Technical Assistance Consultant's Report

Project Number: 39500
February 2010

Socialist Republic of Viet Nam: Preparing the Ho Chi Minh City Metro Rail System Project
(Financed by the Japan Special Fund)

Prepared by

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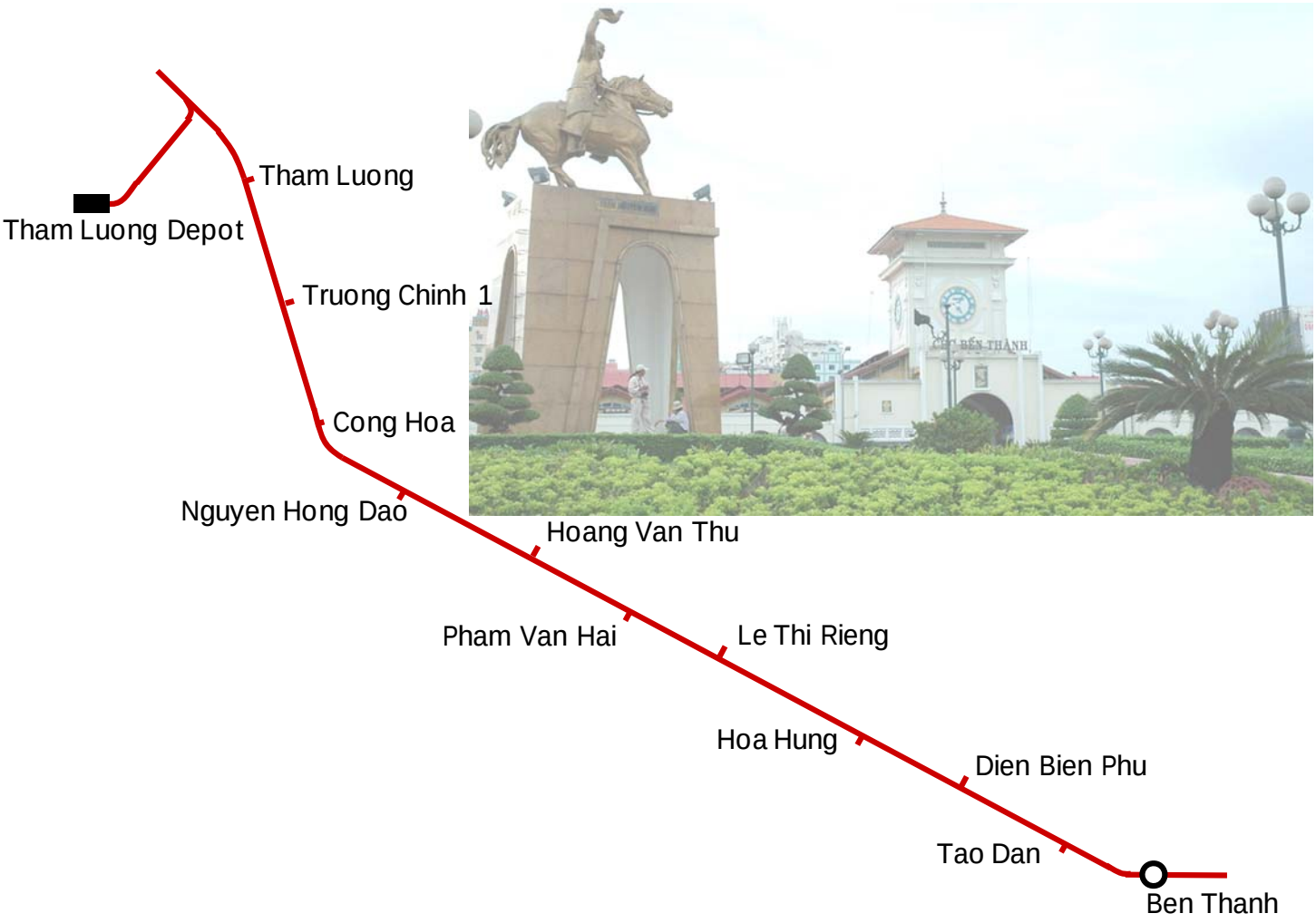
For Ho Chi Minh City People's Committee (HCMC PC)
Management Authority for Urban Railways (MAUR)

Asian Development Bank

Ho Chi Minh City People's Committee
Management Authority for Urban Railways

Ho Chi Minh City
Urban Mass Transit Line 2 Project

ADB TA 4862-VIE



Final Report - Revised
February 2009

MVA ASIA LIMITED

In Association with

SYSTRA TDSI South TEDI TRICC Vision Associates

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ABBREVIATIONS

ADB	Asian Development Bank
AP	Affected Person
CP	Compensation Plan
CPC	Commune Peoples' Committee
DARD	Department of Agriculture and Rural Development
DCC	District Compensation Committee
DMS	Detailed Measurement Survey
DOC	Department of Construction
DOF	Department of Finance
DONRE	Department of Natural Resources and Environment
DPC	District People's Committee
DPI	Department of Planning and Investment
DTUPW	Department of Transport and Urban Public Works
EMA	External Monitoring Agency
FS	Feasibility Study
GOV	Government of Viet Nam
HCMC	Ho Chi Minh City
HOUTRANS	The Study On Urban Transport Master Plan And Feasibility Study In Ho Chi Minh Metropolitan Area
IFI	International Financial Institution
IOL	Inventory of Losses
JBIC	Japan Bank for International Cooperation
LURC	Land Use Rights Certificate
MARD	Ministry of Agriculture and Rural Development
MAUR	Management Authority of Urban Railways (MAUR)
MOF	Ministry of Finance
MOLISA	Ministry of Labor, Invalids and Social Assistance
MONRE	Ministry of Natural Resources and Environment
MOT	Ministry of Transport
MRT	Mass rapid Transit
MVA	MVA Asia Limited
NGOs	Non-governmental Organizations
OCS	Overhead Catenary System
PC	People's Committee
PMT	Project Management Team
PPC	Provincial People's Committee
pphpd	Passengers per hour per direction
PPIAF	Public Private Infrastructure Advisory Facility
PPTA	Project Preparation Technical Assistance
PT	Public Transport
SES	Socio-Economic Survey
TA	Technical Assistance
TUPWS	Transport and Urban Public Works Services
UMRT	Urban Mass Rapid Transit
UMRT2	Urban Mass Rapid Transit Line 2
VND	Viet Nam Dong
VRA	Viet Nam Railway Administration, Ministry of Transport

Acknowledgements

This and other PPTA Reports have been produced with the assistance of many people. The Project Team would like to thank everyone who has given their time in meetings and in the provision of information.

Thanks go to the People's Committee of Ho Chi Minh City for its support and strategic guidance. Many thanks also to Mr. Nguyen Do Luong and his staff at the Management Authority for Urban railways, in particular Mr Le Hong Ha, Mr Nguyen Van Quoc, and Mrs Tran Thi Anh Nguyet.

This project would not have been possible without the active participation of a wide range of stakeholders and the Project Team would like to express its thanks for the enthusiastic cooperation and interest shown by numerous individuals in government agencies, community groups, church groups and the private sector.

Disclaimer

The views expressed in this report are those of the consultant team, unless otherwise indicated. They are not necessarily the views of the Asian Development Bank or of the Government of Vietnam.

1 INTRODUCTION

1.1 Background and Scope

1. This is the Final Report of a study financed under a Project Preparation Technical Assistance (PPTA) by the Asian Development Bank (Project Number 4862–VIE).

2. In January 2007 the Prime Minister approved a Transport Master Plan for Ho Chi Minh City (HCMC) that includes an urban mass rapid transit (UMRT) system consisting of six lines. The Government of Viet Nam requested the Asian Development Bank (ADB) to provide a loan to implement two interconnected lines, Line 2 – Tham Luong – Ben Thanh and Line 3 – Binh Tan – Ben Thanh. The PPTA was commissioned in order to clarify the scope and feasibility of the proposed lines, and to prepare a plan to support project implementation, including institutional and staffing arrangements, capacity building, financing options, and an implementation program.

3. The first stage of the PPTA was a review of the UMRT proposals in the master plan. Following the master plan review the consultants recommended that UMRT Line 1 be extended to the west and absorb the western section of the UMRT Line 3, from Dai Lo hung Vuong/Nguyen Thi Minh Khai intersection to Mien Tay bus terminal. This was agreed in principle by ADB and the consultants were subsequently instructed to focus the remaining components of the PPTA on UMRT Line 2 only. UMRT Line 1 is currently under detailed design.

4. The consultants also proposed to extend UMRT Line 2 to the northwest from Tham Luong to An Soung, about 2.5km, and to southeast from Ben Thanh to the Saigon River on Ham Nghi, about 0.5km. These extensions were agreed but, due to cost constraints, were not ultimately included in the project designed under this PPTA.

5. It was also agreed with MAUR and ADB that the consultants should not include the ticketing system, and Ben Thanh station in the feasibility studies and preliminary designs. It is proposed that these will be considered under separate projects.

6. The scope of this project is therefore the construction of about 12 km of metro line, including a link to the proposed depot. The project includes the construction of 10 stations (not including Ben Thanh) and the depot. It also includes provision of rolling stock. The project scope and alignment are described in Chapter 4.

1.2 Supporting PPIAF Studies

7. To support the work of the PPTA, the ADB mobilized a grant from the Public Private Infrastructure Advisory Facility (PPIAF) to develop appropriate short term and longer term implementation and management arrangements for MRT in the context of wider urban transport, including options for how best to optimize private sector participation in MRT.

8. The objectives of the PPIAF technical assistance (TA) included developing (i) a framework for considering private sector participation in implementation and operation of the Project; (ii) a value-for-money analysis for implementation approaches that involve varying degrees of private sector participation, (iii) a detailed financial model reflecting the preferred approach and measuring the performance of the project from the points of view of the government and private sector participants; and (iv) a stakeholder feedback and a description of necessary institutional and contractual arrangements given the preferred implementation approach

9. A summary of the PPIAF work and outputs is provided in Appendix G.

1.3 Laws, Decrees, Decisions and Other Documents Supporting the Project

10. Key decisions and other documents supporting the project preparation include:

- Letter No. 1464/CP-CN dated October 06, 2004 of the Prime Minister of Vietnam ratifying main contents of the Pre-Feasibility Study of Two Priority Lines of the HCMC Metropolitan Rail System;
- Decision no.1551/QD-UBND dated 10 April 2007 of the city People's Committee approving the Technical Assistance Project "Preparing Metro project in Ho Chi Minh City" funded by the Asian Development Bank.
- No.: 2442/QD-UBND dated 04 June 2007 of the of the city People's Committee approving the Bidding Plan for Technical Assistance Project "Preparing Metro project in Ho Chi Minh City" funded by Asian Development Bank.

1.4 Purpose of the Report

11. This Final Report presents the results of the feasibility studies and preliminary engineering designs of UMRT Line 2. It has been prepared to assist ADB and HCMC PC in determining the technical, economical, financial and environmental feasibility of the project. It is also intended to assist HCMC PC in processing the necessary approval documentation.

1.5 Report Organization

12. The Final Report is comprised of the following nine chapters:

- **Chapter 1: Introduction.**
- **Chapter 2: Project Context** presents the project's demographic, social and environmental conditions, the historic trends in transport demand and supply, and the recent government policies in urban and transport development.
- **Chapter 3: Transport Master Plan & Patronage Demand Forecasts** summarizes the current UMRT development plans, the potential future UMRT demand, recommendations for optimal UMRT network development, and the design parameters of Line 2.
- **Chapter 4: Propsed Metro Line** presents the project's scope, location, alignment and rolling stock.
- **Chapter 5: Service Operations Plan** outlines the characteristics of the proposed metro services on Line 2 including traffic volumes, train capacities, headways etc.
- **Chapter 6: Capital and Operating and Maintenance Costs** sets out the main components of the costs of constructing the project, and the anticipated operating and maintenance costs for the system once it is up and running.
- **Chapter 7: Social and Environmental Safeguards** summarizes the land acquisition and resettlement aspects, the social analysis and poverty assessment, and the initial environmental examination and monitoring program.
- **Chapter 8: Economic and Financial Assessment** presents the economic analysis, the financial analysis, and the financing analysis.
- **Chapter 9: Project Implementation** presents the aspects related to the project implementation, including project approvals, institutional arrangements and capacity building, sources of finance, and risk identification and management.

13. There are several Appendices including the civil works, detailed costs, financial and economic analyses, financial management assessment, and a summary of the PPIAF reports.

1.6 Other Reports

14. This Final Report summarizes the results of studies that have been reported in detail in a series of other reports and papers, including reports prepared under the PPIAF (see section 1.2 above). These include the following:

PPTA Reports

- Alignment Review and Project Concept, August 2007
- Mid-Term Report, December 2007
- Project Context and MRT Master Plan Report, December 2007
- Ridership and Revenue Forecast Study, January 2008
- Technical Paper on Bus Services Restructuring, July 2008
- Environmental Impact Assessment, November 2008
- Resettlement Plan, November 2008

PPIAF Reports

- Financial Modelling Working Paper and Model, June 2008
- Fares and Ticketing Working Paper, June 2008
- Issues and Options for Private Sector Participation and Concession Template Working Paper, April 2008
- Implementation Arrangements: Institutional Options Working Paper, March 2008
- Stakeholder Engagement Plan, March 2008

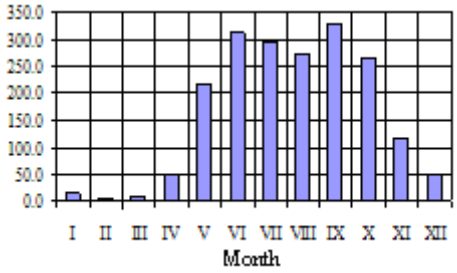
2 PROJECT CONTEXT

2.1 Local Conditions

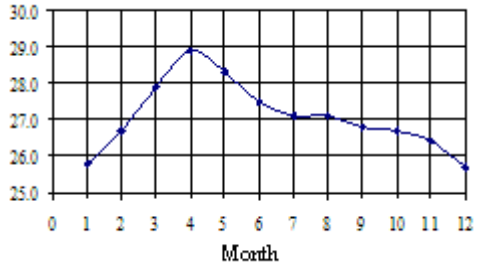
2.1.1 Climate

15. Ho Chi Minh City is fairly warm and humid year-round, with highest temperatures averaging 29C in May, and lowest at around 26C in December / January. Humidity is fairly constant at around 80%, and there is a distinct wet season between May and October when tropical showers and thunderstorms are frequent.

Figure 2.1-1: Climatic Conditions



Rainfall (mm)



Average Temperature ^{o}C

16. Climatic conditions are not well suited to walking more than short distances, particularly during summer months – and this is confirmed from observations of existing travel characteristics. Conditions for construction are better in winter, though not impossible during the summer due to the generally brief and predictable rainfall patterns.

2.1.2 Geology and Hyrdrology

17. Ho Chi Minh City is situated over a thick accumulation of quaternary loose sediment layers, overlying layers of stiff clays and dense sands. This results largely from the accumulation of particles carried and deposited by the Saigon River. It is observed that the constitution of soils in Ho Chi Minh City varies considerably depending on their vertical and lateral distribution.

18. Water level is usually 1 m to 3 m below ground level but the level may vary with different factors like tide. Another aquifer lies in the sandy clay layer 40 m below ground level

19. Overall the distribution of the geotechnical units along the Line 2 tunnel alignment is well documented on the first 40m below ground level. However, almost no data is available deeper than 40m bellow ground level and very little data at this depth is available for the elevated section. Additional boreholes, reaching a depth of more than 50m are needed, in particular at the station locations, to clarify the position of the boundary between the clay and sand layers, and on the aerial sections in order to precisely determine the level of foundations of the viaduct. These investigations were specified early in the FS, but data could not be made available during the timeframe of the study, and the feasibility study is therefore presented on the basis of the data available.

2.1.3 Topography

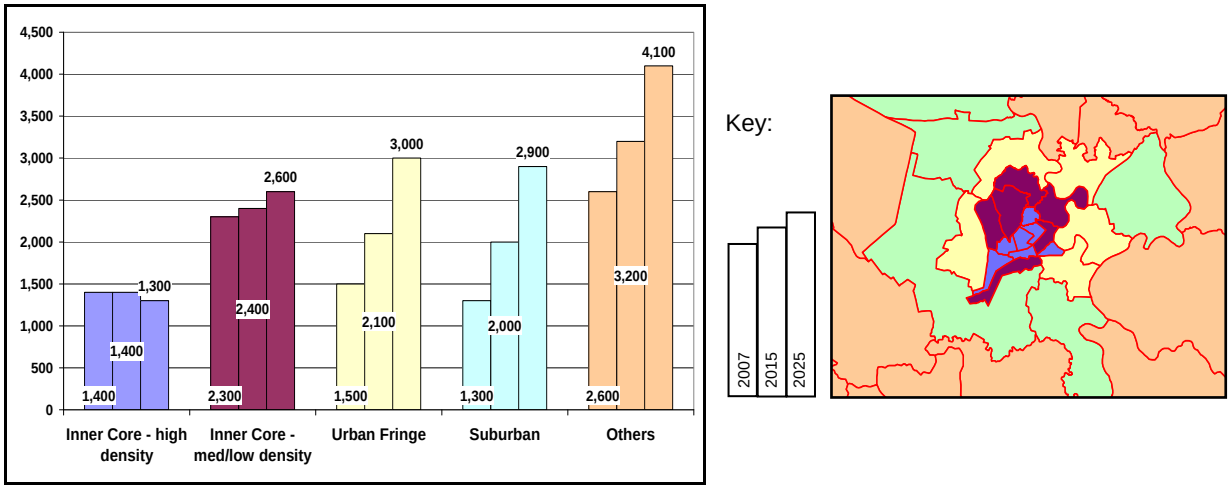
20. Ground levels along the route of the alignment are fairly flat, as is typical of most of the urban area of Ho Chi Minh City. Levels are generally around +3m to +4m, with a low of +2.2m near Ben Thanh, and a high of +5.5m.

2.2 Socio-economic and Demographic Circumstances

21. The last national population census in Vietnam was in 1999. For the purposes of the project estimates of population at base year (2007) and design years (2015, 2025) were made based on the projection data in the reports from HOUTRANS[1] and from the Study on the Adjustment of HCMC Master Plan[2].

22. In 2007 the estimated population of Ho Chi Minh City was over 6.5 million, growing at around 2.9% per year. In addition, more than 2.5 million people live in the adjoining provinces of Lan An, Dong Nai and Binh Duong, totalling more than 9 million people in the Study Area. It is forecast that the Study Area population will reach over 13.8 million by 2025, with 10 million people in HCMC[3]. Most of the population growth is projected to happen in outer areas (the urban fringe, suburban and other outlying communities), while the inner core areas are projected either to decrease their populations (in high density areas) or increase moderately (in medium/low density areas). (See **Figure 2.1-1** for a view of the estimated populations for 2007, 2015 and 2025 in the Study Area.)

Figure 2.2-1: Population Estimates (in thousands) for 2007, 2015 and 2025 by Study Area Types

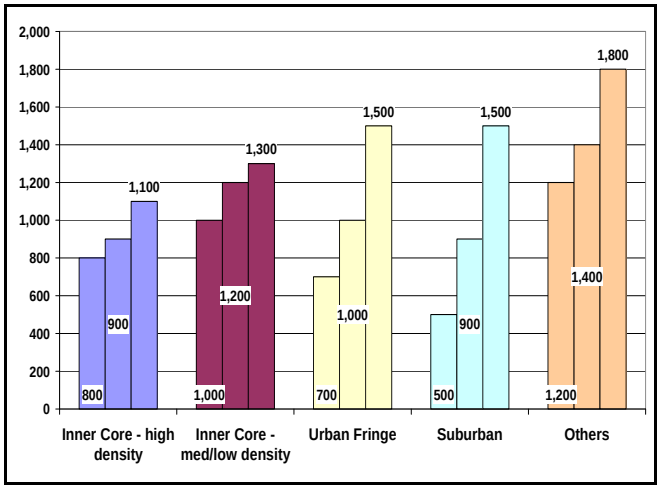


23. In 2007, HCMC employed more than 3 million people and the Study Area almost 4.2 million people. By 2025, it is projected that HCMC will employ more than 5.5 million people and the Study Area more than 7.2 million people. While the employment growth is projected to spread throughout the Study Area ore evenly, the outer areas are still expected to generate most of the future employment (See Figure 2.2-2 for a view of the projected employment for 2007, 2015 and 2025 in the Study Area.)

