00 p.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team, EcosysCorp, Inc.	21	50	71
	Cayetano Sports Complex, Brgy. Bagumbayan	June 08, 2018 8:00 a.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team, EcosysCorp, Inc.	9	31	40
Parañaque City*	Brgy, Hall, San Martin De Porres	June 6, 2018 2:00 p.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team, EcosysCorp, Inc.	8	25	33
Muntinlupa City	Muntinlupa Sports Complex	April 28, 2018 9:00 a.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team, EcosysCorp, Inc., the PNR and the SHFC	179	382	561
San Pedro City	Biñan People's Center	June 7, 2018 8:00 a.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team, EcosysCorp, Inc., the PNR and the SHFC	26	46	72
Biñan City	Biñan People's Center	April 28, 2018 2:00 p.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team, EcosysCorp, Inc., the PNR and the SHFC	288	571	859
Sta. Rosa City	Santa Rosa Auditorium	June 7, 2018 2:00 p.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team, EcosysCorp, Inc., the PNR and the SHFC	106	199	305
Cabuyao City	Santa Rosa Auditorium	April 25, 2018 2:00 p.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team, EcosysCorp, Inc., the PNR and the SHFC	45	21	66
Calamba City	LLC Auditorium, Central 2	June 1, 2018 8:00 a.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team, EcosysCorp, Inc., the PNR and the SHFC	266	652	918

*Second SCM specific for Senate-FTI-Bicutan segment of the MMSP has not yet been conducted. However, this section also overlaps with the FTI and Bicutan stations of the SCRP and will then be integrated in future SCMs conducted for SCRP.

Source: JICA Design Team.

Table 11.2.10 Summary of Issues and Concerns Raised at the Second Round of Stakeholder Consultation Meetings During Feasibility Study for the SCRP Main Line

Query/Concern/ Suggestion/Comment	Response to Query
Entitlements and Rights	
Whether a recipient of the previous housing program who never occupied a provided unit due to its distant location from children's schools are still qualified to avail of the relocation program.	• It can be considered if recipients will return awarded units. • Even if the NHA is not a housing agency who will facilitate the relocation program, the data will still be included for validation. • The concern will be referred to the top management of the SHFC as the reason for not occupying the unit is valid.
Emphasized Section 28 of RA 7279, which states that there should be no demolition without proper relocation.	• Explained that the law dictated that no demolition could be executed if affected persons have not been informed 30 days prior to the demolition. However, the project has been disclosed last January, indicating that there was more than a minimum of 30 days.
Asked for assurance regarding the 30-day rule of notice before demolition.	• The law, Section 28 of RA 7279 will protect PAPs along with JICA and ADB guidelines.
Compensation and Entitlements of Private Property Owners	
Whether the initial 70% payment for structures will be accorded to owners. Whether the 30% balance will be paid.	• The initial 70% will be paid upon execution of the agreement of the negotiated sale. • The remaining 30% will be paid once the structure is completely demolished.
Entitlements and Rights of Renters and Tenants	
Whether tenants are also qualified to avail of the relocation program.	• If tenants fulfill the criteria for qualifications, then they are entitled to avail of the relocation program for the project.
Compensation and Entitlements	
The structure is divided into three (3) rooms between siblings. Each room has its own kitchen. The other rooms are being rented out.	Sharing of compensation for the structure will be internal between the siblings. • Household heads of each room will be interviewed as there are three (3) separate kitchens, which corresponds to the definition of one (1) household.
Whether the crops will be compensated.	• Yes. Crops are included in compensation items.
Schedule of compensation of the 70% payment for structures Whether the 30% balance will be paid.	• The initial is 70% of the agreement of the negotiated sale. • The remaining 30% will be paid once the structure is demolished.
Whether PAPs will be compensated or relocated.	• Clarified that compensation would be paid for affected land and structures, while the relocation program will be given to qualified PAPs.
Issues and Concerns on Tagging and Surveys	
Whether validation, tagging and survey activities undertaken on February 7, 2017 are official.	• Yes. the starting date of tagging, census and survey activities in the Poblacion 1 is February 7, 2018.
Asked for clarification as to why the name of a structure is written on the sticker but the renter's name is recorded on the interview sheet instead.	• Explained that a tag or a sticker is only for structures to determine the number of affected structures for a budgetary purpose. • Both structure owners and renters will be interviewed. • Renters will be interviewed as they may be qualified for the relocation program for the project.
The structure was not tagged because the owner is not present; Whether owners of structures that were not tagged be qualified to the relocation program	• Explained that structures would not be tagged if there is no consent from owners. • There is a reserved control number for a structure that was not tagged. • Informed PAPs that there would be a second round of tagging. • Clarified that structure owners will be included in the awardee list if he/she is qualified to avail of the relocation program based on the SHFC's guidelines. • Assured that the team would return to the area to complete tagging activities.

Query/Concern/ Suggestion/Comment	Response to Query
A schedule for the second tagging activity	• The second tagging will be undertaken during DED when the design is finalized. It will be coordinated with the barangay.
Issues on the Relocation Program and Relocation/Resettlement Sites	
Asked for confirmation regarding the news going around that Brgy. Banlic, Calamba is being considered as the relocation site. Confirmation on the information that the area has already been acquired by JICA	• Disclosed that the SHFC and JICA Design Team visited the city government of Calamba and conducted ocular inspection on potential relocation sites in the city. • Clarified that it was not confirmed if the areas visited were already purchased by the LGU. • Clarified that JICA would only finance civil works or construction for the project. The Government of the Philippines will take care of people who have no chance to avail of ROW compensation as well as the provision of the relocation sites for PAPs.
Requested that PAPs be relocated in an area that is not flood-prone.	• Explained that PAPs would be involved in the planning and the selection of the relocation sites especially for the PP and the community mortgage program (CMP), which allows them get to pick the best relocation site.
Is there a possibility that individual families could apply for a loan from the SHFC? Whether PAPs not associated with any homeowners' association have no chance to avail of the relocation program.	• There is a chance but not through the CMP as it is the relocation program chosen by the DOTr for this specific project.
Whether the CMP under the SHFC is covered by any law.	• Yes. The CMP is under Section 31 of RA 7279. • The CMP is stipulated in Section 31.
Requested that legal heirs of the beneficiary be allowed to continue paying the relocation unit in case that the awardee passes away.	• Continuation of the mortgage will be offered first to legal heirs. If the heirs declined an offer that the unit would be returned to the government, then payments made will be forfeited.
ROW Issues	
Disclosed that a clearing operation along the track in Brgy. Poblacion 1, Calamba City was ongoing.	• Asked if PAPs were informed of clearing operation. • Mr. Jojo Valenciano assured PAPs that the clearing operation would be verified with the engineering team at once.
Clarifications on ROW measurement	• Explained that the 15 m on both sides from the central line of the existing tracks was measured for the purpose of FS. • Added that the 30-m ROW will fit two (2) tracks as compared to the existing single track.
Concerns on Access	
The 30-meter ROW will affect the access of the residents.	• The provision of alternatives of affected access roads and crossings are being considered in the design.
Timeline of the Project	
The target date of project implementation to enable owners to decide whether to make improvements to their structures Asked for confirmation as whether demolition of structures will be carried out by May 2019.	• The project is still at the FS stage. • The target start of construction is May 2019. • Improvements on structures such as additional protection during the rainy season are allowed. • The area should be cleared by May 2019. • Stressed that the timeline of the project was still tentative.

Query/Concern/ Suggestion/Comment	Response to Query
Other Issues, Concerns and Suggestions	
Disclosed that a certain group called Mayor Rodrigo Roa Duterte (MRRD) headed by Mr. Bobby Diesta from the DILG Central Office distributed forms of the Finance Shelter Foundation (FSF) in Brgy. Parian. The FSF has an office in Brgy. Parian. PAPs from Brgy. Parian were forced to fill out the said application form but did not conform as the group did not inform the LGU of such activity. Disclosed that the FSF said that it had an available relocation site for PAPs. Clarified whether the FSF is related to the SHFC.	• The SHFC has yet to undertake any coordination activities with the LGUs, so community mobilizers have not been sent to the ground. • Emphasized that the SHFC has not distributed any application forms. • When SHF representatives touched based with the community, they are easily identifiable as they are wearing official SHFC shirts with the logo. • Validation of tagging, census and survey activities conducted by EcosysCorp, Inc. will be undertaken before the SHFC initiates its activities on the ground.

Source: JICA Design Team.

(3) Additional Round of Stakeholder Consultation Meeting During Feasibility Study for the SCRP Main Line

2187. Aside from the first and second rounds of SCMs presented above, additional series of SCMs were held. The combined first and second SCMs were held in areas with proposed station locations, depot and the NSRP-SC Connection to the North-South Commuter Railway (NSCR). The combined SCMs started with information disclosure of the proposed project regarding (i) areas that the alignment traverses, (ii) locations and the preliminary design of stations, and (iii) the timeline of the project. The addition SCMs were followed by discussion about RAP activities, i.e., (i) census and tagging activities of potentially affected structures, (ii) socio-economic surveys of households and (iii) cut-off date for eligibility.

Table 11.2.11 Outline of an Additional Round of Stakeholder Consultation Meetings During Feasibility Study for the SCRP Main Line

LGU	Venue	Date and Time	Main Participant	No. of		
				M	F	Total
Manila City	Brgy. 629 Covered Court (Sta. Mesa and Paco Stations)	May 17, 2018 2:00 p.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team, EcosysCorp Inc., the PNR and the SHFC	39	46	85
	Brgy. 185 Covered Court (NSRP-SC Connection to NSCR)	May 23, 2018 8:30 a.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team, EcosysCorp Inc. and the SHFC	136	238	374
	Brgy. 473, Algeciras cor. Florentino Sts. (España Station)	May 23, 2018 2:00 p.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp Inc.	87	184	271
	Celadon Residences Clubhouse, Brgy. 350	July 21, 2018 5:00 p.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team, EcosysCorp Inc., the PNR and ADB	46	16	62
Makati City	Facundo St. cor. Medina St. Brgy. Pio del Pilar (Buendia Station)	June 25,2018 8:00 a.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp Inc.	34	28	62

LGU	Venue	Date and Time	Main Participant	No. of		
				M	F	Total
	Magallanes Brgy. Hall (EDSA Station)	June 22,2018 2:00 p.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp Inc.	23	10	33
Taguig City	Villamin Compound, Brgy. Western Bicutan	July 9,2018 2:00 p.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp Inc.	40	46	86
Parañaque City	Brgy, Hall, San Martin De Porres (FTI Station)	July 2, 2018 2:00 p.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp Inc.	17	9	26
Muntinlupa City	Alabang Barangay Hall (Alabang and Muntinlupa Sta.)	May 22,2018 8:30 a.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp Inc.	28	29	57
	Sucat Barangay Hall (Sucat Station)	May 22, 2018 2:00 p.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp Inc.	32	56	88
San Pedro City	San Pedro Pavillion (San Pedro and Pacita Stations)	May 16, 2018 2:00 p.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp Inc., the SHFC and the PNR	7	11	18
Biñan City	San Pedro Pavillion (Biñan Station)	May 16, 2018 2:00 p.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp Inc., the SHFC and the PNR	22	88	110
Sta. Rosa City	San Pedro Pavillion (Santa Rosa Station)	May 16, 2018 2:00 p.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp Inc., the SHFC and the PNR	26	70	96
Cabuyao City	LLC Auditorium, Central School (Cabuyao, Gulod, and Mamatid Stations)	May 16, 2018 8:00 a.m.	Representatives of the LGU, PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp Inc., the SHFC and the PNR	4	26	30
Calamba City	LLC Auditorium, Central School (Calamba Station)	May 16, 2018 8:00 a.m.	Representatives of PAPs, the LGU, BLGUs, the DOTr, JICA Design Team, EcosysCorp, Inc., the SHFC and the PNR	11	13	24
	Brgy. Banlic Covered Court (Banlic Depot)	May 25, 2018 8:00 a.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	54	229	283
	Brgy. Banlic Covered Court (Banlic Depot)	June 13, 2018 9:00 a.m.	Representatives of PAPs, BLGUs, the DOTr, JICA Design Team and EcosysCorp, Inc.	25	35	60

Source: JICA Design Team.

Table 11.2.12 Summary of Issues and Concerns Raised at an Additional Round of Stakeholder Consultation Meetings During Feasibility Study for the SCRP Main Line

Query/Concern/Suggestion /Comment	Response to Query
Issues and Concerns on RAP activities	
The schedule for census, tagging and socio-economic survey (SES) activities	• The schedule for census and tagging activities will be coordinated with the barangay chairman. • The socio-economic survey will be conducted immediately after census and tagging activities.

Query/Concern/Suggestion /Comment	Response to Query
Concerns on PAPs who were not present during census, tagging and/or SES activities	• PAPs may inform the barangay that they permit census and tagging activities to proceed, or that they can give a consent to their neighbors to allow tagging of their structures. • The PAPs could set a schedule for the SES with an enumerator in case that they are not available during the scheduled interview.
Concerns about the cut-off date	• The cut-off date is only applicable to ISFs. • The assigned date will be on the first day of the conduct of census and tagging activities. • All structures constructed after the cut-off date will be not included for compensation. • Persons not residing in the direct impact area at the time of census, tagging and SES activities will not be included in the master list of PAPs.
Treatment for multiple households residing in one structure	• A number of interviews will be carried out based on the number of households in the structure. • A household is defined by a separate kitchen and a food budget for each family.
The schedule for the second interview	• There will only be one interview for NSRP-SC
The schedule for the second tagging activities	• Explained that the second tagging would be an indication that the structure is certainly affected by the project. • Added that the sticker of the second tagging would not have a white background (like the first tag). • PAPs will be notified ahead of time before tagging activities.
The schedule for the next meeting	• The barangay heads will be notified at least a week before. • PAPs who indicated their contact details on the attendance sheet will be notified through SMS.
Project Coordination	
Whether the project has been approved by the NEDA.	• The DOTr confirmed that the project had been approved by the NEDA and was included in the Philippine Development Plan (2017-2022).
Whether the LGU is consulted with about the project.	• IEC meetings have been arranged at the barangay level. • The concerned LGU is also aware of SCMs being conducted, especially concerned departments such as the planning office and the local housing office, as they are also invited to the meetings. • The LGU is also extending its assistance to the project through identification of possible relocation sites.
Timetable of the Project	
The possible length of the stay at the current location of ISFs.	• Construction is scheduled to start from May 2019.
The remaining time for property owners to prepare necessary documents may not be enough, particularly for properties with tax issues and ownership concerns.	• The issues and concerns are noted. • Property owners will be given adequate time to prepare necessary documents to facilitate payment.
Relocation	
The possible length of the stay at the current location of ISFs.	Construction is scheduled to start from May 2019.
The housing partner of the DOTr for the NSRP-SC	The housing partner of the DOTr for the NSRP-SC is the SHFC.
A possibility of intra-city relocation	Intra-city relocation is a priority. However, if there is no available land in the area, vertical relocation (medium-rise building) may be considered. If horizontal relocation is preferred, available land in the nearby areas could be considered.
Whether renters could avail of the relocation program.	Renters could avail of the relocation program if they fulfil the criteria stipulated in RA 7279 Section 16. Their qualifications will be evaluated by the SHFC.

Query/Concern/Suggestion /Comment	Response to Query
Whether the association will construct its own relocation site (ISFs).	Not necessarily, but it has the option. Details like this will be planned by the association with the SHFC. It will be consulted with for interior arrangements of the relocation unit.
Whether those residing at relocation sites who are affected by the project will be recognized as private owners, renters or ISFs.	If PAPs have the title of the unit, they will be considered as private owners. The issue will be referred to the DOTr.
Asked for assurance that they will receive relocation units.	The loan for the project will not be signed if relocation for PAPs will not be executed properly. Demolition will not be permitted unless the relocation site is ready for occupancy. JICA and ADB will be actively monitoring the relocation process, so PAPs do not need to be worried.
Whether they are not qualified for relocation.	They can apply for the next bracket of housing assistance via Pag-IBIG or SSS.
Age restriction of Pag-IBIG	There is a proposal to remove the Pag-IBIG's age restriction, giving the option to the child/children of the owner to continue paying if ever the original awardee is unable to continue the payment.
Transfer of business and business equipment	The government will provide assistance for a transfer and a list of options.
Private property owners asked for relocation assistance since ISFs will receive assistance.	The list of available properties in the city or the neighboring cities will be given to private owners to assist their relocation.
Engineering Design	
The width of the alignment The central line and the exact boundary of the PNR's ROW	For the purpose of the RAP during FS, main tracks will be 30 m in width. The 15 m-15 m (30 m) on both sides will be reckoned from the central line of the existing tracks in the absence of an established ROW and a central line of the PNR. The relocation survey is currently being conducted to determine the central line and the boundary of the PNR's ROW.
Whether there is a possibility that the 30-m and 60-m ROW for main tracks and stations respectively will be extended due to unexpected design changes.	The maximum ROW for main tracks will be 30 m, and 60 m will be the maximum for stations.
Size of stations	Standard stations will measure 60 m x 250 m.
Whether the current station will be used as the new station.	Most stations will be elevated. The stations will be in the same areas as the current stations but not limited at the same location.
Whether there are future development plans given the enormity of the required ROW for stations.	The DOTr has disclosed the information that stations are planned to be intermodal transportation terminals for easy transfer of commuters. Other stations are also seen as connections to different government projects such as the NSCR and the Metro Manila Subway Project (MMSP). A larger station is also needed to accommodate the expected high volume of ridership.
Plans on areas beneath the guideway	The DOTr is planning to develop the area below currently owned by the PNR to be a transportation line for freight.
Elevation of the guideway from the ground	As the project is still at the feasibility stage, the height of guideway is not determined yet.
Length of trains	Eight to ten cars are planned to operate per train with provision for additional cars in the future.
Station utilities and features Asked to consider safe access and mobility of persons with disability (PWDs) especially those with sensory disability to stations.	The DOTr assured stakeholders that all considerations for safe access and mobility of PWDs are included in the design as it is guided by international standards. Added that gender-segregated comfort rooms would also be provided.
Is there a possibility of relocating stations/alignments to other	Informed stakeholders that the size of stations may still be reduced as the design is not finalized yet.

Query/Concern/Suggestion /Comment	Response to Query
areas? This concern is raised during SCMs for all stations, as private property owners are strongly opposing the location of the station in their area.	The proposed alignment maximizes the current PNR's ROW. Going farther than the PNR's ROW will lead to a larger ROW acquisition. There are possibilities of moving stations but only by a few meters. Moving the proposed station locations will be based on the results of FS. The depot in Brgy. Sucat is proposed to support the future long-haul train. Brgy. Sucat is the most optimal location according to previous studies.
Issues and Concerns on Compensation and Entitlements	
Whether it is possible to claim compensation for land property and structure even if nobody is currently residing in the property.	Yes, occupancy of the property will not affect the claiming of compensation. As long as the property has a clean title, the owner of the property could claim compensation.
Asked when compensation amount for properties will be disclosed.	A letter offer from the DOTr will be sent to owners as the information is confidential. Explained that owners would be given thirty (30) days to indicate their response to the offer. The letter offer will be sent during the DED stage.
A schedule of the disbursement of initial payment	For land properties, the initial payment will be 50% of the negotiated amount. Once the title is transferred under the name of the government or the implementing agency (IA), the 50% balance will be paid to property owners. Structures will be paid with 70% of the total estimated amount based on replacement costs. The remaining 30% balance will be paid once the area is cleared, and structures are completely demolished.
Entitlements of those who will not be qualified for relocation	Entitlements will be discussed during the third SCM.
Whether business owners will be compensated for income loss.	At present, there is no law that will provide for compensation of income loss. Since the project is internationally funded, i.e., JICA and ADB, additional compensations and entitlements not provided by national laws may be considered and accorded to PAPs. Entitlements and compensation packages will be discussed during the third SCM.
Homeowners' Association (HOA) to be Formed for the CMP	
Whether PAPs will organize a HOA by themselves.	Community organizers from the SHFC will go to assist the community in forming a HOA.
Whether PAPs can organize it in advance.	Yes, but it will be better to wait for the SHFC's community organizers.
Whether organizing a HOA is compulsory.	Only organized communities or homeowners' associations will be allowed to apply for the CMP. No individuals or individual families will be accepted for a loan.
Maximum number of HOA members	The SHFC has answered that the current ceiling for membership per association was 200. However, there is a proposal to lift the ceiling to accommodate a larger number of PAPs of the NSRP-SC.
Whether the current HOA could be recognized by the SHFC.	Yes, but the SHFC's community organizers will still have to meet with them.
Environmental Issues and Concerns	
Raised concerns on the flooding problem at the location of the proposed EDSA Station in Brgy. Magallanes, Makati City.	Assured that the flooding concern in the area would be considered in the in the final design of the project.
Informed that Meralco, the Manila electric company paid PhP10,000 every month to property owners as a rent for the location of the post.	The DOTr responded that a meeting with Meralco had decided that Meralco would be the one to move the electric post.
Extrajudicial Settlements	
The owner of land is deceased.	Legal heirs will have to process the transfer of title through extrajudicial settlement. This is required as the government will only transact with and compensate the property owner.

Query/Concern/Suggestion /Comment	Response to Query
Whether the transfer of title will be covered by the government.	The transfer of title to the government will be covered by the DOTr. The transfer from deceased owners to legal heirs will be covered by PAPs.
Land Property and Structure Issues	
Stated strong opposition to the location of the Sucat Station in the old Sucat Thermal Power Plant that would bring out the realignment of the rail tracks and entail extensive displacement of residential houses and private properties in Brgy. Sucat and Buli, Muntinlupa City. Suggested that the Posadas Property be considered for the location of the station.	It is not publicized, but the plan is to use the area for the South Long Haul (Bicol bound) interchange, not for the NSRP-SC. Clarified that the original proposal was to put the depot in Laguna. According to FS, it will be better to have a stop in Sucat since the next depot will be in Valenzuela City. The project is still at the FS stage, and the design has yet to be finalized. The suggestion is noted and will be related to the DOTr for consideration.
Expressed strong opposition to the location of the proposed España Station in Brgys. 472 and 473, Manila City. Suggested that the station be located in areas where less properties and structures will be affected.	The location of the proposed España Station in the area has yet to be finalized as the project is still at the FS stage. The final location of the station will be determined during DED.
The areas to be affected by the NSRP-SC alignment in Brgy. 186 are owned by the Manotoc's and are now subject to expropriation by the Manila City LGU. Disclosed that property would be utilized for socialized housing project, in which the beneficiaries are residents in the area.	The concern will be related to the DOTr for further verification.
Disclosed that most of the residents in Brgy. 348 and 349 did not have legal rights to the land. The property is previously partially owned by the PNR, but the ownership was later transferred to the Manila City LGU. The Manila City LGU allowed occupancy of the residents.	The concerns are noted and will be related to the DOTr. The DOTr will closely coordinate with the Manila City LGU to resolve issues and concerns surrounding ownership of the property in question.
Whether owners would be allowed to develop structures on the remaining part of the property after acquisition.	If owners chose not to sell a whole land property to the government, they have freedom to develop the remaining portion of the property.
Whether households of subdivided structures could avail of the relocation program for the project.	They could avail of the relocation program as long as they were interviewed during SES and fulfilled the criteria for relocation. Compensation for subdivided structures will be accorded to the owners.
The owner of the property is abroad (OFW)	The owners abroad can issue a special power of attorney to the person who will be handling acquisition.
The proof of ownership is the deed of sale only, not the title.	Advised to keep the deed of sale. The title should be transferred under their name for them to receive compensation, especially since the direct person with whom the DOTr will transact is the one listed in the tax declaration from the city assessor.
Only a small portion of land will be affected by the project.	The small portion can be acquired through easement of the ROW agreement.

Query/Concern/Suggestion /Comment	Response to Query
	In the easement agreement, the owner will grant a perpetual use of the strip of land as the ROW of the IA and the owner will keep ownership of the land. The strip of land acquired will be compensated based on BIR Zonal Valuation. The title will be annotated, and the part of the property will be used as the ROW. All structures and improvements affected within the strip of land acquired will be compensated based on replacement costs. The owner has an option to keep the remaining land especially if it is still economically viable. If more than 80% of land will be acquired, the owner has an option to sell the whole property.
Issues Concerning PAPs	
Considerations for NHA's medium rise building (NHA-MRB) unit owners in Brgy. 185, 162 and 161 who are paying monthly amortization	If the land is part of ownership, compensation will be accorded to individual owners by unit. Fully paid unit owners will be compensated for the unit. Advised owners who have little amortizations left to pay the remaining amortizations to claim ownership to the unit. Compensation would be based on replacement costs of units, so the owners can recover the payment made. For those who still have a huge sum to pay, the total amortization paid will be reimbursed, and the rest will be accorded to the NHA, as the agency still possess ownership for the unit. The DOTr will be coordinating with the NHA to discuss arrangements and resolve concerns. The consultations will be continued, so stakeholders will be updated on discussion between the DOTr and the NHA.
Expressed concerns on the possibility that their established residence in NHA-MRB units will again be subjected to displacement.	The concern is noted. Admitted the challenge posed by housing buildings of the NHA to the project. Reiterated that the relocation survey was currently undertaken and that the alignment and its ROW have yet to be finalized.
Whether awardees whose structures will be affected by the project will be considered private owners or ISFs.	The concern will be referred to JICA and the DOTr.

Source: JICA Design Team.

(4) Third Round of Stakeholder Consultation Meetings During Feasibility Study for the SCRP Main Line

2188. The third round of SCMs was held from August 18 to August 28, 2018 (**Table 11.2.13**). During the third SCMs, the DOTr presented updates on the project, explained the entitlement matrix and discussed the livelihood restoration and improvement program (LRIP), while the SHFC presented the relocation process and options. A summary of main concerns/issues raised during the third SCM is presented in **Table 11.2.14** and **Table 11.2.15**.

Table 11.2.13 Outline of the Third Round of Stakeholder Consultation Meetings During the Feasibility Study for the SCRP Main Line

LGU	Venue	Date and Time	Main Participant	No. of Participants		
				M	F	Total
San Pedro City, Santa Rosa City, Biñan City, Cabuyao City Calamba City	Santa Rosa Auditorium	August 18, 2018 8:00 a.m.	Representatives of legal PAPs, the DOTr, JICA Design Team, EcosysCorp, Inc., the PNR and ADB	42	72	114

LGU	Venue	Date and Time	Main Participant	No. of Participants		
				M	F	Total
Santa Rosa City	Santa Rosa Auditorium	August 18, 2018 1:00 p.m.	Representatives of ISFs, the DOTr, JICA Design Team, EcosysCorp, Inc., the SHFC, the PNR and ADB	87	269	356
Manila City	Dapitan Sports Complex	August 20, 2018 8:00 a.m.	Representatives of ISFs, the DOTr, JICA Design Team and EcosysCorp, Inc.	285	511	796
	Dapitan Sports Complex	August 20, 2018 1:00 p.m.	Representatives of ISFs, the DOTr, JICA Design Team and EcosysCorp, Inc.	137	303	440
Taguig City, Paranaque City, Muntinlupa City	Cayetano Sports Complex, Brgy. Bagumbayan, Taguig City	August 21, 2018 8:00 a.m.	Representatives of legal PAPs, the DOTr, JICA Design Team, EcosysCorp, Inc., the PNR and ADB	50	68	118
Taguig City, Paranaque City	Cayetano Sports Complex, Brgy. Bagumbayan, Taguig City	August 21, 2018 1:00 p.m.	Representatives of ISFs, the DOTr, JICA Design Team and EcosysCorp, Inc.	88	157	245
Manila City	Dapitan Sports Complex, Instruction St, Sampaloc, Manila	August 22, 2018 8:00 a.m.	Representatives of ISFs, the DOTr, JICA Design Team and EcosysCorp, Inc.	422	771	1193
	Dapitan Sports Complex, Instruction St, Sampaloc, Manila	August 22, 2018 1:00 p.m.	Representatives of ISFs, the DOTr, JICA Design Team and EcosysCorp, Inc.	169	308	477
	Dapitan Sports Complex, Instruction St, Sampaloc, Manila	August 23, 2018 8:00 a.m.	Representatives of legal PAPs, the DOTr, JICA Design Team, EcosysCorp, Inc., the PNR and ADB	157	271	428
	Carmona Sports Complex, Arpilleda, Makati City	August 23, 2018 1:00 p.m.	Representatives of legal PAPs, ISFs, the DOTr, JICA Design Team and EcosysCorp, Inc.	53	56	109
Calamba City	Don Jose Homes Project Covered Court, Brgy. Banlic, Calamba City	August 24, 2018 8:00 a.m.	Representatives of ISFs, the DOTr, JICA Design Team and EcosysCorp, Inc.	197	473	670
	Don Jose Homes Project Covered Court, Brgy. Banlic, Calamba City	August 24, 2018 1:00 p.m.	Representatives of ISFs, the DOTr, JICA Design Team and EcosysCorp, Inc.	186	382	568
Biñan City	Alonte Sports Arena, Zapote Street, Biñan City	August 27, 2018 8:00 a.m.	Representatives of ISFs, the DOTr, JICA Design Team, EcosysCorp, Inc., the PNR and the SHFC	266	645	911
Muntinlupa City	Brgy. Sucat Covered Court, Muntinlupa	August 27, 2018 1:00 p.m.	Representatives of legal PAPs, ISFs, the DOTr, JICA Design Team, EcosysCorp, Inc., the SHFC and the PNR	350	567	917
San Pedro City, Muntinlupa City	Pacita Astrodome, San Pedro City	August 28, 2018 8:00 a.m.	Representatives of ISFs, the DOTr, JICA Design Team, EcosysCorp, Inc., the SHFC and the PNR	91	225	316
Cabuyao City	Cabuyao City Hall AVR	August 28, 2018 2:00 p.m.	Representatives of ISFs, the DOTr, JICA Design Team, EcosysCorp, Inc. and the PNR	50	70	120

Source: JICA Design Team.