24. Viet Nam was among the world's fastest-growing economies with GDP growth rates above 7.0% in 2001-2004 and above 8.0% in the last three years. In 2008, The GDP growth forecast for 2008 is around 8.5%. HCMC is the largest city in Viet Nam and the primary centre of economic activity and, as such, its GDP growth has outpaced the national level growth: between 10% and 12% in 2001-2004 and more than 12% in 2004-2007. In the prospective future HCMC will continue to be the major centre of economic activity of the country.

[1] The Study On Urban Transport Master Plan And Feasibility Study In Ho Chi Minh Metropolitan Area (HOUTRANS), JICA, ALMEC, 2004
[2] The Study of the Adjustment of HCMC Master Plan up to 2025, Nikken Sekkei, Urban Planning Institute, April 2007
[3] For more details on socio-economic conditions the reader is referred technical documents prepared as part of the PPTA: Project Context and MRT Master Plan Report, December 2007, and HCMC Master Plan Ridership and Revenue Forecast Study, Final Report, January 2008.

Figure 2.2-2: Projected Employment in 2007, 2015 and 2025 by Study Area Types



Source: Project team

2.3 Historic Trends in Transport Demand and Supply

25. Since 2003 bus ridership in HCMC has grown steadily. Following the development of the subsidized public transport network ridership has grown from 130,000 daily in March 2003 (42 lines) to 605,000 in 2006 (110 lines). This has built public awareness and trust in the system. In July 2007, the weekday ridership was 675,000 passengers.

26. Despite the recent improvements to the bus system and rapid increases in bus network patronage, the current share of total motorised trips by public transport is still extremely low for a major international city, at less than 5%. The vast majority of trips are made by motorcycle. Car and taxi trips, whilst still a tiny proportion of the total, are increasing fast, and roads are rapidly becoming congested and dangerous due to the mix of traffic and pedestrians.

27. In 2007, private vehicles represented an abnormally high proportion (93%) of total journeys (19.1 million non-pedestrian journeys per day), broken down between motorcycles 78%, cars 1.2%, and bicycles 14%. Historically, car ownership has been lower than in comparable economies in the region. With continued growth of the economy expected in the medium term, there is significant potential for household incomes to rise, enabling many more families to be able to afford to purchase cars (particularly as on 1 May 2006 the Government again allowed used cars to be imported, a move that is expected to lead to falls in prices). Between 2004 and 2007, motorcycle ownership in Ho Chi Minh Province has grown at an annual rate of 8.4% to almost 3.1 million motorcycles. Private car ownership has increased even faster, at 20.7% per year to more than 200,000 vehicles and total car numbers (including taxis, other non-private owners) have grown to almost 400.000.

28. If current trends are not offset by better transport infrastructure and public transport systems, HCMC will face congestion, road safety, and air pollution difficulties similar to those in other large Asian cities such as Bangkok, Beijing, Manila, and Jakarta. The goal of HCMC People's Committee is to raise the share of public transport to carry 25% of all daily motorized trips by 2010 and 50% by 2020, a sharp increase from mid 2007 levels which were as low as 3% in the study Area.

2.4 Government Policies on Urban and Transport Development

29. Many relevant recent studies have been carried out concerning urban and transport development for HCMC. The most significant of the above studies in terms of identifying government policies and HCMC urban and transport master plan refinement is the "HCMC Transport Development Planning to 2020" completed in 2006, since this formed the basis for "Decision 101" and the Official Master Plan which were approved by the Prime Minister. This approved Master Plan targets public transport mode share of 22-26% by 2010-2015 and 47-50% by 2020, and proposes national,

suburban and urban rail networks to achieve this objective. The following chapter describes the current UMRT development plans derived from the approved Master Plan.

30. In addition, the approved Master Plan stresses the need for restraint on private vehicle use due to inability to develop the road network as fast as the rising (unrestrained) demand for private vehicle use. The report proposes three complementary measures:

- To develop the road network according to the principle “integrating road development into public transport development”: segregated lanes for buses and trams must be planned on cross-sections of bridges, roads or wide enough median must be reserved for development of light train, metro.
- To develop multi-modal public transport system with wide network; to organize “from-door-to-door” transport in order to create convenience for passengers.
- To manage demand; to limit private means in order to support development of public transport, by means of vehicle ownership restraint (high registration fees); high parking charges; road pricing charges on trips to central areas.

3 TRANSPORT MASTER PLAN & PATRONAGE DEMAND FORECASTS

3.1 The Approved Transport Plan

31. A Transport Network Master plan for HCMC was approved by the Prime Minister in January 2007. This plan is part of the recommendations for future transport development of the city, which envisage very high priority for public transport development. Modal share of travel in urban areas by public transport is targeted to be 40-50% by year 2025, compared with only around 5% today, and development of an urban rail network is seen as the backbone to achieve this.

32. The transport plan features a network of urban rail lines as shown on Figure 3.1-1. The urban rail network comprises 6 Metro rail (MRT) lines with total length of 109km, as well as two monorail routes, and a tramway.

Figure 3.1-1 Approved HCMC Transport Master Plan MRT Lines

33. Four priority MRT lines have been identified, and it is planned for these to be implemented by 2015:

- Line 1: Ben Thanh – Suoi Tien, 19.7km (shown in yellow on the Figure)
- Line 2: Tham Luong – Ben Thanh, 12.3km, with planned extension across the river to Thu Thiem (red)
- Line 3: Mien Dong – Phu Lam, 13km, with planned northern extension (dark blue)
- Line 4: Nga Sau Go Vap – Khanh Hoi, 11.3km, with planned extensions in both directions (green).

34. The other urban rail lines on the master plan are understood to have secondary priority, but are intended to be in place by 2025:

- Line 5 – a northern inner semi-loop line (purple)
- Line 6 – a north-south section in the western suburbs (brown)
- Southern Monorail – through Districts 7 and 2 along Van Linh Parkway (grey)
- Northern Monorail – feeder service to Line 4 (grey)
- Tramway – along riverfront south of CBD (black)

35. Four suburban train operating services are proposed in the master plan, where suburban trains operate together with long distance trains along existing VNR corridors (shown in light blue on the Figure), as follows:

- Hoa Hung – Bien Hoa – Xuan Loc: 17km (on Trang Bom – Hoa Hung section under North – South Railway);
- Hoa Hung – Phu My: 50km (under HCMC – Vung Tau Railway);
- Hoa Hung – Chon Thanh: 81.5km (under HCMC – Loc Ninh Railway);
- Hoa Hung – My Tho: 70km (under HCMC – My Tho – Can Tho Railway).

36. Two further high-speed “LRT” lines are proposed to serve the development of new urban centres, industrial zones and new international airport, namely:

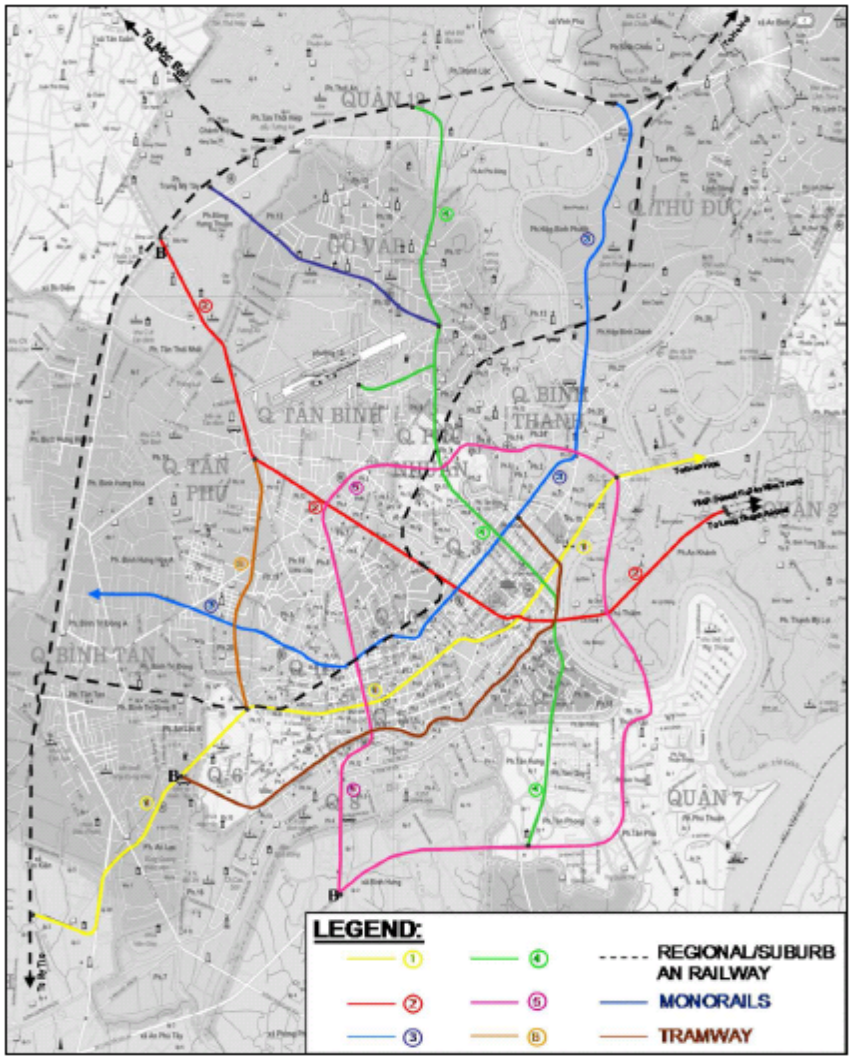
- Tan Thoi Hiep (near north-west corner of proposed Western Ring Railway) to Trang Bang (just beyond Cu Chi District in Tay Ninh Province). This line would be 33km long, and is eventually planned to extend further to Moc Bai on the Cambodian border;
- Thu Thiem – Nhon Trach – Long Thanh International Airport line is 56km long (serving the new urban area and airport).

3.2 Recommended Modifications to the Transport Master plan

37. As with any such plan, the Transport Network Master Plan provides a basis for future planning, but it must also be regarded as a “fluid” plan which is constantly under review as situations and policies change and develop. A major objective of the current study was to review the master plan, aiming to further optimize the network and provide a foundation for more detailed study of the individual lines. At the same time, it was recognized that the currently approved plan provides a framework for various agreements between the City and other parties, and as such no fundamental changes should be proposed in order not to put ongoing projects at risk.

38. One fundamental issue investigated was the extension of Line 1 in the city centre. It was generally agreed that terminating the line at Ben Thanh was not optimal from a network point of view, and various options were investigated for extending Line 1. The preferred option is to extend Line 1 westward onto the current Line 3 alignment. The remaining eastern section of Line 3 would then be relocated northwards for optimal network coverage, and extended to serve the western suburbs of the city which are not served by a radial MRT under the current master plan.

Figure 3.2-1 "Optimised" HCMC MRT Lines



39. Other revisions suggested for the master plan are summarised below, and the overall "optimized" MRT network is shown on Figure 3.2-1.

- Line 3 would be renamed and realigned as an extension to the southwest of Line 1 (as above);
- A new Line 3 running parallel to the northwest of the former Line 3 and across Line 2;
- Extend Line 2 northwards to An Soung bus terminal (about 3.7 km), in order to provide major interchange with buses and future regional rail;
- Realign Line 4 central section to bypass Ben Thanh market and run along the river instead – this improves station distribution in District 1, and simplifies the interchange station at Ben Thanh;
- Line 5 realigned as an MRT circular line, taking over the proposed southern monorail with mass transit in view of the expected high patronage;
- Extend and connect all lines radially outwards to connect with the future regional railways services;
- Extend the planned tramway northwards to interchange with the new Line 3, and to improve catchment in the CBD.

40. Extensive analysis was undertaken of various master plan improvement options using the transport forecasting models, and details of these tests and results are provided in the relevant Technical Paper. The alignment and engineering feasibility of the options was also reviewed in determining the preferred solutions. The indicative estimated changes and benefits of the proposed modifications to the master plan are summarized in Table 3.2-1 below. As can be seen, the improvements require an increase in MRT network of 11%, but increase in investment of only 8%, and yet a revenue increase of 16%.

41. At the time of writing this report, it is understood that the above recommendations are agreed by TUPWS, but not as yet incorporated in the official government master plan.

Table 3.2-1 Summary Comparison of Reference Case and the Possible Future Network

	Approved Master Plan (1)	Possible Future Network (2)	Difference (3) = (2)-(1)	Percent Difference (4) = (3)/(1)
MRT Km	144.37	160.67	16.30	11.3%
Investment Costs (million US$)	8,992	9,713	721	8.0%
Daily Revenues (million US$)	0.702	0.814	0.112	16.0%
Daily Passengers (million)	2.808	3.256	0.448	16.0%
Daily hours in public transport (thousand)[1]	2,658	2,593	-65	-2.4%
Investment (million US$)/MRT km	62.28	60.45	-1.83	-2.9%
Daily revenues (US$)/MRT km	4,862.51	5,066.28	203.78	4.2%
Daily passengers/MRT km	19,450.02	20,265.14	815.12	4.2%

Note 1: Includes rail and bus ridership.
Source: Own estimates.

3.3 Policy Measures and other Requirements

42. As noted, the vision of the HCMC transport plan for 2025 is to have 40-50% of all trips using public transport, with the MRT network providing the backbone of the future transport network. Today only around 5% of travel is by public transport, and this targeted shift in travel behaviour is a massive undertaking for the city, which will require many measures in addition to construction of MRT lines. Some of the key requirements are noted below.

3.3.1 Bus System Development

43. Even with the full MRT network in place, the target PT usage at 2025 implies over 9 million daily trips by bus (many of these would be on routes feeding the MRT). This compares with under 1 million today. Thus there is need for massive expansion of the bus system, including network coverage, fleets, operators, terminals, depots, etc. Furthermore, it is essential that prior to introduction of MRT, people are in the habit of using public transport, and experience shows that most of the early year patronage will be people switching to MRT from bus rather than from private vehicles.

44. Apart from building the MRT lines, development of the bus system and usage may be the biggest challenge for the city. In addition to the physical capacity and fleet requirements, measures needed will include:

- Improved franchising and tendering procedures
- Integrated or common ticketing systems to encourage usage
- Introduction of busways and bus priority measures
- Public awareness, advertising, etc
- Severe restrictions on private vehicle usage (see below)

3.3.2 Private Vehicle Demand Management

45. Improved public transport services will provide the opportunity to impose restraints on private vehicle usage to encourage use of the public transport services provided. Conversely, deterrent measures will be needed to "force" people to switch from private to public transport, in order to achieve the Government policy objectives. But such deterrent measures can only be implemented in conjunction with the PT enhancements.

46. Many measures will need to be considered by Government and some examples include:

- Since use of public transport involves walking to / from the services, major improvements to pedestrian circulation are required – clearance of parking from footpaths, safe road crossings, foot-bridges, weather protected walkways, and strict enforcement to ensure vehicles give priority to pedestrians.
- Make ownership of vehicles more expensive – higher vehicle import taxes, annual registration fees.
- Make usage of vehicles more expensive – significantly increased parking charges, fines for illegal parking, road pricing.
- Make usage of private vehicles less attractive – limit parking provision and availability, greater proportion of road space devoted to public transport and pedestrians.

3.4 Transport Demand Forecasts

3.4.1 Overview

47. Transport forecasts for the study were prepared using a state-of-the-art, 4-stage, multi-modal forecasting model based on the CUBE Voyager software. Model development, calibration, validation, forecasting assumptions and procedures are documented in the Technical Paper on forecasting.

48. The model coverage included the whole of the greater HCMC area together with parts of the adjoining Dong Nai, Binh Duong and Long An provinces. The population of the study area was 9.1 million in 2007, and is projected to reach 13.8 million by 2025. Transport demand forecasts were prepared for a base year of 2007 (for model validation), and forecasting years of 2015 (opening of Lines 1-4) and 2025 (completion of MRT master plan). Fares for all lines were assumed to be VND 4,000 per boarding at today's prices (i.e. adjusted for future years in line with inflation).

49. In order to reflect the Government policy objectives, forecasting assumptions and inputs for the models were set accordingly, reflecting the major policy and other measures as noted earlier. On this basis the model predicts 44% of trips at year 2025 by public transport to, from and within the MRT network area. Sensitivity tests were carried out to understand the implications on MRT patronage if these policy targets could not be achieved

3.4.2 Overall Travel Demands

50. Total transport demand for the study area at year 2025 is forecast to be 35M person trips per day, and at 2015 it is 24M. Mode share at each year is illustrated in Figures 3.4-1 and 3.4-2 below.

Figure 3.4-1 Year 2025 Mode Split (based on policy forecasts)

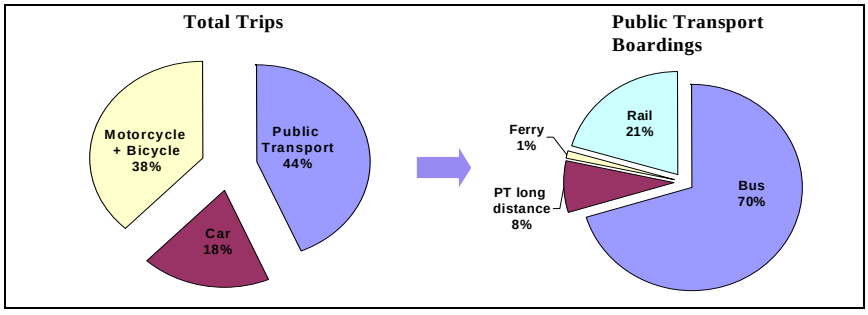
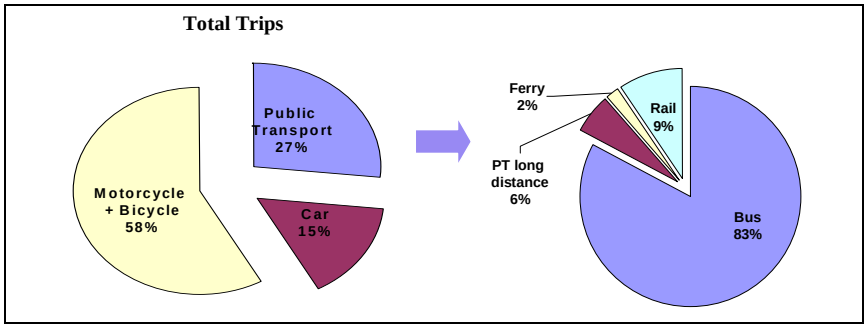


Figure 3.4-2 Year 2015 Mode Split (based on policy forecasts)



3.4.3 MRT Demand Forecasts – Year 2025 (full master plan)

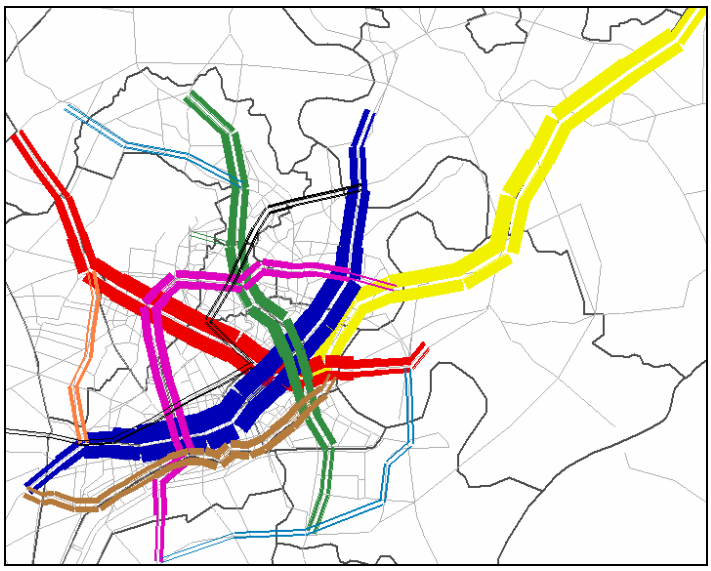
51. MRT demand forecasts were prepared for both the "approved" and "optimised" MRT network master plan scenarios. For the purpose of this report full results are presented for the approved plan, since this represents official policy. Forecasts for Line 2 are checked against the optimised network. Demand forecasts for each line under the approved master plan scenario are shown in Table 3.4-1 and Figure 3.4-3 below.