Table 11.2.14 Summary of Issues and Concerns Raised at the Third Round of Stakeholder Consultation Meetings During Feasibility Study for the SCRP Main Line

Query/Concern/ Suggestion/Comment	Response to Query
Inquiries on Project Details	
The timetable of the project	• Relocation will start from April 2019. The construction will start from May 2020. • Advised to process documents needed to fast-track the payment on compensation.
Whether the 30 m will be extended.	There will be no additional measurement beyond 30 meters except for stations which are 60 meters.
Concerns on RAP Activities	
Structures were tagged, but residents were not interviewed for the SES.	• The household head might have been unavailable when the census team conducted the survey in their area. • The master list is not finalized, and not all people in the master list will be given a relocation unit.
Asked for free transportation for the next SCMs.	Transportation will be provided for barangays far from the venue.
The possibility of being interviewed after the cut-off date since they just moved in.	There will be no entitlements since they moved in after the cut-off date.
Questions Regarding Relocation and the Socialized Housing Program	
Whether both of two households under one structure interviewed will benefit from the relocation program.	• Availing of the socialized housing depends if the household will fulfill the criteria of the SHFC.
Whether the relocation will be given for free.	• The funding organizations would like to give a sense of value to housing awardees. • The beneficiaries will still have to make payment monthly.
Whether the home owner's association is mandatory.	• The SHFC's mobilizers will go to help the community be organized. The SHFC will only grant the loan to organized communities.
Maximum loanable amount	• The maximum loanable amount is PhP 450,000.
How to be a member of Pag-IBIG.	• They will have to pay a two years' worth of membership to become a new member.
Asked about the monthly amortization of relocation	• Discussion with the concerned agencies is still ongoing.
How many square meters will the relocation site be?	• The size of their relocation sites depends on the decision and the plan of the HOA.
Whether they can still be beneficiaries of the socialized housing if their structures will be paid for compensation.	Yes. If they have structures worth of more than a loanable amount of the SHFC (PhP 450,000), they can be assisted to apply a loan to the Pag-IBIG.
Available intra-city relocation	Most feasible intra-city relocation is in the form of medium rise buildings.
Whether those who illegally occupied a structure can be qualified for the socialized housing.	They will also have their own entitlements. If they are interviewed, they will be included in the master list to be validated by the SHFC.

Query/Concern/ Suggestion/Comment	Response to Query
Requirements and the deadline for application to the SHFC	• The beneficiary should be a Filipino citizen and an informal settler aged 18 to 60 who belongs to the low-income bracket, does not avail of any government housing programs and is not a "professional squatter". • Emphasized that awardees of previous government housing projects could not avail of the project's housing program anymore. No double availability. • The CMP will not entertain individual applications. • They can claim compensation once they receive the letter
If those who availed of the Pag-IBIG program before, can they avail of the program again?	As long as they are in good standing.
Concerns on Possible Monetary Compensation	
Compensation for crops and livestock	All crops with commercial value will be compensated. The livestock will be relocated with owners.
Asked if there would be financial assistance for those who will be self-relocated.	Expenses during self-relocation will be shouldered by the government. Those who will be self-relocated are required to have secured shelters.
Soft loan	They will be given the list of those who are offering soft loans from the LGU and small corporations, etc.
Whether it is alright to use compensation for rent only and not avail of a new shelter since she is old already.	As long as the shelter is secured before moving in.

Source: JICA Design Team.

Table 11.2.15 Summary of Issues and Concerns of Legal PAPs Raised at the Third Round of Stakeholder Consultation Meetings During Feasibility Study for the SCRP Main Line

Query/Concern/ Suggestion/Comment	Response to Query
Project Details and Updates	
Start of construction	Construction starts in the 2nd quarter of 2020.
Start of processing relocation	Relocation starts one year ahead of construction (2nd quarter of 2019).
Whether the 30-meter alignment is finalized.	The 30-meter alignment is the proposed study area for the project. The final measurement of the alignment will be finalized after conducting a parcellary survey.
Concerns Regarding RAP Activities	
The structure was not tagged.	• Their structure might not be tagged because 1) they were unavailable during tagging, 2) they refused to tagging of their structure or 3) they are not included in the potentially affected structures. • A control number was reserved for them.
Households who were not interviewed	• If they were not interviewed because they were not available when the enumerators visited, the household head could go to the barangay and get a certificate of residency. • When the second tagging comes and their structure will surely be affected by the project, they will be interviewed, so that they can be included in the SES master list and the database of the project.

Query/Concern/ Suggestion/Comment	Response to Query
Monetary Compensation	
Price range of market values	• Market values will differ from property to property as they will be appraised according to their development and characteristics; • The appraisal will be done by licensed independent property appraisers (IPA).
The compensation for structures and land might not be enough to buy a replacement property.	The IPAs will appraise affected structures during DED considering that the owner needs to buy a replacement for their property.
How to avail of the rental subsidy.	The rental subsidy will only be applicable to those who will.
Entitlements of Business	
Premature effects of the project disclosure to their business, e.g., renters leaving due to uncertainty brought about by the project	• Owners can convince renters attempting to leave since they have a separate entitlement from owners. • The income loss brought about by project disclosure will not be covered or replaced by the project.
Structures are their only source of income.	Income loss will be compensated for a maximum of six months during transition.
Possible business and job opportunities	PAPs have the right to a first offer. If there are business spaces and opportunities or job openings related to the project, e.g., its alignment and stations, PAPs will be inquired first.
A business permit is denied due to the project.	Since the project measurement has yet to be finalized, some LGUs have taken the liberty to pause any developments in the area near PNR properties.
Entitlements of Residential Private Property Owners	
A possibility of replacing their property with another property instead of monetary compensation	The DOTr will assist owners and present them available properties within or near the city.
Land owners but not interviewed during SES	• It is alright if owners were not interviewed. • The owners' details will be taken from the LGU since they are registered owners.
Why is there a Pag-IBIG option for legal owners?	• National laws will only compensate owners for their properties. But since foreign funders have social safeguards, private property owners will still be assisted if they avail of the Pag-IBIG program. • They could avail of the Pag-IBIG program if PAPs choose assisted relocation rather than self-relocation. • Legal owners can choose to apply for the Pag-IBIG if for example, they want a bigger property and if compensation for their property is not enough to pay for their new property.
Who reconstructs a part of their structure which will be affected partially?	Since the owner will be compensated for the affected area, the owner will shoulder reconstruction costs.
Implementation of the Entitlement Matrix	
Doubted the capacity of the government to deliver commitment described in the entitlement matrix.	• Assured PAPs that foreign funding agencies of the project will actively monitor project implementation. • Proper implementation of relocation is part of conditions for the loan agreement that will be signed on December 2018.

Query/Concern/ Suggestion/Comment	Response to Query
Concerns Regarding Property Titles	
Subdivision of a mother title of community mortgage programs	• Reminded PAPs that the title was needed to be compensated for land. • The subdivision of the mother title of CMPs will only be done after all members pay their loaned amount. • The developer should process the transfer of titles. • For the case concerning the Home Guarantee Corporation and San Jose Builders in Manila, concerned agencies and organizations will discuss the issue on ownership of units in the medium-rise buildings.
I have purchased the land/property, but the title of the property has not been transferred yet.	• Advised that the new owner should process the transfer of title early on since compensation will only be paid to the person whose name is indicated in the title. • Reminded PAPs to keep all transactions and agreements between them and sellers.
Questions on the Housing Program	
Whether structure owners could be included in the socialized housing program.	• They can be included if they fulfill the criteria of the project's housing partner, the SHFC. • The SHFC will be validating the master list compiled for the North-South Railway Project—South Line (Commuter).
Suggestions on Information Dissemination	
A notice for upcoming meetings did not reach them.	• Aside from letters sent to barangay chairmen, text message reminders were also sent to PAPs. • Those who have not received text reminders can leave their mobile numbers on the attendance sheet. By doing so, the team can inform them of upcoming meetings.
Asked to provide pamphlets, information materials, or handouts that PAPs can take home and review the entitlement matrix.	• The suggestion is noted. • The entitlement matrix will be uploaded together with the RAP on the websites of JICA and ADB.

Source: JICA Design Team.

11.2.1.5. Focus Group Discussion

2189. The focus group discussion (FGD) was conducted as part of consultations with the affected households in all cities of the proposed SCRP (**Table 11.2.16**). The results of the FGD will be consolidated to substantiate data gathered from the SES and analyzed as inputs for the preparation of the LRIP which will be included in the RAP.

2190. Participants were selected from the list of SES respondents. Criteria for selection were based on sectoral, age and gender representation. Upon registration, participants were asked to sign a consent form that signifies their voluntary involvement in the FGD. The activity deviated from the usual FGD process wherein participants talk about their ideas or opinions on the subject matter. The activity made use of meta cards to allow participants to individually write their answers to guiding questions. In this way, everyone was able to contribute in the process, and no individual dominated the discussion. Similar responses were grouped and synthesized. If ideas were somewhat vague, facilitators allowed participants to elaborate on their ideas to stimulate discussion. To enable mothers with children in tow to participate in the activity, children were gathered in a corner and provided with coloring pages and crayons to entertain themselves while the session is ongoing.

Table 11.2.16 Outline of Focus Group Discussion During Feasibility Stage

LGU	Venue	Date and Time	Sector	No. of Participants		
				M	F	Total
Biñan	2 Conference Rooms: Office of the Mayor, City Hall	April 10, 2018	Vulnerable sector	6	15	21
Santa Rosa	Function Room, 4th Floor, Building A, Santa Rosa City Hall	April 10, 2018	Vulnerable sector	11	52	63
San Pedro	1) Ceremonial Hall, 2) Mountain View Conference Room	April 11, 2018	Vulnerable sector	10	22	32
Muntinlupa	2nd Floor, Resiliency Building, Hall of Justice Compound, Brgy. Tunasan	April 11, 2018	Vulnerable sector	11	13	24
Calamba	Barangay Pansol Quadrangle	April 12, 2018	Vulnerable sector	4	5	9
Parañaque and Taguig	Conference Room 3-4, Legislative Building, Parañaque City Hall	April 13, 2018	Vulnerable sector	7	10	17
Manila	SACES Covered Court, Brgy. 803, Manila	April 13, 2018	Vulnerable sector	2	11	13
Calamba	DILG Multipurpose Hall, New City Hall	April 24, 2018	Business sector	3	3	6
Cabuyao	Cabuyao Central School	April 24, 2018	Business sector	5	9	14
Biñan	2 Conference Rooms: Office of the Mayor, City Hall	April 23, 2018	Business sector	2	8	10
Santa Rosa	Rooftop, Labas Barangay Hall	April 23, 2018	Business sector	3	8	11
Cabuyao	Cabuyao Central School	April 24, 2018	Vulnerable sector	1	9	10
Parañaque and Taguig	Conference Hall, 7th Flr, SM Aura	April 25, 2018	Business sector	0	1	1
San Pedro	Mountview Hall, San Pedro City Hall	April 26, 2018	Business sector	0	3	3
Muntinlupa	Tunasan Bulilit Center	April 26, 2018	Business sector	5	4	9
Manila	SACES Covered Court, Brgy. 803, Manila	May 15, 2018	Business sector	1	5	6

Source: JICA Design Team.

(1) FGD with the Affected Business Sector

2191. Eight FGD sessions were held with a select group of affected business owners in the Cities of Laguna and Metro Manila. The list was taken from the list of business respondents of the SES in the affected communities. The criteria for selection were based on sectoral, age and gender representation.

2192. Topics for discussion were centered on the business owners' or their representatives' apprehensions regarding acquisition of properties in relation to their respective businesses, their concept of livelihood restoration and improvement and their ideas on possible project benefit-sharing schemes that will be acceptable to them. Most apprehensions of the business sector were related to impacts of relocation on their businesses such as loss of income, loss of regular customers, the difficulty of finding a space and re-establishing their business in a new location. To help them restore their income stream, business owners expect cash compensation for the loss of land and structures, transitional allowances as well as the provision of loans as additional capital to re-establish their business. Access to skill training opportunities as to how to run a business would also be a tremendous help for small business owners and ensure the success of their business. As for the project benefit-sharing, business owners expect to be allocated a space to sell during construction and operation of the project. Some businesses also expect to be given a chance to participate in the bidding process to supply construction materials and other stuff needed for the project. What they considered deal breakers was the inability of the government to pay compensation on time, corruption, no consultation with PAPs on project-related decisions

that affect them and too many PAPs and businesses for supports which may affect the project budget. **Table 11.2.17** summarizes FGD results.

Table 11.2.17 Results of Focus Group Discussion with the Affected Business Sector

Guiding Question	Response
On the business side - What are your apprehensions/concerns regarding acquisition of your property?	• They might lose business/income sources. • How to replace/re-establish their business. • No other source of income. • What portion of the property will be affected? • Disturbances on our newly built business. • Financial burdens to rebuild a portion of their business structures. • Loss of regular clients/customers. • Where to relocate and what the situation is in the new area. • Too expensive to rent a space. • How the project would affect the business and their lives.
What are your expectations regarding livelihood restoration and improvement?	• Capital to look for/buy/rent a space for their business and rebuild workspaces. • Cash compensation for affected land and structures. • Transitional allowances while re-establishing their business. • Assistance for establishing an alternate business. • Skill training, for example, regarding how to operate a business, learning new skills/new businesses and product diversification. • Provision of an alternative space to re-establish our shop preferably in populated areas. If they are qualified to be relocated, this would be better.
What are the possible project benefit-sharing schemes? Can you suggest some? During Construction? During Operation?	• [During Construction] • Opportunity to put up canteens/eateries at the construction site. • Opportunity to apply for jobs/become sub-contractors/bid for projects. • [During Operation] • Opportunity to rent a commercial space at train station. • Opportunity to enter into business contracts with the project implementer to supply materials, i.e., hardware.
What is your expected timeline for this? During Construction? During Operation?	• [During Construction] • When construction commences • [During Operation] • When operations start
What do you consider “deal breakers” for the schemes presented?	• If the project does not proceed • The government’s inability to pay compensation on time (difficult to conduct business with government). • No consultations with the affected communities in whatever project-related decisions the government makes. • Due to corruption, cash compensation/financial supports do not reach affected business owners. • Too many affected people and businesses that the government should support. If the government just compensates them for loss of business structures along with financial supports, then they can re- establish on their own.

Source: JICA Design Team.

(2) FGD with the Affected Vulnerable Sector

2193. Similar sessions with the vulnerable sector were also conducted to figure out their apprehensions/concerns regarding displacement of their communities and their respective sources of livelihood. The sessions were also aimed to understand their concept of livelihood restoration and improvement as well as other possible entitlements that will be acceptable to them. Apart from livelihood, discussion also covered identification of their relocation site preferences. Participants were selected from the list of respondents of the SES. The criteria for selection were based on sectoral, age and gender representation.

2194. Generally, participants across all areas in the south are aware and supportive of the project. As such, it was easy for facilitators to get discussion started. However, the knowledge

of participants on livelihood and possible sources of income were quite limited. The first thing that always came to their mind is putting up a sari-sari, a general merchandise store. Most responses were centered on individual household sources of income, not much on something that they can do as a community. When it comes to government supports, financial capital readily emerged as a common response with little thought on skill training and other business supports. For discussion on relocation, intra-city relocation is the preference as much as safety and security of the relocation sites. Participants also emphasized the availability of basic utilities like lighting and water as well as access to basic social services like markets, schools and hospitals.

2195. The results of FGD in Laguna and Metro Manila were consolidated to identify common themes across project areas is presented in **Table 11.2.18**.

Table 11.2.18 Results of Focus Group Discussion with the Affected Vulnerable Sector During Feasibility Study

Guiding Question	Response
What are your apprehensions/ concerns regarding potential impacts of resettlement on your livelihood?	• It is difficult to re-establish and ensure that the current business will continue to provide their income when relocated. • Finding spaces to re-establish their business. • A possibility of losing or being far from their customers and product sources/markets for products. • A possibility of losing or being away from their work/business. • A decrease in business income. • More time and costs for travel if relocated far from their work/business or away from the city center. • No livelihood program in resettlement areas. • What will happen to their livelihood, e.g., trolleys, construction works, vendors and farmers. • They might have difficulty to earn a living. • A possibility of not having land to plant especially for backyard gardening. • Losing social networks, e.g., drivers association.
What support programs do you think are necessary to help you cope up with possible impacts on your livelihood?	• Provision of loans/capital to establish or re-establish their business. • Assistance for relocating their business. • Provision of livelihood programs that will enable them to earn for their daily subsistence. • Allocation of store spaces to re-establish their business. • Opportunities to start their business or livelihood that will provide a stable source of income. • Skill training. • Provision of land to plant vegetables for selling. • Supply of products for selling. • Opportunities to land a job, e.g., permanent government posts, street sweepers, factory workers, carpenters, domestic helpers, janitors, etc. • Assistance in forming/joining an association, e.g., the Tricycle Operators & Drivers Association. • Financial supports/transition allowance while looking for new works in order to invest in fulfilling job application requirements. • Opportunity to own a tricycle as an income source.
If livelihood restoration is not possible, what alternative livelihood programs can you suggest?	• Provision of jobs, e.g., mechanics and health workers. • Cottage industry, e.g., broom-making for export, soap making, embroidery and sewing. • Food processing, e.g., tocino, longanisa, hotdog. • Putting up their business, e.g., repair shops, loading stations, frozen food, native delicacies, motor parts, meat products, viand, livestock and poultry raising, food carts, fishballs, clothes, mini groceries, junkshops, buy and sell. • Capital for their business.
What other programs can you suggest helping improve existing livelihoods and consequently helping improve household income?	• Skill training for construction workers, furniture makers, carpenters, janitors, etc. • Establishing a cooperative that will provide trainings on how to run a business, e.g., online selling, food processing, etc. • Financial assistance/loans from the government for additional business capital.

Guiding Question	Response
	• Provision of materials/equipment to earn a living, e.g., manicure-pedicure sets, sewing, tricycles or side cars. • Provision/opportunities to land a job. • Market linkages/access to product sources.
How do you think the project can help you cope better with the livelihood impacts? During construction? During Operation?	• Sourcing out construction materials from affected people, e.g., hollow blocks, hardware materials, etc. • Putting priority on hiring skilled workers from affected communities, e.g., steel men, masons, carpenters, welders, laborers, painters, etc. who will work at construction sites. • Opportunities and financial assistance for putting up food carts/eateries/sari-sari stores near construction sites. • Allocation of a space for selling at the stations. • Free skill trainings to help land a job during operation. • Provision of permanent jobs, e.g., guards, janitors and assistants for passengers. • Allowing existing tricycle operators and drivers association to operate in the area.
What is your relocation preference?	• Accessible location near or within the city with good roads, proper drainage facilities and no risk from flood and landslide. • Accessible by public transportation. • Having a sturdy, proper and permanent housing with complete facilities and utilities including lighting and water. • Opportunities to own a sturdy house which is free or with affordable monthly housing amortization. • Availability of basic social services like markets, schools, clinics, churches, hospitals and community centers. • Availability of livelihood, work opportunities and a space to put up a store/business. • Availability of land for backyard gardening. • Peaceful, orderly, united and drug-free community with a homeowner's association to look after community welfare. • Equal and fair provision of benefits to affected persons/households. • Immediate relocation to be administered by the PNR. • No NHA involvement.
What are factors influencing your relocation preference?	• To be able to live in a safe, peaceful and orderly community that is free from flood, landslide, drugs and crimes. • Basic necessities including lighting and water as well as the availability of social services are essential for their daily life. • To ensure that the affected persons will truly benefit from relocation. • Housing units provided by other housing programs, e.g., the NHA are substandard and easily deteriorated.
Other suggested resettlement support/assistance	• Advance notice prior to relocation. • Provision of government trucks for hauling. • Financial assistance for relocation to be given directly to the affected households, if possible, to pay for transportation for hauling household stuff, food allowances for daily subsistence while re-establishing their sources of income. • Well-organized relocation process.

Source: JICA Design Team.

11.2.1.6. Public Scoping

SCRP Main Line

2196. Public scoping for the NSRP South Line Commuter (PNR Los Baños) project of the DOTr from Solis, Manila to Los Baños, Laguna was conducted in three (3) cluster areas on January 18, 19 and 24, 2018. The public scoping was facilitated by the EIA Division of the EMB-Central Office to provide information about the project and collect site-specific issues, concerns and inputs for the EIA study. In order to encourage attendance, invitations were sent to key stakeholders and barangay chairmen by a sub-contractor on behalf of the EMB, so that the bureau can promote events further to the general public, and the notice of public scoping was displayed at the venue. The presentation was carried out in Tagalog.

2197. Public scoping sessions began with a prayer, followed by the national anthem. Greeting remarks were given by respective LGUs and followed by introduction of participants prior to a presentation on the EIA process and a project description. A two-hour open forum was allotted to participants to help raise their issues, concerns and inputs for the EIA study.

2198. The overview of the EIA study and the objectives of public scoping were presented by the representative from the EMB's EIA-Central Office. The description and benefits of the project were presented by the DOTr, or the project proponent, while potential impacts and mitigating measures as well as benefits of the project were discussed by Engr. Ledicia T. dela Cruz of Geosphere. After presentations, an open forum which was facilitated by representatives from the EMB's EIA-Central Office to solicit inputs for the EIA study of the project from stakeholders. After the open forum, issues, comments, suggestions and inputs for the EIA study were summarized by Engr. dela Cruz, and participants were advised to contact the EMB, the project proponent and Geosphere for additional issues, concerns and inputs that they may want to raise after public scoping. The public scoping session was then adjourned after closing remarks from the DOTr, the project proponent.

2199. Along with **Annex 2-7c,** the public scoping report is presented in **Annex 11-2**.

Table 11.2.19 Outline of Public Scoping Activities for the SCRP Main Line

Target Affected LGU	Venue	Date and Time	Main Participant	No. of Participants		
				M	F	Total
Manila, Makati, Parañaque, Muntinlupa	Barangay Carmona Covered Court, Barangay Carmona, Makati City, Metro Manila	January 18, 2018 1:00 p.m.	• EIAMD case handlers, the DENR-EMB Central Office • Representatives of the PNR, the DPWH, the MMDA and the MGB • Manila City LGUs (city councilors, representative of the Offices of the Mayor and Vice Mayor, department heads and concerned barangay chairmen and councilors) • Residents from different barangays along the PNR alignment • Makati City LGUs (city councilors, a representative from the Office of the Vice Mayor, department heads and concerned barangay chairmen and councilors) • Parañaque City LGUs • Muntinlupa City LGUs	67	75	142
Calamba, Biñan, Los Baños	LLC Auditorium in Calamba Elementary School Central 2, Calamba City, Laguna	January 19, 2018 1:00 p.m.	• EIAMD case handlers, the DENR-EMB Central Office • Calamba City LGUs (city councilors, a representative from the Office of the Mayor and Vice Mayor, department heads and concerned barangay chairmen and councilors) • Biñan City LGUs • Los Baños LGUs • Residents from different barangays along the PNR alignment	44	20	64

Target Affected LGU	Venue	Date and Time	Main Participant	No. of Participants		
				M	F	Total
Taguig City	Taguig City Satellite Office, Kalayaan Hall, 10th floor, SM Aura, Taguig City, Metro Manila	January 24, 2018 1:00 p.m.	• EIAMD case handlers, the DENR-EMB Central Office • MMDA representative • Taguig City department heads and representatives of the City Legal Office (CLO), the Barangay Affairs Office (BAO), the LBO, the UPAO, the CPDO, the Low-cost Housing Office (LHO) and the City Engineer's Office • Chairman, Barangay South Daang Hari and Staff • Councilor, Barangay Tanyag • Chairman, Barangay Fort Bonifacio • Councilor, Barangay Bagumbayan Chairman, Barangay North Daang Hari • Chairman, Barangay Western Bicutan	13	5	8

Source: JICA Design Team.

Table 11.2.20 Summary of Issues and Concerns Raised During Public Scoping for the SCRP Main Line

EIA Module	Issue/Concern Raised	Response to Query
Project description	In Parañaque City, what areas will be affected by the project?	Based on inputs from Paranaque City LGU, Barangay San Martin de Porres in Paranaque will be affected.
	For Sucat, will the DOTr utilize the existing PNR station?	There are two (2) plans for Sucat, one for a depot and the other for a station. Whether to utilize an existing facility or construct a new one is still in question. Again, the discussion is at the planning stage and can be still changed.
	Will the DOTr fence the railroad? If the DOTr will fence the railroad, how about the roads that the residents of Barangay Buli in Muntinlupa City used to cross from one side to the other side of the railway? There will be no ROW for the people?	For safety, yes. And that is a plan. We understand your concern. We also do not want to close the roads, particularly those that are public roads or were constructed by LGUs for passage of its constituents to the other side of the railroad. We do not want to divide your barangay, municipality or city into two by fencing the railway. Whether we close the road permanently or elevate our structures and provide an access, will be considered in our study and design. As much as possible, we would like to avoid a permanent closing of roads.
	What is the plan of the DOTr with the PNR's Blumentritt station? Will the DOTr widen it? There are residential areas near the station which might be affected.	Again, the required area for stations is 60 m in width and 250 m in length. One issue with the Blumentritt Station is that there is an LRT 1 station right above it. We are coordinating with the Light Rail Manila Corporation to make the Blumentritt Station as an integrated transport terminal for LRT 1 and the SNRP. Most likely, the NSRP will be elevated. We will know structures that may be affected once our RAP team complete its survey.
	Is it true that JP Rizal in Calamba City will be fenced? Would it be possible for the station to have the ROW of 20 meters only?	The ROW is 30 m for the track and 60 m for the station, and the standards are non-negotiable. What is negotiable is the location of the station and the alignment. Regarding fencing, we are not fencing yet since we are still at the study stage.
	Is there a chance that one of the proposed stations will be located in Barangay Pansol, Calamba?	Stations have yet to be finalized. A station in some areas may be transferred to another if it would come out through the study that the plan is not feasible. We are welcome for the proposal if you think that it is feasible and viable to construct and operate a station in your barangay. You can write a letter. We can include the proposal in our study.
	Will the project be pushed through?	I wanted to say, yes. We can only say that it is 100% sure when our loan will be granted by Japan, though. That's why we are conducting this public consultation because this is a part of the process to acquire the ECC. The ECC along with the RAP is the requirement of Japan before the government grant us its loan.
	How high will the railway be elevated and how high is the fence? If it is	We do not have those technical details yet. However, the railway will be elevated including at-grade design. There would be an embankment just like for the MRT.