Table 3.4-1 Ridership Forecast per Line – Master Plan Case 2025

Line	Stations	Daily ridership	Peak Loading
1	14	386,000	25,300
2	18	594,000	26,600
3	17	670,000	21,500
4	14	364,000	13,200
5	18	352,000	9,200
6	7	69,000	2,900
Tram	22	290,000	8,100
XD2	8	60,000	2,000
XD3	4	23,000	1,500

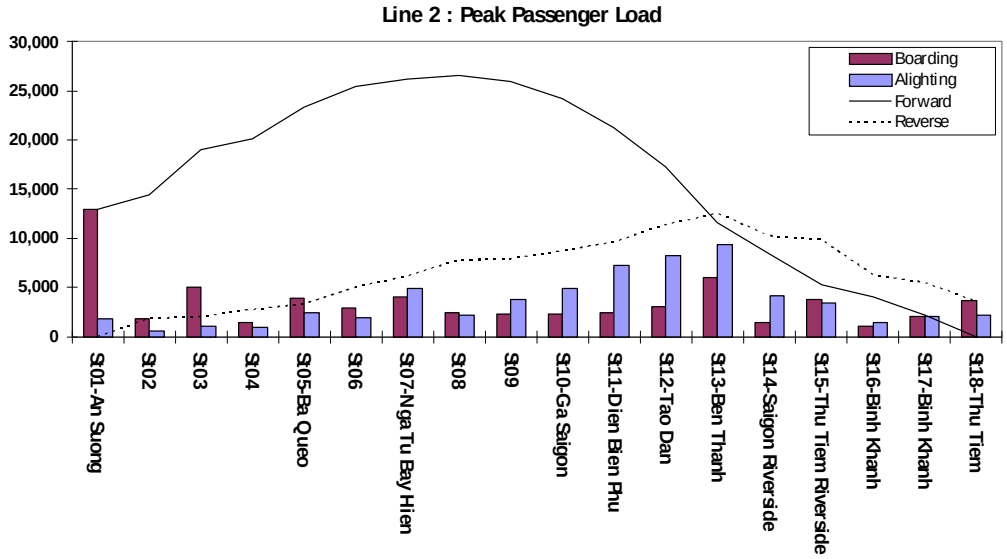
Source: Own estimates

Figure 3.4-3 Schematic of MRT Lines 2025 Demand Forecast – Master Plan Case



52. The morning peak hour station loadings for Line 2 under the above scenario are shown below. It can be seen that the terminal station at An Suong acts as a very major transport interchange with feeder and other buses, and that the busiest alighting stations are in the CBD, with Ben Thanh (interchange with Lines 1 and 4) being the busiest central station.

Figure 3.4-4 Peak AM Passenger Load in 2025 for Line 2 (complete length) – Master Plan Case



53. Under the "optimised" MRT master plan scenario it was found that Line 2 demands would be slightly less, at 551,000 passengers per day, and peak loading of 24,900 pphpd.

3.4.4 MRT Demand Forecasts – Line 2 "Project Line"

54. The ultimate master plan includes Line 2 running from An Suong in the northwest, across the river to terminate at Thu Thiem in the southeast, with a total of 18 stations. This feasibility study however presents the initial Line 2 "Project Line", running from Tham Luong in the northwest to Ben Thanh in the southeast, a total of 11 stations. In order to evaluate the Project Line it is therefore necessary to consider demand forecasts for the reduced line.

55. Forecasts for year 2025 were prepared with other assumptions as above, but with the project line of only 11 stations. Bus networks were restructured to optimise the project line, and thus the end station Tham Luong would provide the major interchange rather than An Suong with the full Line 2. Similarly, for 2015 Line 2 was represented with 11 stations, whilst the other Lines 1, 3 and 4 were included in the network.

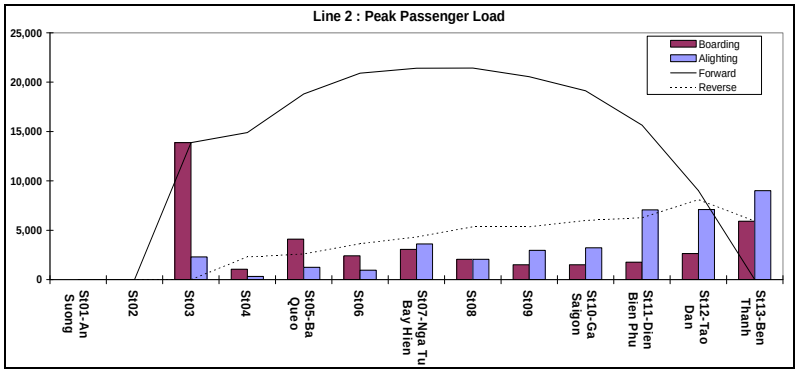
56. The forecast model was utilised to project 2015 and 2025 ridership demands. Beyond the 2025 time horizon it is difficult to predict metro patronage with any confidence. However these are required for financial analyses and estimates were calculated on the basis of a steady annual growth from 2025 to 2035 of 3.5%. This is similar to the growth rate used in projections for Line 4 from 2022 to 2037 (3.7%), a figure that reflects HCMC PC's public transport growth policy. Resulting forecasts are shown in Table 3.4-2 and Figure 3.4-5 below.

Table 3.4-2 Summary Demand Forecasts for Line 2 – Ben Thanh – Tham Luong

Year	Daily Boarding	AM Peak Load
2015	173,800	8,500
2025	481,700	21,400
2035[(1)]	679,500	30,200

[(1)] Considers 2025-2035 annual growth rate of 3.5%.

Figure 3.4-5 Peak Passenger Load in 2025 for Line 2 Tham Luong to Ben Thanh – Master Plan Case



3.4.5 Ultimate Capacity for Line 2

57. The forecasts above indicate the demand estimates for Line 2 at the key design years, and the project is designed on this basis for the purpose of this feasibility study. However it is worth noting that based on the proposed technology with minimum headways reduced to 2 minutes (the minimum feasible for the proposed system), the Line 2 is capable of providing a higher ultimate capacity. This ultimate capacity is estimated at between 40,000 and 60,000 pphpd, with the range depending on assumed passenger crowding of between 5 persons per m^2 (normal full loading) to 8 persons per m^2 (absolute crush conditions). To achieve this capacity would require improvements to signaling and access capacity, but demonstrates that the Line will be capable of serving well into the long term future for the city.

3.4.6 Transport Interchanges and Park'n'Ride

58. As noted, the demand forecasts have assumed that bus routes will be restructured so that the buses feed passengers to MRT stations, rather than providing a competing alternative mode. This implies that there will be high interchange demands between bus and MRT at MRT stations.

59. Furthermore, it is expected that there will also be high demand for interchange between private modes (car and in particular motorcycles) at MRT stations, as it may be attractive to many people to use their motorcycle to ride from their home to the MRT station, and then take the MRT into the city centre. This will be especially the case if policies are put in place to make motorcycle access and parking in the city centre prohibitively expensive or restricted (such policies will be essential if the high PT mode share is to be achieved).

60. The two main stations requiring bus "public transport interchange" (PTI) will be the end stations, Tham Luong and Ben Thanh, although it must be noted that Tham Luong may be an interim end station if the line is later extended to An Suong. At both of these stations it is recommended that suitably sized PTI's are planned and constructed integral with the MRT stations and surrounding areas

61. Demand for motorcycle parking is also expected to be particularly high at the terminal station (Tham Luong or An Suong), and it is recommended that a motorcycle (and car) "park'n'ride" facility be planned at this station, again to be fully integrated with the MRT station, PTI and surrounding land uses. There is expected to also be demand for motorcycle parking at most interim stations, since the line passes through areas of high residential density. It may not be necessary to provide parking at all stations, and it is recommended that opportunities are studied in conjunction with station area planning studies to determine optimal locations and integrated designs for park'n'ride facilities.

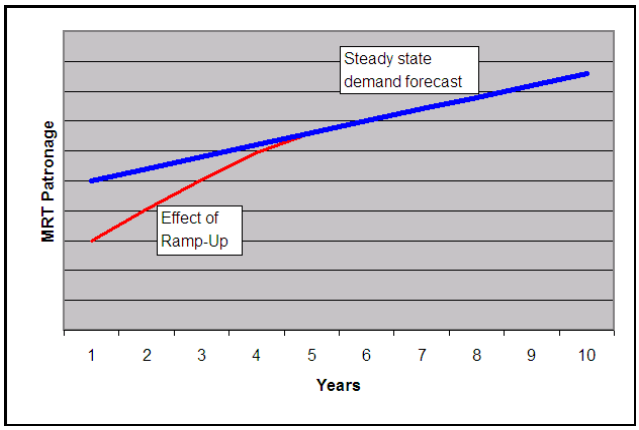
3.4.7 Ramp-Up

62. Experience with other new Metro systems both in Asia and worldwide shows that it usually takes some time before actual ridership patterns build up to those forecast by the demand models.

This is due to time taken for people to understand the new system, adjust their travel habits, and may also be affected by time taken to implement bus restructuring, to develop good station accesses to nearby buildings, and to implement the complementary policy measures to encourage usage of public transport. Ramp-up can also be affected by other "external" factors such as political or economic changes, fuel prices, and even natural disasters. The ramp-up effect and period can be significantly influenced by advertising and promotional campaigns both in advance of, and upon, opening of the new Line

63. Thus the extent of the ramp-up effect depends on many factors, and is very difficult to quantify precisely. Our estimate for HCMC Line 2 is based on experience in other cities, and in particular in Bangkok where the first Metro line opened in late 1999. In Bangkok it is estimated that opening year patronage was some 30-40% below "steady state" estimates, and that it took some 4-5 years for the effect to dissipate. The ramp-up effect on opening year patronage is illustrated in Figure 3.4-6 below.

Figure 3.4-6 Ramp-up Effect



64. On the basis of this ramp-up estimate, the economic and financial analyses of the project have incorporated the ramp-up factors shown in Table 3.4-3 below.

Table 3.4-3 Ramp-up Factors Applied to Demand Projections

Year	% of Model Demand Used
2016	60%
2017	85%
2018	92%
2019	97%
2020	100%

3.4.8 Sensitivity Tests

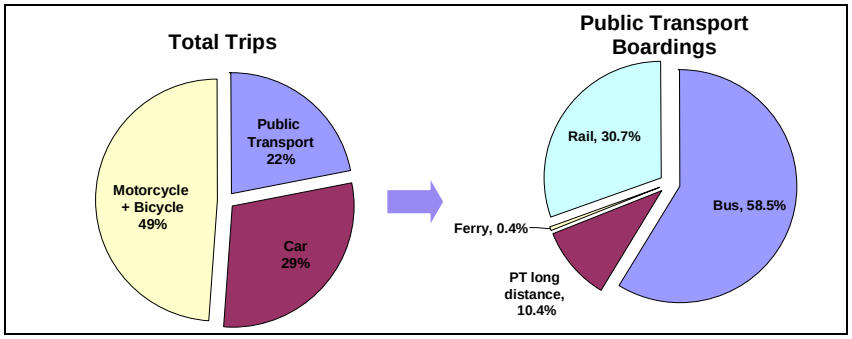
65. In order to understand the uncertainty and risk in the demand projections, a number of sensitivity tests were carried out. These are reported in detail in the Technical Paper and key findings are summarised below.

Trend Forecasts

66. As noted earlier, the above demand models were adjusted to reflect the Government "policy" objective of achieving 40-50% PT mode share by 2025. This will entail a massive shift in travel behaviour and introduction of some very strong transport and policy initiatives. Clearly there is a risk that this may not happen as quickly or to the extent targeted. Therefore forecasts were developed for a "trend" scenario – still based on major PT transport improvements and strong policy initiatives, but with parameter values based on the consultants' experience of what has been achieved in other cities.

67. This scenario resulted in a much lower PT mode share at 2025 as illustrated in Figure 3.4-7 below. Under this scenario ridership demand for Line 2 (still based on the master plan network) is estimated at 135,000 in 2015, and 405,000 passengers in 2025. These compare to 174,000 and 594,000 respectively under the master plan policy scenario.

Figure 3.4-7 Projected Modal Split in 2025 – Trend Case Scenario



Fare Sensitivity

68. The fare assumed on Line 2 (and other MRT Lines) in the forecasts above is VND4,000 per boarding (constant in real terms, ie adjusted for future years in line with inflation). Sensitivity tests indicated that this fare would be close to optimum for maximising revenues at year 2015, but that by year 2025 a higher fare of VND6-7,000 would yield higher revenues, as a result of increasing prosperity and hence willingness to pay for the premium service.

Bus Network and Bus Restructuring

69. Various tests were carried out on different bus network, speeds, interchange convenience, etc. The most significant of these was the implication of bus restructuring. In the base case forecasts it is assumed that bus routes are restructured on introduction of MRT such that there is no significant competition, and that the bus routes complement rather than compete with the MRT. In effect this forces PT passengers to use the MRT lines, thus ensuring good usage of MRT and minimising the need for road-based PT in the city centre.

70. Experience in other cities has shown that such restructuring does not always happen in practice. The model tests indicated a major impact on MRT ridership if buses are allowed to compete freely with MRT, with MRT ridership reduced by 18% overall, and for Line 2 up to 38%.

4 THE PROPOSED METRO LINE

4.1 Project Summary

71. This chapter describes the proposed metro line, including the alignment, stations and the rolling stock for which it has been designed. The civil works for the project are described in Appendix C. Additional analysis can also be found in various working papers submitted during the course of the PPTA (see section 1.6).

72. The main engineering components of the proposed project are summarised in Table 4.1.1 below.

Table 4.1-1: Summary of the Project Engineering Components

Components	
Underground line (includes garage at Ben Thanh)	9,575 m
Elevated line	1,563 m
Llink to depot (elevated and at grade)	1,100 m
Underground Stations*	9
Elevated station	1
Depot (including workshop)	1
Repair and maintenance equipment	1 set
Signaling system	ATC
Trains	12 x 3-car units

* Ben Thanh station is not included in the scope of Line 2, or Line 1, as it will be part of another project. (Ben Thanh Station of Line 1 also not included).

4.2 Design Overview

4.2.1 Design Objectives and Standards

73. The project has been designed bearing in mind the overarching objective to provide a user-friendly and convenient means of transport that will attract large numbers of passengers and thereby contribute to achieving the Government's high public transport usage targets. It is based on the use of large, high-capacity metro trains.

74. Design standards are discussed in detail in Appendix C and in Volume 2. For the purposes of preliminary engineering under this feasibility study a range of international standards have been used. These will be reviewed and amended if necessary during detailed design.

4.2.2 Type of Train and Power Supply

75. At the commencement of the project a number of rolling stock specifications were reviewed for their appropriateness to the HCMC metro system. Projected ridership is quite high by international standards and consequently Line 2 has been designed for the typical characteristics of a metro train of a size at the larger end of the scale.

76. Power is normally supplied to metro systems in one of two ways, either via a conductor rail alongside the track known as '3rd Rail' (usually 750V), or via an overhead catenary wire system (usually 1500V or 25kV).

77. Internationally both systems are widely used. Examples of metro systems using each type are **listed by region, country and city in Table 4.2-1. Both systems have advantages and disadvantages** and these need to be considered in the final selection of the preferred option. Public

safety is a prime concern particularly as the future projected frequency of trains is every 2 minutes in each direction. It will be essential to prevent any public encroachment onto the track at all times, whichever system is used.

Table 4.2-1: International Examples of Metro Power Supply

Region	Country	3rd Rail Systems	Catenary Systems
Asia	China	Beijing	Shanghai, Guangzhou, Shenzen
	Hong Kong		
	India	Kolkata	Delhi
	Japan	Tokyo, Nagoya, Sapporo, Yokohama	Tokyo, Osaka, Kyoto, & others
	Korea		Seoul, Incheon, Daegu, Busan, Daejon, Gwangju
	Singapore	MRT	
	Thailand	BTS, MRT	
	Taiwan	Taipei	
Europe	Czech Republic	Prague	
	Denmark	Copenhagen	Copenhagen
	France	Paris, Lyon, Marseille, Lille, Rennes, Toulouse	
	Germany	Berlin, Munich, Nuremberg, Hamburg	Cologne, Bonn
	Greece	Athens	
	Hungary	Budapest	
	Italy	Milan	
	Netherlands	Amsterdam, Rotterdam	
	Romania	Bucharest	
	Spain	Barcelona	
	Sweden		Stockholm
	UK	London, Glasgow	Tyne and Wear
N & S America	Argentina	Buenos Aires	Buenos Aires
	Brazil	Rio de Janeiro	Sao Paulo
	Canada	Toronto	Montreal
	USA	New York, Washington	Pennsylvania
Australasia	Australia		Sydney, Adelaide

4.2.3 The Route for Line 2

78. The starting point for the project design was the Feasibility Study carried out by TEWET in 2003, and updated in 2005[4]. That study considered a number of options for horizontal alignment of the line, as well as different arrangements for underground and elevated sections. The alignment options were considered as part of the Master Plan review described in Chapter 3. However, no changes are proposed to the general route of Line 2 in the project designed here, and it generally follows the alignment of roads Duong Cach Mang Thang Tam Tam and Duong Truong Chinh as shown in the TEWET report. The details of the alignment are described later in this chapter.

79. Having established the general route of Line 2 following Duong Cach Mang Thang Tam and Duong Truong Chinh, there was little scope for alternative horizontal alignments. The positioning of the line is tightly constrained by buildings adjacent to the street.

[4] Feasibility Study 2003 (updated 2005) for the two Priority Lines of the Metropolitan Rail System (METRAS), TEWET

4.2.4 Interchanges

80. Under the optimised transport master plan (see Chapter 3) there are potential linkages between the section of Line 2 to be constructed under the project and four of the other proposed metro lines (1, 3, 5, and 6 – see Figure 3.2-1 and Table 4.5-1). It is of primary importance that the metro system is designed to facilitate maximum opportunity for passenger interchange between the lines. Whilst no specific provisions have been made in the design of Line 2 stations for interchange facilities, it has been ensured that the addition of pedestrian linkages to the other lines are feasible. The interconnectivity of lines and the potential and viability of utilising workshops for more than one line will be addressed in future studies.

4.2.5 Underground/Overground

81. As mentioned above, the TEWET study considered the advantages and disadvantages of combinations of underground and elevated sections for the line. The recommendation from that study was that all stations from Ben Thanh to Cong Hoa be underground and that the first elevated station would be Truong Chinh 1.

82. However, following discussions between the PPTA team and the airport authorities, it was established that the line should remain underground where it passes along the south-western boundary of the airport. With this arrangement Truong Chinh 1 station is underground and the first elevated station is now Tham Luong.

4.2.6 Fare Collection and Ticketing

83. The options for fare collection and ticketing including integrated systems are discussed in the PPIAF Report 'Fares and Ticketing Working Paper, June 2008' and summarised in Appendix G. Passenger convenience will be essential for the success of the HCMC metro system. To this end comprehensive integration of fares and ticketing across all metro lines should be the target, and this will be addressed in the proposed metro and public transport integration study.

4.3 Rolling Stock

84. Line 2 has been designed to accommodate trains of an appropriate size to meet projected ridership demands (see Chapter 3). Design calculations have been based on train cars 20m or 22m long, and 2.95m or 3.2m wide. These dimensions are at the larger end of the scale of train sizes which means that the project as designed will accommodate a wide range of train types and systems. The trains will initially run in 3-car units, later expanded to 6-car units to suit demands

85. Key dimensions assumed for the rolling stock are as follows:

- Length of 3-car train (including couplers) : 60m or 66m
- Overall width : 2.95 or 3.2m
- Overall height 3.655 or 3.8m (including HVAC units)
- Each 3-car train : seating for 156 or 126 with standing space for 471 or 695 at 5 persons per m^2, (or 1038 at 8 persons per m^2)
- Internal layouts of the cars will follow international best practice for mass transits

4.4 Alignment

86. As mentioned above, horizontal alignment is quite constrained due to locations of the stations within the narrow streets, and the need to avoid building foundations. The adopted minimum radius for general track in open air or tunnel is 300m, reduced in exceptional cases to 250m. In stations straight alignment has been adopted at this stage, but this may be reduced to minimum radius is 1,500m, exceptionally 1,000m subject to detailed design. In depot and access areas minimum radius is 160m, with exceptional reduction depending on rolling stock.

87. For optimum passenger convenience, underground stations need to be shallow. However, the geological analysis reveals that soil conditions for optimum tunnel boring and minimum settlement risk are deeper. This leads to a requirement for steep gradients between stations and tunnels to optimize design. The future need for the line to cross beneath the Saigon River will also require fairly steep gradients. A maximum gradient of 5% has been adopted for the design, with gradient on one rail in cant sections always less than 6%. Minimum slope is 0.2% for drainage purposes. Vertical transition curves are parabolic at minimum radius 1,500m, exceptionally reduced to 1,250m. Overlap of horizontal transition curves, and vertical transition curves, is avoided wherever possible.

4.4.1 Overall Alignment

88. The overall alignment is illustrated in Figure 4.4-1.

89. The first phase of Line 2 to be constructed under this Project has a total distance of about 12km. The line starts just south of Ben Thanh, then continues in a north-westerly direction along Cach Mang Thang Tam and Truong Chinh to end at Tham Luong. The line will include a spur of about 1.1 kilometres to the depot in Tham Luong. In a future phase, it is planned that Line 2 will extend to An Suong in the north, and across the river to Thu Thiem and beyond in the east. Most of the line from Ben Thanh to Truong Chinh (around 9.6km) is underground, to suit the high density urban developed areas. The northern part of the line (around 1.6km) is elevated, on the median of Truong Chinh.

90. Twin single-track bored tunnels are proposed for the underground alignment (with cut-and-cover at stations). The use of cut and cover tunnel method was considered, but was rejected since it would have significant resettlement impacts along the narrow streets. The use of a single larger (double-track) bored tunnel was also considered, but whilst costs would be similar to the single-track tunnels, the larger single tunnel would require deeper stations, would need to provide additional safety exits, and would increase the settlement risk over the tunnel.

4.4.2 Alignment Details

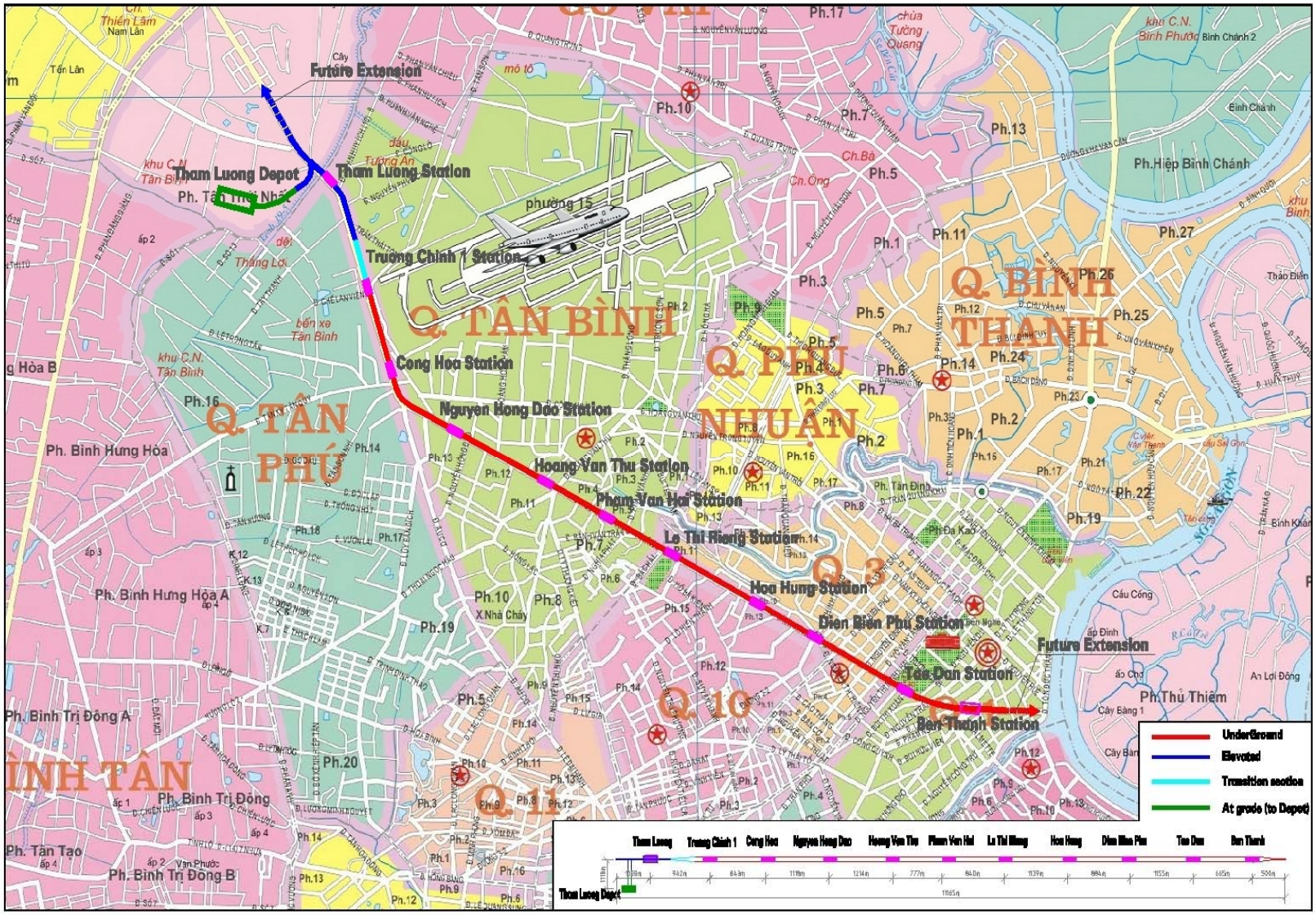
91. Line 2 will intersect with Metro Line 1 at Ben Thanh. Whilst the interchange will be subject to a separate study, it is assumed in this FS that Line 2 will pass beneath Line 1, and therefore the alignment is fairly deep at almost 30m below ground. Due to the short distance, and in order to avoid building foundations, the line remains deep to Tao Dan station, which is 19.8m below ground. A minimum radius of 250m is also required on this section to avoid building foundations.

92. The line follows a straight alignment along Duong Cach Mang Thang Tam. Stations are spaced at roughly 1km intervals, and the vertical profile undulates to follow optimum ground conditions for the bored tunnels, whilst keeping stations as shallow as possible for passenger convenience.

93. In the TEWET pre-feasibility study alternative routes were considered including one which incorporated an interchange with Ga Saigon National Railway Station. However the route adopted for this PPTA is consistent with the TEWET preferred alignment that does not link to Ga Saigon. This is for a number of reasons:

- The route would follow very narrow streets or pass through residential areas, which would require extensive disruption and resettlement
- It is understood from the authorities that the main Ga Saigon station will be relocated in future, but that an urban commuter station may be built at this location
- Good interchange can be provided between Line 2 and a commuter station at Ga Saigon by pedestrian tunnel links (around 400m)

Figure 4.4-1: UMRT Line 2 general Location and Alignment



94. The line remains underground on Truong Chinh past the end of the Tan Son Nhat airport runways, and then surfaces through an open cut transition area of around 230m just beyond Truong Chinh 1 station. The line runs on viaduct along the centre of Truong Chinh until it terminates just beyond the spur connection to the Tham Luong depot.

95. As currently planned, the northern end of the viaduct is offset from the road centre-line due to the limited curvature possible on the crossover at this location, and this results in the need for portal column supports across the road. Another option would be to extend the line around 200m further north until the crossover can be located on a straighter section of road; this may make good sense if the Line is to be extended northwards in future, and it is suggested that this issue is reviewed at the next design stage.

4.4.3 Alignment Design Issues

96. General constraints on the alignment include:

- As the typical stations have an island platform due to the choice of twin tunnels, the width of platform fixes the spacing of the twin tunnels centre lines: 16.5m. Nevertheless, as it is explained hereunder, spacing has to be reduced to 10.5m in order to limit the influence of tunnels on existing fiction piles supporting buildings of second row. Therefore the alignment out of each station has a curve and counter-curve to reach the 10.5m spacing.
- For passenger comfort, it is avoided as often as possible to overlap horizontal and vertical transition curves. As it has been considered more important to have first the tunnel dive, the alignment with a 16.5m spacing is kept from the station platform end till the end of the vertical transition curve.

97. Particular constraints on the alignment are as follows:

- a radius of 250 m has been set between Ben Thanh and Tao Dan to avoid a friction pile on the north side of the street and to avoid going under the New World hotel.
- a radius of 250 m has been set before Tao Dan station on Ben Thanh direction to avoid running the tunnel under buildings
- A crossover for temporarily reversing trains in case of problems on one portion of the line, is implemented, east of Hoang Van Thu. This crossover starts within the station Hoang Van Thu in the technical rooms area. This crossover is a constraint for the alignments since it requires more than 200 m of straight line.
- A garage with a crossover is implemented, east of Ben Thanh. It encompasses two side tracks for future extension of the line towards Saïgon river, a garage track “Y” shaped for a 6-car train, 2 switches and a double switch. Its overall length is 225 m
- A transition zone, West of Truong Chinh, makes horizontally the two single track merge into a double track tunnel box and vertically raise the track level to reach ground level.
- A switch on each track is implemented West of Tham Luong station to join the main line, on viaduct, to the double track, on viaduct, connecting the depot
- A crossover is set, west of the junction between the main line and the connection to the depot for reversing trains. In order to shorten the length of viaduct which not commercially operated, the crossover is implemented as close as possible to the connection to depot. As the crossover needs to be set on a strait line and as a straight line has to be set between two turn out, the viaduct alignment can not be in the axis of the avenue. As a matter of fact, the bearing of the straight line is fixed by the Tham Luong bridge.
- A radius of 160 m is set for the tracks of the viaduct connecting depot. The track has no cant since trains are operated without passengers at a reduced speed. 160 m is also the radius of the switches of the turnouts.

4.4.4 Vertical Profile

28. General constraints on the vertical profile are as follows:

- All underground stations except Ben Thanh and Tao Dan have, at this stage of the study, their rail level at 15.5 m below ground level, as a compromise between tunnel overburden for safety of excavation and attractivity of station for passengers. Therefore, in order to provide to the tunnel a deeper overburden on line for decreasing settlements, the track dives to reach a depth of about 25 m below ground level (20 m for tunnel overburden) .Nevertheless, the station platform is always horizontal. The slope varies from 2.5 to 5% depending on local constraints.
- A minimum slope of 0.2% is set for drainage.
- The level of track on viaduct is 7m to keep a road clearance of 5 m.
- The level of track on elevated station is 11.3 m to take into account the clearance of the concourse slab level.
- Tracks do not have minimum slope for drainage, a slope is given to the slab.
- In order to decrease the length of the transition works, west of Truong Chinh station, a slope of 5% is set on the ramp.

29. Particular constraints on profile include:

- On the West side of the line, the level of track is fixed by the level of Ben Thanh: 23 m below ground level (for crossing line 1). As a matter of fact, the distance between Ben Thanh and Tao Dan is too short to raise till 15.5 m below ground level at Tao Dan. Furthermore, tunnel must be below a set of friction piles West of Ben Thanh. Consequently, the level of track at Tao Dan is 19.8m below ground level.
- Ben Thanh track level also determines the level of the garage.
- The level of the station Ham Nghi of the eventual extension of Line 2, 19.2 m below ground level is also fixed by Ben Thanh level and by the possibility of an eventual crossing of the Saïgon river by caissons with a 5% slope.
- The level of track on viaduct on Tham Luong bridge is 14.5 m – determined by the level of the track on the main viaduct line.

4.4.5 Crossover Sections

98. Turnaround crossovers are provided at either end of the alignment in commercial operation, at the junction of the link to the depot, and an intermediate emergency crossover is provided near Hoang Van Thu station.

99. At Tham Luong, which is presently the terminal station, a crossover is located on the viaduct after the station and before the junction of the main line with the connection to depot. It allows train to reverse direction during every day operation.

100. Before Ben Thanh at Ham Nghi street the crossover (Ben Thanh Garage) will require cut-and-cover construction of a 3-box tunnel, which will allow for trains to turn-around and also will be compatible with the future southwards extension of Line 2. The dimensions of the cut-and-cover box will be 225m long by 18m wide, and will be constructed between outer diaphragm walls on either side.

101. The crossover at Hoang Van Thu allows trains to switch between tracks in case of emergency. This crossover will also require cut-and-cover construction, effectively forming an extension of around 130m to the station box structure.

102. The crossover at the end of the viaduct in Truong Chinh street, allows the train to maneuver for running in or out of the viaduct connecting the main line to depot. This crossover is too far from the terminal station to be used for reversing trains during every day operation.

4.5 Station Locations

103. Within the general alignment described above, and reflecting the normal criteria for positioning metro stations, there is not a great deal of scope for alternative station locations. The stations proposed are in positions similar to those in the TEWET study, although there are minor variations. A detailed description of each station and its location is given in Appendix B of this report.

104. Stations along Line 2 are located based on a number of criteria. These include the following:

- Within general alignment along Duong Cach Mang Thang Tam and Duong Truong Chinh
- Approximately 1km between stations (based on 500m maximum walking distance)
- Near activity centres, major road junctions etc.
- Space available above ground for station construction and access points
- Minimisation of resettlement impacts

105. The location considerations and constraints are summarized for each station in Table 4.5.1 below. The Table also shows the distances between the pedestrian access points of adjacent stations to provide an indication of walking distances.

Table 4.5-1: Line 2 Station Location Considerations and Constraints

Station	Location Considerations and Constraints	Potential Linkages
Ben Thanh	City centre interchange station. Space for station construction and access points.	Probable passenger interchange with Line 1, and maybe Line 4
*Distance between stations: 530m**		
Tao Dan	Adjacent to Tao Dan Park. Space for station construction and access points.	
Distance between stations: 1040m		
Dien Bien Phu	Under major road junction (roundabout).	Possible passenger link via subway to Line 3
Distance between stations: 700m		
Hoa Hung	Near Hoa Hung Market and railway station. On alignment of Duong Cach Mang Thang Tam.	
Distance between stations: 1020m		
Le Thi Rieng	Adjacent to Le Thi Rieng Park. Space for station construction and access points. On alignment of Duong Cach Mang Thang Tam.	
Distance between stations: 700m		
Pham Van Hai	Approximately midway between two adjacent stations. On alignment of Duong Cach Mang Thang Tam.	
Distance between stations: 680m		
Hoang Van Thu	Close to major road junction. Local design constraints to incorporate station and crossover. On alignment of Duong Truong Chinh.	Possible passenger interchange with Line 5
Distance between stations: 1070m		
Nguyen Hong Dao	Approximately midway between adjacent stations. Local constraints to minimise resettlement impacts. On alignment of Duong Truong Chinh.	
Distance between stations: 960m		
Cong Hoa	After bend in track alignment. Near major road junction. On alignment of Duong Truong Chinh.	Possible passenger interchange with Line 6
Distance between stations: 720m		
Truong Chinh 1	Near major road junction. Local design constraints to incorporate transition section. On alignment of Duong Truong Chinh.	
Distance between stations: 800m		
Tham Luong	Before curve in track alignment. Near road junction. On alignment of Duong Truong Chinh.	

* Distances measured from pedestrian entrances

4.6 Station Design

4.6.1 Design Principles

106. The public areas of the stations are designed and dimensioned in order to give conformity to both comfort in everyday use and in emergency conditions (as noted earlier). All public parts of the stations are accessible to those of reduced mobility by means of lifts. Escalators are generally provided in the upward direction only, with down escalators in cases where demands are very high or level difference is high.

107. The technical areas of the stations are divided into Technical rooms and the Operational Rooms. Their sizing and arrangement is based upon experience and similar systems around the world. Underground stations have considerable ventilation and air-conditioning plant rooms, while the public areas of elevated stations are open and naturally ventilated.

4.6.2 Design Standards

108. Stations are designed in accordance with international standards, in particular the NFPA 130, 2007 edition. Station and access/egress sizing is generally dictated by emergency evacuation criteria, for which key assumptions and parameters used in the design are based on:

- Full train loads of 6-car trains at 2 minute headway, with 1.5 surge factor
- Platform evacuation within 4 minutes or evacuation to point of safety (concourse slab) 6 minutes
- Maximum platform loading of 5 persons per square metre

109. For normal operations, escalators are provided in the upward direction at all stations (between both platform – concourse, and concourse – street), but provision is made for future incorporation of additional downward escalators. Lifts are also provided at all stations to facilitate access for the disabled.

110. In general minimum provision of stairs between each platform and concourse is as follows, but this is cross-checked against forecast demands, and greater provision is made where necessary.

- 1 stair width (useable) 1.9m + 1 escalator width 1m
- 1 stair width 3.7m (useable)
- 2 emergency stairs width 2.2m (useable per stair)

111. All stations require technical and operational rooms. The sizing and arrangement of these is based on experience of similar systems. Underground stations have considerable ventilation and air-conditioning plant rooms, while the public areas of elevated stations are open and naturally ventilated.

4.6.3 Underground Stations

112. All underground stations (except future Han Nghi station) feature island (central) platforms. Ben Thanh and Tao Dan are deep stations with 3 levels (platform, intermediate and concourse), whilst all others have 2 levels below ground (platform and concourse). Platform length is 135m at all stations, and the overall length of the station box including technical and plant rooms is typically 193m. The typical layout of an underground station is shown in Figure 4.6-1 below.

Stations 1 & 2 – Ben Thanh & Tao Dan

113. Ben Thanh will be a major interchange station between Metro Lines 1, 2 and possibly 4, together with surface transport (bus terminal, taxis, etc) and surrounding developments such as Ben Thanh Market. A separate design and planning study is proposed for the interchange station area, and thus Ben Thanh station is not included in the scope of the present project.

114. Tao Dan station is deep due to the alignment constraints and therefore features an intermediate level between platform and concourse, but otherwise adopts the standard layout above.

115. Because of the extra depth to accommodate technical and plant rooms, both Ben Thanh and Tao Dan stations are shorter than the standard 2-level stations, at 175m (compared with 193m).

Stations 3 to 9 – Dien Bien Phu to Truong Chinh 1

116. These are all "standard" underground stations with two exceptions:

- Dien Bien Phu - Additional underground passageways are proposed to connect to surrounding developments, giving the station a total of 6 street-level accesses (compared to the standard 4).
- Hoa Hung - Depending on future plans for Ga Saigon National Railway Station (under review by HCMC PC), direct subway connections to Hoa Hung Metro station can be added.

Figure 4.6-1: Typical Layout of an Underground Station

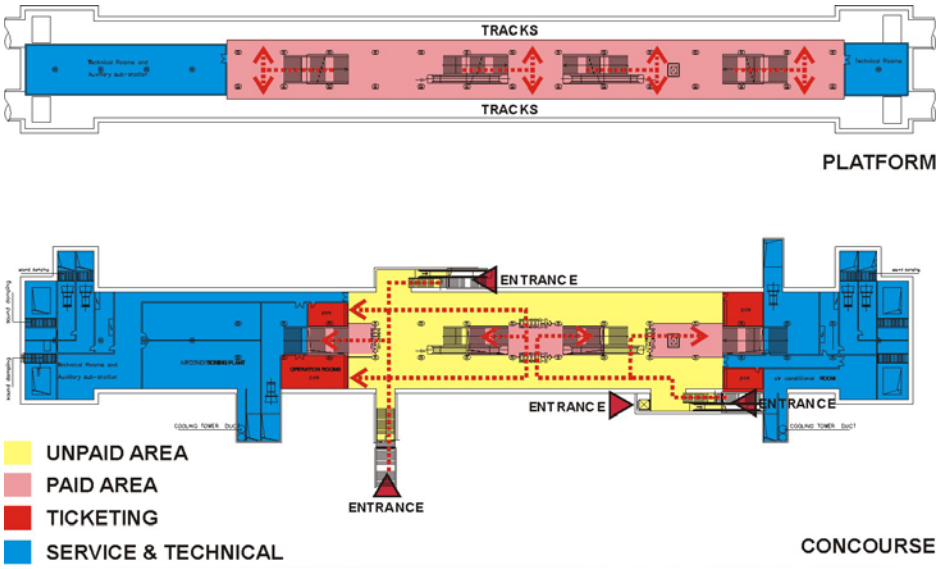
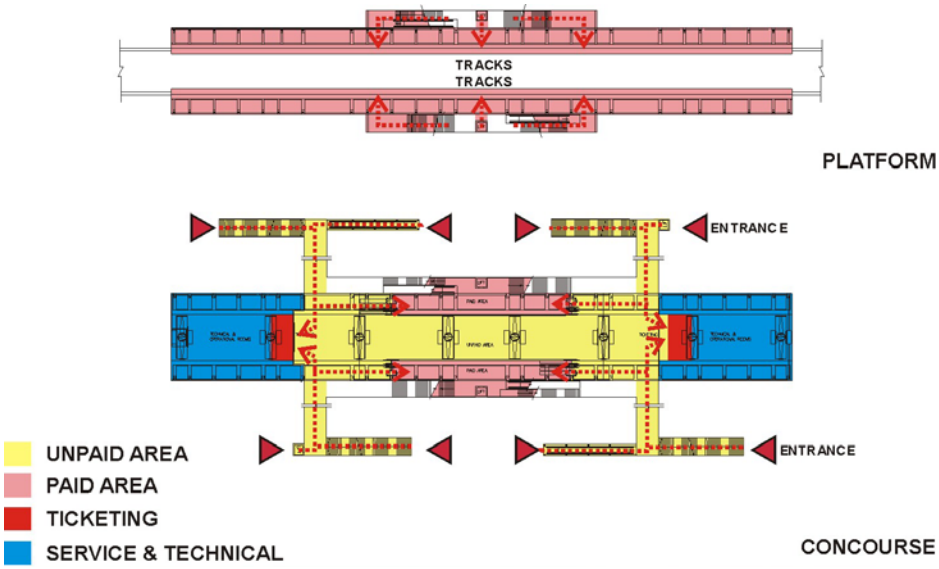


Figure 4.6-2: Typical Layout of an Elevated Station



4.6.4 Elevated Station

117. There is only one elevated station in the initial Line 2 project, at Tham Luong, although there will be future similar stations when the line is extended to An Suong as planned. These elevated stations will lie above the existing highway, generally with single column supports in the median. The typical layout for an elevated station is shown in Figure 4.6-2. The concourse level is located approximately 7.5m above the road, with platform levels approximately 5.4m above the concourse.