EIA Module	Issue/Concern Raised	Response to Query
	elevated and fenced, how about road crossings?	
	Is the DOTr conducting a feasibility study? What is the timeline for the feasibility study?	Yes. This public consultation is already a part of the feasibility study. For the timeline, it will be completed by 2022.
	Where is the exact location of the station and depot in Los Baños?	There is no final location yet for stations, depots and other facilities. The detailed design has yet to be started. We are still at the feasibility stage. Once we have the detailed design, however, we will consult with LGUs. Just to give you an idea, we have met with IRRI. We are considering the option to utilize the lot which the entity is leasing from UPLB for the depot. However, that has yet to be finalized.
Water	During heavy rain, Barangay San Vicente in Biñan City is easily flooded because the PNR post blocks the waterway. The post blocked the waterway, so there was the deposition of sediments, and our river depth is getting shallow.	Thank you. Yes, we will consider your sentiments in our study. That's why we have these consultations. Actually, this is just a start of series of consultations, so we can also gather inputs from you. We hope you will accommodate us so by the time that we will go to your barangays or community, Likewise, we can consider you inputs just like this for our study. The alignment has yet to be finalized, and our principle here is that, as much as possible, we do not want to affect critical structures such as cultural heritages, churches and schools. Regarding your concerns, we need to formalize them. You can write a request letter to the PNR, so they can take actions.
People	The Skyway project will utilize the ROW of the PNR, 60 m from the central line on the left side, while the DOTr 's project will utilize the 30-meter ROW of the PNR? who will be responsible for relocation of affected residents of Barangay 507 in Manila City? The DOTr or the proponent of the Skyway project?	This is a separate project. The proponent for the NLEX-SLEX Connector Project is the DPWH. It is true that the DPWH will also use the existing ROW of the PNR. We already had several coordination meetings with the department since we need to discuss the sharing of the ROW. Based on our meetings, the DPWH is ahead of us in terms of project timeline. They are already conducting their survey and tagging activities and have drawings of their structures. The DOTr, on the other hand, is still working on the design process. Since we are a little behind the department in terms of the project timeline, we will be the one to adjust. Our design team is studying and will take into consideration the design of the DPWH project. As mentioned a while ago, the DPWH will carry out relocation. In this project, we will also implement relocation. So far, we only held the first consultation meeting. After the third SCM, we can identify households that will be affected by the NSRP.
	There would be lots of houses and infrastructure that will be affected in Barangay 811, Manila City if the ROW is 30 m. This includes legal land owners.	Historically, the PNR's ROW is 30 m. That would be 15 m from the central line to one side of the railway and another 15 m from the central line to the other side. We are still at the design stage. Our design team is asking for the 30-meter ROW because, historically, that is the PNR's ROW. PAPs, particularly landowners, within the 30-meter ROW, may rest assured that their rights will not be violated. We have another sub-contractor that is preparing the RAP in accordance to RA 7279 and JICA standards.
	There is a law that condominiums and housing projects of the President couldn't be displaced. What will happen to the housing projects of President Ramos and Marcos that are located near the railroad?	We are still in the design process. Eventually, we will have a ground survey to determine who will really be affected.
	There are lots of projects such as the NLEX-SLEX Connector Project. Please coordinate with the City of Manila, so that residents will be informed and not be confused, particularly concerning the ROW.	Yes. We are coordinating with the City of Manila.
	What is the plan of the DOTr with ISFs? Where would they be relocated? Will the relocation site be provided with facilities or utilities that are needed by relocatees?	I would like to invite you to the SCM on January 22 at Manila City Hall. We would answer all your concerns regarding resettlement there. As of now, we are still at the planning stage. We are not yet implementing our RAP. Regarding your concerns about relocation sites, recently we had our agreement with the SHFC. The entity will be responsible for relocation sites and make sure that the sites are in favorable conditions. And we have the PCUP. They will make sure

EIA Module	Issue/Concern Raised	Response to Query
		and verify that the social economic status of relocatees will not be lower than their previous status.
	What will happen to legal owners? Will they be relocated and compensated? Who will do appraisal of their properties?	As of now, our ideal ROW is 30 m. Under RA 10752, the "Right-of-Way-Act", affected formal or informal settlers have their rights. Under this act, we have what we call a negotiated sale wherein the current market value is used to compensate owners of properties/structures that will be affected. We have the SHFC and the PCUP to ensure that affected families will be compensated accordingly. We have government financial institutions accredited by the Bangko Sentral ng Pilipinas. All questions regarding resettlement will be answered in the public consultations for the RAP. Though resettlement is part of the EIA study, this is only a framework. The details and other concerns will be answered in the RAP.
	Who will finance relocation of the informal settlers? Is it national or local governments?	Just to give everyone the background information, this public scoping is being held for environmental impacts. We have other ongoing consultations right now in Los Baños and other LGUs, which focus on resettlement only. All your concerns regarding resettlement will be answered there. To your question, we, the DOTr have a budget for resettlement. We will have three (3) consultation meetings. At the moment, we are still at the first SCM. In the second SCM, we will discuss details about resettlement and entitlement packages.
	Since the project is not being implemented, and the PNR property is not guarded, ISFs who relocated before kept coming back.	Concerns on previously relocated ISFs coming back are not only raised from Binan. This issue may be linked with improper implementation of RAPs. Because of concerns like this, the DOTr ensures that consultation meetings are being conducted to gather issues and concerns of PAPs to provide more options for resettlement and entitlement packages to the potential affected families. A PP is being pushed for this project in order to ensure that affected families and persons patronize relocation.
	How about terrorists? Has the DOTr considered security issues?	The project is funded by JICA, which follows strict compliance with safeguard standards as well as local and national policies. Thus, PAPs may rest assured that a security issue is being considered in the study.
	Can the DOTr look into sources of income of those that will be resettled? The DOTr should also consider the accessibility of relocation sites from the workplace of relocates, so that they do not need to come back to the PNR properties.	The DOTr is not connected with the group conducting the survey. The project is currently at consultation stage only. Surveys have yet to be started. Relative to relocation, resettlement and entitlement packages will be discussed during the second SCM. The DOTr is trying to come up with packages that will be patronized by relocates, so they will not come back to PNR properties.
	The temporary road that connects Purok 5 to the property of Barangay Tanyag, Taguig is within the 30-meter ROW of the PNR. This is currently the only way for Purok 5 residents. The road is approximately 100 m and not registered with Taguig City Government.	• Even without this project, the PNR already owns the said ROW. For clarification, the following questions are needed to be answered. • Where is the temporary road? • It is the road connecting from the proper road to Purok 5, right? • How long is it? • If going to Los Baños, where is it located? • Was that road constructed when the land was owned by the PNR?
	Usually, affected residents are not employed for projects because contractors bring in their own personnel.	Coordination meetings are held to raise and address such concerns. In addition, the EIA requires the proponent to hire workers from host LGUs. The DOTr can include this issue in their contract with their contractors requiring them to hire locals from the barangay, city or municipality. The barangay may also include a condition in the barangay permit for contractors to secure clearance from the barangay for all their workers to ensure that they hire local workers. If not followed, you can raise this issue to the MMT, so the DENR, which will issue a notice of violation if contractors are not compliant.
	The DOTr should conduct consultations with all affected barangays for the RAP.	The conduct of consultations is a part of the RAP process. The DOTr is to verify with JICA why some barangays were not yet consulted. For clarification, the public hearing is for the ECC and not for the RAP. Consultations for resettlement of PAPs whose houses and

EIA Module	Issue/Concern Raised	Response to Query
		other assets are affected are handled by the RAP team. The team is conducting separate consultations per barangay.
	May we suggest that Barangay San Martin in City of Parañaque be invited for consultations since they have about 200 ISFs encroaching on the PNR's ROW?	The DOTr is to verify the schedule of consultations in barangays. Initially, they attended the public scoping session which was held in Makati last January 18.

Source: JICA Design Team.

SCRP Interconnecting Line

2200. The Public Scoping meeting for the SCRP interconnecting line was conducted on July 1, 2019 at Paranaque City. This session catered the three concerned LGUs and was attended by several stakeholders such as the officials and representatives from the LGU, private sector, home-owners associations, peoples' organizations, and other interested public. **Table 11.2.21** provides the summary of the public scoping done while **Table 11.2.22** lists the summary of issues and concerns noted during the public scoping.

Table 11.2.21 Outline of Public Scoping Activities for the SCRP Interconnecting Line

Target Affected LGU	Venue	Date and Time	Main Participant*
Pasay, Parañaque, Taguig	Covered courts of United Hills Village, corner of Atis St. and Narra St, Parañaque	01 July 2019	EIAMD case handlers, the DENR-EMB Central Office Paranaque City LGU Pasay City LGU Taguig City LGU Residents from different barangays along the MMSP interconnecting sections Homeowners Association of Makati South Hills, Upper West McKinley, Airmen Village, United Paranaque Subdivision 1 Religious Groups Construction Corporation Peoples' Organization and representatives for women, farmers, senior citizen, and youth Education group General Public

*A total of 150 participants attended the Public Scoping meeting for the SCRP interconnecting line.
Source: JICA Design Team.

Table 11.2.22 Summary of Issues and Concerns during the Public Scoping for the SCRP Interconnecting Line

EIA Module	Issue/Concern Raised	Response to Query
Project description	Why was the project channeled here instead of under SLEX or under the PNR location? I think it would be easier if it would go under SLEX or PNR, and then the station will be somewhere near our subdivision. Do you think it can still be moved? Did you consider the area in the Veterans area, the Arca South area? I think the Arca South area will be the most beneficial station, also the traffic area near the tenement. Those are the populated areas.	JDT: The construction method for this station is going to be open-cut – we need to dig the ground from the top. For SLEX, we cannot dig it from the ground. For SLEX we have the Skyway, and the Skyway has a lot of piles going underground. We have to protect the Skyway when we are digging underground, which is almost impossible because there are many, many piles in that area. It will also be a very, very, expensive undertaking, even more expensive than the whole project. For the PNR area, the FTI station for the NSCR will already be in operation before our project is completed. We cannot dig the ground while that station is in operation. That is why we need to select our location considering all those developments; that is the main reason why we selected this location.

EIA Module	Issue/Concern Raised	Response to Query
	May we see a cross-section of your project? If the box in the map is the station, is it possible to put it above PNR instead of underground so you won't need to acquire properties in our area anymore?	JDT: (shows map of cross-section) The PNR track is here. Before us, these four tracks should be constructed here. We have an underground facility here. This area is after the East Service Road. East Service Road has to be diverted because these four tracks is already occupying some part of the East Service Road. Our station is more further than that.
	What will happen to the roads that will be affected by the project? Will these roads be restored after construction? Will we be able to retain the use of our subdivision gates after construction?	JDT: If you are concerned about the access of the roads, that will be returned back. Our station is going to be cut and cover, so we need to divert the existing East Service Road further to the east. So all the roads connecting to the East Service Road will be connected to the new East Service Road that is diverted.
	Please channel all your plans for the subdivision through our homeowners association so we can also invite all affected residents for a discussion. Can you re-channel or divert this project to SLEX or even Arca South? Or somewhere along C5?	DENR-EMB: DOTr have a presentation on the exact properties that will be affected. For now, what they can present are indicative areas only. We understand your concerns as property owners that is why as part of the EIA process, we are noting your issues and concerns before we amend the ECC, and DOTr should be able to resolve those issues and concerns.
	Is the open and dig method the most cost effective construction method? I understand that in some places like Japan, they were very efficient in their construction and they did not do open and dig. Why do you need to implement open and dig method here?	JDT: The subway has two parts – one is the station, and the other is the track connecting the stations. The track connecting the stations will be constructed underground. For the station part, it has to be constructed from the ground because the station is a box structure. Our FTI station is underground. We are going to connect to the South Commuter line at Bicutan. Our underground station has to go all the way above the ground, far away, 14 m above the ground. So at that point we cannot use the tunnel going this way. We have to dig the ground that is why we need a wider area in this area. Even if we move it further away from the village, we still need to do cut and cover here because our alignment is restricted by the Bicutan station. If after FTI our station going towards the south was underground, we will not need a larger area.
	I suggest you stop the project at Arca South rather than going to Bicutan so you can avoid passing through a private residential area.	DENR-EMB: This is noted.
	Previous plans about the project were already provided and discussed with us. Why were changes in the project made and why are these changes necessary?	AECOM: (showing map) In the old ECC, the alignment was from Valenzuela, going all the way down here. But since there is a faultline in this area, the alignment had to be shifted. It also has to have an interconnection with the NSCR that is why it is now longer.
	How deep is the TBM?	AECOM: It will be about 16 meters below ground.
	Can the station be located near the bus station in Arca South so that the commuters can easily walk from the bus station to the subway station?	AECOM: Your suggestion is noted
Land	Can the project utilize government lands and roads instead of land from our subdivision?	DOTr: The East Service Road will be used and will be part of the construction; it will be diverted. DENR-EMB: Your concern is noted and this will be included in the EPRMP of the project.

EIA Module	Issue/Concern Raised	Response to Query
	What is the intensity that the tunnel boring machine will bring on the ground? What is the intensity if you use for example an earthquake scale?	AECOM: That will form part of our study and will be included in our report.
	Who will be responsible for managing and removing construction debris during the implementation of the project? Our experience with the contractors of other projects is that they don't have a sense of urgency in terms of disposing construction debris and it is blocking our roads and pedestrian walkways.	AECOM: Your concern is duly noted.
Air	What are the expected vibration, dust, and noise impacts within 500 m from the project site and above? Do we need to refit/reframe our strucutures and strengthen our houses? What is the strength of the shaking that we will feel during construction and during the operation of the subway? Did you consider the fault that is located near us?	AECOM: We will be conducting a study on the potential effects of vibration as part of the EPRMP. Our study will also cover environmental modules related to air, water, land, and people. The study will be done within the next two months. The copy of the study will be made public so you will also have a chance to take a look at the study and provide your comments. Everything will be disclosed in the website of DENR-EMB. Rest assured that we are taking note of all your issues and concerns so we can include them in our study.
	Please also consider the utilities of the village such as the electric lines, water lines, and sewage lines that will pass through the alignment. What will happen to these? Please include this in your study.	AECOM: This is noted.
	When is the actual start of the project construction and its groundbreaking?	Barangay Representative: Apparently they already started in Quezon City. So I guess in our area it will be in the next 1 to 2 years. The forecast of the government is that 2022 the project should start already, we are already in 2019, so three years. Everything will be completed by 2025.
	Is the ECC a pre-requisite for this project? After this meeting, will you be able to to certify that you will give them clearance in the aligned portion? If you give them the ECC, does that give them a go signal to undertake the project?	DENR-EMB: Yes, the ECC is a pre-requisite. After this Public Scoping, they will submit an EIA report detailing all the mitigating measures, where the exact alignment will be, and what will be its effect to the community. If based on our evaluation and the evaluation of our Review Committee they have mitigated all the potential impacts, then we would have no reason not to issue the amended ECC. The ECC is not a permit for them to start the project. The ECC is a planning tool for them to be able to mitigate and contain the potential impacts of the project.
People	Which properties will be affected by the project? What law/s will apply? Will this be RA 10752? One section of RA10752 states that the market value will be used. What agency will determine these market values? There is also a clause in that law that states that the Central Bank has a list of independent appraisers, from your experience, has this been applied? If a homeowner protests the negotiated sale, we will proceed to expropriation proceedings. How long does this usually last? In case that the government will expropriate certain properties inside the village, what will happen to the perimeter wall? Will the	DOTr: That is correct, we will use RA10752. The basis for valuation of affected lands willl be the current market value. For the PO sections, DOTr got the Landbank of the Philippines through competitive process; the priority are the GFIs or the Government Financing Institutions – right now we only have two – the Landbank of the Phlippines and Development Bank of the Philippines; in the event that we cannot utilize them, we can use any independent property appraiser accredited by the Central Bank. We have not started with the procurement process for the appraiser of the remaining sections from after the PO sections until the NAIA extension. For the affected structures we will use the replacement cost value. Structures will be valuated based on its current market value (as if new) even if the structure was built a long time ago.

EIA Module	Issue/Concern Raised	Response to Query
	government pay for this? We want to ensure the security of our village.	We will give an offer to buy. We will issue three documents to the affected property owner. First is the Notice of Taking, informing property owners of the date that improvements can no longer be added to the property. There will be a detailed measurement survey to check the extent of the impact to the property, both to the land and the structure. After that we will issue a letter to the property owners if they wish to donate their property. This is voluntary and will not be demanded from the property owners. If the property owner does not wish to donate the property, then they will be issued a letter offer to buy. Our first and final offer will be based on the appraised value that will be turned over to us by either the GFI or independent property appraiser – the replacement cost value of the structures and the current market value of the land. If after 30 days we do not receive a response from the property owner, we will automatically file it for expropriation. The partner of the DOTr will be the Office of the Solicitor General. Once we file the case in the appropriate RTC, within seven days we can already deposit the equivalent zonal value of the property and 100% of the replacement cost value of the structure. After that we can already ask for a Writ of Possession so we can use the property while possessing the just compensation for the affected property. The alignment of the subway will be secured so there will be a perimeter fence during construction. What we can pay are only the affected structures. If there are fences that serve as security of your subdivision that we will impact, we will pay for them at its replacement cost. There will still be a lot of surveys that will be done after this meeting including parcellary surveys to determine the number of parcels of lots that will be affected and who the property owners are. There will also be a socio-economic survey to talk to all the property owners. What we can present now is the picture of the alignment, but we still need to conduct a survey to determine the boundaries. DENR-EMB: During Public Scoping, it is possible that there are questions about the project that still cannot be answered at this stage because further studies are still required. Right now I understand that what is being presented is just the concept, but it can still change during detailed design. As DOTr mentioned, they still need to conduct a survey to identify exactly what properties will be affected. But rest assured that the answers to your questions will be presented in the EPRMP and during the Public Hearing. DOTr: Based on the current plan of the MMSP, 70 m from the road side until the line is what will be fully acquired by the DOTr.
	Which part of the red line will be affected? Is it the surface or underground only? Where will the station be located?	DOTr: (showing map) This whole area is what will be acquired by DOTr to create the station. This red area is the whole station box of the subway, and it is located along East Service Road. For the station, excavation is required; it will then be filled after; this means that all structures above will need to be demolished. The tunnelling is only for the interstation, which are the areas that connect the stations with each other.

EIA Module	Issue/Concern Raised	Response to Query
	What will happen to the structures where the line is shown? Do you need to demolish the buildings there and then later on give them back to the homeowners? What will happen to our subdivision's entrance and its accessibility if you demolish this portion of the subdivision and acquire the properties there?	DOTr: Once construction is completed underground, the area on the surface will be used by the project as station plaza; it can have mixed-use development and it will also be used as an intermodal facility. DENR-EMB: According to the design team this is not yet finalized. But this will be included in the EPRMP and it will also be presented during the Public Hearing. I believe there will also be separate consultation meetings for the ROW.
	Our church will be affected by the project including the residence of our pastor that is provided by the church. Will we be provided an alternative location for our worship services, as well as our pastor's residence?	DOTr: We will conduct a resettlement action planning, the resettlement action planning is where the details of all the issues of the affected property owners will be tackled. We will be organizing another meeting specifically for the RAP; currently it is difficult to answer this now because some of the locations are still indicative. Once we superimpose the design with what is on the ground, then we can see the actual properties that will be affected. All those who will be affected will be sent notices. We can only define the metes and bounds of the project affected areas once we complete the survey.
	Where will the affected residents be resettled? Can DOTr use PNR's property instead of acquiring lands from United Hillls Village? Just a suggestion, can the station be moved to the area near FTI because the area available there is larger compared to the area here?. We would like to formally request the DOTr that the design, relocation, and extension of the subway project be re-adjusted to the property owned by PNR.	DOTr: There is another DOTr project in that area, which is the NSCR Calamba Extension. This will be adjacent to the subway and there will be an interconnection. The alignment of the subway is designed as a casting net; its location will catch riderships in different locations. Another important consideration why the subway was located here is the interconnectivity with other railway networks. If we move it further up, there are more developments that will still be undertaken by the DOTr in that area.
	I understand that the station plaza will run in front of this village and will be above ground. Will the railway therefore come up to the surface? If the plaza is above ground how will we be able to access it? Between FTI and Bicutan, the whole area will be above ground?	DOTr: After the FTI station, we will be having this interoperability with the PNR. The subway will be elevated after the FTI station; so it will go up and have an interoperability with the NSCR Calamba Extension. DOTr: Yes, after the FTI station it will go up.
	Can the East Service Road be diverted westward, parallel to the railroad track and within the property of the PNR instead of towards United Hills Village?	AECOM: I believe that has been answered and noted already Sir.
	When will affected residents receive compensation, before or after the construction activities start?	DOTr: We will follow the law and the JICA guidelines. We will pay affected property owners prior to displacement, unless it is via court; via expropriation. If it is expropriation, we will be given a Writ of Possession, and then we will enter the property. For those under negotiation, you will be paid first.

EIA Module	Issue/Concern Raised	Response to Query
		Our next public consultation will revolve around all the ROW acquisition concerns.
	Have you considered the existing volume of traffic in your planned road closures and diversions?	AECOM: We will be starting with the field surveys for our traffic impact assessment by next week, including along your area in Cucumber Road and East Service Road. Traffic is definitely being considered in our studies and will be part of the EPRMP.
	The riding public is concentrated near Bayani area and not in this village area. I think that it would be better if the station is put there in Bayani area instead of here.	AECOM: Your concern is noted Sir; we will come back to you to present our study and respond to your queries in more detail.
	Please explain the retention payment scheme of the government. Will this be applied to this project? We do not want this scheme to be applied to this project. What will be the arrangement if there is an unpaid real property tax in the affected property?	DOTr: Let me share what we are doing with our other projects. That is true, RA10752 clearly states that a certain percentage will be withheld while transferring the property to the implementing government agency. But wer are also following the JICA guidelines. The JICA guidelines is very clear on the requirement that full compensation is required prior to displacement. We have sections in the MMSP, Valenzuela, Quezon City, and we are implementing there 100% payment. This applies if the property does not have a problem. If the property has a problem, we still pay, but we will retain a certain portion so that the property owner is given time to fix the property documents. We have an entitlement matrix giving consideration to the different circumstances of the properties and property documents. We only apply the BIR zonal value if it is via expropriation but if its via negotiation it is automatic that the current market value will apply. DOTr: The real property tax is the obligation of the property owner, that is paid to the local government unit. With regards to RA10752, we are the ones who will be shouldering the capital gains tax, transfer tax, everything, we will shoulder that. We cannot pay the real property tax because that is the obligation of the owner. You need to secure tax clearance for us to be able to pay you 100%. We will ask the opinion of our legal department regarding your proposal that the DOTr also shoulder the real property tax. It would be helpful if you can write us as well so we can seek legal opinion. We are also being observed by JICA. Any violation of DOTr will have an effect on the loan for this project.
Others	I would like to know how we can get other information and access it so we can refer to it in the future.	AECOM: After this meeting we will be collating all the issues and concerns. The results of our study will be made available in the website of DENR-EMB. DENR-EMB: Our website is emb.gov.ph.

Source: MMSP Public Scoping Report for EPRMP, 2019

11.2.1.7. Public Hearing

SCRP Main Line

2201. For the SCRP main line, three (3) sessions of clustered public hearing were conducted, two (2) in the National Capital Region (NCR) and one (1) in Laguna. For the NCR, public hearing sessions were held in Makati City on June 20, 2018 and another one in Taguig

City on June 21, 2018. For Laguna, the public hearing session was held in Sta. Rosa City on June 22, 2018. Details of the clustered public hearing are presented in **Table 11.2.23**.

Table 11.2.23 Schedule, Venue and Participants of Public Hearings for the SCRP Main Line

Target Affected LGU	Venue	Date and Time	Main Participant	No. of Participants		
				M	F	Total
Makati and Manila	Barangay Carmona Covered Court, Barangay Carmona, Makati City, Metro Manila	June 20, 2018 9:00 a.m.	• EMB public hearing officer, DENR-EMB Central Office • EIA case handler and EIA Review Committee, DENR-EMB Central Office • DepEd Manila • PCUP representatives • Polytechnic University of the Philippines (PUP) representatives • MMDA and MSWD representatives • DPWH-NCR representative • Senior Citizens' Affair Office (OSCA) – Makati representatives • Manila City LGUs (department heads, councilors, concerned barangay chairmen and Kagawad) • Makati City LGUs (department heads, councilors, concerned barangay chairmen and Kagawad/council members) • Celadon Residences Homeowners Association representatives • Concerned residents	48	44	92
Muntinlupa and Parañaque	The Lakeshore Tent, C6, Lower Bicutan, Taguig City	June 21, 2018 1:00 p.m.	• EMB public hearing officer, DENR-EMB Central Office • EIA case handler and EIA Review Committee, DENR-EMB Central Office • HUDCC representatives • MMDA representative • DPWH NCR representative • Taguig City LGUs (department heads, concerned barangay chairmen and Kagawad/council members) • Muntinlupa City LGUs (department heads, councilors, concerned barangay chairmen and Kagawad/council members) • Parañaque City LGUs (department heads, concerned barangay chairmen) • Tricycle Regulatory Office – Parañaque • Concerned residents	75	101	176
San Pedro, Biñan, Santa Rosa, Cabuyao, Calamba	Sta. Rosa Auditorium, Rizal Boulevard, Sta. Rosa City	June 22, 2018 9:00 a.m.	• EMB public hearing officer, DENR-EMB Central Office • EIA case handler and EIA Review Committee, DENR-EMB Central Office • PCUP representative • DepEd Biñan • DepEd Cabuyao • San Pedro LGUs (concerned councilors and Barangay chairmen) • Biñan LGUs (department heads, concerned barangay chairmen and Kagawad/council members) • Sta. Rosa LGUs (department heads, councilors and concerned barangay chairmen) • Cabuyao LGUs (department heads, councilors, concerned barangay chairmen and Kagawad/council members)	68	102	170

Target Affected LGU	Venue	Date and Time	Main Participant	No. of Participants		
				M	F	Total
			• Calamba LGUs (department heads, councilors, concerned barangay chairmen and Kagawad/council members) • Samahang Magkapit-bahay sa Tabing Riles (SAMBARIL) representatives • Barangay Uno Calamba City Neighborhood Association (BUCCNA) representatives • Ospital ng Biñan representatives • Cabuyao Central School representatives • Magdiwang representatives • Concerned residents			

Source: JICA Design Team.