Station 10 – Tham Luong

118. The station is located above the intersection of Truong Chinh road and the entrance to Tan Binh Industrial Zone. Without the need for air-conditioning plant, technical rooms are accommodated beneath the platforms at either end of the station, and the overall station length is just 140m.

4.7 Depot

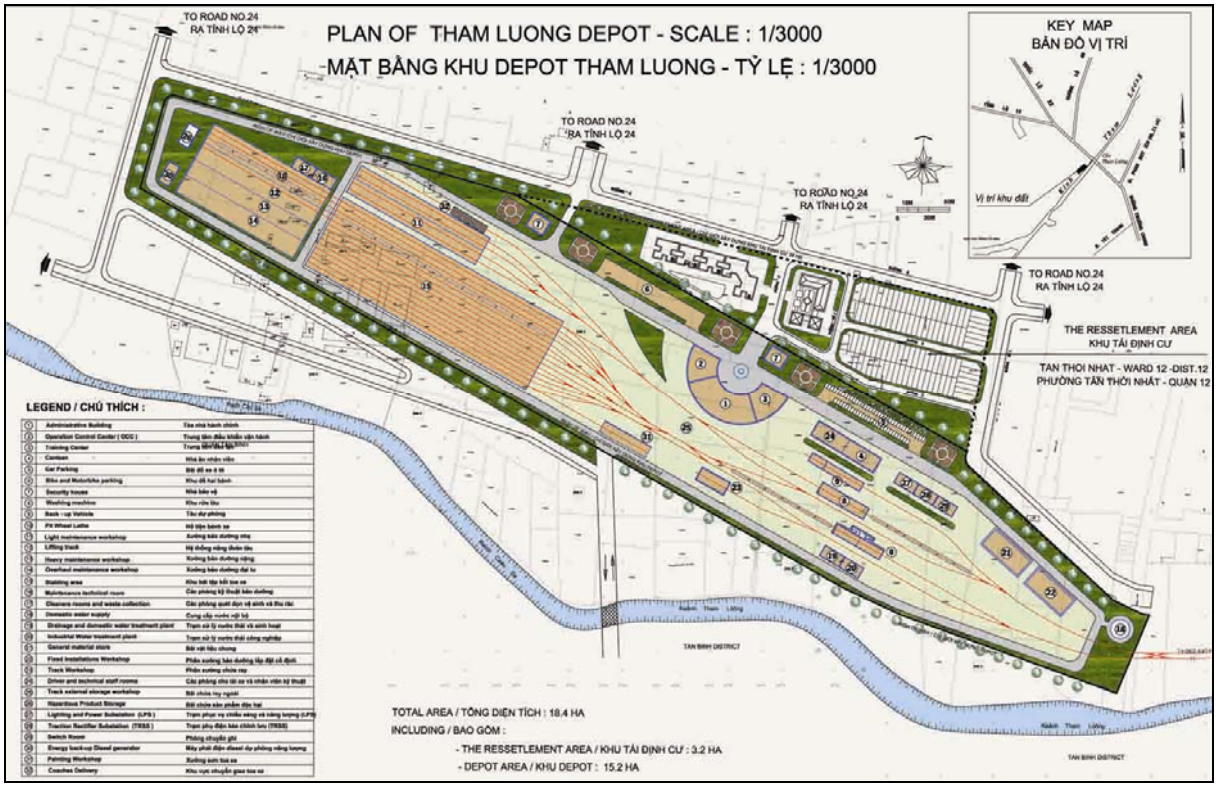
119. The depot is to be located on an area of land at Tham Luong, connected to the main line by a 1.1km spur. The location for the proposed depot was established under the TEWET study. It is understood that site selection was based on the availability of undeveloped land in the vicinity of the route of Line 2 and that initial land acquisition proceedings had commenced prior to the start of this PPTA. The site of the proposed depot is well located to enable efficient operation of Line 2 (see Chapter 5). The main components of the depot are as follows, and the proposed conceptual layout plan is shown in Figure 4.7-1 below.

- Train washing machine
- Lathe on pit
- Motor traction maintenance
- Test track
- Traction office
- Substation,
- Parking position
- Different shop dedicated to different level
- Motor traction maintenance
- Test track

120. To meet the traffic forecast for 2035 it has been calculated that nineteen 6-car trains will be necessary. The depot has the capacity for stabling 28 6-car trains and is therefore more than adequate for an expansion of services. Further detailed design studies will determine the definitive size of the stabling area. Initially only the depot tracks for twelve 3-car trains will be constructed to meet the needs in 2015. Nevertheless, all the turnouts for future tracks will be installed to avoid any hindrance to the depot when the latter is extended.

121. As mentioned above the depot as designed has spare capacity over and above the projected needs of the part of Line 2 to be built under this project. The rationalization and sharing of depots by more than one metro line should be considered in order to reduce investment costs for HCMC. Preliminary analysis shows that the Line 2 depot might be utilized by Line 6 as there is an opportunity to link the two lines at Cong Hoa. However such decisions should not be made on a piecemeal basis. These issues need to be addressed as part of a city-wide study of metro and public transport integration.

Figure 4.7-1: Tham Luong Depot Conceptual Layout Plan



5 SERVICE OPERATIONS PLAN

5.1 Purpose of the Operations Plan

122. This chapter provides data regarding traffic characteristics, operation modes and the basic component calculations, i.e. train capacity, operational headway between trains, dwell time in stations, number of vehicles, and the principles of the main systems. The Technical Paper Operations Plan, July 2008, provides full details of the Line 2 operating plan.

5.2 Design Demand

123. The operational design bases the dimension of a transport system on the projected demands for peak times at various time horizons. For the three time horizons considered in the Study the maximum passengers per hour per direction (pphpd) demand for Line 2 – Ben Thanh – Tham Luong, are the following:

- Year 2015 corresponds to finalization of construction and equipment testing: 8,500 pphpd (see Table 3.4-2).
- Year 2025 corresponds to a medium horizon where hypothetically other UMRT lines included in the Master Plan are in operation: 21,400 pphpd.
- Year 2035 corresponds to a long-term horizon where hypothetically all other UMRT Lines are in service and demand has stabilized: 30,200 pphpd.

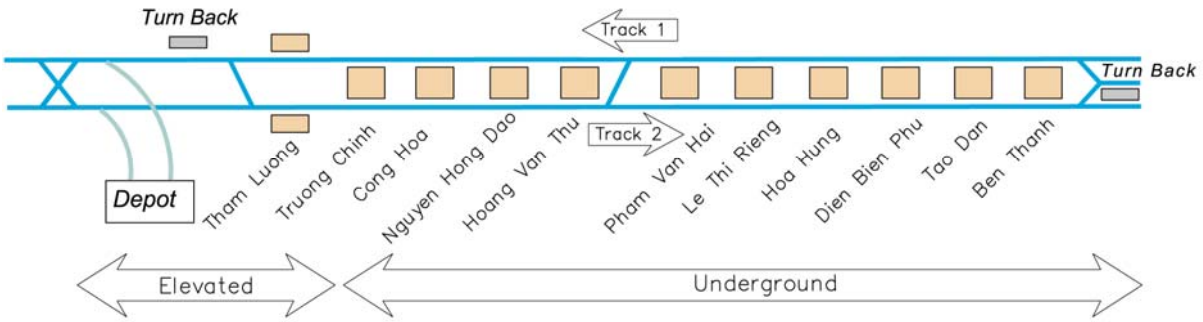
124. For the off-peak period, it is considered that the traffic will be 75% of the peak load, and the evening demand is 50% of the peak load. For Sundays and holidays it is estimated that the traffic represents 75% of the working days passengers.

5.3 UMRT Line 2 Operational Design

5.3.1 General Operational Aspects

125. Line 2, comprising 11 stations, runs north-west from the city centre, extending from Ben Thanh (station 11) to Tham Luong (station 1) - see Figure 5.3-1. The depot is located near station 1 where trains are stabled. Line 2 has two tracks and all trains will run at the right hand side in normal flow. The total operational length of the line is about 11.2 km.

Figure 5.3-1: Sketch of Track Layout and Stations



5.3.2 Structure of Services

126. The schedules of service will start at 5.00 a.m. and finish at 12.00 p.m. On working days the peak periods are considered to be 6.30 a.m. to 8.30 a.m. and 4.00 p.m. to 6.30 p.m. (based on the transport demand distribution). Evening service will operate for 4 hours, from 8.00 p.m. to 12.00 p.m. It is anticipated that on Sundays and holidays the demand distribution will have less significant peaks.

5.3.3 Service frequency

127. Table 5.3-1 summarizes the service frequency for years 2015, 2025 and 2035. Service frequency for the peak period is derived from the design demand (pphpd) described in Section 5.2 and train capacity of 695 passengers per 3-car trains (5 passengers per m^2) in 2015 and 1,390 passengers per 6-car trains in 2025 and 2035. For off-peak, evening service, Sundays and holidays, the service frequency is determined based on the assumed proportional demand described in Section 5.2, with a minimum acceptable service frequency of 12 minutes.

Table 5.3-1: Frequencies of Service (Time Interval Between trains) at the Various Time Horizons

Period	Working Days			Sundays and Holidays		
	2015	2025	2035	2015	2025	2035
Peak period	5'00	4'00	2'45	6'30	5'15	3'45
Off-peak period	6'30	5'15	3'45	7'45	7'00	5'00
Night service	10'00	8'00	5'30	12'00	10'30	7'30

Source: Project team.

5.3.4 Commercial Speed

128. The commercial speed for Line 2 – Ben Thanh – Tham Luong was estimated taking into account the running time between stations, the reserve time (and, thus, running time with coasting) and station dwell time. The running time and reserve time between stations was calculated with specific tool used for the Paris Transit system (RATP) called MATYS, taking into account the train and line's characteristics described in the previous chapter. The dwell time was calculated based on estimated boarding and alighting per station, the number of doors (4 doors per car) and lanes per door (2 lanes per door) in the train, the passenger flow rate (1 passenger per lane per second), the headway, and the time required for technical reasons (door opening, door closure warning time and door closing).

129. The total estimated running time from Ben Thanh to Tham Luong (Track 1), a distance of 9.53 km, is 930 seconds, with a resulting commercial speed of 36.9 km/h. From Tham Luong to Ben Thanh (Track 2), the total estimated running time is 945 seconds, with a resulting commercial speed of 36.3 km/h. The Technical Paper Operations Plan, provides a detailed description of total running times, including speed/distance between station diagrams.

5.3.5 Fleet Size Calculation

130. The calculation of fleet requirements to meet the forecast patronage demands at 2015, 2025 and 2035 are given below. Fleet requirement is determined by the total estimated running time detailed in the previous paragraph, plus the last stations' track changing time and regulation time at terminal (280seconds at Tham Luong and 320 seconds at Ben Thanh), divided by the target schedule presented in Table 5.3-1 for the peak period.

131. The operational design considers a 5% train reserve (rounded up), to replace potentially defective trains during the daily service. In this way, the operational design maintains normal headway between trains, as well as the standard transportation capacity, by eliminating any of the consequence that would result from a train failure (delays and increased headways between trains, etc.).

132. Additional trains are necessary, based on maintenance needs. Due to preventative and corrective maintenance requirements, some trains are not always available. On average, 10 % (rounded up) of trains in operation are under maintenance. The calculations of rolling stock fleet shown in Table 5.3-2 consider this percentage.

Table 5.3-2: Rolling Stock Fleet Size Estimation for Line 2 – Ben Thanh – Tham Luong

	2015	2025	2035
Operation headway Minutes)	5'00	4'00	2'45
Trains in operation (rounded up)	9	11	16
Operation reserve (5% rounded up)	1	1	1
Maintenance reserve (10 % rounded up)	2*	2	2
Total fleet size	**12* (3-car)**	**14 (6-car)**	**19 (6-car)**

*Note: 11 3-car trains are adequate for 2015, but an even number are required to be later combined into 6-car trains as these should be comprised of units of the same specification and age.
Source: Project team.

133. In order to maintain a convenient service to customers under predicted passenger growth numbers additional trains will be purchased at intervals of 5 years (4 x 6-car trains in 2020, 4 in 2025, 3 in 2030 and 2 in 2035).

5.3.6 Operating Modes and Train Traffic Management

134. The depot will be used for stabling trains. Crossovers are located at the depot location, north of Tham Luong station and just southeast of Hoang Van Thu station. Turnouts are located at the northwestern end of the line north of the depot crossover and at the southeastern end of the line, southeast of Ben Thanh station (see Figure 5.3-1). Insertion and withdrawal of trains will make use of the crossover coming out of the depot and the turnouts at the northwest end of the line. The southeast crossover will be used for turning trains around and for short stabling. The crossovers and turnouts will be used in case of degraded operations to facilitate temporary provisional fractional services, single track operations or shuttle operations.

135. Day to day train traffic management will be carried out on a first level by the train driver, in charge of checking the rolling stock and installations are in total working order, conducting small repairs of straight-forward and frequent technical faults, and switching on the pre-planned degraded driving modes. The Operations Center (OCC) will constitute the second level of surveillance, ensuring that the theoretical timetable is adhered to and enforcing a real-time timetable in case of disruption.

6 ESTIMATED CAPITAL & OPERATIONS AND MAINTENANCE COSTS

6.1 General

136. This chapter presents a summary of the estimated capital costs and operational and maintenance costs for the project as described in previous chapters. The breakdown of capital costs is given in Appendix D, Detailed Capital Cost Estimates. Details and a fuller explanation of the derivation of operation and maintenance costs are provided in Appendix E.

6.2 Capital Cost Estimates

6.2.1 Basis for cost estimates

137. The estimates of cost of the Metro line 2 from Ben Thanh Market to Tham Luong Depot were based on results of preliminary engineering design of the Consultant, quantity estimates of each work item and studies on construction planning and method as described in the preceding chapters. Total investment cost was calculated for the whole line of 12,257 m, from Ben Thanh to Tham Luong and access to Tham Luong depot, and 10 stations, 9 underground stations and 1 elevated station. Ben Thanh station was not included in the total construction cost of this project (see Chapter 1).

6.2.2 Quantities Estimates and Unit prices

138. Table 6.2-1 summarizes the main quantities of each category of works and equipment (see Appendix D for details on quantities and costs).

139. Unit prices of construction works are based on material cost, equipment cost, labour cost, administration cost and profit for detailed work items. Unit prices have been analyzed against current price (Quarter I – 2008) and adjusted as per requirement in order to obtain the most practical unit price. For special works such as underground boring, railways equipment installation (which have never been carried out in Vietnam before), unit prices are calculated according to the Consultant's assessment of Ho Chi Minh City's conditions and experience international experience. The Technical Paper "Capital and Operating and Maintenance Cost Estimates, May 2008", provides detailed description of unit prices for all work items.

6.2.3 Civil Works Construction Costs

140. Table 6.2-2 summarizes the civil works construction costs. Civil works includes 6,966m of underground tunnel section (i.e. a total of 13,932m of bored tunnel), 2,513m of viaducts, 1 section of open tunnel and 1 section of cut and cover tunnel. It also include the construction of 9 underground stations and 1 elevated station, 18 emergency and/or dewatering cross-passages and 1 rear garage at Ben Thanh.

141. The above mentioned construction cost does not include land use cost and cost for removal and relocation of technical infrastructure works which are included under a separate item.

6.2.4 Equipment Costs

142. The equipment costs include all non-system related and system related electrical and mechanical equipment, as described in Table 6.2-2, and rolling stock (12 x 3-car trains plus spares). At this stage an indicative amount has been included for the system for delivering power to the trains. Detailed estimation will be required once a choice of catenary or 3rd rail has been made. The costs do not include ticketing system costs, which will be covered under a separate contract.

6.2.5 Depot Costs

143. Depot costs includes civil works and equipment for the depot complex, including rolling stock stabling areas, maintenance areas, and administrative and operations areas, and fencing.

Table 6.2-1: Main Quantity of Works Estimates

Item	Quantity
INFRASTRUCTURE	
Overall length of line including connection to depot	**12,257m**
Overall length of underground line including stations (no underground sections in depot link)	**9,575m**
Overall length of elevated line including connection to depot	**2,513m**
Overall length of at grade line (part of connection to depot only)	**169m**
Main Line (not including depot link)	**11,138m**
Length of bored tunnel section	6,966m
Total length of bored tunnels	13,932m
Cumulative length of underground stations including crossover at Hoang Van Thu	2,026m
Length of tunnel in cut and cover section	222m
Length of tunnel in open cut section	136m
Length of garage at Ben Thanh	225m
Length of elevated section	1,563
Link to Depot	**1,119m**
Length of elevated section	950m
Length of at-grade section	169m
Stations	
Number of underground stations (not including Ben Thanh)	9
Number of elevated stations	1
Cross Passages	
Number of large cross passages	16
Number of small cross passages	2
EQUIPMENT	
Trains	12 x 3-car train units
Repair and maintenance equipment in depot	1 set

Source: Project team.

Table 6.2-2: Total Project Capital Cost Estimates (in US$ million)

Cost item	Local	Foreign	Total
Civil works			
Underground	206.51	137.67	344.19
Above ground	20.84	2.32	23.16
Total civil works	**227.35**	**139.99**	**367.34**
Non-system Electrical and Mechanical			
Track supply and lay-out	8.66	10.59	19.25
Turnouts	1.08	3.24	4.32
Power delivery system	1.06	4.25	5.31
Fire fighting	0.88	2.65	3.54
Pumping	0.66	1.55	2.21
Ventilation and smoke exhaust	4.44	10.36	14.81
Heating, ventilation, airconditioning (HVAC)	1.11	3.33	4.44
Escalator	1.79	10.13	11.92
Elevator	0.83	4.72	5.55
Lighting	2.29	5.34	7.62
Total non-system E&M	**22.81**	**56.16**	**78.97**
System Electrical and Mechanical			
SAE IV, OCC, SCADA	0.62	5.55	6.17
Data transmission, telecoms, public announcement	1.14	10.30	11.44
Radio	0.62	5.61	6.24
Traction power (sub-stations & cables)	2.27	12.86	15.13
Aux voltage transformers & high voltage station	1.24	7.04	8.28
Earthing/protection	0.16	0.90	1.06
Signalling and automated train control (ATC)	6.64	37.64	44.28
Total system E&M	**12.70**	**79.89**	**92.59**
Rolling Stock			
Rolling stock	0.00	57.24	57.24
Spare parts for rolling stock	0.00	2.86	2.86
Total rolling stock	**0.00**	**60.10**	**60.10**
Depot civil and equipment			
Depot civil works and equipment, mobile and fixed	11.66	21.65	33.30
Total depot civil and eqipment	**11.66**	**21.65**	**33.30**
Ticketing System*	**0.00**	**0.00**	**0.00**
Automatic fare collection (AFC)	0.00	0.00	0.00
Ticket stock (smart card & token)	0.00	0.00	0.00
Total ticketing system	**0.00**	**0.00**	**0.00**
Total civil works and equipment	**274.52**	**357.79**	**632.31**
Pre-investment stage costs			
Detail design (2.5% of CW & equip)	3.16	12.65	15.81
Supervision (5% of CW and equip)	9.48	22.13	31.62
Other general items (3.0% of CW and equip)	18.97	0.00	18.97
Total pre-investment stage costs	**31.62**	**34.78**	**66.39**
Resettlement costs			
Land compensation	85.74	0.00	85.74
Other compensation and resettlement costs	29.34	0.00	29.34
Total land compensation and resettlement	**115.08**	**0.00**	**115.08**
Total costs without contingencies	**421.21**	**392.57**	**813.78**
Physical contingencies			
Civil works and equipment	27.45	35.78	63.23
Pre-investment stage costs	3.16	3.48	6.64
Resettlement costs	11.51	0.00	11.51
Total physical contingencies	**42.12**	**39.26**	**81.38**
Total costs with contingencies	**463.33**	**431.83**	**895.16**
VAT	**49.19**		**49.19**
TOTAL	**512.53**	**431.83**	**944.35**

(Not including price contingencies and financing costs)

6.2.6 Resettlement Cost

144. Land acquisition and resettlement cost were estimated based on the preliminary land acquisition requirements estimates. These estimates are based on the preliminary engineering design of civil works, including building areas for stations, the social survey identifying land compensation requirements and households that will need resettlement, and market price survey. The Draft Resettlement Plan, May 2008, provides a detailed description of the resettlement aspects of the project.