2202. Public hearings were presided by the case handler of the project from the EMB-Central Office, observed by the EIARC. The open forum was presided by public hearing officers commissioned by the DENR-EMB. Additional issues and concerns raised during public hearings were incorporated into the environmental impact statement report (EISR), and the details are found in **Table 11.2.24**. Also, the complete public hearing reports are presented in **Annex 11-3.**

Table 11.2.24 Summary of Issues and Concerns Raised During Public Hearings for the SCRP Main Line

EIA Module	Issue/Concern Raised	Response to Query
Makati Venue		
Project description	We wrote a letter to Atty. Matias, Chief EIA Division of the EMB-DENR to ask if Celadon Residences will be affected by the project. Our barangay, Brgy. 350, is not included in the impact statement. We hope that you can respond to our letter, in writing, so we will be guided.	• The EMB-DENR acknowledges the receipt of letter to the EMB. They will respond to your letter, but in the meantime, the DOTr and Geosphere are here to answer directly if your residence will be affected. • The DOTr has ongoing talks with the property manager of Celadon Residences. They will be conducting SCMs specifically with Celadon residents. The property manager is just asking for a formal letter from the DOTr and project design details, which at this stage, might have yet to be finalized. What they want at this moment is an initial dialogue.
	When you called for a meeting in Brgy. 473, you explained about this project to the constituents. They were saying that you would occupy 60 m x 70 m. That is about half a hectare. A lot of civilians, living there for a long time, were told by representatives that the affected residents would have to vacate the area. We were instant squatters. They told us to vacate the area and pay us. However, we are residing there for 60 years and then all of the sudden, you will tell us to leave? What happened to my suggestion if you can reduce the area, 60 m x 70 m, that you will get? This time you showed us that the cross-section of the train will almost occupy the Algeciras and Prudencio Streets.	The DOTr wants to clarify that the correct information is 30 m from the center of the alignment, not 60 m x 70 m.
	In the first meeting held in Brgy. 473, I was not present. There is Algeciras St, Prudencio St. and then the railroad. Based on the presentation, I would like to ask if the 60-meter width on the mid-line of the railroad? It means 30 meters from the right side?	• While the final central line of the track is not yet finalized, the total width of the track itself is 30 m, which means 15 m from each side of the central line.

EIA Module	Issue/Concern Raised	Response to Query
		• The 60-meter width is determined for study purposes only to find out the most feasible location for stations, which will minimize the effect of the project to residents near the proposed railway.
	There's a need for a thorough clarification because people are confused. From the midpoint of the railway track, can you draw the ROW, so we would understand, and it would not cause undue stress?	For the alignment, 15 m on both sides from the central line. For stations, 30 m on both sides from the central line.
	How about the area that will be affected by the North-South Connector Road Project of the DPWH? What is the distance of the project from the central line of the railway, is it still 15 meters?	For sections where the DPWH has used the current PNR alignment, the alignment will move to the side, while maintaining the 30-meter width. There is currently close coordination with the DPWH regarding the final design for these sections.
	The DPWH project will be on the left side of the ROW, and then this project will be on the right side? How would that be? You will get 30 meters from the midline?	The midline/central line will be moved, and the alignment will be moved with it. The DOTr will maintain the 30-meter train alignment for safety reasons.
	Is it possible that you coordinate with the DPWH to have joint venture on the ROW by any ways? Would it be possible that the DPWH project will be at the top and you will be underneath or vice versa? You can help a lot of people if you can do that.	Yes. That is one of items in the ongoing talks with the DPWH. The DOTr will maximize the use of the ROW without compromising the safety of operations, both of the connector road and the PNR.
	The PNR's ROW is 30 meters, so you will move 15 m outward. This will cover the road, approximately 9 m, the sidewalk, approx. 2 m, therefore, you will get approx. 4 m from our property line. There's already a tagging in our area. Would there still be a road and sidewalk at the front of houses or that will be totally covered by the PNR?	At this point, the DOTr is only at the preliminary stage, so tagging is an only initial count of potential affected structures. We will get to the detailed design phase where the final affected structures will be identified.
	Is your perspective drawing of stations already finalized?	The DOTr only has typical station types. The technical design has yet to be finalized.
	The PNR's ROW is 30 m. For stations, you will extend another 15 m. Here in Manila, we have a lot of roads. If you will get more ROW, the width of our existing roads would be narrower.	The DOTr has three structures to build, and some of that are elevated, so it may provide solutions for roads that will be within the alignment. They will continue to coordinate with the DPWH and local government units regarding possible effects of the railway to the existing road network, but our goal is to minimize the number of roads that will be affected by this project.
	How about easements? Would that be included in the 30-meter ROW? Would the freight line use the same line (with this project) and be included in the 30-m width?	Yes, the easement is included in the 30-meter width.
	When will be the final design ready? We will be expecting a presentation from the DOTr in Feb 2019?	The detailed design phase will be completed by February 2019, but as early as August and September. The DOTr is looking to finalize the alignment in order to wrap up the RAP.
People	Will you conduct SCM in Celadon Residences? We only have limited information about what will happen. So, there are still many individuals who were not yet informed.	Yes, actually the DOTr is planning to implement a SCM especially for the Celadon residents.
	We are coordinating with Ecosys Corp. We are actually waiting for the response of our letter. We are waiting for the schedule of SCMs.	The papers are being processed. The DOTr has an initial schedule on June 25. They want to formally respond to your letter.
	We are talking about the urban area. Owners of lots are already spending for facilitating papers of land. Others were already looking other places to	What the DOTr is saying to private, especially legal PAPs is that they will know the cut-off date if we will serve the

EIA Module	Issue/Concern Raised	Response to Query
	transfer. We hope that you will not back out from this. Otherwise, all the money that these residents spent will be wasted.	notice of taking. Our time frame will be known by the end of the year. It will be our choice to improve your property or not before that cut-off date.
	If the final tagging is already completed and the affected residents were already identified, what is the methodology of transferring to resettlement sites or relocation sites? And will there be compensation?	The DOTr follows RA 10752 "Right of Way Act", so they will appraise a property based on its current market value. The DOTr will request services of an appraiser preferably government financing institutions, usually Landbank or the Development Bank of the Philippines. For affected structures, improvements, crops and trees, we will get an IPA or an accommodator of landbank for a replacement cost.
	How to determine a market value and what if the owner would not agree (with the market value)?	Nationally agreed standards are used by our appraisers. If the owner does not agree with appraisal, the law states that the process is a negotiated sale but only a one-time offer. For other venues maybe to be expropriated, a court will decide the just compensation.
	This project will lead to traffic. No one is updating us on alternatives (routes). There is already heavy traffic even if there's no construction yet.	The DOTr is conducting traffic impact assessment, but the traffic management plan will be delegated to the bidding construction contractor. Part of the bidding process will be promoted to evaluated their traffic management plan.
	We have a self-generating power station. If that would be affected through expropriation, what would happen? What is your definition of stakeholders since the power generating facility supplies power to approx. 300 houses in our community? If we will call for SCMs, all of our community will be invited since they will also be affected?	• The DOTr has a technical team dedicated to studying the relocation of utilities. As of now, everything is included for feasibility study and has yet to be finalized. • Separate talks between the DOTr technical team and utility providers will be made. • Any interested members of the public are invited to attend SCMs of the DOTr.
	How would you secure the area in case there will be ongoing expropriation process? How about the location? How will it be secured by you? We, in Celadon Residences, have perimeter walls. Will the walls be open in case there will be the ongoing expropriation process? What will happen to security of our area? Are you going to provide extra security? This is a big concern in our community.	The DOTr will arrange our the third SCM which will allow them to discuss more thoroughly regarding matters like this and more.
Others	What are the grounds/concerns for the ECC not to be issued?	The ECC issuance may be denied if there are requirements not met as per EIA. Regarding compliance, we can issue fines against violations or noncompliance with technical and social requirements of the project. This is in force for the whole life span of the project.
	Do you have a hotline where we can call?	The DOTr is finalizing its mechanism regarding grievance redress, and as soon as we assign our point persons and make the GRM structure finalized, details will be disclosed during one of our upcoming SCMs.
Taguig Venue		
Project description	You mentioned that you would utilize the ROW of the existing railway, right? Why is there a need for tagging since the 15 m-15 m is already 30 m. That is already your property. Why is still tagging implemented? What for?	The first tagging is for potentially affected structures and/or residences. It has yet to be finalized, but it is only for study purposes. The second tagging will be conducted for final structures that will be

EIA Module	Issue/Concern Raised	Response to Query
		affected. The tagging process identifies who will be included in the budget allocated for compensation during relocation.
	Approximately 10 m from the central line of the railway, there is a national power. It encroached in your ROW by about 5 m. What would you do with that? Would you demolish it and transfer it farther from the railway? Would you relocate the posts?	Utilities that are within the final alignment will be relocated.
	If you are saying that you have yet to identify the central line, what was the basis of demolition that happened before? ISFs were evicted and resettled in Southville 3. Why don't you use the central line that the PNR used before, so that there would be no further discussion of demolition, especially in Muntinlupa.	This is a new project of the DOTr. The demolition that happened before is not part of this project. The DOTr has yet to finalize the central line of the new project.
	When would the construction start? May 2019? When you say construction, it means that the area is already cleared? We need to know it, so we can count backward when we should start to vacate for relocation.	Yes. The target date is May 2019 for construction, which will also mark the start for clearing operations.
	In your presentation, a majority of the south portion of the tracks will be elevated? The 38 km will be elevated. Does it mean that the whole stretch of the railway in Metro Manila will be elevated?	There will be an elevated portion from Bicutan down to the south portion of Metro Manila.
	The most common complaint of residents is the noise from train horns. There is a suggestion to close the unrecognized crossings to limit noise from train horns. Here in Muntinlupa, there are a lot of unrecognized crossings, even in subdivisions. What is your plan with the criss-cross in the railway? It would be good if the railway will be elevated, so there would be no need to close the roads.	The new trains will not be noisy unlike the present design. Since the present design allows crossings, warning signals are in place for safety purposes. Crossings are one of the considerations in the present feasibility study.
	Do you have a waste disposal plan per station and would there be intermodal from stations to terminals?	There will be a waste disposal plan per station, and stations are designed to integrate a transport terminal, so that commuters do not have to walk far.
People	A company called, Ecosys Corp, called for a meeting in barangay hall (Sucat). They explained about the project. However, since then, the meeting caused fear, worries and doubts in our area. They were talking about demolition. The project is still under study. Then, why are they talking about demolition? In our area, we have (land) titles. Those that they identified to be affected were subdivisions. We are residing there for hundreds of years already. They are also conducting tagging. The project is still under study. The term "demolition" caused fear for our residents. Is it possible for the tagging to be stopped? The residents were afraid. If you will continue, we cannot assure that nothing would happen since many of the residents are afraid of their situation. Since it would still take a long time before project implementation, is it possible to stop the tagging?	Initial talks are being done now. People are informed of the project as early as possible, so no one will be surprised later on. This is an important part of the feasibility study.
	We all know that the relocation site should have water, lighting and electricity. If the target start of construction is May 2019, where is the relocation site? And, what is the process of their transfer to the relocation area?	The DOTr is talking with the LGU and the SHFC for possible relocation sites as early as now. A proposal states that they should be located in cities or near cities and ensures that these sites will have utilities, schools, markets and livelihood opportunities.
	What is the mandate of MMDA in the traffic management plan?	

EIA Module	Issue/Concern Raised	Response to Query
Others	Not all people can attend this kind of hearings. Can you post on the internet or any websites regarding the progress of the project? We will just monitor it from there, so it would just be very simple.	Project updates are posted on the DOTr website and FB account. They are also posting updates on the EMB website: www.emb.gov.ph. The draft EIS is posted there as well as proponent details. The DOTr will also have a GRM hotline, so that you can ask information regarding this project.
Sta. Rosa Venue		
Project description	Before, the LIAC was already formed. However, the project was not pushed through. How many percent will this project be implemented? Will the RAP be implemented?	The DOTr expects this project to be pushed through since this is aligned with the President's targets/vision.
	Pansol is the hot spring capital of the Philippines. If there is no Pansol, there is no traffic in Calamba. I would like to push our request to revive the station in Pansol. This project and the revival of the station in Pansol would be a big help to solve the problem in traffic.	
	The City of San Pedro has a San Pedro Urban Renewal. The plan on the environment is good. Have you coordinated with the Office of the Mayor? If you have a project, you should consult with the city.	The master plan of San Pedro was considered at the start of the project. The station planning is coordinated with the City Planning Office of every city hall concerned.
	In Muntinlupa, the railway has drainage facilities. Would that be extended up to here in Laguna? It would be better if there is a drainage system to prevent flooding.	The design of the drainage system is currently studied, but its design will depend on the final alignment.
	The questions that were previously raised were good. We hope that the resource person with whom we could talk is accountable enough to answer our questions. We hope that you can send answers to our questions. I am also concerned with noise, impacts of the project on traffic and the frequency of train operations. Calamba, has not only families but industries including the tourism industry. Our market at the crossing will also be affected.	• The EMB's goal for public hearings is to answer your queries as technically sound as possible. There will be more SCMs to address all the concerns raised. • Further, the DOTr does not want to cause undue stress by presenting information as final and then revise them later. This project will undergo a thorough study before it will be finalized. Rest assured, additional information will be disseminated to our stakeholders.
Air	Cabuyao Central School is very near the railway. Would it be affected by the project? Will the noise of the train and construction works affect students? Also, since our three-storey building is made of steel and screws, wouldn't it be affected when the train operates? We just want to ensure safety of our students.	The DOTr will conduct surveys for the alignment, identify affected structures, include your concerns and get back to you for responses.
People	We had already the first SCM last January, followed by another SCM in April. They explained us about the PP. We called our members. The problem, however, is that they have yet to coordinate with our mayor. We hope that they will coordinate first with the mayor and talked about ISFs since the project including the laws that they presented is good.	The DOTr will get details of what happened and relay it to the consultant.
	Would it be possible to relocate to each barangay? The relocation site before was far from hospitals, markets and schools. The transportation is also difficult and there was no livelihood in the area. That's why most relocatees returned to the 'riles'. So, if it's only possible that we will be relocated to our own barangay, we would be happy.	The ideal target of the DOTr is for the relocation sites to be as near as possible to your original locations, preferably within the barangay. The worst-case scenario happens if we cannot find a suitable location nearby. The SCM in May will be held to discuss this issue further.
	Why is it that the affected residents do not know who is the particular person with whom they can talk? What office and where? This is a big project. The public do not need to wait for public hearings	The RAP contractor for conducting consultation meetings is Ecosys, and there is ongoing coordination with potential affected barangays.

EIA Module	Issue/Concern Raised	Response to Query
	or stakeholder meetings for their concerns to be addressed. Do you have already an assigned or accredited mobilizer to do the documentation for them? I heard last year that the PCUP was doing the accreditation of mobilizers.	
	Do you have an established contractor for development? Because there are those who went to our barangay and showed presentations about housing. They said they could finish the housing project within six months. They are giving us forms. We want to know if they are telling the truth.	They are not from our team, so their statement cannot be verified.
	When will the housing project start? They are saying that the railway project will continue until 2020? Is that true?	In terms of relocation, before construction starts, affected stakeholders will be fully relocated. That is stated in the guidelines that we follow. Before any infrastructure is built, relocation should be completed.
	What we are asking is just quality (for the relocation). Even if there is payment from us as long as it has quality and complete facilities, schools, health centers, hospitals with livelihood near transport facilities and far from dumpsites.	The DOTr will follow the standards set by JICA and ADB, so it will meet stringent requirements regarding basic facilities needed in a good relocation site.
	Would there be a separate body coming from JICA for the relocation site? Does this mean that the budget for relocation is compensation for disturbance or all the housing projects? There would be a separate budget that will be funneled out to the SHFC for this PNR project?	The budget will come from the DOTr, with the SHCF as our social key housing agency.
	They mentioned that 50% would be given if we sign that we will leave. However, we could not understand the remaining 50%. Is this disbursed after I leave the 'riles'? Before, it was 70-30, but based on our last meeting, it was already 50-50.	The details will be coming from our ECOSYS consultants to make concerns further addressed during the third SCM. Compensation will be given 100%.
Others	We cannot deny that affected residents go to the elected official since they do not have any other access to the government. Their access is their elected officials. To reduce the pressure to our elected officials, we hope that there would be a separate consultation meeting with the Sangguniang Panglungsod.	Noted.

Source: JICA Design Team.

SCRP Interconnecting Line

2203. The Public Hearing for the SCRP Interconnecting Line was conducted on September 3, 2019 at Taguig City. Similar with the Public Scoping, this session catered the three concerned LGUs and was attended by several stakeholders such as the officials and representatives from the LGU, private sector, home-owners associations, peoples' organizations, and other interested public. **Table 11.2.25** provides the summary of the Public Hearing done while **Table 11.2.26** lists the summary of issues and concerns noted.

Table 11.2.25 Outline of Public Hearing Activities for the SCRP Interconnecting Line

Target Affected LGU	Venue	Date and Time	Main Participant
Pasay, Parañaque, Taguig	TESDA, Taguig City	03 September 2019	EIAMD case handlers, the DENR-EMB NCR Office Paranaque City LGU Pasay City LGU Taguig City LGU National Agencies (TESDA, MMDA, PNP) Affected Barangays Residents from different barangays along the MMSP interconnecting sections

Target Affected LGU	Venue	Date and Time	Main Participant
			Homeowners Association of Makati South Hills, United Paranaque Subdivisions 1, 3, 4, Bonifacio Naval Station Religious Groups Construction Corporation Peoples' Organization and representatives for women, farmers, senior citizen, and youth Education group Philippine National Bank General Public

*A total of 90 participants attended the Public Hearing meeting for the SCRP interconnecting line.
Source: JICA Design Team.

Table 11.2.26 Summary of Issues and Concerns during the Public Hearing for the SCRP Interconnecting Line

EIA Module	Issue/Concern Raised	Response to Query
Land	I believe there's also a government property in the area that is near where UPS is. If the project is built there, it will not hit any existing community. Or instead, how about if the PNR also goes underground and meet the subway below?	DOTr: The location of the Taguig intermodal station was key to the decision in choosing FTI as one of the stations as the intermodal station is foreseen to link riders to the MMSP. The underground structures of NAIA X interconnection and SLEX also were a major consideration in choosing the alignment and subway station in the Paranaque area since these structures go several meters underground. The flight path of planes going into and out of NAIA was also considered. These were considered during the consideration and eventual selection of the current proposed FTI station.
	Why not construct a bridge instead of a temporary road? Then shift the construction yard, instead of going through our village, maybe we can put it in the north after the construction? Have you explored everything that we can do?	DOTr: Initially, the proposed PNR station and the proposed FTI station were envisioned to be side by side occupying the 20 m PNR ROW, the 15 m ROW for the East Service Road and several meters into United Hills Village (UHV) for the temporary and permanent construction areas. However, it is being considered that the MMSP FTI station be located directly under the proposed NSCR-Ex FTI Station. The stations on top of each other will still occupy the 35 m total of the PNR ROW and East Service Road ROW but the East Service Road will need to be diverted east which will affect properties 15 m north of the UPS border. The MMSP will also need a temporary yard east of the diverted East Service Road with a width of 10 m which will be returned to the owners after the construction.
	Your team was asking for another loan for that part of the original FTI station to Bicutan which is about 1.5 km; why do you have to go down? If you're really set to Bicutan why do you have to go down? You can't attain a maximum speed for a high speed train down under because you are now approaching the terminal station which is Bicutan. In the PNR station once you're approaching a terminal, the train will go slow, so from FTI, isn't it more logical that you just stay at grade or in the surface and have a transit station in FTI? The project is encroaching too much of UHV. Also, can you put the new East Service Road on top of the subway?	DOTr: The entire railway network is fully funded. With respect to the three major railway projects going north-south through Metro Manila (LRT 1 and extensions, PNR and extensions and MMSP and extensions) these stations are envisioned to converge in the Parañaque area due to geographical constraints (Manila Bay to the west and Laguna de Bay and mountain ranges to the east). Two of the lines (MMSP and PNR) are envisioned to converge at FTI. The stations on top of each other will still occupy the 35 m total of the PNR ROW and East Service Road ROW but the East Service Road will need to be diverted east which will affect properties 15 m east of the UPS border. The MMSP will also need a temporary yard east of the diverted East Service Road with a

EIA Module	Issue/Concern Raised	Response to Query
		width of 10 m which will be returned to the owners after the construction.
	We encourage you to explore diverting the new East Service Road into the existing Cucumber Road to avoid taking the 15 m permanent works planned which will affect the UHV properties. There are no jeepney riders alighting starting from Paje to Cucumber Road. As residents of UHV we are willing to go down to our houses from Cucumber Road. We are also willing to have the present East Service Road permanently diverted to Cucumber Road to avoid the project affecting our properties.	DOTr: If we are to pursue this, we have to change our station use assumptions. If this is possible, this means that all entries and exits will come from the side of Cucumber. We will explore this.
	Instead of using the properties of the 200 tax payers, try to borrow an area from Arca South for the temporary construction yard for 5 years.	DOTr: There's a big construction yard to store all equipment, piling, and construction materials but there's also a construction yard that will surround the assets of MMSP. We are exerting efforts to minimize the amount of property that will be acquired for the strip or temporary construction yard.
	We are worried that we might experience flooding in the low-lying area of Pasay if the spoils will be placed in the reclamation area of Maricaban.	AECOM: The site is only an option as of now. The storage of spoils will also require permits. There are other projects that could also potentially use the MMSP excavation spoils, and its storage is not limited this one area only.
	In the EIA it was found that the soil is soft. What if flooding occurs during pre-construction? Instead of having the MMSP alignment go through Barangay 183 why not try to divert it under the Villamor Golf Course? Aside from less residents to be affected, concerns regarding vibration can be avoided. During construction, traffic may bottleneck at St. Therese; what will happen to the private cars that need to pass through? Has our safety been considered after the construction of the project?	DOTr: It is part of the consideration, as the option is not yet final. It is not just the land and soil that were studied but also the social impacts. DOTr will consider all of it. Traffic impact assessment is also part of the study. We'll investigate it. We're assuring the residents that the security of the communities is part of our plans.
	Why was the original plan of establishing a station at FTI changed to Bicutan? What will be our assurance that we will not be affected or disturbed by the project? We are just 30 to 40 meters way from the project site construction. Last year, it was stated that only 15 m will be affected. Why has the affected area expanded?	DOTr: This is due to DOTR's plan to have its railways interconnected. In the case of MMSP, it is the interconnectivity of the MMSP with the North-South Commuter Railway Project. It is stated under JICA guidelines, that there are certain requirements to be followed socially and environmentally throughout the lifetime of a project. We will strictly follow these guidelines to ensure that any impact would be minimized or mitigated. We are currently studying how we can stay within the PNR right of way to lessen the affected properties
	Can we already identify specifically the structures to be affected?	DOTr: To determine the areas to be affected, a survey and socioeconomic profiling must be conducted first. Currently, we only have the drawings. We need to undergo parcellary survey then conduct ground truthing to confirm the results of the parcellary survey. After that we will conduct socio-economic survey. After that we can determine the specific structures that will be affected.
	The Nazarene Church will be affected by the project. We are hoping to get compensated	DOTr: We cannot assure you that the property will get paid within a year but we are assuring you that there will be no properties that will need to be replaced, not

EIA Module	Issue/Concern Raised	Response to Query
	within the year to give us enough time to look for another place.	until DOTr already paid the owner of the property as this is part of JICA's guidelines and it is in the Law (RA 10752); compensation is required first before clearance/replacing of the properties. While awaiting payment/appraisal, the property owner must look for another place; if the owner does not meet the allotted time given to them by the DOTr in looking for another place, they will be given a temporary rental subsidy where the owner will be given an extended time to stay and look for a place.
	Is there an established system for compensation (replacement cost of the property, area where the owner can find/look for another place)? I hope DOTr will not neglect the owners of the properties.	DOTr: We have an entitlement matrix, but we don't have the valuations; DOTr will be in partnership with government banks such as the Landbank of the Philippines or the Development Bank of the Philippines who will appraise the affected lots and structures so we can determine how much compensation will be given to the owners. DOTr will not neglect the affected owners/ communities, they will be compensated and be paid in the right amount. This is why we are conducting a Resettlement Action Plan to identify which properties will need to be replaced and which affected person will need to be relocated.
	What will happen if the owner of the lot and structure is not the same person? Will the owner of the structure be compensated?	DOTr: It depends if the person who built the structure has consent or authority from the lot owner to build a property in the lot and if he has tax declarations of the improvements. The tax declaration will be the basis of DOTr for determining if the person will be qualified for relocation/compensation. If the owner of the structure has no tax declaration, DOTr will identify them as an informal settler and will be subject to further processes if they will qualify for the compensation/relocation.
	It was mentioned in the presentation that most of the study area is composed of adobe soil, which can be brittle and may be subject to subsidence as a result of constant activities.	DOTr: Geotechnical investigations were conducted. The results of the studies showed that the soil is appropriate for the excavation and tunnelling. In terms of vibration, we plan to employ anti-vibration devices such as sleeper tracks to significantly attenuate vibration.
	How will compensation will be dispensed if there are several of us who reside within the affected property? We acquired it from our deceased parents, but the title is still in the name of our grandfather.	DOTr: Any property that are still owned/named under a dead person must undergo extra judicial settlement. The siblings should discuss how it will be divided. DOTr will recognize the new owner of the property, and will be the one who will be compensated.
	Will Cucumber Road be considered as a permanent diversion for the East Service Road? Will the FTI station be removed? Will there be other alternative options in terms of access roads?	DOTr: The proposed FTI station is being considered to be placed directly under the proposed NSCR-Ex FTI station to reduce the number affected property along the proposed FTI station. As of now, there are no alternative options as we are avoiding increasing the social impacts, so we are focusing on the East Service Road, but we will consider the Cucumber Road for further study.
	Will trees need to be cut to make way for the subway stations?	AECOM: Based on the map shown earlier most of the right of way is along built-up areas. The trees affected by the alignment will be accounted for through a tree inventory. Prior to tree cutting, a tree cutting permit will be secured by DOTr from the DENR. DOTr will replace the trees that will be cut as required by law.

EIA Module	Issue/Concern Raised	Response to Query
		DOTr: In the new law, the trees to be affected must be subject for payment. Appraisal is needed as the owner of the planted trees or vegetation will need to be paid.
	If a lot was sold to a new owner, but the title is still named under the previous owner, how will this be compensated? I would also like to suggest planting fruit bearing bonsai trees if you are planning to plant trees in the stations.	DOTr: The person who is in the title will be the person who will be compensated. The title will be DOTr's basis as proof of the ownership of the properties, unless there is a deed of absolute sale; this must be annotated in the title in the registry of deeds. DOTr will honor the person who bought the property. We will consider your suggestion in our greenery options.
People	UPS 1 will be highly affected, how will DOTr ensure that all the options will be taken into consideration so that homeowners will not be affected by the project?	DOTr discussed the overview of the future railway plans of the DOTr and how the MMSP fits within the planned railway network. DOTr showed that the MMSP links the railway planned up to Clark in the north and railway planned up to Calamba in the south
	Have you identified the relocation site of the affected residents? How much will be the compensation for the affected properties and what is the process for this?	DOTr: If the property has a title, the current market value that will be released by the appointed GFI will be applied. The resettlement is only for informal settlers.

Source: MMSP Public Hearing Report for EPRMP, 2019

11.2.2. Consultation/Participation During Detailed Design

11.2.2.1. Meetings with Local Government Units

2204. Nine (9) sessions of LGU meetings were conducted during the DD of SCRP Main Line, one per affected LGU. The details of dates, venues and the number of participants is presented in **Table 11.2.27**. Issues and concerns raised with corresponding responses are summarized in **Table 11.2.28**.

Table 11.2.27 Outline of Detailed Design Meetings with Local Government Units for the SCRP Main Line

Target Affected LGU	Venue	Date and Time	Main Participants	Topic	No. of Participants		
					M	F	Total
Manila	Universidad de Manila Lobby, Ermita, City of Manila	September 19, 2018	City Officials, Barangay Officials, PUP Sta. Mesa, National Housing Authority, Social Housing Finance Corp., Home Guarantee Corporation, Asian Development Bank	1st DD IEC	54	29	83
	Department of Engineering and Public Works (DEPW) Office, Manila City Hall	January 11, 2019	City Officials Social Housing Finance Corp., PNR, Presidential Commission for the Urban Poor, National Housing Authority	Meeting on Livelihood, Creation of LIAC, Public Rental, Rental Subsidy, and Help Desk	11	6	17
	Session Hall, Manila City Hall	August 9, 2019	City Officials, Barangay Officials, ADB, PNR (including PNR BLISS), PCUP	2nd IEC	51	36	87
Makati	Conference Room, City Administrator's	September 21, 2018	City Officials, Barangay Officials, PNR, ADB	1st DD IEC	7	12	19

Target Affected LGU	Venue	Date and Time	Main Participants	Topic	No. of Participants		
					M	F	Total
	Office, Makati City Hall						
	City Administrator's Office, Makati City Hall	March 7, 2019	City Officials, PNR, Social Housing Finance Corp.	Meeting on Livelihood, Creation of LIAC, Public Rental, Rental Subsidy, and Help Desk	7	12	19
	DES Multi-Purpose Hall, 7F, Building 2, Makati City Hall	June 27, 2019	City Officials, Barangay Officials, PNR, ADB	2nd IEC	11	12	23
Taguig	Taguig Satellite Office, SM Aura, Taguig City	October 2, 2018	City Officials, Barangay Officials, PNR, ADB, DepEd	1st DD IEC	16	14	30
	Taguig Satellite Office, SM Aura, Taguig City	February 21, 2019	City Officials, PNR, Social Housing Finance Corp.	Meeting on Livelihood, Creation of LIAC, Public Rental, Rental Subsidy, and Help Desk	24	13	37
	People's Hall, Taguig Satellite Office, 9th Floor, SM Aura Tower, Taguig City	September 10, 2019	City Officials	2nd IEC	19	16	35
Pasay	Conference Room, City Administrator's Office, 2nd Floor, Pasay City Hall	October 23, 2019	City Officials	IEC	13	12	25
Parañaque	Mayor's Office, Parañaque City Hall	September 28, 2018	City Officials, Barangay Official, DepEd	1st DD IEC	12	11	23
	Mayor's Conference Room, Parañaque City Hall	February 8, 2019	City Officials, PNR, Housing and Urban Development Coordinating Council, Metro Manila Development Authority, Presidential Commission for the Urban Poor, National Housing Authority, Social Housing Finance Corp.	Meeting on Livelihood, Creation of LIAC, Public Rental, Rental Subsidy, and Help Desk	19	8	27
	Conference Room, Mayor's Office, Parañaque City Hall	July 11, 2019	City Officials, PNR, ADB	2nd IEC	12	4	16
Muntinlupa	Audio-visual Room, Muntinlupa City Hall	14-Sep-18	City Officials, Barangay Officials, Social Housing Finance Corp.	DD RAP Activities	26	9	35
	Mayor's Office, Muntinlupa City Hall	September 21, 2018	City Officials, Barangay Officials	1st DD IEC	19	15	34
	Business Permits and Licensing Office, Muntinlupa City Hall	January 11, 2019	City Officials, Barangay Officials, PNR, Social Housing Finance Corp	Meeting on Livelihood, Creation of LIAC, Public Rental, Rental Subsidy, and Help Desk	14	9	23

Target Affected LGU	Venue	Date and Time	Main Participants	Topic	No. of Participants		
					M	F	Total
	Kamali Function Room, Mezzanine 1, Acacia Hotel, Alabang	July 25, 2019	City Officials, Barangay Officials, HUDCC, SHFC, NHA, PCUP, PNR, ADB	2nd IEC	14	17	31
San Pedro	Mayor's Office, San Pedro City Hall	September 21, 2018	City Officials, Barangay Officials	1st DD IEC	14	12	26
	Mayor's Office, San Pedro City Hall	January 10, 2019	City Officials Social Housing Finance Corp. PNR	Meeting on Livelihood, Creation of LIAC, Public Rental, Rental Subsidy, and Help Desk	12	6	18
	City Administrator's Office, San Pedro City Hall	May 31, 2019	City Officials	Project Updates and Creation of LIAC	3	3	6
	Ceremonial Hall, Mayor's Office, San Pedro City Hall	June 25, 2019	City Officials, PNR, ADB	2nd IEC	13	17	30
Biñan	Mayor's Office, Biñan City Hall	September 20, 2018	City Officials, Barangay Officials, DepEd	1st DD IEC	13	11	24
	Mayor's Office, Biñan City Hall	January 15, 2019	City Officials, PNR, Social Housing Finance Corp.	Meeting on Livelihood, Creation of LIAC, Public Rental, Rental Subsidy, and Help Desk	13	6	19
	Conference Room, 2nd Floor, Biñan City Hall	March 21, 2019	City Officials, Social Housing Finance Corp., Housing and Urban Development Coordinating Council, PNR	Pre-local Inter-agency Committee Meting	8	7	15
	Mayor's Office, Biñan City Hall	March 27, 2019	City Officials, Barangay Officials, Social Housing Finance Corp., Housing and Urban Development Coordinating Council, PNR	Local Inter-agency Committee Meting	15	10	25
	Mayor's Office, Biñan City Hall	April 25, 2019	City Officials, Barangay Officials, Social Housing Finance Corp., Housing and Urban Development Coordinating Council, PNR	Local Inter-agency Committee Meting	18	19	37
	Mayor's Office, Biñan City Hall	May 23, 2019	City Officials, Barangay Officials, Social Housing Finance Corp., Housing and Urban Development Coordinating Council, PNR	Local Inter-agency Committee Meting	21	15	36
	Mayor's Office, Biñan City Hall	June 4, 2019	City Officials, Social Housing Finance Corp.	Creation of LIAC Sub-committee on Beneficiary Selection Arbitration and Awards Committee (BSAAC) and Site Selection Committee	5	3	8

Target Affected LGU	Venue	Date and Time	Main Participants	Topic	No. of Participants		
					M	F	Total
	Biñan City Hall	June 27, 2019	City Officials, Barangay Officials, PNR, ADB	2nd IEC	18	20	38
Santa Rosa	Mayor's Office, Santa Rosa City Hall	September 20, 2018	City Officials, Barangay Officials, DepEd	1st DD IEC	15	10	25
	Mayor's Office, Santa Rosa City Hall	January 17, 2019	City Officials, PNR, Social Housing Finance Corp.	Meeting on Livelihood, Creation of LIAC, Public Rental, Rental Subsidy, and Help Desk	14	7	21
	Mayor's Office, Santa Rosa City Hall	July 19, 2019	City Officials, PNR, ADB	2nd IEC	16	12	28
Cabuyao	Mayor's Office, Cabuyao City Hall	September 20, 2018	City Officials, Barangay Official, P. Alvarez Property, Cabuyao Investment and Development Authority	1st DD IEC	13	12	25
	Audio-visual Room, Cabuyao City Hall	January 7, 2019	City Officials, PNR	Meeting on Livelihood, Creation of LIAC, Public Rental, Rental Subsidy, and Help Desk	11	10	21
	City Urban Development and Housing Affairs Office	March 19, 2019	City Officials, Social Housing Finance Corp., Housing and Urban Development Coordinating Council, PNR	Pre-local Inter-agency Committee Meting	11	8	19
	Audio Visual Room, Cabuyao City Hall	June 20, 2019	City Officials, Barangay Officials, ADB, PNR	2nd IEC	19	18	37
Calamba	Mayor's Office, Calamba City Hall	October 2, 2018	City Official, Barangay Officials, National Irrigation Agency (NIA)	1st DD IEC	16	15	31
	Housing Office, Calamba City Hall	January 10, 2019	City Officials Social Housing Finance Corp.	Meeting on Livelihood, Creation of LIAC, Public Rental, Rental Subsidy, and Help Desk	10	5	15
	Mayor's Office, Calamba City Hall	January 15, 2019	LGU Calamba, DOTr, JDT	Depot site planting			
	DILG Office, Calamba City Hall	March 19, 2019	City Officials, Social Housing Finance Corp., Housing and Urban Development Coordinating Council, PNR	Pre-local Inter-agency Committee Meting	5	5	10
	Mayor's Office, Calamba City Hall	April 2, 2019	City Officials, Barangay Officials, Social Housing Finance Corp., Housing and Urban Development Coordinating Council, MERALCO, Philippine National Police-Calamba, PNR	Local Inter-agency Committee Meting	24	12	36

Target Affected LGU	Venue	Date and Time	Main Participants	Topic	No. of Participants		
					M	F	Total
	Mayor's Office, Calamba City Hall	July 10, 2019	City Government Officials, Barangay Officials, PNR, ADB	2nd IEC	17	12	29
Bay	Sangguniang Bayan Session Hall, Bay, Municipal Hall	September 28, 2018	Mayor, Municipal Official Barangay Official, - Home Owner's Association (HOA)	IEC	9	9	18

Table 11.2.28 Summary of Issues and Concerns Raised during 1st DD IEC Meetings with LGUs for the SCRP Main Line

LGU	Concern		Response
	RAP Issue	Environmental Issue	
Manila	• Request for more than one help desk in Manila due to the magnitude of affected people. • Affected residents of Brgy 811 are currently renewing their HOA to fight for their rights regarding relocation. They asked not to leave them behind. • Clarified the coverage of the DOTr's assistance relative to extrajudicial settlement and asked if expenses of affected land owners relative to extrajudicial settlement would be waived. • EO convening the LIAC not yet approved by the mayor. The RAP's sub-contractor substituting functions of the LIAC in terms of social preparation. • Ensured proper coordination with the NHA prior to the conduct of survey and tagging activities to avoid confusion among their affected beneficiaries. • The NHA was not given due respect and not properly informed during RAP activities of the feasibility study. • Asked if consultations were held prior to the project (study/design).	• No environmental issue raised.	• One help desk is to be established per LGU. But the installation of at least two help desks for Manila will be considered due to the magnitude of PAPs. • JICA and ADB are strict with social safeguards and will conduct monitoring the implementation of these safeguards until PAPs are relocated. • The rights of relocatees/PAPs will be guaranteed. • The DOTr is to establish a Project Inter-Agency Committee (PIAC) that would address concerns including the provision of legal assistance. • Regarding estate taxes, the DOTr has coordinated with the Department of Finance (DOF) concerning the possibility of compensating only the affected portion. • The RAP sub-contractor is not substituting functions of the LIAC and further explained that the RAP process is different for foreign-funded projects. • The Urban Development and Housing Act (UDHA) and other Philippine laws are respected, but also JICA and ADB standards are followed. • Convening of the LIAC is part of the implementation structure which is to come later. • Consultations start during FS based on local and international guidelines. The project commenced in December 2017. Consultations/ IEC meetings with LGUs were immediately conducted and participated by mayors, LGU officials,

LGU	Concern		Response
	RAP Issue	Environmental Issue	
			and barangay officials. LGUs were consulted as early as project conceptualization pre-feasibility.
Makati	• The inclusion of the processing of permits in the contract with the contractors was suggested. • An inquiry on the DD duration because the project has to disclose any requirements needed from LGUs since they are preparing the budget for 2019. • An inquiry on who is the agency responsible for the segregation of affected lots. • Whether identified PAPs during FS are still not finalized. • Conducting SCMs are general. The LGU is waiting. • As for the final list, it is hard for constituents to keep attending SCMs while they do not clearly know that they will be affected by the project or not. • A request for an "aerial view" of the alignment to easily identify affected properties in reference to data being requested by the DOTr. • Asked if there are affected government agencies. • Structures in Makati • Asked about the measurement of the alignment. • Inquired on the type of structures. • Asked if the current PNR station will still be operational and if there is a plan about the station.	• Impacts on the traffic • Asked if applications for tree cutting/removal permits would also be passed through the LGU.	• Assured the LGU that the matter regarding permits would be included in the contract. • The start of construction will be in May 2020, and the DOTr will handle resettlement costs. • The DOTr will handle a segregation plan. • Explained that potential PAPs would still be invited on the first SCM during DD. Families who are on the final list will invited for the second SCM during DD. • Aerial view is available, but the affected are still regarded as "potentially affected" since a parcellary survey is yet to be completed. Government structures like Skyway will be avoided. Meeting with the LGU could be arranged with the DOTr to give updates, which could be the next year since Ecosys is still gathering data. • The alignment will be 30 meters (15 m on each side from the central line), and a station will have an alignment of 60 m. • Buendia and EDSA stations are at-grade structures since there is infrastructure like Skyway, which will be in conflict with stations and be elevated. The tracks will be elevated after FBI. Blumentritt Station will be elevated higher since it will be above the LRT. • The project will be an entirely different system. There will be temporary operations for the current PNR during construction of the NSRP. There are plans to construct a freight line in the future. • There is ongoing study assessing traffic impacts of the project • The DOTr will secure endorsement from the LGU relative to securing tree cutting/removal permits.
Taguig	• Asked when the convening of the LIAC would happen according to the schedule of RAP activities. The LGU suggested starting working on the establishment of the LIAC as there are activities	• Concerns on drainage in Brgy, Tanyag • The DepEd expressed supports on IEC activities in	• The LIAC would be convened once a parcellary survey is completed to further discuss with the DOTr. • Intra-city relocation is

LGU	Concern		Response
	RAP Issue	Environmental Issue	
	that may already be covered under the LIAC. The LGU followed up on DOTr and PNR representatives who would be members of the LIAC. • Asked if relocation sites were already identified. Taguig City could not relocate its constituents to Trece Martires, Cavite (TMC) City due to the moratorium of TMC. • Inquired on the availability and provision of a list of PAPs, which allows newly elected barangay officials to be familiarized and provide assistance to the project. • PAPs are very sensitive on displacement/relocation issues and raise their grievances to their barangay officials firsthand. • Asked construction of a station in South Daang Hari due to the removal of Nichols Station in Taguig. • Clarification on the measurement of the alignment. • The number of households per structure continuously increases due to the announcement of compensation for the project. Extended family members have listed themselves as the head of the family. • Inquiry on the integration/interconnection of the project with other infrastructure projects of the national government, e.g., MMSP.	schools that may be affected by the project.	encouraged. Tanza and Trece Martires in Cavite as candidate relocation sites when intra-city relocation is unavailable. • The list is still not finalized and still subject to a change. Essential documents will be given to the LGU once the project details are finalized. • The LIAC serves as a venue to address PAPs' grievances. • Barangays will inform their constituents that the project is still at the DD stage and that the help desk will be set up. • The inclusion of the Nichols Station among the NSRP stations is now definite. Its design and location, however, is still being examined in consideration of its impact on sensitive receptors/structures in the area such as the skyway project. • The initial measurement used for FS is 30 meters (15 m on each side from the central line). The 30-meter ROW will follow the results of the relocation survey at the DD stage. • PAPs were informed during SCMs that only those who were tagged within the cut-off date would be compensated. • The MMSP will be connected with the NSRP. Interfacing is still being examined. FTI Station will be located in Arca South. • Concerns on drainage in Nichols is being thoroughly studied by the technical team. The team will get back to the LGU to get their opinions and suggestions on technical details of the alignment.
Parañaque	• The barangay stated that there were potential project affected families with concerns on titles. • The representative of the Office of the Senior Citizen Affairs stated that the entitlements of senior citizens should be ensured.	• Improper disposal of construction wastes/ garbages of sub-contractors of other projects. • Noise pollution and vibration from construction equipment which could affect the learning environment of nearby schools such as Sto. Nino High School and	• The help desk will be established in every city to address project concerns. • The assessment of the contractor's capability and the submission of construction. • A management plan will be ensured. A safety net on management plans will be monitored by ADB and JICA. • Putting up temporary noise barriers within construction sites will lessen noise

LGU	Concern		Response
	RAP Issue	Environmental Issue	
		Paranaque Science High School. Implementing construction at night or during weekends to avoid effects to students is suggested. • Traffic congestion in the proposed station area since the nearby service road is narrow. • Concerns on how to control air pollution.	pollution and vibration to be endorsed to the engineering team. • The finalization of traffic impact assessment and the formulation of a traffic management plan.
Muntinlupa	• With regards to project implementation, construction materials were noticed being placed in Sucat. • Inquiry on the percentage that the property of the National Power Corporation (NAPOCOR) will be converted to a station.	• Inquiry on trees affected by the project. • Concerns on project impacts outside the ROW, e.g., flooding and noise.	• Construction materials noticed on-site were for the PNR's upgrading project and not for the NSRP-SC Project. • The NAPOCOR property will be definitely the new station. • Tree inventory will be conducted with DENR-FMB. • Noise barriers will be provided by the project. Drainage will be designed for the project in coordination with the LGU and the DPWH.
San Pedro	• The LGU asked for a list of land and structures affected by the project. • Inquiry on ROW boundaries.	• Concerns on flooding if drainage is not properly planned. • Asked to have a greening program for unutilized ROW as a part of the development.	• The LGU will formally ask the DOTr to share the list of land and structures affected by the project. RAP surveys during DD will be conducted to finalize the list of PAPs. • The DOTr explained about the track alignment width and the station width required by the project. • Drainage will be designed for the project in coordination with the LGU and the DPWH. • The LGU will coordinate with the PNR and the DOTr regarding the PNR's unutilized ROW for planting.
Biñan	• Fencing of ROW. Worried that ISF might be proliferated again if not secured. • Requesting copies of survey results/master list of final affected families. • Inquiry on housing assistance to be provided to PAPs. • One of barangay chairpersons asked for twenty housing units to provide them to their constituents who are also in need of permanent housing (not affected by the NSRP project).	• Flooding. Integration of the existing conditions and drainage systems into the design. Flooding occurs in Brgy. Canlalay due to recent developments in the area. • Site-specific analysis with regards to possible hazards. The LGU's inquiry on engineering. • Engineering geological and geohazard assessment report (EGGAR) for the project. • Accidents, traffic and	• The ROW for the NSRP-SC Project will be fenced to deter illegal entry and protect project components, e.g., viaducts. • The LGU can formally request a list of affected families to the DOTr. RAP surveys during DD will be conducted to finalize the list of PAPs. • Discussed that housing assistance was through the community mortgage program of the SHFC. • It was explained that there was a screening process for housing assistance. It was also suggested to ask for a housing project through regular programs of the SHFC.

LGU	Concern		Response
	RAP Issue	Environmental Issue	
		heights of viaducts. Consideration of traffic flow and safety.	
Santa Rosa	• Affected utilities. Will utilities like piping be affected by the project? • The LGU requested for the list of affected families. • The LGU asked for the final measurement for main alignments and stations. • The LGU asked for a possible realignment if the sports complex is potentially affected. • There are untagged house structures.	• Tree planting. Consideration of the ROW is not part of development.	• The DOTr and the DPWH will study the issues. • Existing utility lines affected by the project for relocation. • The LGU can formally request the list of affected families to the DOTr. RAP surveys during DD will be conducted to finalize the list of PAPs. • The final measurement and alignment will be shared with LGUs. RAP surveys during DD will determine structures that will surely be affected. • The LGU will coordinate with the PNR and the DOTr regarding PNR's unutilized ROW for planting.
Cabuyao	• Sales data in the LGU are available. However, the Assessor's Office does not use it because most are undervalued.	• No issues raised.	• Data of recent sales is one of many bases for a market value. The Bureau of Internal Revenue will conduct further research. A private appraiser is also hired. An actual ocular is conducted with the highest best use.
Bay	• Concerns on unfinished national projects • Asked if the project will be delayed due to a change in presidency. • Inquiry on the Bicol Railway Project. • PAPs have already organized in HOAs.	• No issues raised.	• The project will be pushed through even with a change in presidency. • The PNR mentioned that the Bicol Railway Project will be pushed through. • The LGU will write a letter to the DOTr and ask for a meeting to inform the HOA that they will not be affected by the project.
Los Baños	• HOA representatives asked about the South-Long Haul Project. • Request for survey results. • The mayor asked if the LGU will still be included in the project. He pointed out their existing transportation issues and the dwindling availability of land for resettlement.	• No issues raised.	• HOAs can apply with the LGU in SHFC programs. • The LGU will send an official request to the DOTr for survey results.
Calamba	• The NIA asked about a replacement cost and implementation arrangements including relocation of irrigation facilities and actual structure replacement for affected irrigation facilities.	• No issues raised.	• A replacement cost will be shouldered by the DOTr, but implementation arrangements are to be subjected to further discussion between the DOTr and the NIA.
Pasay	• The city mayor inquired on the required area measurement for public rental facility. • DOTr inquired to the LGU the prevailing rental cost within the city and if there are any available rental facilities.	• No issues raised.	• Area measurement for public rental facility could be determined once the number of families who are ineligible to socialized housing is finalized. • LGU has no identified available rental facilities and

LGU	Concern		Response
	RAP Issue	Environmental Issue	
			the rental cost varies from one area to another area. In one of the barangays, the prevailing rental cost is Php 10,000 per month however there are no available house/room for rent.

Source: JICA Design Team.

Table 11.2.29 Summary of Issues and Concerns Raised during 2nd DD IEC Meetings with LGUs

LGU	Concern		Response
	RAP Issue	Environmental Issue	
Manila	• Inquired the basis of compensation for property • How the affected families could verify that the replacement cost is really the fair market value. • Are there stalls in the station for entrepreneurs and if there are possibilities that the project affected persons/ entrepreneurs will be prioritized • Inquired on the location of the relocation site. • The possible interruption of students going to school during relocation of families, especially if off-city • Stated that renters living in private properties should not be considered as ISFs. • Inquired the time frame of surveys to be conducted. • Why drone shots / aerial photography was conducted if the project is not in the Detailed Design? Census and tagging were already conducted within and near Paco Station.	• No environmental issue was raised	• The replacement cost will be based on the current market value. There should be no depreciation. • An independent appraiser will conduct a computation study to determine the fair market value of the affected properties. • DOTr noted the suggestion in prioritizing the project affected persons/ entrepreneurs. • If there are available spaces within the city, in-city relocation is the priority option. The project, as much as possible, wants to avoid off-city relocation. • The timing of relocation will be considered to avoid schooling interruption. • Families without proof of ownership are considered ISFs including renters which will be classified later as renter and sharers. • SCMs with the potentially affected persons will be scheduled after the IEC Meeting. Demarcation and surveys in each area will start once SCM has been conducted. • No personnel went to the ground to conduct aerial photography and surveys during Detailed Design Stage. Activities conducted were during the FS Stage.
Makati	• As per record of the city government, there are no ISFs living along the PNR railway since the city, together with the barangay, conducts operation to maintain the cleared areas.	• Requested for the copy of approved Environmental Management Plan (EMP).	• 140 identified ISFs are affected by the project not owning a land. These are families that cannot show proof that they are the landowners. • DOTr committed to provide a copy of EMP.
Taguig	• Raised that there are no affected families within their city. The identified families might be living within Paranaque City.	• The city government is being criticized by barangays for the environmental impacts of other projects, and suggested DOTr to	• Explained that surveys to be conducted will identify the boundaries of LGUs. • A Survey will be conducted to determine if affected ISFs are newly residing in the area or

LGU	Concern		Response
	RAP Issue	Environmental Issue	
	• Inquired if there are ISFs since the government has already relocated all ISFs along the PNR right-of-way and strongly suggested not to assist professional ISFs. • Asked where the specific ROW of the NSCR-Ex is. Will another 30-meter will be acquired aside from the existing PNR.	provide Material Recovery Facilities in construction yards and implement Green building design eg Rainwater Harvesting. • The LGU suggested for a Memorandum of Understanding between the LGU and DOTr for the Environmental and Management Plan.	not. No relocation assistance will be provided to professional squatting syndicates, if proven. • NSCR-Ex will utilize the existing PNR ROW. The 30-meter Project ROW includes the PNR ROW. • It will be required for the contractor to comply with all policies of the national and local governments. DOTr, with the help of LGU will ensure minimal impact of project construction.
Parañaque	• No major issue raised.	• Wanted to know where the wastes will be thrown during the construction and be guaranteed that noise pollution, water pollution etc. will not be a problem.	• There will be coordination with the LGUs and implementation and monitoring units. ADB and JICA will also have its own monitoring to make sure the project is compliant.
Muntinlupa	• LGU inquired if rental subsidy will be provided to the returnees/ ineligible to socialized housing and if the DOTr will provide support. • Anti-Squatting Syndicate Team conducts clearing operation along the railway. However, the team could no longer do their operations since structures have tags and families are now being affected by the NSCR Ex Project. LGU also stated that PNR shall be responsible in demolishing the structures, not the LGU. • The representative added that census and tagging were conducted without the knowledge of LGU. • LGU representatives asked for clarification if the project will not provide assistance to ISF residing in a newly built structure.	• LGU requested for the copy of ECC. • LGU representative inquired if DOTr will provide roads if a major • road will be closed. • LGU inquired if Traffic Impact Assessment (TIA) is done.	• According to the Republic Act 7279, returnees should be disqualified. It was stated that no rental subsidy is indicated in the said law. Moreover, a temporary housing will be permanent if families stayed for a year. However, the project will provide rental subsidy to the PAPs until the permanent relocation sites are constructed. • PNR's clearing operations are affected due to the project. A Policy Framework on clearing the structures within the Danger Zone is being crafted. Once approved, the said framework will be the basis of clearing the structures. In addition, PNR Security Team conducts regular clearing operations. However, their agency lacks human resource. the barangay is the one to maintain the cleared railway. PNR suggested to have a Memorandum of Agreement with barangays in maintaining the railway once cleared. • On the concern of LGU having no knowledge about the conduct of Census and Tagging, DOTr had a series of IEC Meetings with the LGU attended by the concerned city offices and barangays to be affected by the project prior the actual conduct of RAP Surveys including Census and Tagging. • The project will provide assistance to ISFs residing in newly-built structure in

LGU	Concern		Response
	RAP Issue	Environmental Issue	
			consideration of the cut-off date for compensation eligibility. • DOTr to provide copy of the ECC to the LGU. • The project will not affect major roads. if there are identified landlocked areas, DOTr will acquire properties for access roads. The project will possibly provide 2-meter access road within the ROW. • TIA is not done. LGU requested for the immediate provision of TIA to the LGU once finished.
San Pedro	• Inquired if LGU San Pedro can request for list of affected PAPs. • Inquired if the old railway would be removed. • Inquired how DOTr will pay those PAPs that will be affected by the project.	• Inquired if the stations have medical facilities to address fire and health concerns that may happened within train station. • Inquired how would be the parking of the stations will be like. He added that it would be terminal or parking lots.	• After the validation, the Masterlist will be provided to LIAC. • Replied that the old railway will not be removed. • PAPs will be paid based on the current market value; whether they are ISFs or Land Owners. The Notice of taking will be sent to Legal owners so that the documents required for compensation will be completed by the PAPs. The offer to buy will be include the appraised value of DOTr on the PAP's property. • The stations will follow the National Building Code, which requires buildings to have medical facilities like ambulance • Terminals will be integrated in stations with a high passenger/ user demand
Biñan	• Since the LIAC has been created, wouldn't it be confusing on identifying the roles and responsibilities of LIAC and RIMC. • Raised that a daycare center and a health center will be affected by the project. • Inquired if who will be the one responsible in reconstructing an affected wall. • Barangay Sto. Nino raised concern on possible landlock in One Asia area. • Barangay Canlalay has also raised possible landlock of one subdivision / private property. • Asked if there are roads to be closed during project construction. • Raised the possible returning of relocatees if the ROW will not be	• Raised that the city is prone to flooding. • Raised that since the design is elevated, it might be prone to derail of train.	• LIAC is solely responsible for the relocation of informal settlers along the project right-of-way. On the other hand, RIMC will monitor the output of LIAC and will be the responsible for the housing of ineligible for socialized housing. RIMC will process the compensation and entitlement of both affected legal owners and the ISFs. • Relocation location needs to be identified. The mentioned facilities will be rebuilt. RIMC will coordinate with the concerned barangay. • It would be the structure owner responsible on the reconstruction of the affected wall since replacement cost will be provided. • Confirmed that the area as described by the barangay secretary will be landlocked. • Private properties in Barangay Canlalay could ask access from the next or across subdivision. • No road will be closed. Re-

LGU	Concern		Response
	RAP Issue	Environmental Issue	
	fenced and will not be secured. • Inquired on where to place the construction equipment and materials. • Raised that there are claimants of PNR land even the land where the Expressway traverse.		routing plan will be presented on Traffic Management Assessment. • PNR discussed that the agency has security officers. There is possibility to have a MOA between the barangay and PNR. • There is a proposed casting yard to place all the construction equipment and materials. • Responded that PNR has the land title. • DOTr will ensure that the project will not cause additional flooding to the city. Furthermore, a Drainage Management Plan will be implemented. • There would be a noise barrier that would also act as barrier to prevent derailing of train.
Santa Rosa	• Inquired for the reason why Santa Rosa City has only one proposed station where in fact, the city is more progressive compare to other cities in Laguna with proposed two stations • Requested for the copy of master list of PAHs • Commented that the project is condoning the squatting syndicates with the housing assistance to be provided • Asked on the length of stay of relocatees to the Public Rental facility. • Asked for clarification if the LGU is the one responsible on land acquisition and prefers in-city vertical type of housing for the PAPs due to low number of available lands within the city • Inquired if there will be a road under the elevated viaduct. • Asked if the project will reach the target timeline of construction.	• LGU suggested to establish the MMT to avoid issues experienced with other project i.e. Cavite-Laguna Expressway wherein environmental-related issues were raised but MMT was not yet established. • Asked if there will be a provision of free parking and number of parking allocated for the 800-meter within the station Transit Oriented Development	• The study conducted prioritized the existing stations and the proposed station location was consulted with the past administration and considered economic factors. • The list will be provided to the LGU once finalized. • The Project is foreign-funded, which needs to comply to the social safeguards policy of ADB and JICA. International community treats returnees and previously awarded beneficiaries of socialized housing as project-affected persons. • Relocatees could stay in the facility as long as they can pay the rent. this approach will be a 'stepping stone' for the families to improve their living and eventually find a permanent housing. • Funds for construction of Public Rental will be shouldered by DOTr. DOTr requested for assistance to facilitate the identification and acquisition of sites • There will be a two to four-lane frontage road access to the station. • The construction will be simultaneously done and there will be numerous contractors. • The project has a feature of station plaza, transport terminals, and parking which will be based on the demand forecast from consultants. total of 15,000 square meters will be allocated.
Cabuyao	• Inquired on how long	• Major concern is the	• DOTr is planning to have rental

LGU	Concern		Response
	RAP Issue	Environmental Issue	
	the rental subsidy will be provided to PAPs and the rate of subsidy. • Raised that some private property owners have ROW markings. • Inquired if senior citizens are entitled to socialized housing and to other compensations.	drainage system and catchment basin of floods during heavy rains; suggestion to fully explore the waterways that will be affected by the project. • Raised issue on the waste management. • On road crossing within the existing PNR tracks, raised if they could do some earth filling for the traffic passing the tracks.	subsidy until the relocation sites are constructed and the amount will be the average prevailing rate of rent in the city of Cabuyao. • Informed that if those property will be affected, they will be compensated as per project entitlement and further informed to wait for the parcellary to confirm the impact for those private property owner as mentioned. • Suggested that senior citizen should convey such entitlement to their next of kin. • Study team provided in-depth study for the flooding that may impact by the project and further replied that the LGU should consult the Department of Public Works and Highways (DPWH) on the drainage problem of the city. • Waste management system will be carried out and will be properly addressed before any construction will start. • Suggested the City Engineering's Office to provide official communication to the PNR management.
Calamba	• Inquired if the requirements like establishment of helpdesk are pre-conditions for the Loan Agreement with JICA and ADB. • Inquired who will give the compensation of those Informal Settler Families living in PNR ROW. • Inquired who will develop the resettlement site.	• Raised land conversion in Banlic • Raised that if the station will push through near the city hall which has limited space, a lot of inconvenience will happen Including heavy traffic. DOTr should not look into the land area because LGU Calamba already has plans for that place.	• There are guidelines that need to be followed by DOTR, JICA Guidelines and ADB Safeguard policy. • DOTr is now coordinating with Landbank of the Philippines so that the compensation can be given to PAPs through cash card. • SHFC will develop the resettlement site. • LGU will take care of the conversion • The reason why the size of the proposed station is wide (60 meters by 250 meters) because it includes UV terminal and bus terminals.