145. Total land compensation and resettlement costs include land compensation (around 75% of the total resettlement costs) and other compensation and resettlement costs (around 25% of total resettlement costs). Other compensation costs include compensation for buildings, compensation for secondary structures (auxiliary equipment), compensation and relocation of public facilities (electrical, water and sewage, telephone, optical cabling, sidewalks, etc.), cost for relocation arrangement, external monitoring and administration.

6.2.7 Taxes and Duties

146. VAT has been calculated based on its application at the rates in Table 6.2-3 below.

Table 6.2-3: Application of VAT

1)	**VAT (10%)**	
	Civil works:	all civil works
	Non-system E&M:	Lighting
	E&M systems:	Earthing/protection
	Depot:	Depot civil works and equipment
	Consulting services:	Detail design, Supervision
	Incremental administration:	Other general items
2)	**VAT (5%)**	
	Non-system E&M:	Pumping, Heating, ventilation, airconditioning (HVAC), Escalator, Elevator
	E&M systems:	Aux voltage transformers & high voltage station
3)	Cost items other than the above mentioned, i.e. rollingstock, resettlement cost are 0% VAT.	

147. All items imported for the project are duty exempt.

6.2.8 Other Investment Costs

148. Consultancy costs representing 7.5% of civil works and equipment (including 2.5% for detail design and 5% for supervision) and 3% for incremental administration and other general items, were also added to the total project costs.

149. Physical contingencies at 10% of the total capital infrastructure and system costs, resettlement costs and consultancy and general item costs, ware added to allow for uncertainties due to the construction of other risks (e.g. geology, ground conditions, major service diversion, changes in market conditions, etc.).

150. Finally, price contingencies and financial charges during construction were also added to estimate the total project costs. Section 8.2 and 8.3 provides more details on the financial and financing analysis of the project.

6.3 Operating and Maintenance Cost Estimates

6.3.1 Introduction

151. The annual operating and maintenance (O&M) cost estimates for Line 2 have been estimated for 2015, 2025 and 2035.

152. The O&M cost is the sum of the following two main categories of costs:

- Staff costs: cost estimation for the whole staff: administrative, operation, maintenance and engineering;
- External costs such as cost of electricity, materials and consumables.

6.3.2 Personnel Costs

153. The annual personnel cost is calculated following the organization and staffing described in Appendix E. The organization is a simple structure with a General Management (including counselling and quality control) and three line departments: Operations, Maintenance and Administration. The total estimated manpower requirements for operations and maintenance are 780, 800 and 814 for 2015, 2025 and 2035 respectively.

154. For the purpose of staff cost estimation, the staff was split in the following 6 categories (estimated annual salary in US$ in early 2008 in parenthesis):

- Employees in managing position (US$6,485)
- Administrative and managerial clerks, OCC supervisors, engineers (US$5,650)
- Drivers (US$5,089)
- Station supervisors, skilled workers ((US$3,724)
- Secretaries, drivers, platform ticket controller, security staff(US$2,767)
- Unskilled workers (US$2,523).

6.3.3 External Costs

155. The electricity consumption is based on trains (traction and auxiliary on-board equipment), stations and depot consumptions. The onboard auxiliary equipment consumption is function of the time when trains are switched on. It was considered 15 hours a day for each train and 50kWh for the auxiliary consumption. For underground stations, the required power supply was estimated in 950 kW. For elevated stations, the required power supply was estimated in 270 kW. For depot, it was considered a total power consumption of 1 MWh.

156. The electricity price, considering it will be supplied by a voltage of 110 KW, is determined in early 2008 as the following:

Table 6.3-1: Cost of Electricity

With voltage supplied of more than 110 KW	785 VND/KWH	Offpeak hours ***04:00 to 18:00***
	425 VND/KWH	Low hours ***22:00 to 04:00***
	1590 VND/KWH	Peak hours ***18:00 to 22:00***

157. The consumables category includes all the necessary material and fluids to operate and maintain the system: lubricant materials, sand, water and detergents. This category also includes the power supply for administrative and maintenance buildings (lighting, power, air conditioning). Based on experience, this cost item is assumed to be 15% of staff cost.

158. This materials category includes all the material pieces to be bought for the maintenance activity, the outsourced maintenance for specific equipment such as electronic parts, optical fiber components or computers, with 70% considered of foreign source and 30% of local source. The

estimated amounts are elaborated from costs database from various similar systems (infrastructure, trains and fixed equipment).

6.3.4 Annual O&M Cost Estimates

159. The following Table 6.3-2 provides the annual O&M cost estimates for 2015, 2025 and 2035, with reference year of the first quarter of 2008.

Table 6.3-2: Annual Operating and Maintenance Cost Estimates (US$ at first quarter 2008 prices)

Cost Item	2015	2025	2035
Unskilled staff	914,849	920,895	925,941
Other staff	1,539,746	1,672,138	1,674,307
Electricity	5,823,155	6,711,043	7,151,726
Consumables	368,189	380,855	390,037
Materials	2,882,647	2,950,588	3,086,470
VAT	288,265	295,059	524,700
Total	**11,816,851**	**12,930,578**	**13,753,181**

Source: Project team

7 SOCIAL AND ENVIRONMENTAL SAFEGUARDS

7.1 Land Acquisition and Resettlement

7.1.1 Resettlement Plan

160. A Resettlement Plan (RP) has been prepared setting out the impacts, entitlements and compensation proposals. The RP is based on surveys of the project alignment and on interview surveys with affected persons (APs). Two rounds of interview surveys were conducted. The first, which covered land and property owners, took place between January and April 2008. The second round was undertaken in July 2008 and covered tenant shopkeepers and employees in all affected shops.

7.1.2 Impacts of the Project

161. The project will acquire 22.2 Ha of land at 15 wards of 6 districts in HCMC. The census and inventory of losses found that:

- There are 403 properties affected by land acquisition. Of these 376 are private households (HH) and 27 are public properties.
- In the 376 privately owned HH, 1,879 persons will be affected, 899 males and 980 females. Of the total privately owned HH, 139 are female-headed HH.
- 322 of the affected properties are shops employing an estimated 900+ shop workers
- 241 of the shops are leased
- 51 fully affected HH whose remaining land areas after acquired are less than 15 m^2 will be relocated;
- There are also affected underground facilities will be affected such as water supply system, drainage, electricity network, telecommunication, etc.

162. **Legal and Policy Framework**. The legal and policy framework for compensation, resettlement and rehabilitation under the Project is defined by the relevant laws and regulations of the Government of Viet Nam and the ADB policies. In case of discrepancies between the Borrower's laws, regulations, and procedures and ADB's policies and requirements, ADB's policies and requirements will prevail, consistent with Decree No. 131/2006/ND-CP which provides that in case of "discrepancy between any provision in an international treaty on Official Development Assistance, to which the Socialist Republic of Viet Nam is a signatory, and the Vietnamese Law, the provision in the international treaty on ODA shall take precedence" (Article 2, Item 5).

163. **Project Entitlements:** The project entitlements developed and presented in the RP correspond to the impacts identified during the census and inventory of losses. It should be noted that these entitlements may be enhanced, as necessary, following the conduct of DMS and consultation with APs to ensure that losses are restored, if not improved. The draft Entitlement Matrix is shown in Table 7.1-1

164. **Participation, Disclosure and Grievance Redress:** Many different instruments, channels of consultation and participation were organized during the RP preparation period from December 2007 to August, 2008 with APs and involving agencies. Project policies and options with regard to relocation, compensation and income restoration have been discussed during the meetings. Concerns and suggestions raised by the affected people were elicited and incorporated in the RP. All are important bases to develop the compensation and resettlement policy, income restoration programs, relocation site development of the RP.

Table 7.1-1: Draft Entitlement Matrix

Type of impact	Eligibility/ application	Entitlement policy	Implementation measure
1. Residential land 1.1 Fully affected (Includes APs where the remaining area is less than 15 m^2 or from 15 m^2 to 36 m^2 but do not want to stay. As directed in a decision 135/2007 and Viet Nam standard 353-2005).	All APs having LURC or, in absence of it, APs recognized as stable occupants by local authorities or simply APs included in census and the APs inventory.	- <u>Land or apartment for land:</u> - Allocation of plots or apartment according to District PC approved allocation regulation. Area of the plot or apartment is at least as the same as the lost plot. - - Land provided with joint title to husband and wife - <u>Cash for land:</u> Cash for land compensation at the replacement cost. - APs who manage their own relocation will receive an additional assistance based on the areas of affected houses as stipulated in the relocation policy of HCMC. - APs will be allowed to pay in installments with low or zero interest if the compensation package for lost land is not enough to buy plots or apartments at new sites which have been developed by authorities of HCMC.	- Clearly inform APs about the sites and apartments which will be developed or available in each affected district. - Develop relocation sites and condominiums at the affected districts or within HCMC for APs. - Replacement plots or apartments will be allocated at least 5 months prior to land clearance for the project. The site must be ready for housing and with physical infrastructure and social services according to Viet Nam standards. LURC will be granted to APs with no cost. - Other allowances will be paid to APs at least 1 month prior to displacement. - Carry out DMS, approve compensation plan as the schedules and pay APs at the replacement value for affected properties in the year the compensation is paid. Disseminate compensation plan to APs and post it at ward office as required by laws.
1.2 Partially affected (PAs are the remaining area more than 15 m^2 and less 36 m^2 but do not want to relocate and PA with a remaining area from 36 m^2 above).		- Cash compensation for affected area at replacement cost. - Cost for owners to rent equivalent properties during the time that reconstruction is not possible (due to station construction) and during the period of recnstruction.	- Carry out DMS, approve compensation plan as the schedules and pay APs at the replacement value for affected properties in the year the compensation is paid. - Payment for compensation at least 05 months and allowances at least 01 month before acquired land for the project.
2. Properties on land (house; substructures) 2.1 For fully affected	All APs having Land Use Right Certificate (LURC) and buiding ownership or,	- Compensation for existing building and structure based on full replacement cost and costs for reinstalling other attached facilities such as telephone, water meter,	- The construction materials that can be salvaged upon dismantling of existing structures. No deduction of salvageable materials.

Type of impact	Eligibility/ application	Entitlement policy	Implementation measure
structures (fully affected area or partially affected but non-affected part could not be retained).	in absence of it, APs recognized as stable occupants by the local authority or simply APs included in the census and APs inventory.	electricity meter, etc. - The reasonable rental loss due to the project will be compensated. Additional assistance to improve new houses for HH with a value of affected house less than the cost to build a house of type 4 with area of 30 m^2.	- District to carry out DMS to identify if APs have remaining areas sufficient to rebuild the structure or not. Disseminate compensation plan to APs and post it at ward office as required by laws. - APs have choice (i) cash for self-construction for their structures or (ii) request the project to provide new structures at resettlement site. - Compensation will be provided to APs at least 4 months prior to displacement for house type 4 and more than 5 months for house types 1, 2 and 3. - Pay AP at the replacement value of the house and other fixed assets in the year the compensation is paid.
2.2. For partially affected structures (non-affected part can remain and is viable within normal safety standards)	Existing houses affected	- Cash compensation for demolished area at replacement cost. - Cost for renting equivalent premises for the period of station construction plus 6 months for reconstruction of properties.	- Compensation paid at least 2 months before deadline for house demolition request.
3. Living facilities (such as water supply connection; cable telephone, cable TV**,** electricity connection etc.)	All APs (owners or lessees of the structures)	- Compensation for cost of installation and connection fees	- Compensation will be paid at least 1 month before request of demolishing the house.
4. Affected business (both running by the house owners and tenant users)	- All AP who lease houses of the owners for businesses.	- The reasonable income loss due to the project will be compensated. - Additional assistance to restore the livelihood through feasible restoration programs/ activities.	- Identify APs with and without tax payment to local authorities. - Consult with APs, local authorities and NGOs for feasible restoration programs/ activities. - Compensate for losses and allowance for a

Type of impact	Eligibility/ application	Entitlement policy	Implementation measure
			transition period. - Monitor the implementation of restoration program to make sure that APs are at least to restore to pre-project level.
5. Affected employees	Who are working for the house owners or tenant users	- The reasonable income loss due to the project will be eligible to assistance allowance of their income loss for three months.. - If the affected employees can't be hired by the original employers, they can be assisted (such as providing useful information) to find new jobs similar to their original ones in same or the neighboring areas.	- Identify all affected employees. - Consult with them for their assistance required.
5. Trees	APs who have tress affected.	Compensation at the replacement cost.	- Identify through DMS and compensate at least one month before acquire land for the project.
6. Tombs and graves	APs who have tombs and graves affected.	Compensation at the replacement cost.	- Identify through DMS and compensate at least one month before acquire land for the project.
7. Public Facilities (Electric poles, telecom, irrition system, commune and village structures etc.)	Owners of affected assets	Compensation at replacement cost for the affected facilities or reconstructed, reinstallation, if required by the owners..	- Compensated in cash and with time sufficient for reconstruction/reinstallation. - Completion in kind (if required by the owners) before demolishing the affected ones.
8. Affected vulnerable groups (women headed HH; poor families; disabled APs etc)	All vulnerable APs	Additional assistance as defined by the laws and policies of HCMC	- Pay in cash at least one month before land acquired for the project. - Implement the programs designed for them.

165. The funding for all compensation, assistance and resettlement is intended to be financed by the City.

Table 7.1-2: Cost Estimate to Implement the RP:

No	Item	Total in (1,000 VND)	Total in USD
1	Compensation for land	1,371,919,000	85,744,938
2	Compensation for houses	196,010,100	12,250,631
3	Compensation for secondary structures (auxiliary equipment)	2,335,600	145,975
4	Compensation for public facilities	23,000,000	1,437,500
5	Allowances	221,544,180	13,846,511
6	Cost for relocation arrangement	7,400,000	462,500
7	External monitoring	990,000	60,000
8	Subtotal cost (A)	1,823,198,880	113,949,930
9	Administration (1% of A)	18,231,989	1,139,499
	Total	**1,841,430,869**	**115,089,429**

Source: Project team.

166. **Implementation Arrangements:** Responsibilities of all relevant authorities and institutions from Central to Commune/ward levels are clearly described in the Decree 197/ND-CP-2004 and Decree 84/ND-CP-2007 as following.

- The PPC of HCMC and its relevant departments are responsible for reviewing, approving land acquisition; compensation costs at replacement values, relocation site development and directing the lower levels in implementing the RP.
- District People's Committees, District Compensation Committees (DCC), people's committees of affected wards will be responsible for carrying out DMS and compensation plans and payment for each AP as well as settling complaints from APs.
- The monitoring and evaluation will be done to make sure that the objectives and principles of the RP are met.
- A clear mechanism of complaint and settlement is also developed based on the laws of Viet Nam through three main steps from Ward to the City levels.

7.2 Social Analysis and Poverty Assessment in Resettlement Plan

167. The Social analysis and poverty assessment in the resettlement plan was prepared from the census information and from the socio-economic survey. The census information covers the totality of potentially affected HH. The socio-economic survey (SES) was conducted on 87 randomly chosen households, around 20% of the total households.

7.2.1 General Information Analysis

168. The previous section described the general impact of the project with regard to land acquisition and resettlement. The project will acquire 22.2 Ha of land, affecting 403 properties, of which 93% are privately owned and 7% are publicly owned.

169. Of the total affected private HH, 51 HH are fully effected (i.e., remained residential land is equal or less than 15m^2), requiring resettlement, and 325 are partially affected. All of the partially affected HH have expressed their desire to stay at their original places. Only 3 private HH hold a temporary residential status.

170. A total of 322 houses were identified as house-com shops and 54 houses without shops. Of the 322 shops, there are 236 cloth retail shops and 44 restaurants, food and coffee shops. The remaining 42 are tailors, repair shops.

171. The distribution of HH by class is the following: class 1: 3.2%; class 2: 18.4%; class 3: 34.6%; class 4: 43.3% ; temporary: 0.5%. Thus, there is a predominance of class 3 and class 4 households.

7.2.2 Type of Affected People by Gender

172. A total of 1,879 persons reside in the privately affected HH, 899 males and 980 females. In addition, 139 HH (37% of the total private HH) are female-headed HH. The average land holding of male-headed HH is 52.7 m^2 and 59.5 m^2 for female-headed HH.

7.2.3 Household Size

173. The average HH size at the surveyed HH is rather large and reaches about 7.82 persons/HH, of which, the dominant size is 5-6 persons accounting for 40%. With regard to female-headed HHs, the average HH size is even bigger, reaching 9.35 persons/HH. The data shows that although the surveyed land area of each HH is small, number of affected people (AP) is proportionally higher.

7.2.4 Age Distribution

174. In terms of age distribution, the SES indicates that the working age group is dominant with 78%; school-age group (under age 17) accounts for 15% % while the elderly group (over 60) is only 7%. Both male and female age distribution show similar patterns.

7.2.5 Educational Attainment

175. According to the SES, the rate of persons who reaches the level of high school or higher is 59%, of which 26% is at College and above. The rates show that educational levels in the surveyed localities are rather high. Males show higher educational levels than female AP, with 67% with high school or higher education for males versus 52% for females.

7.2.6 Social Policy and Poor Households

176. There are four types of affected HHs that are often taken care in policies of the State: martyr/invalid during the wars; heroic mother; contribution to the revolution or/and the poor. The SES shows that there are not any poor affected HHs[5] and heroic mothers. Nevertheless, there are five martyr/invalid HHs and 11 HHs who contributed to the revolution.

7.2.7 Main income Sources

177. The main source of incomes of most of the HHs derives from their shops. Some do business at their shops, but many others lease shops to earn their livings. Some can concurrently lease their shops and get pension or salary. Nevertheless, main incomes mostly derive from the shops. The pension or salary could be considered as a secondary source.

178. Of the HH members, some are the spouses of householders. Therefore, they also enjoy main income from leasing or doing business at the shops. However, the majority of HH members, 170 out of 288 males and 187 out of 306 females receive salary from their work.

[5] Poor HHs means that they have to hold poor certification book issued by local authority.

7.2.8 Type of Employment

179. Of the 681 SES persons, the State employee reaches the highest rate about 13.1%, in which males and females are nearly equal, followed by number of persons doing small business/trading at 12.8%. Other employments represent manor proportions. However, number of student/pupils is noticeable at around 15.1%.

7.2.9 Income and Expenditures

180. The dominant per capita income, accounting for 31.1% of the total SES persons, ranges from 1.5 million VND to 2.0 million VND. However, per capita incomes higher than 2.0 million VND account for 30.0% of the total SES persons

181. In general, income of HHs in the surveyed areas is rather good. In Tan Binh district, the income of HHs in ward 11 is highest and reaches VND 35,500,000 in female headed HHs and VND 25,000,000 in male headed HHs. It is followed by male headed HHs at ward 4, Tan Binh that reaches VND 21,876,000. The lowest income is male headed HHs at Tay Thanh ward of VND 3,838,000. Detail is table below. The main reasons of the higher income of HHs in Tan Binh compared with that of HHs in other districts are (i) HHs in the area have a bigger land area (ii) their houses are located in the very busy trading street of Truong Chinh. The average income of all male-headed HHs is about VND 10,986,000 and a little higher of female-headed HHs of VND 9,960,000.

182. The male-headed expenditure for basic needs varies from VND 3,543,000 to 16,713,000 per month and the female-headed expenditure varies from VND 2,348,000 to VND 8,970,000. , In general, the average income of all HH reaches VND 10,514,000. This amount is higher the average expenditure of VND 6,799,000. However, the income – expenditure balance at each group of HHs is not always like that. The income – expenditure comparison reveals that 16 out of 47 male-headed HHs, accounting for 34%, may face to income – expenditure inadequacy. In the group of female-headed HHs, the number is 8 out of 40 HHs, equal 20%.