Source: JICA Design Team.

11.2.2.2. Meetings with National Government Agencies

2205. As part of consultation activities, meetings with NGAs such as the DENR-EMB, the PCUP, the SHFC and the NHCP were held in order to effectively comply with each agency' requirements and regulations.

Table 11.2.30 Outline of Stakeholder Consultation Meetings with National Government Agencies During Detailed Design for the SCRP Main Line

Date	Agency	Subject	Venue
Environment Related Meetings			
September 25, 2018	DENR - EMB	Meeting on ECC, MMT	DENR-EMB Central Office,

Date	Agency	Subject	Venue
		and Environmental Standards	Visayas Ave., Quezon City
September 27, 2018	National Commission for Culture and Arts (NCCA)	Old PNR Structures along NSCR Ex Alignment	DOTr Office, Mandaluyong City
Oct0ber. 24, 2018	DENR - EMB	Possible change of design from FS to DD	
November 14, 2018	DENR - FMB	Tree Cutting and Earth Balling	DENR-FMB Central Office, Visayas Ave., Quezon City
November 21, 2018	NCCA, NHCP, NM	Project's impact on affected historical structures	NCCA Building, Intramuros, Manila City
Dec. 10, 2018	DENR - EMB	Update of EIS by ADB	
December 11, 2018	National Museum	Planning for Archaeological Impact Assessment for Bamban Hill Historical Site	National Museum of Fine Arts, Manila City
Jan. 7, 2018	DENR NCR	Tree Inventory and TCP/EP Application Procedures	
January 8, 2019	DENR Region 4A	Tree Inventory and Cutting Permit Application Procedures	Dencris Business Center, Calamba City, Laguna
January 11, 2019	LLDA, DOTr, JDT	General information presentation and inquiry regarding permitting requirement.	
RAP Related Meetings			
September 05, 2018	SHFC	RAP Implementation Arrangements and Timeline	Board Room, 5th Floor, BDO Plaza, Paseo De Roxas, Makati City
September 27, 2018	SHFC	RAP Implementation Arrangements	BDO Plaza, Paseo De Roxas, Makati City
October 30, 2018	SHFC	RAP Implementation Arrangements	Columbia Towers, Ortigas, Mandaluyong City
November 20, 2018	SHFC	RAP Implementation Arrangements	BDO Plaza, Paseo De Roxas, Makati City
November 22, 2018	Department of Social Welfare and Development (DSWD)	Rental Subsidy / DSWD's Conditional Cash Transfer Program	DSWD Central Office, Batasan Rd., Quezon City
December 12, 2018	DOLE, DA, DTI, DSWD, BIR, NAPC, HUDCC, DAR,	Inter-Agency Meeting on North-South Railway Extension Project	DOTr-MRT3 Depot Office, EDSA, Quezon City
January 9, 2019	TESDA	Provision of vocational training for the Livelihood Restoration and Improvement Program (LRIP)	TESDA Compound, Taguig City
January 22, 2019	Department of Labor and Employment (DOLE)	DOLE's involvement for the Livelihood Restoration and Improvement Program (LRIP)	DOLE Office, TM Kalaw, Manila City
January 23, 2019	PAG IBIG (HDMF)	PAG IBIG Housing, Rental Subsidy, and Public Rental	PAG IBIG Office, Shaw Boulevard, Mandaluyong City
February 7, 2019	Landbank of the Philippines	Provision of rental Subsidy through LBP Cash Transfer and LBP appraiser	Landbank Plaza, Marcelo H. del Pilar St., Manila City
February 15, 2019	Social Housing Finance Corporation	RAP Implementation Arrangements	IBP Tower, Ortigas, Pasig City
March 7, 2019	Department of Trade and Industry (DTI)	DTI's involvement for the Livelihood Restoration and Improvement Program (LRIP)	DTI Office, Makati City
March 14, 2019	DSWD	DSWD Sustainable	DSWD Central Office,

Date	Agency	Subject	Venue
		Livelihood Program	Batasan Rd., Quezon City
March 18, 2019	SHFC	Livelihood Development Program and RAP Implementation Schedule	BDO Plaza, Paseo De Roxas, Makati City
May 09, 2019	SHFC	RAP Implementation Arrangements	BDO Plaza, Paseo De Roxas, Makati City
June 26, 2019	Landbank of the Philippines	MOA for cash transfer for rental subsidy	Landbank Plaza, Marcelo H. del Pilar St., Manila City
July 4, 2019	Landbank of the Philippines	MOA for cash transfer for rental subsidy	Landbank Plaza, Marcelo H. del Pilar St., Manila City
August 30, 2019	SHFC	RAP Implementation Arrangements	BDO Plaza, Paseo De Roxas, Makati City

Source: JICA Design Team.

11.2.2.3. Stakeholder Consultation Meetings

2206. The first round of SCMs during DD were held for each affected LGU as shown in **Table 11.2.31**. After presenting the latest information in each meeting, invited PAPs were encouraged to participate in the open forum to express their comments/suggestions/opinions. A summary of main concerns/issues raised at the first round of SCMs during DD is presented in **Table 11.2.32**.

Table 11.2.31 Outline of the First Round of Stakeholder Consultation Meetings During Detailed Design for the SCRP Main Line

LGU	Venue	Date and Time	Main Participant	No. of Participants		
				M	F	Total
Manila	Clubhouse, Celadon Residences, Brgy. 350, Sta. Cruz, Manila	September 25, 2019 6:00 p.m.	PAPs from Phase 2-Cluster 1: Barangay 350 (Celadon Residences)	24	63	87
	Covered Court, Brgy. 811, Paco, Manila	September 25, 2019 1:00 p.m.	PAPs from Barangay 800, 810, 811, and 866	9	11	20
	Covered Court, Brgy. 867, Manila City	August 26, 2019 8:00 a.m.	Phase 2-Cluster 4: 815 (Paco Station), 865, 835, 836, 868, 816, 860, 862, 867, 871, 872	244	421	665
	Covered Court, Brgy. 811, Manila City	August 26, 2019 2:00 p.m.	Phase 2-Cluster 4: 769 (Vito Cruz Station), 800, 803, 807, 811, 750, 764, 808	260	424	684
	Covered Court, 3rd Floor, Barangay Hall, Brgy. 628, Manila City	August 24, 2019 8:00 a.m.	Phase 2-Cluster 3: 628, 629 (Sta. Mesa Station), 630	41	58	99
	Brgy. 567 Covered Court, Manila City	August 24, 2019 1:00 p.m.	Phase 2-Cluster 3: 422, 426, 428	96	149	245
	Firmeza St., corner Algeciras St., Brgy. 443, Manila City	August 22, 2019 1:00 p.m.	Phase 2-Cluster 3: 442, 443, 444, 446, 450	48	91	139
	Algeciras St., Brgy. 473, Manila City	August 20, 2019 8:00 a.m.	Phase 2-Cluster 2: 472, 473 (España Station)	51	95	146
	Algeciras St., Brgy. 483, Manila City	August 20, 2019 1:00 p.m.	Phase 2-Cluster 2: 368, 474, 483, 484, 485, 487	160	370	530
	Oroquieta Rd. corner Antipolo St., Brgy. 348, Manila City	August 16, 2019 8:00 a.m.	Phase 1-Cluster 1: 348, 349 (Blumentritt Station), 356	182	239	421
	Covered Court, Brgy. 224, Manila City	August 16, 2019 1:00 p.m.	Phase 1-Cluster 2: 218, 224, 227, 228, 359	27	25	52
Makati	Parada Covered Court, Ben Harisson,	August 15, 2019	Barangays Magallanes, Bangkal, Pio del Pilar, San Antonio	129	124	253

LGU	Venue	Date and Time	Main Participant	No. of Participants		
				M	F	Total
	Mayor's St., Brgy. Pio del Pilar, Makati City	8:00 a.m.				
Muntinlupa	Muntinlupa Sports Complex, Brgy. Tunasan, Muntinlupa City	September 12, 2019 8:00 a.m.	Cluster 2: PAPs from Barangay Cupang, Alabang, Bayanan, Putatan, Poblacion, and Tunasan	150	253	403
	Brgy. Sucat Covered Court	August 27, 2019 8:00 a.m.	Cluster 1: Sucat	126	322	448
	Brgy. Buli Covered Court	August 27, 2019 2:00 p.m.	Cluster 1: Buli	31	43	74
	Baywalk Covered Court, Brgy. Bayanan, Muntinlupa City	January 8, 2019 2:00 p.m.	Representatives of the DOTr, the PNR, ADB, JICA Design Team, the SHFC, the LGU and PAPs	135	399	534
Santa Rosa	Dita Barangay Hall, Santa Rosa City	October 30, 2019 8:00 a.m	PAPs from Barangay Dita	12	14	26
	Olympia Court, Brgy. Labas, Santa Rosa City	September 13, 2019 2:00 p.m.	PAPs from Barangay Pooc and Tagapo	16	35	51
	Olympia Court, Brgy. Labas, Santa Rosa City	September 13, 2019 8:00 a.m.	PAPs from Barangay Dita, Dila, and Labas	67	142	209
	Santa Rosa Auditorium, New City Hall Compound, Santa Rosa, Laguna	January 16, 2019 8:30 a.m.	Representatives of the DOTr, the PNR, ADB, JICA Design Team, the LGU and PAPs	61	176	237
Biñan	Brgy. Canlalay Covered Court, Biñan City	September 11, 2019 8:00 a.m.	PAPs from Barangay Canlalay	24	42	66
	Brgy. Platero Covered Court, Biñan City	September 11, 2019 2:00 p.m.	PAPs from Barangay Platero, Sto. Niño, and San Vicente	21	24	45
	Alonte Sports Complex, Biñan, Laguna	January 15, 2019 8:30 a.m.	Representatives of the DOTr, the PNR, ADB, JICA Design Team, the LGU and PAPs	254	461	715
San Pedro	Atrium Hall, Ground Floor, New City Hall Building, San Pedro City Hall	September 14, 2019 8:00 a.m.	PAPs from Barangay San Vicente, Nueva, Fatima, Pacita 1, San Antonio	71	79	150
	San Pedro Astrodome, San Pedro, Laguna	January 8, 2019 8:30 a.m.	Representatives of the DOTr, the PNR, ADB, JICA Design Team, the SHFC, the LGU and PAPs	157	388	545
Cabuyao	Covered Court, Brgy. Sala, Cabuyao City	October 08, 2019 2:00 p.m.	PAPs from Barangay Banay-Banay, Banlic, Bigaa, Mamatid, Niugan, Poblacion 1, Poblacion 3, Pulo, Sala, and San Isidro	63	145	208
	Barangay Sala Covered Court, Cabuyao, Laguna	January 7, 2019 1:00 p.m.	Representatives of the DOTr, the PNR, ADB, JICA Design Team, the SHFC, the LGU and PAPs	53	65	118
Calamba	Covered Court, Halang Elementary School, Brgy. Halang, Calamba	October 26, 2019 8:00 a.m.	PAPs from Barangay Halang and Real	91	306	397
	Covered Court, Farconville Subdivision, Brgy. Parian, Calamba	October 03, 2019 2:00 p.m	PAPs from Barangay San Cristobal and Parian	111	277	388
	Covered Court, Brgy. Poblacion 3, Calamba, Laguna	October 03, 2019 8:00 a.m.	PAPs from Barangay Poblacion 1, Poblacion 3, and Lecheria	105	200	305
	Covered Court, Don Jose Subdivision,	September 26, 2019	PAPs from Barangay Banlic	93	191	264

LGU	Venue	Date and Time	Main Participant	No. of Participants		
				M	F	Total
	Brgy. Banlic, Calamba,	2:00 p.m.				

Source: JICA Design Team.

Table 11.2.32 Summary of Issues and Concerns Raised at the First Round of Stakeholder Consultation Meetings During Detailed Design for the SCRP Main Line

Query/Concern/Suggestion/Comment	Response to Query
Entitlements and Rights of PAPs	
Representative from the Housing Office of Cabuyao City inquired how to ensure that the one interviewed is the owner of the structure. She also stated that there were inquiries received by their office regarding this matter.	Validation will be conducted by the DOTr and proof of ownership will be requested to the claimants.
A PAP who was interviewed during the SES asked if they can receive entitlement benefits if the owner evicted her due to an unpaid monthly rent. She also complained that furniture and materials left in the house were lost.	This needs to be validated since this is a special case. Being in the master list does not mean that the family is qualified since the DOTr will validate. The owner has the right to evict the renter who does not pay the rent.
One of the PAPs stated that her father-in-law who was interviewed during SES died. She asked what will happen to their entitlement.	The structure will be compensated by the government and audited by the Commission on Audit. AH advised to provide proof of ownership like a barangay certification.
One of the PAPs asked if they can go home to their provinces instead of being relocated far from their present residence and if they will be provided a financial assistance.	The entitlement matrix was discussed at the third SCM during FS. According to the entitlement matrix, aside from replacement costs, families who preferred the “Balik-Probinsya” will receive one-way tickets going for the province and food allowance.
One of the PAPs stated that the landowner was deceased already and that the title was named after the owner.	The DOTr explained that they needed to undergo extra judicial settlement. A separate consultation meeting with legal owners/occupants will be conducted.
Owners of rental structures asked if they are entitled to a housing unit/relocation.	If they are living in the structure on the cut-off date, then yes.
One of former renters stated that structure owners forcedly evicted them.	Since former renters were interviewed, they were advised not to worry. The DOTr will also conduct validation.
Whether computation for replacement costs (for land and structure) will be multiplied to two.	The actual cost will prevail. An independent appraiser will conduct surveys regarding nearby hardware, fees for laborers, among others. And there is no standard multiplier.
Some PAPs asked if their affected trees will be compensated.	It was explained that there was cash compensation for owners of affected fruit bearing trees and timber trees.
There are some attendees whose houses were demolished in 2011, and they asked if they will also benefit from the entitlement of the NSCR-Ex Project	The facilitator explained that families whose houses were demolished before the cut-off date were not classified as PAPs of the NSCR-Ex Project.
Entitlements for renters	The entitlement matrix was explained to concerned PAPs, confirming that they will receive compensation.
One of PAPs asked if a dog house will be compensated	Dog houses are classified as associated structures and will be compensated.
Whether affected families who were previously awarded by housing projects from the government will still be entitled for compensation.	One of ADB and JICA’s policies is that no one should be left behind. The concept of public rental wherein affected families who are not qualified for the socialized housing was defined.
A legal owner asked if 50% of his property needs to be acquired and if replacement costs of house structure or land will be given.	The replacement costs for structures and land are different. If the person is a legal owner, he/she will be compensated for the structures and land.
Some PAPs asked if their affected trees like banana and mango trees will be compensated.	There is compensation for owners of affected fruit bearing trees and timber trees. For the perineal crops, owners will be given enough time to harvest fruits. For annual crops, owners will be compensated depending on costs of trees.
A niece of the interviewed PAP is now a caretaker of the tagged house.	It was explained that compensation for replacement costs of structures will still be given to owners. In this case, her uncle is the owner unless rights will be given to her.

Query/Concern/Suggestion/Comment	Response to Query
One of PAPs raised concerns that their former tagged house structure was burnt. The family is now residing in another barangay.	What happened is a natural calamity, and it will no longer be compensated. The family is still entitled to housing assistance if they are qualified.
Some attendees stated that they were owners of structures tagged. The ones who were interviewed during SES are rent-free occupants.	The concept of PAPs are ones presently residing during the first tagging and SES activities. The concept of physical displacement and economic displacement was also discussed. Therefore, owners who will be compensated at a replacement cost is not entitled to relocation assistance. They were also advised to further wait for the validation of the DOTr.
One of PAPs stated that she formerly rented a tagged structure, but the owner evicted her.	If she was interviewed, she will be in a master list. The DOTr will conduct validation.
There is a rumor wherein non-registered voters of Biñan will not receive any compensation or assistance even if the project will affect them.	The political aspect of the city has nothing to do with the project. It was further explained that it was not indicated in ADB's and JICA's guidelines that they would not benefit from any entitlements if they are a non-registered voter of a city.
Asked if newly built structures will be compensated and if families have entitlement from the project.	The project has a cut-off date wherein tagged structures and families who were interviewed during census and tagging activities.
One of the attendees stated that she bought a house along the railway and that former residents who were interviewed by Ecosys went to Ilo-Ilo province.	Affected families are the ones residing in the area during the conduct of census and tagging activities. New occupants need to produce a document proving that a structure has been sold to them.
One of PAPs stated that her live-in partner was an awardee of NHA's housing program and that the one interviewed by Ecosys during SES was her live-in partner. The structure was also named after her live-in partner. She worries that they will not be qualified for the socialized housing project by the SHFC.	The LIAC will identify if they qualified the socialized housing project. If they will be disqualified by the LIAC, public rental is the option.
It was asked if renters who were interviewed during SES are still entitled for the socialized housing project if structure owners evicted them.	If renters were evicted without a valid reason, they are still entitled (if qualified) for the socialized housing since they are in the database.
A couple asked if they can rebuild their house which was destroyed by storm. They also gave information that they transferred the other side of the rail track.	It is fine to fix their house affected by calamity.
Several PAPs are long-time renters of 30 to 45 years. Their concern is what will be their entitlement.	Tenants and renters have their respective entitlements on socialized housing or PAGIBIG which depends on their income.
Owner of an affected Industrial facility located in E. Jacinto st cor. Medina St informed that they have machineries that transporting this equipment before cost them around PHP 25 M, and they are thinking that this may cost double at this time, their question is if this will be compensated.	Affected machineries will be included in the appraisal for compensation purposes.
Legal owners raised their dilemma on compensation for the affected land. They are thinking that the government may not offer a price acceptable to them considering that the zonal value in Brgy Pio del Pilar may cost more or less PHP 100,000.00 per sq. and they might not have sufficient amount to buy nearby properties.	Land Bank and Development Bank of the Philippines are the two government agencies that will provide the appraisal of affected properties. Criteria on the appraisal was reiterated in the SCM to address the concerns of PAPs.
PAPs requested clarification on the replacement cost for properties with only a few meters affected and the appraisal of their land.	If the affected structure will not be functional anymore or the structural stability will be affected, then the whole structure will be compensated. For the land, criteria and conditions has to be met by the PAPS to be considered for appraisal of specific affected lands.
One of the PAPs raised if they can have their properties appraised by private appraisers as basis of compensation.	DOTr will tap the Land Bank or Development Bank of the Philippines for the appraisal value to be adopted in the letter offer
A PAP, who was an awardee of an Executive Order of a previous President together with around 56 others, sought clarification if they are considered as ISFs or	The case is now with the Supreme court awaiting judgment. This will be further discussed with the LIAC for Manila such as how to address such issue**.**

Query/Concern/Suggestion/Comment	Response to Query
legal owners. They further stated that the land they occupy is having legal dispute with the LGU of Manila and PNR.	Nevertheless, it was mentioned that the structure will be compensated using replacement cost.
Property is still named to a deceased relative and was not divided among siblings and the parents have passed away already. Those living are from the third generation and have not paid amelioration taxes.	They were advised to go to the assessor since the property owners failed to pay taxes after certain number of years, then property is auctioned. As for the arrears, government will pay for the arrears deducted to the payment of the property. An extrajudicial settlement will be the best resort for this. The Help Desk can also help them on how to process this. A Help Desk will also be established in the City Hall in October. Furthermore, PAPs were encouraged to address the extrajudicial settlement so that proper documentation could be achieved prior to any compensation to any given property.
A PAP raised that the heirs are paying real property tax, but siblings are yet to receive separate titles because title transfers are costly	Ecosys said that DOTr has helped people in executing extrajudicial settlement. The PAP was advised to go to the help desk also. (Annabelle Herrera, RAP Team leader of Ecosys)
A caretaker of a property attended the SCM and would like to know if they could occupy whatever would be left of the property after the clearing, no matter how small it would be.	The decision to use or sell the remaining property belongs to the owner, according to Ecosys.
One of the issues raised by a senior citizen expressed approval of the project but wished to be enlightened about “just compensation.” particularly those residing in the Bliss area.	He was assured that he will be properly compensated and part of the just compensation will be for all the improvements using the replacement cost scheme.
Queries was raised by those living in the BLISS Property beside the tracks, majority of them are renting the property for decades, what will happen to them or what will be their entitlement.	Renters and sharers will be entitled through socialized housing or assisted relocation but defends on their income.
Possible landlock of some families in since their only access is the PNR ROW.	Easement could be provided within the project ROW, however if technical requirement may not warrant easement access within the ROW and if there will be no feasible access within the property, addition 2 to 2.5-meter easement will be required.
A registered property is named to both husband and wife who are already separated.	Advised the wife to discuss the matter with her husband and come up with a settlement so that documentation could be addressed for the entitlement and compensation by DOTr.
A legal property was sold to other person however there is no any document of the transaction. Original property owner is deceased.	Advised to discuss with the buyer for an agreement and file an EJS, if time comes that the matter could not be settled, expropriation case will be filed.
Inquiry if a setback will be provided if a perimeter wall will be constructed.	Setback to be provided in accordance with the Building Code.
Inquiry on payment scheme for the compensation for their affected properties.	For the land, 50% will be paid upon signing of the Deed of Absolute Sale and the remaining will be paid once the affected property will be annotated in the title. For the structure, 70% will be paid once agreement to demolish and improvement is signed, and the remaining will be paid once the property will be demolished.
A legal PAP inquiry on what will happen if the 30-day duration indicated in the Letter Offer.	If after the 30 days based on the letter offer has lapsed, the government will file an expropriation proceedings for the eminent domain, that based on the existing laws, the court will issue a writ of procession and the property will be taken by the government and compensation will be decided by the court.
An owner of an apartment building raised that the property will not be paid on a fair value that would able them to buy a new property in the nearby area.	Compensation will be based on current market value which will be the consideration of the appraiser.

Query/Concern/Suggestion/Comment	Response to Query
The arch in the affected subdivision in Santa Rosa will be affected. PAP requested information on the compensation.	All structures to be affected by the project will be compensated based on the replacement cost using the current market value.
A property is under the name of PAGIBIG and only few months are amortized.	Compensation issue shall be discussed with PAGIBIG to determine the details of the sharing of the compensation.
A PAP inquired if there will be a detailed appraisal and how many companies will appraise the property.	It is specified in the law that there must be an independent appraiser. For the Resettlement Action Plan, the project also has an independent appraiser. Property owners were encouraged to cooperate during the surveys and appraisal and provide information and as-built plans to help the appraisal to come up with a more realistic opinion value of the property.
A PAP asked if an emotional impact assessment was conducted and if compensation for it will be provided. Provision of common commissionable like signing bonus was also suggested.	Emotional and sentimental value are acknowledged by the project however, there Is no compensation and there is no tangible basis for it. Signing bonus is not written in the Philippine law as well as with JICA and ADB guidelines.
Are the affected landowners be exempted for transfer tax and other fees.	Affected owners are not exempted to taxes / fees, but it will be DOTr to pay it to BIR on behalf of the owner's name. Capital Gains Tax will be paid by DOTr since it is the agency to acquire the property. For the Extra-Judicial Settlement, the property owner shall be the one responsible for the fees.
PAPs in Celadon Residences in Brgy. 350, Manila asked on the entitlement to be provided for the affected row houses and who is responsible for the reconstruction of their houses.	Lots along the alignment will be acquired by DOTr. Since houses in Celadon shares one beam, all houses along the affected row will be compensated but the land will still be under the owner's name. It is the landowner's responsibility to reconstruct the house since replacement cost will be provided.
A PAP in Celadon Residences asked if families not affected by the project will be compensated due to the possible effect of the project to the subdivision's security, noise, and lighting which could depreciate the value of the remaining properties.	The project is a government project which is subject for auditing and basis for provision of compensation is required. There is no basis for compensating the families for the possible depreciation of the properties not affected by the project.
A PAP stated that the government shall handle the cost of rent expenses of families living in the partially affected structures while the project construction is ongoing.	DOTr has an ongoing discussion with funding agencies such as ADB and JICA and will ensure that the project will not cause additional burden to the affected families. Assured that the concern will be included in the compensation / entitlement
Concerns on Alignments, Stations and Depots	
The measurement of station for PAPs to identify it the project will affect them.	The SCM is intended for PAPs living inside the PNR's property/ROW. There is no finalized alignment yet for stations.
One of PAPs asked to set an additional measurement aside from the 30-meter measurement.	The final measurement will be identified during DD.
Some PAPs asked for the boundary.	It was advised to wait for the detailed measurement survey.
Whether land beyond the 30-meter easement will be acquired by the government.	Acquisition of land will depend on the location. For a station, land beyond the PNR's property needs to be acquired. There is no finalized configuration yet for stations.
One of PAPs stated that only 50% of his structure will be affected since 15 meters on each side of the railroad will be needed for the project.	If it is unsafe to live in the remaining house structure, a full replacement cost will be provided. A separate consultation meeting with legal owners will be conducted.
Fifty percent of an apartment building is affected by the project. One of tenants/renters asked if the whole apartment building needs to be demolished.	If a house structure is unsafe to live, it needs to be demolished, and full compensation will be given to the structure owner. They were advised to wait for a surveyor to determine if the apartment building is really affected by the project.

Query/Concern/Suggestion/Comment	Response to Query
PAPs inquired about the lots to be acquired by the Project	Plan Alignment was presented for the PAPs to have an idea of the alignment particularly the station area required. The streets that will be traversed by the project in Brgy Pio del Pilar were specified but clarified that what is shown in the plan may be slightly different on-ground. Further, PAPs were informed that ground demarcation will start after the SCM in the afternoon.
Some residents inquired why the stations are too expansive. The PAPs are apprehensive that government might sell this to a major developer.	The project will only acquire what is needed and the apprehension of the PAPs are not true.
A representative of Brgy San Antonio, Makati, raised that the meeting was the first they attended and only then did they know that new property owners will be affected.	Measurement survey done before is for Feasibility study only, and with the current plan under DED, there will be new affected properties.
Brgy San Antonio representative requested a separate SCM for Brgy San Antonio of Makati alone to address the issues and concerns of their barangay.	SCM for specific affected barangays may be conducted after the ROW demarcation on the ground for which the PAPs agreed.
PAPs inquired about the lots to be acquired by the Project.	Plan alignment was presented for the PAPs to have an idea of the alignment particularly the station area required. Further, a description of the extent of ROW demarcation on-ground was provided but clarified that what is shown in the plan may be slightly different on what's on-ground.
PAPs whose properties will be affected by 1 to 2 meters requested that their properties be spared.	DOTr will only acquire what is needed for the project. PAPs with on ground demarcation and ROW marking will possibly start by next week.
PAPs raised concern that the ROW line is not straight.	The alignment will require curvature going to the station. Further, PAPs were reminded that demarcation on the ground will be conducted to determine the extent of the ROW.
A representative from Brgy 228, Manila, raised that they are now affected after not being affected from previously.	The current DED updated the FS study which was undertaken more than a year ago.
A participant asked what will happen to the existing PNR Blumentritt Station.	The station will be relocated but the PNR trains will still be operational.
PAP expressed his thought that NSCR Ex Project will have two railway projects, which will have more impact to nearby properties.	NSCR Ex Project will be elevated, but the railway on the ground will be used for freight. The elevated commuter railway project will be completed first.
A PAP requested for an official document indicating the exact measurement of the impact on his property.	Impact on land will be measured during the parcellary survey determining the exact measures of land to be recovered from each legal owner, and the extent of damage to private properties. Once the parcellary and as built surveys are completed, request for a copy of the parcellary map can be made with the help desk.
PAPs inquired why the alignment will affect more properties in their barangay considering that DOTr should use the PNR tracks as much as possible to avoid acquiring properties.	DPWH has already made arrangement with PNR that they will occupy the PNR ROW, which is the reason that NSCR ex Project will acquire private properties adjacent to the PNR tracks that will accommodate the alignment and the station dimension as required.
Possible derailing /crashing of train since the project design is elevated	Project will adopt Japan's technology in constructing the railway wherein seismic design was considered.
A legal PAP in San Pedro requested to narrow down the alignment for minimal impact.	Minimizing the impact of the project was considered and done during the Feasibility Study stage. The project has technical requirements to consider / follow and the alignment has already been finalized.
An attendee in San Pedro asked the station location details for them to identify if their property will be affected by the project.	Due to technical requirements, station locations were moved a bit south of the existing legacy San Pedro Station and a bit north of the existing Pacita Station. Markings to be conducted will identify final project affected structures.
Some PAPs in Celadon Residences located in Brgy. 350 in Manila inquired on the details of alignment's	Aerial view of the map is for presentation purposes only for PAPs to have an idea on the alignment. Surveys to

Query/Concern/Suggestion/Comment	Response to Query
shape, why the presented map is not accurate, and if columns will be constructed along the alignment.	be conducted could provide actual markings on the ground. The alignment avoided the road inside the subdivision. The structure to be constructed is elevated and the road will not be affected.
A PAP concerns that the RA 7279 section 28 stated that there will be no notification of at least 30 days and the salary should be given equivalent to 60 days.	The provision is for eviction of families living and residing to danger zone and the applicable law is the RA 10752.
Representative of MRH Corp. of B&A Building in San Martin de Porres in Paranaque inquired on the construction timeline of the project.	Start of construction of Solis to Blumentritt Section will be on the last quarter of 2020 and other areas will follow.
PAPs raised concern on two stations: san Pedro Station and Pacita station being too close to each other of approximately less than 2km. Suggested to have only one station in the city.	The travel demand forecast is computed until 2040. Curvature portion at the existing Pacita Station needs to be avoided by the proposed Pacita station, which will be moved further to the north of the existing. For San Pedro Station, the elevation tracks from Muntinlupa will be higher which may require longer vertical alignment transition for the proper train deceleration which is the main reson why the station will be moved further south of the existing. Design of two stations will have least impact givent the current design.
Why Elvinda Village will be affected by the project.	PNR tracks will be operation during and after the NSCR-Ex Project construction which will serve the current commuter from calamba up to Tutuban and in the future these tracks will be on the eastside and the viaduct for NSCR-Ex will be in the west side which will require additional acquisition outside PNR ROW in Elvinda Village for the station space needed.
A subdivision plan in Brgy. Fatima, San Pedro Laguna was shown which overlaps the PNR ROW around one to two meters.	The concern will be endorsed to PNR which has the jurisdiction of the concern.
Concerns on Housing and Resettlement	
Some PAPs asked the locations of resettlement sites and stated that they preferred to be resettled near their present residence.	The SHFC is the key shelter agency tapped by the DOTr to provide housing projects for affected families in the south portion of the project. The SHFC representative advised attendees to wait for the final tagging. The agency will go to their areas to assist them in forming a community association to be registered to the House and Land Use Regulatory Board to access the housing project.
There are PAPs who are not members of an existing organizations/associations. Will they become a member of the existing organization if they will surely be affected by the project?	The SHFC responded that they would surely be a member of an organization/association if they will be affected and need to be resettled.
Some PAPs worry that they cannot afford the monthly amortization of relocation housing units since some of them do not have a permanent job.	The DOTr and the consultants are currently studying the affordability of amortization. The livelihood component of the project was also discussed.
One of PAPs raised that their structure was a house but a pink sticker was posted in their structure.	The second tagging has yet to be started, and no pink sticker has been posted.
Some PAPs asked the locations of resettlement sites.	JICA and ADB's priority location of resettlements sites is within the city. A representative from the City Urban and Development Housing Office of San Pedro updated that possible locations of resettlement sites within the city had been identified. However, the LGU is waiting for the process to acquire and develop the sites.
Some PAPs raised concerns that they were not a member of any HOA and asked how they will be given housing assistance.	Representative from the SHFC mentioned that their agency was tasked to assist affected families in providing housing programs. The representative added that their work would begin during DD. The SHFC will coordinate with affected families to assist them in forming community associations.

Query/Concern/Suggestion/Comment	Response to Query
A leader of a PO commented an individual approach for providing resettlement sites was presented and then asked what the approach for the existing POs will be. The organization is now in the process of looking for a possible relocation site.	The SHFC will assist affected families. The DOTr suggested coordinating with the SHFC. The leader should ensure that members are surely affected by the project. Even if they are a member of a certain PO, they are not entitled to any housing assistance.
Some PAPs raised concerns that they have heard a rumor that POs will be prioritized.	PAPs were advised not to worry since the SHFC will coordinate with affected families and assist them in forming an association. The approach of the SHFC for providing housing assistance wherein the said agency provides loan to a community association/HOA.
The locations of resettlement sites were asked.	Relocation sites are not yet identified. Relocation sites and eligibility will be tackled in the second SCM during DD.
Some PAPs asked how affordable the monthly amortization of the socialized housing project would be.	There is discussion on how to make the amortization affordable. Costs of amortization will be based on a family's current living conditions and their capability to pay. Additionally, the livelihood component of the project was discussed.
PAPs from Apolega Village in Brgy. Banlic, Calamba have already formed an organization registered to the House and Land Use Regulatory Board and is requesting for the next action to be undertaken by the association.	SHFC as the partner of DOTr for resettlement will coordinate with the association to discuss relocation concerns.
Concern if legal PAPs will be provided of relocation sites.	Legal PAPs could be part of the assister relocation wherein PAPs could be preferred by DOTr to PAGIBIG housing.
Concerns on the Timeline	
Date of demolition	The DOTr's representative mentioned that the start of project construction is May 2020. Clearing and relocation will be started in 2020, prior to construction.
PAPs also raised concern on project timeline with construction already starting in July 2020. They are raised that the start of construction is very soon and they will have a short time to prepare. In this regard, they requested DOTr to come up with a timeline for the PAPs to include activities for them to comply.	DOTr staff took note of the suggestion.
On timeline issue, one of the Business Owner concern is the timeline of the start of construction by July 2020, considering that he has so many employees that will be displaced, he asked what will be the exact timeline or when will be the time that they will vacate the affected properties.	This will still require validation prior to the issuance of NoT and Letter offer and the exact time for the PAPs to transfer will be announced in a later time maybe after the validation. Nonetheless, the July 2020 start of construction will be in the Solis Blumentritt section and the other section for Manila will follow.
Timeline of establishment of help desk in Biñan city hall.	Help desk will be established by October 2019.
Timeline of acquisition; when does DOTr will start acquiring the affected properties.	Tentatively, parcellary could be completed within the year or early next year (2020). The outputs will be validated and the Notice of Taking will be issued. By then, the timeline of property acquisition can be defined.
Concerns on Environment	
Asked on the government's plan on noise, dust, debris, and traffic that will be caused by project construction.	Project has environment mitigation measures based on the approved IEC. Multipartite Monitroing Team will also be formed composed of LGU barangay and community organization to address environmental concerns during construction.
A PAP in San Pedro raised that the project may cause flood and could have an effect on their water system since there is a two-meter wide and one-meter deep irrigation canal parallel to the PNR ROW.	DOTr together with National Irrigation Administration has conducted validation of irrigation canals. A Multipartite Monitoring Team will be created to address flooding concerns. The proposal is to provide temporary

Query/Concern/Suggestion/Comment	Response to Query
	canals and the drainage plans are subject for approval of DPWH, NIA, and the city government.
Other Concerns	
It was stated by one of the PAPs that there was a tarpaulin in barangay hall of Putatan, saying that settlers within the PNR's property must vacate the area.	PNR representatives responded that they did not post a tarpaulin.
There was feedback from other Kalipunan ng Damayang Mahihirap (KADAMAY), a people's organization that there would be no process of relocation and that all affected houses will be demolished.	The Philippine government is asking for assistance from a foreign country for the project. Lenders will not help the Philippine government if it does not follow ADB and JICA safeguards. With this, there will be no demolition and eviction without proper resettlement.
One of PAPs stated that only one tag/sticker was provided even though they are three siblings with different house structures.	The concern will be endorsed to the tagging team to clarify why only one tag has given to them.
Some PAPs asked why only one tag was given to them if there are more than one family presently living in a house.	Stickers/tagging are intended for structures and not per family.
Some PAPs stated that their stickers were lost and that some were washed off.	PAPs were told not to worry since there is a database. The concern will be endorsed to the tagging team to clarify why only one tag has given to them.
There is only one tag for five families with different house structures. Most of family members are at work during SES.	The stickers/tagging are per structure and not per family. There are reserved tagging/control numbers for house structures which do not have stickers due to absence of present structure owners during census and tagging activities.
Some PAPs asked the purpose of a "marking" activity conducted last week.	The purpose of the marking activity is to measure PNR boundaries. The RAP activities during DD have yet to be started.
Some PAPs stated that they were not interviewed during the conduct of surveys, and their house structures were not tagged.	The photo documentation was conducted to ensure that affected structures are documented even if they were not present during the conduct of tagging. There are reserved tagging/control numbers for house structures which do not have stickers due to absence of structure owners during census and tagging activities. The DOTr will conduct validation which can identify if claimants are actual occupants. The barangay will be informed of the schedule for tagging during DD.
Owners of newly built structures asked not to demolish their house until they have found a new one.	The project will start in 2020, which gives them ample time to look for a new home.
Brgy. Chairman of Pio del Pilar, Makati, stated that proper information dissemination should be undertaken to address the concerns of PAPs, particularly in their barangay, and to avoid confusion among the stakeholders.	DOTr will further coordinate with all involved barangays for proper information dissemination.
Makati LGU representative from CSWD inquired why they are only being informed now and stated that LAPRAP reports and RAP workshops were conducted for other national projects.	DOTr had an IEC with the LGU of Manila last June 27, 2019 and the FS RAP report was published in the ADB and JICA website. Furthermore, the RAP workshop will be tackled in the upcoming LIAC activities to be coordinated by SHFC with the LGU of Makati.
PAPs raised a concern as to the magnitude of impact to their barangay.	DPWH did a prior agreement with PNR to utilize the PNR ROW for the NLEX SLEX connector project which is on the other side of the tracks. This resulted to additional ROW required that will affect private properties.
There is a PAP who claimed that their title is written in Spanish and some houses are already 100 years old.	If they have paid for Real Property tax (RPT), then their title will be honored. If the house is 100 years old, then it will be appraised as a new house.
An ISF claimed that the surveyors missed tagging her house. During the census, she claimed that they were not surveyed since their house is hidden in between private owners.	Aside from SHFC validation, a validation together with DOTr, the barangay and the LGU will be conducted. At the same time, she was advised to wait for the markings. She was also advised to text or call the DOTR hotlines.

Query/Concern/Suggestion/Comment	Response to Query
The PAPs particularly renters and sharers asked if there is a relocation site planned already.	DOTr said that there is no site yet but the Mayor prefers in-city relocation. The PAPs suggested to build tenement housing near their area. DOTr assured them that there will be other meetings for this and they will be consulted.
PAPs expressed wariness of the scheduled start of the construction: July 2020. For some PAPs this is too soon and quite unrealistic.	It was clarified that the construction along the project alignment will not be simultaneous, but by July 2020 clearing operations may be started. The PAPs were asked to wait for the confirmation of the date of construction along their part of the project alignment.
A PAP was interviewed during the FS, but was not sure if her name made it to the masterlist. And asked if all information could just be cascaded down to the barangay. Ecosys maintained that the barangay units were represented during the meetings at the city-level LGU.	She was advised to go the help desk to confirm if she was part of the masterlist, on the issue of information dissemination, relayed that the barangay units were represented during the meetings at the city-level LGU. Some of the PAPs' questions can be answered by the barangay representatives, but if no answers are available at the barangay unit, the PAPs can go directly to the help desk.
Another concern is there are renters who had been renting for decades, one of the renters requested that a separate meeting will be held in the future for all the renters so that full information could solely discussed to them.	The suggestion was fully noted, however, in the future, DOTr explained that SHFC may have separate meeting with them particularly on the socialized housing program. DOTr advised the renters that if on some cases are evicted, they should report to the help desk their whereabouts, so that DOTR staff during validation will know where they relocate or transfer.
Another concern of PAPs living in the Bliss area on that the property they are renting is that the landlord/ property owner is not paying NHFMC, their concern is not to pay also their landlord/property owner.	PAPs should consult some legal experts and that will explain to them the Rent Control Law,
One of the concerns is the proposed relocation sites, majority of the PAPs was living in the area for a long time and they don't want to be relocated elsewhere except in the city of Manila.	DOTr said that there is no site yet but the Mayor prefers in-city relocation. The PAPs suggested to build tenement housing near their area. DOTr assured them that there will be other meetings for this and they will be consulted.
Homeowner Association in Purok 6 and Batibot Compound in Brgy. Tunasan in Muntinlupa City requested to send any communication *ie* invitation to the association in behalf of their members.	The request is noted; invitation for the next SCM will be sent through the association.
PAPs in Brgy. Cupang in Muntinlupa City concern the frontage road within the PNR ROW which may affect the adjacent properties.	DOTr is currently discussing with DPWH on what will happen to the road as mentioned. A 2 to 2.5-meter easement will be provided if ever properties will be landlocked. If easement cannot be provided within the project ROW, an additional area will be required.
Asked on what will happen if a property owner / PAP refused to accept the offer from DOTr.	Expropriation case will then be filed to the property owner who refused the offer.
Is the certified true copy of the land title will be considered as proof of ownership.	PAP was encouraged to coordinate with the Registry of Deeds for them to get the owner's copy of the land title.
Is the project will push through even if there will be a change of administration on the next presidential election.	It is not in the best interest of the Philippines not to continue the project funded by International Organizations and there are commitments towards ADB and JICA for the project to be implemented. Loan will be paid by the Philippine government regardless if the project will push through or not.
A PAP asked on the basis of the fair market value.	Independent appraiser will consider the recent sales, BIR, and information from the real estate companies for the prevailing market price.
PAP inquired on how to go about the unpaid Real Estate tax of a structure.	DOTr could establish partnership with the City Assessor's Office for the issuance of tax declarations given the situation that structure is not reflected in the tax declaration. However, it is the City Assessor's Office to determine if there is a penalty for it.
A homeowner's association officer in Celadon Residences and PAPs raised concern on possible	The project recommends and will ensure non-interruption of basic services. DOTr had a coordination

Query/Concern/Suggestion/Comment	Response to Query
water interruption since the water tank will be affected by the project. Asked if the sewerage system will be considered.	meeting with Maynilad Water Services, Inc on the concern and the service provider is required to submit relocation plan. Sewerage System will also be considered. DOTr to further coordinate with Alveo Land Corp (developer) on the matter.
Apolega Village Homeowners' Association concern is that the property thaty they are occupying is still in the name of the association, and they are requesting assistance on how to subdivide the lot so that it will be registered to the respective owners.	DOTr will request assistance from LGU and it will be discusses with the Local Inter-agency Committee for possible assistance.
The chairperson of Brgy. San Cristobal in Calamba asked for information on the proposed access road from the tracks to the National Highway that there will be a possible impact to the project alignment.	Access road will be probably required with the Transit Oriented Development (TOD) which will be coordinated with the LGU. However, there is no finality yet since the project is still in the study stage.
Property was recently transferred to PAGIBIG housing. PAP asked if they will continue to pay. The PAP also raised concern that receipts of the materials bought for house construction/improvement were lost.	Encouraged PAP to discuss the concern with PAGIBIG, that the payment will be thru PAGIBIG but it should deduct the cost that the PAP invested, once DOTr will start acquiring, PAP should stop the amortization.
A caretaker has no contact with the owner of a privately-owned property.	Further research will be conducted to reach the property owner.
The owner of the privately-owned property lives in other country.	Advised PAP to relay to the property owner to execute a Special Power of Attorney so that she will be recognized by DOTr for any transaction to be made.
PAPs in New Santa Rosa Homes raised that there are some properties that were fully paid and are waiting for the transfer of the document.	Category on the amortization standing and compensation will be further discussed in the next consultation meeting.

Source: JICA Design Team.

11.2.2.4.Focus Group Discussions

2207. In the detailed design phase, a separate batch of FGD was held for livelihood restoration with the vulnerable sector. Three sessions were conducted for FGD. FGD participants from the vulnerable sector were randomly selected from the list of all PAPs with vulnerability based on the socio-economic survey (SES). As for livelihood restoration, the sampled PAPs did not show up for the scheduled FGD, so they were replaced by PAP volunteers whose livelihood is affected by the project.

(1) FGD for Livelihood Restoration for the SCRP Main Line

2208. FGD sessions concerning livelihood restoration were held from November 7, 2018 to January 16, 2019 at Manila, Cabuyao, San Pedro, Muntinlupa, Binan and Santa Rosa. **Table 11.2.34** summarizes issues and concerns raised by participants during the three sessions.

Table 11.2.33 Outline of Focus Group Discussion Concerning Livelihood Restoration During Detailed Design for the SCRP Main Line

Date	LGU	Venue	No. of Participants		
			M	F	Total
November 07, 2018	Manila	Barangay 227	1	4	5
November 08, 2018	Manila	Barangay 384	3	6	9
November 08, 2018	Manila	Barangay 349	5	12	17
November 09, 2018	Manila	Barangay 356	9	13	12
November 09, 2018	Manila	Barangay 359	8	6	14
January 07, 2019	Cabuyao	Barangay Sala Covered Court, Cabuyao City	8	10	18
January 08, 2019	San Pedro	Pacita Astrodome, San Pedro	10	13	23
January 08, 2019	Muntinlupa	Muntinlupa City Hall Covered Court	12	23	35
January 15, 2019	Biñan	Biñan City Astrodome	9	51	60
January 16, 2019	Santa Rosa	Auditorium, Santa Rosa City Hall	18	23	41

Source: JICA Design Team.

Table 11.2.34 Summary of Issues and Concerns Raised during DD FGDs for Livelihood Restoration for the SCRP Main Line

FGD Questions	Responses from Participants
1. Major concerns regarding the project	• Participants expect that by the next meetings, they will receive information on what is the plan of the LGU and other agencies involved in the PNR project for their businesses. • Some participants have a positive outlook about the project. They are supportive to the government's project and would like to give their full cooperation. • Some participants have mixed emotion with this project. They felt happy and sad at the same time. • Participants are hopeful for the plans of the government for them and wanted to make sure that they will have a good transition. • Asked for advanced notice if the implementation pushes through • Asked for showing final alignment and barangay mapping • Commented over the importance of compensation. • Asked about the possibility of in-city relocation • Asked for information regarding resettlement if everyone will be eligible for housing • Asked for the government will provide socialized housing units before the resettlement implementation takes place. • Expressed concern over the status of housing, stating they do not want substandard houses, or convert to cash distribution • Appealed for transportation assistance upon the transfer of their properties. • Participants requested for considering the proximity of resettlement to key workplaces. • Raised issue over suitability resettlement site for housing with utilities • Expressed concern over the safety of the new neighborhood and its effect on children • Participants asked for establishment of community centers in which the children can play so that they will not be strayed to wrongful behavior • Participants asked for accessibility of transportation, and ability to choose schools where the children wanted to attend • Asked for provision of transporting vehicles to the resettlement area • Expressed concern over their livelihood. • Requested for affected families to be employed in the project construction • Participants requested for job vacancies related to production • Participants requested for financial support and start-up capital for businesses • Asked for trainings for livelihood depending on viable businesses in the resettlement site

FGD Questions	Responses from Participants
	• Proposed livelihood activities such as coconut and other crops • Asked for strategic market location (workplace and enterprise), • Requested for extensive livelihood support for those that are not able to work due to constraints. • Respondents fear for the fate of their businesses once the resettlement occurs. • Requested for organization of livelihood opportunities for the unemployed • Asked about the Possibility of starting micro enterprises in the resettlement area • Requested for Possible formation of cooperatives and social groups for efficient dissemination of information.
2. Expectation of employment and livelihood upon relocation	• Expected the government to give them and their children employment and livelihood appropriate to their interest, age, and experience. • Stressed their desire for their work to continue despite the relocation – to their existing clients or other possible prospects. • Expecting that the government will give them the same source of income as they have right now, while others would like to have their own livelihood since they didn't have one. • Asked for assistance in starting micro businesses such as stores • Suggested for additional companies to come in for more job vacancies. • Requested for employment opportunities proximate to the resettlement site • Asked for scholarship assistance for the affected children • Requested for capital support for affected tricycle drivers. • Expressed concern over how their employment and livelihood will be, since majority found workplaces in the city, and will there be any viable transport and educational institutions in the resettlement site • Asked of how will livelihood be differentiated for the affected families • Hoping for an industrialized environment, with suitable housing • Requested for livelihood assistance for the indigents • Asked for new employment opportunities • Requested for programs that will help them to form micro businesses • Asked if the resettlement site will be accessible to key government facilities and commercial establishments • Appealed for affordable fares or improving in-city transport especially during night time • Entrepreneurs expressed concern of continuing their enterprises upon resettlement. • Asked for any livelihood assistance and training programs to the affected persons
3. Government's role during the preparation and implementation of employment and livelihood support	• Expressed willingness to participate to any related programs of the government that will help them sustain their everyday needs. • Looking for assurance from the government to give the affected families something to work on for them to gain income. • Appealed for proper care with the affected families. • Appealed for more support coming from local government, with consistent statement • Stated that some seniors experience difficulty accepting the relocation • Stated the hearsay about miserable conditions of those that had been transferred • Requested for housing with basic utilities • Requested for comprehensive livelihood assistance, with target business market • Suggested comprehensive projects like what one of the politicians is doing. • Expressed their desire to be given appropriate houses with good neighborhood, with public facilities and commercial establishments • Most of the project-affected people would like to receive financial assistance to start up a business such as tailoring shop, repair and maintenance shop, electronic shop, canteen and convenient store. • Asked for improvement of transport system in the city for mobility • Asking for available trainings to expand employment or entrepreneurial opportunities. • Stressed the importance of unbiased public service (no extra favors to be given to a few) • Asked about the readiness of the resettlement site before demolition • Requested basic facilities and utilities within and adjacent to the resettlement site to be ready

FGD Questions	Responses from Participants
	• Requested for comprehensive livelihood restoration support from government • Appealed that the Government must help them regain their livelihood, mostly in stores or eateries, suggesting to have markets in their area of relocation, and/or improve transportation efficiency within the area • Requested to organize job fairs • Requested assistance for micro enterprises and those who are planning to engage in such • Requested Assistance in the transfer from the project area to the resettlement site • Appealed for Livelihood opportunities for the vulnerable sectors, such as Senior Citizens, PWDs and Single Parents • Asked of Financial assistance for the indigents
4. Private establishments' role during the preparation and implementation of the employment and livelihood support	• Suggested for the government to recommend the project affected persons to private companies, or at least to support them in finding employment • Asked for the repealing of age limit in working. • Requested to be more considerate with the status of the applicants. • Respondents would like the private companies to conduct training seminars and workshops where they can learn and gain start up knowledge and skills about their prospective livelihood. • Suggested social cooperation of companies to help people in utilizing their acquired skills in education for livelihood. • Requested for educational institutions to facilitate skills training • Asked for employment opportunities, scholarships and technical-vocational courses sponsorships • Asked for the possibility of giving donations instead of loans • Most of their expectations were in the government and not on the private sector. • Requested for soft loans from NGOs and foundations • Asked to organize livelihood support for indigents such as tricycle units • Asked to help the government in putting up key facilities in the resettlement site • Asked for NGOs and foundations willing to provide healthcare offices for the affected persons • Appealed for Aid in providing job opportunities and livelihood, preferably start-up capital
5. Awareness and responses in forming a cooperative	• Suggested for proper conservation and accounting for savings fund • Few respondents are familiar with cooperative, but majority expressed interest in supporting its formation. • Perceived cooperative as means for soft loans that will distribute profit for its participants • Perceived as livelihood association, source of assistance, providing weekend trainings • Respondents expressed interest in forming cooperative/s that will concentrate on livelihood and entrepreneurship posed appeal to the respondents • Some of the participants have negative impression on cooperative, because of the experiences shared by some members in their community (e.g. corruption, incorrect financial handling, failing to inform members of their disbursements).

(2) FGD with the Vulnerable Sector

2209. **Table 11.2.35** and **Table 11.2.36** summarize the outline of FGD participants and issues/concerns raised by the vulnerable sector.