7.2.10 Ownership of Assets, Water Source and Sanitation Facilities

183. Almost HH have essential facilities such as motorcycle, washing machine, refrigerator, telephone etc. However, only two have cars.

184. There are not any HHs who have to use water from drilling wells for cooking and drinking. 100% surveyed HHs are using pipe water. 100% surveyed HHs use toilets with septic tanks.

7.2.11 Vulnerable Households

185. The survey reveals that only one type of vulnerable HHs is female-headed HHs in the surveyed area. All respondents are ethnic Kinh, which is not considered an minority in Vietnam.

7.3 Environmental Impact Assessment

7.3.1 EIA Report

186. A full description of the project's environmental conditions, projects alternatives considered, anticipated environmental impacts and mitigation measures, summary of economic assessment, environmental management and monitoring plan, and public consultation and information disclosure, are contained in the Draft Environmental Impact Assessment (EIA), August 2008.

7.3.2 Environmental Impact Assessment and Proposed Mitigation Measures

187. For this PPTA study, the Consultants have identified the main environmental impacts involved in implementing and operating the UMRT Line 2 – Ben Thanh – Tham Luong. A distinction is made between temporary impacts during the construction phase and permanent impacts during the operational phase. These impacts are described taking account of the project's environmental context. In addition, proposals for mitigation measures are defined for impacts deemed excessive.

188. The main conclusion of the EIA is that the proposed Line 2 is proved to have significant positive effects to the development of Ho Chi Minh City. Benefits to the economy, traffic congestion reduction, quick and safety transport, employment opportunities, fuel consumption reduction, and air quality improvement are the obvious positive effects from the metro line.

189. Besides, the potential adverse environmental impacts on air quality (during construction phase), water environment, noise and vibration, solid waste, ecology, population resettlement are also taken into consideration. Basing on these detail potential adverse environmental impacts, appropriate mitigation measures have been developed for consideration.

190. The EIA concluded that project impacts from both construction and operation will be minimal, and can be mitigated through the use of best practices and appropriate technologies. With the implementation of the Environmental Management Plan and the Monitoring Plan, the Project is not expected to have significant environmental impacts. Internal and external monitoring and audits will be conducted to ensure that standards and regulations are being followed.

191. The following **Table 7.3-1** provides a summary of the Environmental Management Plan, which contains the type and source of impact, location, parameters to consider, proposed mitigation measures and applicable standards.

Table 7.3-1: Environmental Management Plan

Types of Impact	Activity phase	Source of Impact	Location	Parameters	Mitigation Measures	Applicable Standard	Implement-ation organization	Supervision organization
Air pollution	Construction	Dust from earthwork, emission from construction vehicle	Open construction sites and roads	TSP, NO_x, SO_2	▪ Install barriers around the open construction sites. ▪ Cover carefully the construction materials and excavated soils during transport and storage. ▪ Water spraying inside and around the construction sites as well as for transport vehicle wheels. ▪ Good transport regulation.	TCVN 5937:2005	Constructor	Project management unit, Department of transport and social works
Noise	Construction	Powered mechanical equipment and vehicle	Open construction sites and roads	50 - 75 dB	▪ Install noise barriers. ▪ Re-route and regulate the traffic, a main source of noise ▪ Combine noisy operations to occur in the same time period. ▪ Avoid night-time activities if possible. ▪ In case of night construction: need permission of local authority; inform ahead to residents about why, when and how long the night construction is needed; avoid school exam time. ▪ Use low noise and vibration machines; equip silencer for engines. ▪ Concreted mixer, power generated and other stationary equipment will be carefully placed to be far away from residential areas.	TCVN 5949:1998	Constructor	Project management unit, Department of transport and social works, DONRE, local authority
	Operation	Train and track noise	Along the line	50 - 75 dB	▪ Reduce noise generation by smooth wheels on smooth tracks ▪ Reduce ground-borne noise transmission by compact, massive design, vibration isolation and high damping ▪ Reduce sound radiation by shielding ▪ The glass sound barrier could be the suitable choice for air-borne noise mitigation	TCVN 5949:1998	Constructor	Project management unit
Vibration	Construction	Powered mechanical equipment	Open construction sites and	75 VdB	▪ Use low noise and vibration machines; equip silencer for engines. ▪ Using press –in piling method.	TCVN 6962:2001	Constructor	Project management unit, DONRE

Types of Impact	Activity phase	Source of Impact	Location	Parameters	Mitigation Measures	Applicable Standard	Implement-ation organization	Supervision organization
		and vehicle	roads		▪ Install supporting wall piles to reduce vibration and settlement impact at underground stations.			
	Operation	Train and track contact	Along the line	75 VdB	*Mitigation at source:* ▪ Track design: vibration could be reduced significantly by applying resilient fasteners, ballast mats, resilient supported ties, floating slabs, Rail grinding on a regular basis and Wheel truing to re-contour the wheel. ▪ Maintenance procedures: effective maintenance programs are essential for controlling ground-borne vibration. When the wheel and rail surfaces are allowed to degrade the vibration levels can increase by as much as 20 dB compared to a new or well-maintained system. *Limiting the propagation:* ▪ concrete walls between a source and receiver could be applied to mitigate vibration. *Mitigation at receivers:* ▪ for new buildings, this is generally via base isolation or by isolating spaces within buildings (box-in-box structure), which are more effective at dealing with ground-borne noise.	TCVN 6962:2001	Constructor	Project management unit
Wastewater	Construction	Washing construction equipment and vehicles; from workers	Working sites	COD, BOD, Oil, SS, etc.	▪ Clean construction sites daily to avoid run off from sites to spoil water bodies. ▪ Good management of construction, chemicals and machine maintenance. ▪ Contractors such as HCMC Urban Environmental Company will be hired to treat and dispose solid and toilet waste generated during project construction.		Constructors	Project management unit
	Operation	From train maintenance and from passengers	Stations and Tham Luong depot	COD, BOD, Oil, SS, etc.	▪ Install septic tanks at stations. ▪ Install wastewater treatment plant in Tham Luong depot	TCVN 5945:2005	Constructors	Project management unit, DONRE

Types of Impact	Activity phase	Source of Impact	Location	Parameters	Mitigation Measures	Applicable Standard	Implement-ation organization	Supervision organization
Solid Waste	Construction	From earthwork and worker activities	Working sites camps		▪ Excavated soils will be taken out only at two sites (23 September and Le Thi Rieng parks), then transported by a contractor to a well managed temporary dumping site Cu Chi, a suburban ward of Ho Chi Minh City which has low density of population. ▪ Normal and hazardous waste will be treated by contractors such as HCMC Urban Environmental Company.		Constructors	Project management unit, DONRE
	Operation	From train maintenance and passengers	Stations and Tham Luong depot		▪ Non hazardous solid waste will be collected at each train station. If possible, place the labelled waste containers in passenger terminals for metals, glass, paper, plastics and food wastes. *For hazardous materials management:* ▪ Use of aqueous detergent cleaning solutions or steam cleaning, or use and recycling of aliphatic cleaning solvents. ▪ Use of water-based paints. ▪ Use of track mats to retain wayside grease and other contaminants. ▪ Avoiding use of new or replacement parts with asbestos containing materials.		Constructors, maintaining workers	Management unit
Ecology Loss	Construction	Prepare temporary sites for receiving materials and taking out excavated soil	23 September and Le Thi Rieng parks		▪ After the project finish, re-vegetation will be done in order to compensate tree loss.		Constructor	Project management unit, Department of transport and social works

7.3.3 Environmental Monitoring Program

192. The following **Table 7.3-2** provides a summary of the proposed Environmental Monitoring Program. Environmental monitoring will be carried out in both the construction and operation phases. In the construction phase, the monitoring will be done in two levels: daily and regular monitoring, to be carried out by contractors and construction supervision companies. Environmental staff will be trained prior to the start of construction for the monitoring which will include mostly visual monitoring of air borne dust, surface issues. Hand-hold noise meters will be used to monitor the noise level at sensitive receptors during construction. The objective of this daily monitoring program is to identify environmental issues at the same time as the construction activities on these sites to that appropriate mitigation actions, if needed, can be initiated and implemented timely to minimize the impacts.

193. At the same time, in addition to the daily monitoring by contractors, a formal environmental monitoring program will also be carried out during the construction, as well as operation phase. This program will be conducted by professional environmental monitoring program with main objective to provide official records on environmental and regulatory compliance status.

Table 7.3-2: Environmental Monitoring Plan

Environment	Item	Contents
Air	Parameter	Temp, Wind speed, Wind direction, Humidity, Pressure, TSP, NO_2, CO, SO_2, THC
	Length	2 years for construction and first 2 years in operation
	Frequency	Once a quarter and 1 day each time
	Time	7:00, 10:00, 17:00, 21:00
	Location	Stations of line 2: Ben Thanh, Dien Bien Phu, Hoang Van Thu, Tham Luong, An Suong
Noise and Vibration	Parameter	Noise level equivalent (Leq) Vibration Level Meter
	Length	2 years for construction and first 2 years in operation
	Frequency	Once a quarter and 1 day each time
	Time	One during the day and one at night
	Location	13 stations of line 2 and Vo Thanh Trang market, Lac Quang church, Van Hanh pagoda
Water	Parameter	Surface water: Temp pH, COD, BOD, SS, Total N, Total P, Hg, Pb, Oil, DO, Coliform
	Length	2 years for construction and first 2 years in operation
	Frequency	3 months/time for construction phase; 6 months/time for operation phase
	Time	Day time
	Location	Bach Dang wharf (Saigon River), Khanh Hoi bridge (Saigon River), Tran Quang Dieu bridge (Nhieu Loc canal), Tham Luong bridge (Tham Luong canal), Tham Luong canal (near National road 1A)

8 ECONOMIC AND FINANCIAL ASSESSMENT

8.1 Approach

194. The approach to the economic analysis looks at the proposed project for the Urban Mass Rail Transit Line 2 (UMRT2) of Ho Chi Minh City (HCMC) and aims to take into consideration the specific characteristics of integrated urban transport systems. A metro system is not a list of individual lines that act independently and UMRT is not a stand-alone investment but part of an integrated network. The metro system is a network of rail lines that interlink with each other and which integrate with other modes of transport, thereby providing both local connections and strategic links to other destinations, provinces, cities and internationally. Moreover, metro or alternative mass transit systems have a critical role to play in the future development of large, modern, growing cities, such as HCMC.

195. Given the constraints of modelling the entire catchment area and transport network, it was necessary to adopt a limited approach to the with and without project scenarios adopted for the EIRR analysis. The economic analysis is therefore undertaken in three parts.

196. The first part considers the metro network as a whole and identifies the role and function of the UMRT2 as part of the network. It provides the economic rationale based on an examination of the current problem, policy, sector and local area analysis and examines alternative solutions and a least cost approach to achieving incremental improvements as far as possible given available data. Although often overlooked, this evidence-based economic rationale is a fundamental requirement of any project analysis.

197. The second part provides a project-specific EIRR, adopting a constrained with and without project situation that considers the impact of a shift in ridership from bus to rail, all other things being equal. Benefits that are valued and incorporated in the EIRR calculation include travel time savings, vehicle operating cost savings and employment generation.

198. The third part considers the contribution of UMRT2 and the metro system as a whole in achieving a target modal split for public transport. This includes additional travel and cost savings as well as other benefits streams including value creation through economic activity at stations, the induced uplift in property values, reduction in accidents and the environmental benefits of lower congestion. The economic analysis adopts ADB and other guidelines. Wherever possible, reference is made to other metro systems and projects, primarily those in Asia.

8.2 Economic Rationale

8.2.1 Context

199. As the largest city in Viet Nam and the country's economic centre, HCMC has experienced rapid economic growth and development in the last decade[6]. The city population has grown from 5.2 million in 2000 to 6.7 million in 2007. Over the same period, the real annual rate of economic growth was 11%; the number of enterprises increased more than threefold; the number of registered employed grew by more than 50%; and GDP per capita grew by about 70%. Since 2000, the output value of the service sector alone has more than doubled and the number of visitors to the city has also doubled to 3.5 million a year. Such rapid growth has transformed the city's economy and improved the living standard of the population but at the same time has placed enormous strain on infrastructure and the road network in particular.

[6] All data: Statistical Yearbook, Ho Chi Min City, 2007

8.2.2 The Problem

200. Only 15 years ago, the most popular mode of transport was by bicycle. Rapid growth in incomes has facilitated motorbike and car ownership; there are currently some 3.1 million motorbikes and 400,000 cars in HCMC. Of the estimated 19 million non-pedestrian trips a day, 93% are now by private vehicle with the most popular mode being motorbike accounting for some 78% with cars only 1% and bicycles 14% and the remainder using public transport modes.

201. Despite the low proportion of car trips, according to a recent study undertaken by the National University[7] the existing traffic congestion in HCMC is already proving costly to the socio-economic development of the city. The study examined the congestion conditions by adopting admissible road areas for different modes of transport, ranging from 0.75 sq m for a pedestrian to 30 sq m / person for a car. It found that the average delay at peak times was 45 minutes and points to the lack of traffic discipline as well as overall traffic volume and the low share of public transport in the modal split as the source of the problem. The study estimated that the socio-economic cost was about VND14,000 billion a year (equivalent to some USD0.8 billion), some 6.25% of the total HCMC GDP. This includes wasted investment in private vehicles, travel delay, wasted fuel costs for private vehicle trips and waiting time, impacts of deaths resulting from traffic accidents and the opportunity cost of land given over to parking for private vehicles.

202. Although this 6% estimate seems almost unbelievably high[8], even if the actual amount was half or even just 20% of this estimate, the socio-economic impact would still be very severe and certainly high enough to warrant immediate action. The current situation is expected to deteriorate even further as population continues to increase and household incomes continue to rise, particularly as more people turn to cars which require almost three times the space of a motorbike per person and an estimated 15 times the space of a bus per person. There is an urgent need to provide sustainable modes of urban transport that provide both effective, efficient and safe means of transport within the city and links to external transport networks linking cities and regions of Vietnam, South Asia and the rest of the world. Without it, the economic potential of Ho Chi Minh will be constrained; competitiveness, congestion, air pollution and safety will be compromised, and there will be consequential effects on wealth generation, household incomes, the urban environment and quality of life.

8.2.3 National and City Level Policy and Strategic Plans

203. The National Government is acutely aware of the importance of adequate infrastructure in facilitating growth and poverty reduction and attributes high priority to the transport sector in supporting sustainable economic goals. This priority is reflected in the planning process and also in the allocation of budget resources. In Vietnam, as with most other centrally planned economies, at National level, there are a series of long term strategic plans and more specific five year plans for overall socio-economic development, urban development and specific sector development, including transport. These plans are supported/articulated by specific laws, such as the National Railway Law and various Government Decisions, such as Decision 101[9], which provide guidance and direction to planners and decision makers.

204. The National Socio-Economic Development Plan[10] (SEDP) 2006-2010 provides the most comprehensive and up-to-date overarching plan. It sets out the role and expectation of the transport sector in promoting economic growth, reducing poverty and enhancing safety and environmental protection. The HCMC Transport Master Plan to 2020 (TMP) provides the basic framework for construction, development and completion of the transport network in the future. It sets out the plans and rationale for developing the Metro system as part of the urban transport network to support the plans and policies of the overall HCMC Master Plan and the socio-economic development of the

[7] Study on Public Transport Structure by Bus in Ho Chi Min City, National University, HCMC, 2008
[8] The consultant noted some potential double counting in the analysis but the order of magnitude remains large and the overall message of the study – that congestion is a costly constraint - remains the same
[9] PM Decision 101 of 2007
[10] The Five Year Socio-Economic Plan 2006-2010, Ministry of Planning and Investment

Southern Focal Economic Area. The TMP is prepared in consultation with all relevant departments of HCMC Government and approved at National level by the Prime Minister.

8.2.4 Analysis of Alternatives

205. Given the street layout and building density, expanding the HCMC road network in the inner city to accommodate unchecked growth in private transport is simply not practical. Possible alternatives for mass transit include bus and rail systems. The HCMC Transport Master Plan (TMP) sets out the objectives that were considered in determining the most appropriate system. A key consideration was the ability of any system to adequately cope with the peak demand – capacity at peak hours was considered vital. Other considerations included speed, safety, reliability, and a long daily operational time (>20 hours). The chosen mode was also required to be popular with end users, which by its nature infers a series of service delivery objectives in terms of affordability, ease of access, frequency of service, cleanliness, customers' safety amongst others.

206. The potential capacity of the bus system was considered in terms of the anticipated population and travel demands by 2020. The road network, layout, land-use and densities were incorporated. Bus capacity was estimated to meet only 18% of travel demand. As such the TMP concluded that as a long term solution, the urban bus system could not and should not play the main role of mass transit in the public transport system. The TMP sets out a framework for considering the required critical population mass and associated volumes for different types of transport system – see Table 8.2-1.

Table 8.2-1: Critical Population Mass and Selection of Preferred Urban Transport Systems

Population scale (1,000)	**Maximum volume** (person/hour/direction)	**Transport means**
15-20	-	Private means
20-60	Less than 1,000	Buses + private means
60-100	1,000-2,000	Mainly buses + private means
100-300	2,000-6,000	Mainly buses + taxi + private means
300-500	6,000-8,000	Trams + buses + taxi + private means
500-1,000	8,000-12,000	LRT + buses + taxi + private means
Over 1,000	Over 12,000	Urban – suburban railway; metro and the means mentioned above

207. The TMP suggests that some person/hour/direction volumes could reach 16-26,000 by 2020 and selects an urban rail system as the preferred solution, supported by other forms of transport. The TMP quotes international experience as supporting evidence: "Arguments and evidence from countries which spent many years organizing urban transport systems have come to the conclusion that only railway mass transit (Metro or urban-suburban railway) is able to take on the leading role" TMP, HCMC. The view expressed in the TMP is that a mass rail transit system is the most appropriate long term solution is also supported by the National University Study.

208. Short and medium term solutions through improving bus systems would be logical and cost effective, given the lead time required for mass transit rail systems. Rationalisation and expansion of the number of bus routes has already begun. Indeed, bus ridership has increased 5 times from 2003 to 2007 and the number of routes has increased from 42 to 110. Interim plans have been drawn up for further bus rationalization to encourage greater ridership; many of the bus routes are along the proposed Metro system lines.

8.2.5 Project Selection, Cost Effectiveness and Beneficiaries

209. Having established the rationale behind the selection of rail as the main rapid transit system, this section considers the priority of the proposed UMRT2 and selection of alignment and stations with respect to cost effectiveness. TMP proposed a total of 6 Metro radial and loop lines linking the main centres of the city with total length of 108.7 km. The proposed Line 2 Project forms an integral component. Table 8.2-2 shows the proposed network and the proposed implementation schedule.

Table 8.2-2: UMRT2 is one of six Planned Inter-related Metro Lines

Line	Stations	Status	External Funding
1	14	Under detailed design, Operational from 2014	JBIC
2	11	Under preparation, Estimated operational from 2016	ADB & others
3-6	80	Under preparation, Estimated operational date 2025	Under planning

210. The TMP discusses the assessment and type of system in three identified zones: inner city area, new inner city area and suburban area. In the inner city area underground rail is really the only feasible option due to the road layout and other selection criteria including protection of cultural, historical and other assets. In the new inner city area elevated or at-grade rail is possible given the relatively wide cross section of highways. In suburban areas, road and rail systems are included.

211. Of the six metro lines, the TMP identifies three (lines 2, 3 and 4) as priority lines that are especially important to HCMC as they follow the corridors with the highest traffic volume and would make the most progress in mitigating congestion. The priority lines also form a basic network from which to develop the wider Metro system for the whole of HCMC. No data is available to compare the incremental cost of different lines. The proposed project for UMTR2 has been surpassed by Line 1 which is funded through the Japanese Bank for International Co-operation. However, once the general route of UMRT2 was decided the project has aimed to mitigate the socio-economic impacts of resettlement, and environmental impacts wherever possible. The length of the line and the number of stations was also rationalized from an original 18 stations to 11 stations to reduce the cost and focus the initial line on the areas with the highest population density and potential ridership. Stations are located to coincide with main road junctions to enhance connectivity with other local transport modes.