Table 11.2.35 Outline of Focus Group Discussion with the Vulnerable Sector During Detailed Design for the SCRP Main Line

Date	LGU	Venue	No. of Participants		
			M	F	Total
February 18, 2019	Santa Rosa	Function Hall, Santa Rosa City Hall	5	11	16
February 19, 2019	Biñan	Mayor's Office, Biñan City Hall	1	4	5
February 19, 2019	Cabuyao	Audio-Visual Room, Cabuyao City Hall	4	8	12

Date	LGU	Venue	No. of Participants		
			M	F	Total
February 20, 2019	San Pedro	Multipurpose Hall (Atrium), San Pedro City Hall	4	18	22
February 21, 2019	Muntinlupa	Hall of Justice, Muntinlupa City	2	8	10
September 17, 2019	Manila	472 Barangay Hall, Sampaloc, Manila	5	6	11
September 17, 2019	Manila	483 Barangay Hall, Sampaloc, Manila	2	10	12
September 18, 2019	Manila	448 Barangay Hall, Sta. Cruz, Manila	8	8	16

Source: JICA Design Team.

Table 11.2.36 Summary of Issues and Concerns Raised during DD FGDs with the Vulnerable Sector for the SCRP Main Line

Guide Questions	Responses from Participants
1. What do you know about the NSCR-Ex Project?	All structures along the alignment that the government needs for the project will be removed and will be compensated, even crops and trees. Surveys will be conducted to their area to determine the replacement cost. Some mentioned that relocation assistance will be provided to the affected families. Participant are still lacking information on the Project. One participant reasoned out that there is no assurance that all entitlement presented will be given to them. Participant raised that the relocation assistance is uncertain and if there is any, not all PAPs are entitled to it Participants mentioned that the railway project will traverse from Blumentritt in Manila up to Calamba in Laguna, but some of them have received information that the project will extend to Bicol province. One participant raised uncertainty of the real and final measurement of the project: initially, it was 30m however, during the last consultation meeting attended, it became 60m. For the design of the project, railway tracks will be elevated, and the existing railway will be utilized for freight / cargo.
2. What do you know about the resettlement program of the government?	Attendees are aware that identifying the permanent resettlement sites is through a community association, which they need to form. Livelihood assistance will be provided to them to ensure that beneficiaries could pay their monthly amortization. One of the attendees recalled that a transportation assistance will be provided to the affected families who opted to return to their province. Property (land and structure) will be compensated. Families will be relocated in Pandi in Bulacan and in Cavite. Transportation assistance will be provided to the affected person who is currently working. Families will be assisted by Social Housing Finance Corporation. City Mayor of Manila announced that relocation site will beq within the city. While the relocation site is being finalized, families will be provided money to pay for the rental fee.
3. What are the things you like and do not like about the resettlement program? Why?	Participants recommended that housing units have comfort room, kitchen, and loft. For houses of families with person with disability member, a ramp must be provided Resettlement site locations are uncertain. Exact date of project construction and start of relocation is unknown Exact amount of compensation for loss of structure and land is unknown
4. Considering your responses about the resettlement program, how do you think the government can make the resettlement program be more responsive to your needs?	Allot the forepart housing units for families with PWD and elderly members. Provide resettlement sites which are accessible to transportation. Participants prefer to be resettled within the City since they are used to it and all of their needs are accessible. If there are no resettlement sites within the city of Biñan, PAPs recommended the city of Calamba as option due to its vicinity. Participants recommended that housing units for families with person with disability member, a ramp must be provided, and entrance doors are near the road. The resettlement location must not be flood-prone. One of the attendees shared that previous government housing project provides lot only and no structures. She prefers a readily available housing unit with basic utilities such as electricity and water. Provide assistance during demolition especially to families with members who are senior citizens and persons with disabilities.

Guide Questions	Responses from Participants
	Consider the timing of relocation of the affected families. Avoid relocation during school year. Relocation sites should be near to community facilities such as school, market, church, and hospital. Allow families to self-demolish their houses for them to keep / re-use the salvageable materials. Provide livelihood assistance in the relocation site for solo parents and the unemployed. Avoid relocation of families to the existing resettlement sites. Participants preferred to be relocated in a newly constructed resettlement site.

(3) FGD with UHV Residents for the SCRP Interconnecting Line

2210. An FGD session concerning the design study of the SCRP Interconnecting Line was held on February 13, 2020 at the Manila Metro Rail Transit System Line 3 (MRT 3) Depot in Quezon City. Table 11.2.35 and Table 11.2.36 summarize the outline of FGD participants and issues/concerns raised by the United Hills Village (UHV) representatives.

Table 11.2.35 Outline of Focus Group Discussion with the UHV Representatives During Detailed Design for the SCRP Interconnecting Line

Date	LGU	Venue	Participants
February 13, 2020	Parañaque (United Hills Village)	MRT 3 Depot, Quezon City	Representatives of the DOTr, DPWH, the PNR, ADB, JICA Design Team, the GC, the LGU, the Barangay SMDP and PAPs from UHV and Malugay

Table 11.2.36 Summary of Issues and Concerns Raised at the Coordination Meeting with UHV Representatives During Detailed Design for the SCRP Interconnecting Line

Query/Concern/Suggestion/Comment	Response to Query
UHV Representatives asked for a detail of the interface of the tracks that will pass up to Bicutan.	Mr. Leonel De Velez (DOTr) responded that portions of United Hills Village (UHV) and United Paranaque Subdivision (UPS) will be acquired for the East Service Road.
After DOTr's explanation that the no. of affected structures reduced from 212 to 74 (worst case scenario), one of the representatives of UHV responded that they do not want expropriation in their village whether it is 212 or less.	Mr. De Velez (DOTr) responded that SCRP does not need to expropriate. However, it is necessary to retain a 14-meter service road for the convenience of the residents. For the structures that will be partially affected, DOTr clarified that there will be full replacement cost at current market value.
UHV representatives asked regarding the method of identification of affected structures.	DOTr responded that it was only identified through the maps since the subcontractors who are supposed to undertake the survey were not permitted to enter the village.
After DOTr's presentation of the planned road diversion in Cucumber Road (considering that East Service Road will not be reinstated), a UHV representative commented that service roads must be parallel with the expressway. He also clarified that it is not UHV requiring the service roads.	Mr. De Velez (DOTr) responded that it is the Department of Public Works and Highways (DPWH) requiring the 14-meter service road. DOTr also consulted Taguig City Local Government Unit (LGU) and they agreed that Cucumber Road to A. Bonifacio will be utilized as a permanent diversion road.
One of the residents asked if emerging before the Cucumber Road has been an option.	Usec. Timothy John Batan (DOTr) explained that one of the major constraints is the columns of C6 Project of DPWH.
UHV representatives asked if a geotechnical study was conducted and if the report is available.	DOTr confirmed that a geotechnical report is available (boreholes up to 40-meter deep) and can be shared with UHV.

Query/Concern/Suggestion/Comment	Response to Query
A representative of UHV also raised her concern that there are many elderly living in the village and their well-being might be affected because of the environmental impacts of the project such as pollution (dust), noise and vibration. She also mentioned that pollution from digging might cause early death among the elderly.	Usec. Batan and Mr. De Velez (DOTr) responded that there are mitigation measures that will reduce the environmental impacts of the project.
UHV representatives asked if there is a connection with the Taguig Integrated Terminal Exchange (ITX)	DOTr confirmed that there will be an underground pedestrian connecting FTI station to ITX
One of the residents asked if people are valued in the project.	Usec. Batan (DOTr) responded that they exert efforts to consult stakeholders as part of the loan covenants of the projects being implemented.
DOTr asked if it is possible to do initial surveys in the area.	UHV representatives responded that they need to internally consult with the residents first.
The representatives from UHV clarified if they have a say whether a 5-meter, 9-meter and 14-meter acquisition is possible.	UHV suggested to have another consultation meeting with the residents after they relay the initial information presented by DOTr.

11.2.3. Other Information Disclosure

11.2.3.1. Production and Distribution of Printed and Other Materials

2211. The DOTr prepares public information brochures in English and Tagalog, leaflets, flyers for the grievance redress mechanism (GRM) and hands out materials to inform communities about the environment, health and safety issues, the LRIP, resettlement activities as well as any other material when necessary. The DOTr prepares and distributes materials summarized in **Table 11.2.37** to the public.

Table 11.2.37 Material to be Distributed to Project-affected Persons

Phase	Material to be Distributed
Detailed design	Project information brochure in Tagalog and English versions Project poster Flyers promoting the GRM (two types) Help-desk tarps (4 types) DOTr's standard presentation material (audio visual production) Available livelihood and employment opportunities, e.g. train operation, necessary skills and the schedule of skill training/hiring per LGU Information on the process of resettlement

Source: JICA Design Team and ADB.

2212. As of now, no official printed material for information disclosure has been reproduced. The proposed layouts for the print materials of the SCRP have undergone a pretest on April 4, 2019. The proposed materials are now undergoing a revision based on the results of pretesting activities. **Figure 11.2.1** to **Figure 11.2.5** show layouts used for a pretest of printed materials.

Figure 11.2.1 NSCR-Ex Poster

Figure 11.2.2 NSCR-Ex Brochure for the Grievance Redress Mechanism (Side A)

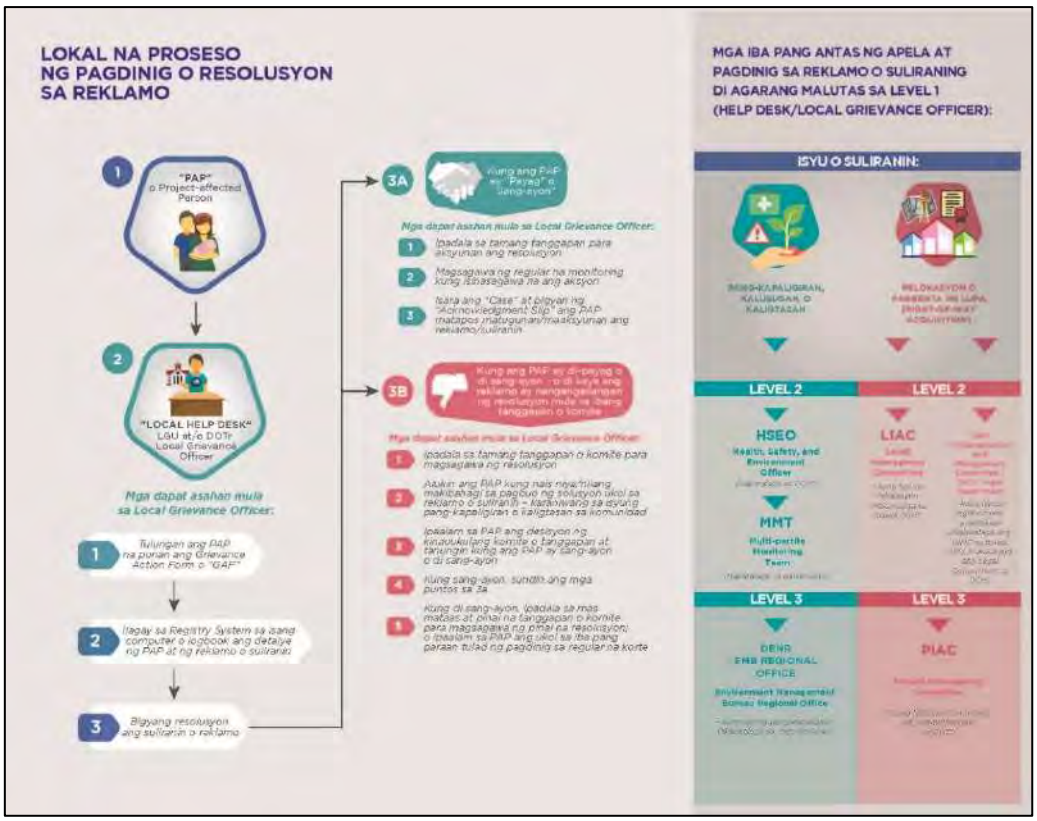


Figure 11.2.3 NSCR-Ex Brochure for the Grievance Redress Mechanism (Side B)

Figure 11.2.4 NSCR-Ex Information Brochure (Side A)

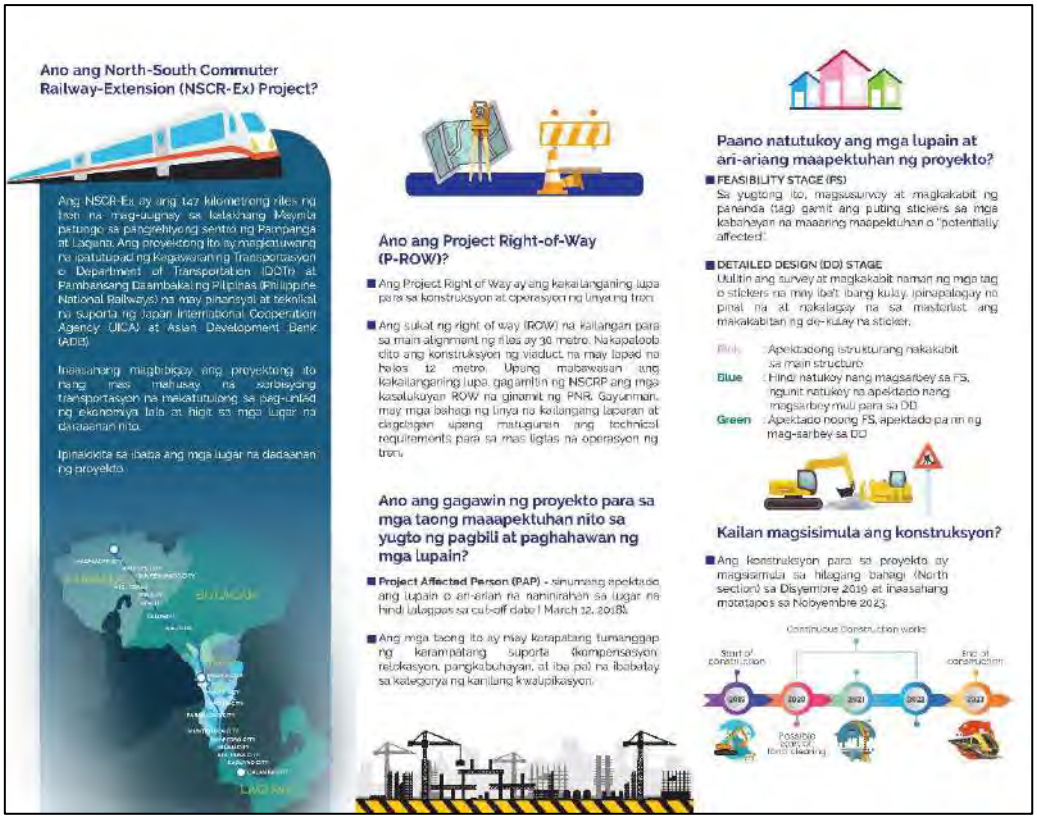


Figure 11.2.5 NSCR-Ex Information Brochure (Side B)

11.2.3.2. Online Disclosure of Project Information

2213. Official EIS reports as well as multi-media were uploaded to the respective websites of the agencies involved. The DENR-EMB, ADB and JICA used their official websites as a platform for online information disclosure, while the DOTr used social networks including Facebook and Twitter.

(1) Social Media

2214. The DOTr posts the project information using the project's public relations platforms by utilizing social media such as Facebook and Twitter as a venue for information dissemination and interactive engagement with the wide range audience. Photographs, videos and stories regarding the project have been posted on the project's Facebook and Twitter accounts set up in February 2019.

Table 11.2.38 Social Media Accounts of the Project

Media Name	Account Name	Logo
Facebook	North-South Commuter Railway Project https://www.facebook.com/northsouthcommuterrailway/	
	Department of Transportation https://www.facebook.com/DOTrPH/	
Twitter	Overheard sa Biyahe https://twitter.com/OSBiyahe	

Source: JICA Design Team

(2) Online Newspaper

2215. Another medium for online information disclosure is the publication of articles on well-known news websites. Available information on the SCRP regarding its launch, loan agreements, bidding and description was disclosed starting from May 2015 to March 2019. The SCRP main line and SCRP interconnecting line are currently in the detailed design phase and feasibility study phase, respectively which explains the absence of articles with more elaborate information.

Table 11.2.39 Articles Released on Online Newspapers

News Agency	Subject	Date	URL
Railway Pro	Philippines to launch tender for Phase 2 of North-South rail project	May 7, 2015	https://www.railwaypro.com/wp/philippines-to-launch-tender-for-phase-2-of-north-south-rail-project/
Manila Bulletin	First-ever subway in Metro Manila could be partially operational by 2020	March 20, 2018	https://news.mb.com.ph/2018/03/19/first-ever-subway-in-metro-manila-could-be-partially-operational-by-2020/
Rail Journal	Japan and Philippines sign loan agreement for north-south commuter railway	January 22, 2019	https://www.railjournal.com/passenger/commuter-rail/japan-philippines-sign-loan-agreement-north-south-commuter-railway/
Rappler	Gov't to bid out Phase 2 of North-South rail project in May	May 7, 2015	https://www.rappler.com/business/industries/208-infrastructure/92421-north-south-railway-ppp-bid
Business World	Invitations issued to bid for last rail deals in Malolos-Clark line	May 19, 2019	https://www.bworldonline.com/invitations-issued-to-bid-for-last-rail-deals-in-malolos-clark-line/
Business World	21 firms show interest in Malolos-Clark railway contract	March 11, 2019	https://www.bworldonline.com/21-firms-show-interest-in-malolos-clark-railway-contract/
Philippine Information Agency	PNR Clark Phase 2 catching up with Phase 1	March 10, 2019	https://pia.gov.ph/news/articles/1019521
Manila Bulletin	PH's first-ever subway starts construction — DOTr	March	https://news.mb.com.ph/2019/12/25/phs-first-ever-subway-starts-construction-dotr/

Source: JICA Design Team.

11.2.3.3.Media Release/Press Briefing

2216. The DOTr prepares media releases and press briefings prior to the project's milestones such as the project's launch or the start of civil works to inform the wide audience. **Table 11.2.40** shows released information related to the project.

Table 11.2.40 Media Release

Agency	Subject	Date	URL
DOTr	PHL, Japan Sign Exchange of Notes for North-South Commuter Railway Extension Project	November 22, 2018	http://dotr.gov.ph/55-dotrnews/674-phl-japan-sign-exchange-of-notes-for-north-south-commuter-railway-extension-project.html

Source: JICA Design Team.

12. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

2217. The proposed South Commuter Railway Project aims to provide a commuter and intercity railway service connecting Metro Manila and its adjacent northern and southern suburban areas and is deemed to be an important mass transit backbone for Metro Manila as well as for the growth corridor of the Greater Capital Region (GCR), comprising of Region III, National Capital Region (NCR) and Region IV-A.

2218. The project is classified as environment Category A project as per ADB SPS requirements. Accordingly, this comprehensive EISR has been prepared. This EISR including EMP fulfill the policy and regulatory requirements of the Philippine Environmental Statement System (PEISS), the ADB SPS 2009, and the JICA Guidelines for Environment and Social Considerations (2010). The necessary Environment Compliance Certificates (ECC) for the project have been issued by the Philippines Department of Environment and Natural Resources through the Environmental Management Bureau (DENR-EMB).[1]

2219. The alignment of the proposed South Commuter Railway Line and depot areas are not located in any environmentally sensitive or protected areas. Environmental screening and assessment of likely impacts and rating of risks shows that with implementation of mitigation measures the project will not result in significant residual environmental impacts.

2220. The main impacts of the proposed South Commuter Railway Project are the relocation of the residents living along the right of way, diversion/relocation of utility facilities, removal of trees, blockage of access roads, and the generation of dust, noise and vibration during construction; and noise impacts on communities adjacent to the railway during operation. Spoils generated by project, primarily during tunneling works, will be hauled into pre-designated disposal areas where soil erosion control measures will be applied. The project will help improve the condition of traffic by providing a faster and less polluting public mass transport. The grade-separated railway line will effectively minimize community severance along the line, reduce the risk of flooding and ensuring high level of operational safety. There may be health and safety risk due to increase in heavy equipment and machineries during construction.

2221. Specific measures to address these concerns are included in the EMP. Sound construction site safety management systems and careful planning and implementation of rerouting schemes including early installation of traffic signages in consultation with local government units (LGU) will be essential to minimize safety risks and avoid excessive temporary traffic disturbance. Contractors will be required to strictly adhere to core labor standards, and to provide HIV-AIDS and COVID-19 risk awareness and prevention programs to construction workers.

2222. DOTr also commits to conduct regular monitoring activities to monitor and evaluate its performance in implementing the mitigating measures. Environmental monitoring requirements are defined in chapter 8 (Environmental Compliance Monitoring, or EMoP), chapter 10 (Institutional Plan for EMP Implementation) and chapter 6 (Social Development Plan) of the EISR. The EMoP will ensure that relevant mitigation measures provided in the EMP are timely implemented and corrective actions may be formulated if these are found inadequate or

[1] ECC-CO-1807-0018, issued by DENR-EMB on 13-Aug-2018; ECC-CO-1708-0017, issued on 25-Oct-2017 with Amendment of ECC-CO-1708-0017 issued on 22-Nov-2019 by DENR-EMB.

unsuitable as also required by JICA and ADB safeguard policies.

2223. A comprehensive analysis of noise impacts shows that during construction stage, active construction areas will experience increased noise levels. Pier construction will generate the most severe noise impacts. A 3-m temporary barrier made of wood or metal confining the active construction area is enough to reduce construction noise to Ldn 60 dB(A) during footing construction activities, resulting to no residual impacts. The construction of the pier heads where the noise sources are elevated and higher than the noise wall may result in temporary noise disturbance. For the underground section the construction impacts will be mostly associated with noise generated from the cut and cover activities and the TBM launching at FTI station. The United Hills Village and United Paranaque Village were identified as the sensitive areas around cut and cover areas. Installation of a 290m long, 3m high perimeter wall around the construction area, mainly on the eastern boundary of area around FTI station, will be adequate to reduce the impacts within 3 dB(A) as required in the IFC-EHS guideline.

2224. Increased noise levels are anticipated from the operation of the project line at elevated sections. Installation of a continuous 1 m high concrete wall throughout the alignment will keep the noise levels within 3 dB(A) as required in the IFC-EHS guideline, except 887m length in three sections all in Makati City i.e. from chainage 10+464 to 10+743, north bound; from chainage 12+577 to 12+970, north bound; and from chainage 13+093 to 13+288, south bound. A composite noise protection wall with a vertical element of 3.0 m, and on top two elements of 0.25 m and slope of 45 degree will be provided at these three locations. Besides these, other measures such as optimize the number of train operation at nighttime to reduce generated noise; provision of noise control device such as muffler to all stationary sources (i.e. generator set); and regular inspection and proper maintenance of trains and tracks to reduce operational noise are proposed. Overall, the impacts of noise are expected to result in a moderate increase in ambient noise levels, confined to local construction sites away from noise-sensitive receptors and limited to daytime period and short in duration. The project will result in moderate residual noise impacts during operation phase.

2225. Analysis of vibration impacts following the FTA guidelines shows that adverse impacts are expected mainly during construction stage for viaduct and operations of the TBM. Two sensitive receptors to ground-borne vibration were identified along the proposed Senate-FTI underground section and these include the numerous structures within the Philippine Airforce Villamor Air Base and National Nutrition Council (NNC) Nutrition Building. The predicted vibration levels during tunnel boring was estimated at 0.26mm/s which is lower than the 2.5mm/s guideline value and no damages are expected from TBM operation. The predicted level is low enough not to cause disturbance, startle, cause annoyance or interfere with work activities. Vibration monitoring will be conducted during tunneling works at these two sensitive receptors. During operation of the underground section, the predicted ground borne vibration was estimated at 59 VdB and 53 VdB at the ground floors of the buildings in the Villamor Air Base and the NNC, respectively. These values are within the assessment criteria value of 75 VdB for institutional land use. This indicates no adverse impact from vibration is anticipated during operation of the underground section. However, measures such as regular inspection, proper maintenance and reconditioning of trains and tracks such as rail grinding, slip-slide detectors and maintenance or replacement of suspension system, brakes and wheels etc. are included in the EMP. With these measures the project is not anticipated to result in any residual vibration impacts.

2226. Meaningful public consultation and information disclosure was undertaken during EISR preparation. Several thousand potentially affected people and key stakeholders were consulted

through meetings, public hearings or focus group discussions. In general, the proposed SCRP was supported by potentially affected people. The LGUs and local residents appreciated that the proposed SCRP will offer express commute to Metro Manila and its adjacent northern and southern suburban areas, improve the traffic scenario in the region and lessen the air and noise pollution from vehicles. Meaningful consultation will continue during project implementation in accordance with the information, education and communication (IEC) framework developed for the project. The scope of the Grievance Redress Mechanism (GRM) established for the Malolos-Clark Railway Project will be expanded to cover the SCRP. Grievance redress officers for the SCRP have been recruited under the NSCR Ex-PMO. In addition, local government units will have each designated grievance redress officers to manage and monitor grievances on the project. These officers will be trained of the processes by the GR officers of the NSCR Ex-PMO.

2227. Best available technology and best management practices are built-in to the project design. All project components will be implemented and monitored in line with standards of Philippines, ADB and JICA safeguard policy requirements, and international good practice. Of special note is that the Senate-FTI tunnel section and all stations will adhere to fire safety and emergency preparedness and response requirements of the NFPA 130 standard (and related standards referred therein), ensuring compliance with international good practice for underground railway systems.

2228. As the executing agency (EA) for the Project, DOTr is responsible for ensuring compliance of the project with the conditions of the ECC. Further, DOTr will ensure that all the provisions necessary for implementing the EMP and the EMoP – including budgets and agreements with other concerned national and local government agencies – are included in all contracts in compliance with JICA Guidelines (2010) and ADB's Safeguard Policy Statement (SPS, 2009). DOTr is also responsible for adequately staffing the NSCR Ex PMO and establishing the Environmental Guarantee Fund (EGF) for the project. The proposed project institutional set up includes adequate personnel to implement, monitor and report on environment safeguards. DOTr will delegate EMP implementation responsibilities to the following entities: (i) The NSCR-Ex PMO and its Environment, Social, ROW and Legal Division (ESRL); (ii) the general consultant (GC); (iii) the contractors (including sub-contractors); and (iv) the external monitoring agent (EMA) who will independently verify compliance with the requirements of the environmental management plan for the Project.

2229. Based on the analysis of information and feedback received from various stakeholders, this EISR concludes that potential significant impacts from the project can be addressed and it is unlikely that there will be any significant residual environmental impacts.

B. RECOMMENDATIONS

2230. The project is still at preliminary design phase, with detailed engineering design (DED) ongoing for the main elevated railway section including stations; DED for the underground segment is yet to be initiated. As part of the DED, DOTr will conduct, or instruct the General Consultant to conduct, supplemental environment and safety investigations and assessments. These will include, but not be limited to: independent audit on tunnel safety, emergency preparedness and response plan (EPRP) aligned with regulatory requirements of the Philippines as well as international good practice as per requirements of NFPA130; traffic impact assessment and development of traffic management plan; groundwater impact assessment for the tunnel section; monitoring of vibration levels at sensitive locations i.e. at the Philippine Airforce Villamor Air Base and Philippine Nutrition Center (PNC) prior to and during

tunneling works.

2231. This EISR will be reviewed and refined to include more field data and detailed analysis based on project site conditions and accordingly the mitigation measures recommended in this EISR will be refined and revised, including adjustments in environment management budget. Hence, this draft EISR will be subject to further review and revision prior to contract awards.

2232. For all contract packages under the SCRP, the final EMP will be included in the respective bidding documents before starting the tendering process. DOTr will take necessary measures to ensure appropriate staff and consultants are recruited as proposed in the institutional arrangements section.

2233. The Project is currently at appraisal stage, and although no major changes in the Project design and location are anticipated, this EISR may need updating for any change in design prior to start of civil works or during construction stage.

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