212. Direct project beneficiaries will be those persons who use the travel corridor of UMRT2 (Urban Mass Rail Transit 2), some 481,700 metro person trips a day by 2025 as well as passengers of other transport modes who indirectly benefit from reduced congestion in the same corridor. Indirectly, the catchment population (which includes provinces outside the city) of some 13.8 million by 2025 persons will benefit from having access to the metro system, as well as the associated indirect benefits of supporting and enhancing the sustainable growth of HCMC and the improved quality of the urban environment.

8.3 Project EIRR Analysis

8.3.1 Performance of Metro Systems, International Experience

213. According to RailNet, there are some 40 cities with existing metro systems in Asia and many more in various stages of planning such systems. Depending on the prevailing country political and economic environment, some of the systems are owned and operated by private companies/corporations or by Government. Cities such as Tokyo, Hong Kong, Singapore, Bangkok, Shanghai and more recently places such as Shenzhen and Guangzhou demonstrate that mass transit systems in Asia can perform very successfully in financial and economic terms. They provide a critical economic function through the mass transportation of persons, without which the city would undeniably lose efficiency and competitiveness because of increased time and cost spent on travel and more road accidents. Metro stations, if close to the city centre or commercial area, often act as a focal point for commercial activity, wealth creation and employment through acting as a catalyst for property development as well as adding value to existing property and facilitating the development of new districts. The trend towards city competitiveness being judged on its urban environment, vibrancy and livability as well as other factors lends support to the economic case for metro systems which can provide mass transit operations without compromising the city's physical layout and design and can facilitate the pursuit of environmental targets to reduce pollution caused by motor vehicles. In addition, in countries where the system is operated by the private sector in a commercial way, the organization itself also provides value added in the transport sector, directly contributing to economic activity and GDP. In Singapore for example, the SMRT Corporation estimated the economic value

added, i.e its contribution to GDP at factor cost, to be S$103 million in 2007, equivalent to about $75 million a year[11].

214. Limited information is publicly available on the economic viability of new systems or extensions to previous systems. The Feasibility Study for HCMC Metro Line 1, Ben Thanh – Suoi Tien Section showed an economic rate of return of some 31% [12]. Studies undertaken for metro lines in Shenzhen and Zhengzhou show economic rates of return ranging from 13% to 15%. However, the relevant assumptions and calculations are not available such that these can only provide a broad guide, rather than a benchmarking exercise.

8.3.2 With Project and Without Project Scenarios

215. Under the counterfactual without project situation, the UMRT2 is excluded from the metro system. However all of the other five lines go ahead. In this way the project economic analysis aims to examine the incremental impact of UMRT2. The ridership of each mode of transport is determined through the detailed demand model forecasting undertaken as part of the PPTA and reported in the ridership and revenue forecast paper[13]. This incremental approach is a conservative one in terms of the economic benefits of the UMRT2 because it assumes that the modal split to 43% public transport can be achieved through policy measures with or without UMRT2. The difference in the two scenarios is the shift from bus to metro, with virtually no change in the number of person trips or allocation by mode. Whilst this is academically correct, it is also rather a hypothetical situation since if UMRT2 which, as shown in the economic rationale, is a fundamental part of the basic metro network and one of the top priority lines, then a situation in which all the other lines are built but UMRT2 is not built, is highly unlikely. A more realistic counterfactual would be one in which not only UMRT2 but other lines of the metro did not go ahead; one in which the counterfactual situation would be significantly worse. Indeed, as set out in the analysis of alternatives, there is really no feasible alternative to the metro network, then it should be appreciated that the counterfactual situation adopted results in a conservative approach to the assessment travel related economic benefits.

Table 8.3-1: Existing, With and Without Project Situation, Daily Person Trips and Modal Split

	Existing Situation		2015				2025			
			Without Project		With Project		Without Project		With Project	
Daily Person Trips	Nos ('000)	%	Nos ('000)	%	Nos ('000)	%	Nos ('000)	%	Nos ('000)	%
Metro	0	0%	509	3%	682	5%	1,841	10%	2,323	13%
Other	445	4%	3,503	24%	3,359	23%	5,989	33%	5,591	31%
Subtotal Public	445	4%	4,012	27%	4,041	27%	7,830	43%	7,914	43%
Car	799	7%	2,197	15%	2,195	15%	3,293	18%	3,276	18%
Motorbike	10,536	89%	8,371	57%	8,346	56%	6,940	38%	6,879	38%
Bicycle	97	1%	229	2%	229	2%	235	1%	233	1%
Subtotal Private	11,432	96%	10,798	73%	10,770	73%	10,468	57%	10,388	57%
Total	11,877	100%	14,800	100%	14,811	100%	18,298	100%	18,302	100%

Source: Consultant estimates
Note: The UMRT2 is operational by 2016 but the model design years were taken as 2015 and 2025. The difference in the with and without project situation would be 173,000 trips/day if the line were open in 2015, a year later the number is 190,000 trips/day.

[11] The SMRT Corporation includes rail, bus and taxi transportation, the largest contribution is the metro system
[12] Transport Engineering Design Joint Stock Inc – South Railway – Highway Consultants, Investment Report. However, this estimate is not considered to be particularly reliable since the FIRR in the report is exactly the same.
[13] The with and without situation adopted in the demand forecast scenarios to generate time and travel cost benefits for the economic analysis excluded bus rationalization. To be consistent with ridership patterns adopted in the rest of the PPTA, the results were adjusted to accommodate bus rationalization in conjunction with UMRT2.

8.3.3 Key Assumptions

216. The EIRR analysis is undertaken over the period to 2040, in constant prices and adopts the domestic price numeraire. The annual economic costs and benefits are included in relevant years. The economic opportunity cost of capital (EOCC) is assumed to be 12%. Given the strict hypothetical incremental approach to the with and without project situation, a lower rate could be justified and 12% lies on the upper limit of the appropriate EOCC.

217. The demand for public versus private transport modes in the planning of the HCMC transport network is policy driven. The TMP sets out the target modal split of between 47% and 53% for public sector modes by 2020. This is very high by international standards. The modal split assumed in the forecasting models is 43% public transport by 2025. To achieve this target will require a comprehensive and strictly enforced series of financial and other policy measures to ensure that private sector modes are relatively inaccessible and expensive whilst at the same time the public network is affordable and attractive. Reorganization of the bus network is a critical part of supporting policy for successful implementation of the metro system. The consultants estimate that failure to reorganize the bus network, might result in reduced ridership of the metro of about 40%.

218. Based on international experience, it takes time for consumer to alter their behaviour once a new modal choice or new travel option becomes available to them as they do not have perfect information. The speed at which consumers alter their behaviour towards their longer term preference will depend on the degree of advertising, existing market penetration, public perception, policy on alternative modes of transport and a range of other factors. "Ramp up" is assumed at rates of 60% in year 1, reaching 100% by year 5 (2020) to accommodate reduced ridership in the early years than would be predicted by the modeling exercise.

8.3.4 Economic Costs

219. Economic capital and operational costs are derived using the financial estimates and adapting them to economic prices. The total economic capital cost of construction is $804 million. The annual economic operating cost in 2016, the first year of operation is $11 million. Table 8.3-2 summarises the main assumptions in deriving the costs.

Table 8.3-2: Assumptions in Calculating Economic Cost

Exchange rate	$1 = VND16,000	Land value	Opportunity cost based on agricultural output at depot site
Shadow exchange rate factor	1.04	Fuel price	$80 per barrel
Taxes and subsidies	Excluded	Value of Time	Increase in line with GDP
Shadow wage rate for unskilled labour	0.65	Economic life	100 yrs underground 50 yrs above ground 30 yrs track 15 yrs equipment

8.3.5 Economic Benefits Included in the EIRR Calculation

Time Savings

220. The time savings are calculated based on the relative total time for trips made on a daily basis within the catchment with and without the project and projected by the demand forecast model. The model simulates the travel patterns of the catchment population, estimated at 9.1 million in 2007, growing to 13.8 million by 2025. Details of the model and its assumptions are reported in the HCMC Ridership and Revenue Forecast Study. The model disaggregates households into four different income levels and mode of trip as well as taking into account the relative cost and time of the journey undertaken. Generalised cost and fare sensitivity is modeled based on four levels of household

income and affordability is assumed to increase in line with GDP over time. The value of time for each household income level is based on the revealed preference survey undertaken as part of this PPTA. In very broad terms, by 2016 (before ramp up) there are about 190,000 daily trips on the UMRT2. Daily travel time savings across all modes is about 60,000 hours. The weighted average value of time is about $1 per hour. Daily travel time savings are thus about $60,000 a day for the 14 million person trips in the catchment area. This gives an average time saving across all person trips in the catchment of 0.2 minutes and an annual saving of about $21 million. The savings in travel time increase over time as ridership increases and value of time grows with income and affordability with savings amounting to about $100 million by 2025.

Vehicle Cost Savings

221. Vehicle cost savings are calculated on a similar basis as the value of time, comparing the km cost of all trips in the identified catchment area with and without the project. The cost per trip is built up by different mode and includes repair and maintenance, fuel, parking and public transport fares. Sensitivity tests on fares were run and the price elasticity of demand was found to be in the region of about 0.8 in 2015 (fairly elastic) to about 0.4 by 2025 (fairly inelastic). This is logical since affordability rises over this period and fares become a smaller part of the household income. In 2016, the daily saving in vehicle km is about 365,000 and the cost, about $0.1/km. Daily vehicle cost savings are estimated as about $40,000 a day or $15 million a year in 2016 rising to about $45 million by 2025.

Employment Generation

222. Approximately 800 jobs will be created in the direct operation of the proposed UMRT2. Indirect and induced jobs will also be created through the purchase of goods and services by the organization responsible for operating UMRT2 and expenditure of direct and indirect employees. Temporary jobs will also be created in the construction industry in designing and building the Metro and in providing materials and equipment and associated trading and logistics provision.

223. Permanent jobs in the Metro organization are treated as additional to the economy since the bus network reorganization will facilitate feeder and inter-related services, such that employment in the transport network as a whole is not reduced by any significant amount upon the opening of UMRT2. Permanent jobs are valued adopting the GDP value-added /employee ratio in the transport sector in HCMC to the number of staff assumed in each year[14]. The economic benefit in 2016 is about $9.6 million rising to $9.8 million in 2025.

8.3.6 EIRR Analysis

224. The EIRR analysis calculates the Net Present Value (NPV) of the cash flow of economic costs and valued benefits over the period to 2040 at the chosen discount rate as well as the overall Internal Rate of Return. Table 8.3-3 summarises the results. For the Base Case, the NPV is about $14 million and the IRR is 12.2% which marginally exceeds the EOCC of 12%. However as discussed above, if a more conservative EOCC were chosen the IRR would comfortably exceed the hurdle rate.

225. There are a number of risks to the project; the most important risks for the economic analysis are the risks that affect ridership and the modal split of future passenger journeys. The greatest risk is that policies to meet the target public transport modal split do not occur. It is not possible to specifically test this hypothetical case to recalculate the counterfactual but if these policies are not implemented, it is possible that ridership is only 60% of that assumed under the base case, under this test the IRR is 8.7%. Increases in fuel prices over the economic rate assumed would actually increase the benefits of the project, since metro offers an alternative to fuel consuming private modes of transport and any switch to metro would provide greater cost savings. The impact of ramp up is fairly small. If it takes 10 years rather than five years for the ridership pattern to settle into its long term state, then the IRR falls from 12.2% to 12.0% but still manages to equal the EOCC hurdle rate.

[14] Statistical Yearbook, 2007, HCMC

Table 8.3-3: Results of the EIRR Analysis, Base Case and Sensitivity Test

Base Case		EOCC 8%	EOCC 10%	EOCC **12%**
Net Present Value (NPV)	$ million	557	216	**14**
Ratio Benefit/Cost (B/C):	Ratio	1.9	1.4	**1.0**
Internal Rate of Return (IRR):	%			**12.2%**
Switching Value (Benefit Decrease)	%			**2.6%**
Switching Value (Cost Increase)	%			**2.6%**
Risk and Sensitivity				
Supporting Policy Not Implemented (IRR)	%			**8.7%**
Ramp up Happens Later (IRR)	%			**12.0%**

226. This calculation which sets a very limited incremental difference between the with and without project situation provides the very lower limit of the estimated actual EIRR. Other benefits not included in the calculation and the contribution of the UMRT2 to the overall metro system in achieving modal split and economic benefits needs to be considered for overall viability.

8.3.7 Economic Viability

Benefits Not Included in the EIRR Calculation

227. There are other benefits associated with the economic contribution of UMRT2 to HCMC that have not been factored into the EIRR analysis. First, if we assume that UMRT2 contributes to the overall shift to public transport modes, there will be far greater time and vehicle cost savings arising from the project. Considering the wider contribution of UMRT2, there are also other benefits streams that have not been included.

Land and Property Benefits

228. The most important additional benefit streams are associated with land and property benefits. A mass transit system that does not require great expanses of land for roads enables the city to be more centralized, negating the need for additional infrastructure that would be required under a more decentralized urban layout; there is also considerable opportunity for economic activity to concentrate at easy access points in the city, i.e. stations. Typically elsewhere in Asia, stations have generated great economic benefits through enhancing connectivity or opening up new development areas. In some cases such as the MTR Corporation in Hong Kong, the metro is funded through the sale of land development rights at stations, such that the Treasury captures financially some of the economic benefit generated. The potential in HCMC in terms of land and property benefits is considerable.

229. However, to-date, commercial / residential development at stations has not been considered under the feasibility study and as such, the incremental impact has not been able to be valued and included in the EIRR. However, anecdotal evidence can provide some order of magnitude of the impact. Modern office buildings in District 1 are typically in the order of 10,000-20,000 sq m GFA. Taking prime rent as a proxy for economic value, at current market rents of about $45 a sq m, this gives an annual value of about $5-10 million. This is one single office building which if included in the EIRR calculation would increase the IRR by 0.5%. Of course, it would not be appropriate to assume all new development was additional, some would represent development that would have occurred elsewhere and is displacement rather than additional. But even if conservative estimates were taken, say only ten additional office buildings resulting from improved connectivity in the city centre, this would drive up the EIRR considerably – to about 17%. However, there would also be property impacts from improved connectivity for existing property which increases the value of land around

stations and as seen elsewhere often leads to changing use and function of the area with associated economic activities occurring as a result. Finally, assuming that the UMRT2 contributes to the overall shift to public transport modes, there are benefits from the opportunity cost of land from parking of motorbikes.

Reduction in Traffic Accidents

230. Similarly, if we assume that UMRT2 contributes to the overall shift to public transport modes, there will be savings in traffic accidents. In 2006, there were about 1200 fatalities as a result of transport accidents in HCMC. Of those, the vast majority were attributed to motorbikes and the majority of these occur in urban areas. Over the period 2007 to 2025, with the shift to public transport, some 4 million trips by motorbike are saved. Simply comparing the current situation with the future, some 480 traffic fatalities could be avoided, some of which certainly could be attributed to UMRT2.

Reduction in Pollution and Improved Living Environment

231. Estimated reduction in pollution and the value that people place on improvements in their living environment, with and without a metro system would be a research project in its own right. It is clear that a shift of mode to public transport would provide a far better pedestrian environment at-grade and lower levels of air and noise pollution. Being a relatively low rise city, compared to those in other parts of Asia, having a comfortable, clean and safe pedestrian street level could be a major comparative advantage in terms of livability.

8.3.8 Conclusion

232. There is a strong rationale for investment in urban rail mass transit in HCMC. The alternative, to base all public transport on an expanded bus system, is neither practical, nor would it yield such benefits in terms of safety, cleanliness, urban environment objectives and livability. Current congestion is costly in socio-economic terms and will continue to become more costly to the economy and competitiveness of HCMC and Vietnam as a whole if it is not addressed.

233. Comparing the situation of a future HCMC with a metro system with UMRT2 and one with a metro system without UMRT2 yields limited economic benefits because it only reflects a shift in ridership from buses to metro. Adopting such a counterfactual does not really reflect the wider benefits that accrue because UMRT2 is part of a metro system, not just an independent piece of infrastructure. Even so, testing the economic viability in this strict incremental approach including employment generation, time travel savings and vehicle cost savings yielded an EIRR of 12.2% which marginally exceeds the hurdle rate. Sensitivity tests demonstrate the importance of the implementation of supporting policy measures in mitigating the risk of reduced ridership on the metro system. This is particularly important given the very high target for public transport modal share.

234. Other benefits of the UMRT2 being part of the wider system include greater time and travel cost savings, benefits of greater connectivity facilitating economic activity and property development and value and savings in land from avoided parking requirements as well as direct and indirect impacts on the living environment from avoided congestion. To not invest in a mass rail transit system would affect the future competiveness of HCMC, not only in terms of its economic activity, but as a place where people want to live, visit and do business.

Table 8.3-4: Results of the EIRR Analysis, Base Case and Sensitivity Test

Incremental Economic Impact of UMRT2

(in US$ millions at first quarter 2008 constant prices)

Year	Costs				Benefits				Net Benefits	Benefit	Costs	Sensitivity	Sensitivity
	Investment	Operating and Maintenance	Lost Production	Total	Travel Time Savings	Operating Costs Savings	Permanent Employment	Total		Switching Test	Switching Test	No Policy Implementation	Slower Ramp Up
2009	10	-	-	10	-	-	-	-	-10	-10	-10	-10	-10
2010	100	-	0.1	100	-	-	-	-	-100	-100	-103	-100	-100
2011	105	-	0.1	105	-	-	-	-	-105	-105	-108	-105	-105
2012	128	-	0.1	128	-	-	-	-	-128	-128	-131	-128	-128
2013	174	-	0.1	174	-	-	-	-	-174	-174	-178	-174	-174
2014	188	-	0.1	188	-	-	-	-	-188	-188	-193	-188	-188
2015	100	-	0.1	100	-	-	-	-	-100	-100	-102	-100	-100
2016	-	11	0.1	11	15	10	9.6	34	23	22	22	9	19
2017	-	12	0.1	12	24	15	9.6	49	38	36	37	18	28
2018	-	12	0.1	12	30	19	9.6	59	47	45	47	23	40
2019	-	12	0.1	12	37	22	9.6	69	57	55	57	29	50
2020	-	12	0.1	12	45	25	9.6	80	68	66	68	36	61
2021	-	12	0.1	12	53	29	9.6	91	79	76	78	42	72
2022	-	12	0.1	12	62	32	9.6	103	91	89	91	50	86
2023	-	12	0.1	12	73	36	9.6	119	106	103	106	59	102
2024	-	12	0.1	12	87	41	9.6	137	124	121	124	70	122
2025	84	12	0.1	96	103	46	9.9	158	62	58	59	-1	62
2026	-	12	0.1	13	116	50	9.9	176	163	159	163	93	163
2027	-	13	0.1	13	132	54	9.9	196	184	179	183	105	184
2028	-	13	0.1	13	150	59	9.9	219	207	201	206	119	207
2029	-	13	0.1	13	171	64	9.9	246	233	227	233	135	233
2030	-	13	0.1	13	195	70	9.9	275	263	256	262	153	263
2031	75	13	0.1	87	223	77	9.9	310	222	214	220	98	222
2032	75	13	0.1	87	255	84	9.9	349	261	252	259	122	261
2033	-	13	0.1	13	291	92	9.9	393	380	370	380	223	380
2034	-	13	0.1	13	334	101	9.9	444	431	420	431	254	431
2035	42	13	0.1	55	383	110	9.9	503	448	435	447	247	448
2036	-	13	0.1	13	439	121	9.9	570	557	542	556	329	557
2037	-	13	0.1	13	504	132	9.9	647	633	617	633	375	633
2038	-	13	0.1	13	580	145	9.9	735	722	703	721	428	722
2039	-	13	0.1	13	667	159	9.9	836	823	802	823	489	823
2040	-488	13	0.1	-474	769	175	9.9	953	1,428	1,403	1,440	1,046	1,428
Total	**590**	**312**	**2**	**904**	**5,738**	**1,767**	**245**	**7,749**	**6,845**	**6,645**	**6,821**	**3,746**	6,792

Base Case					**Sensitivity Tests**		
		8%	10%	**12%**	12%	12%	12%
Net Present Value (NPV)	$ million	557	216	**14**	-0	0	-207
Ratio Benefit/Cost (B/C):	Ratio	1.9	1.4	**1.0**			
Internal Rate of Return (IRR):	%			**12.2%**	**12.0%**	**12.0%**	**8.7%**

8.4 Summary Financial Analysis

8.4.1 Introduction

235. The details of the financial analysis, including methodology, other assumptions and input data, projected financial statements, other calculations, and sensitivity tests, are to be found in Appendix A of this Volume. Financial analysis has been carried out to assess the project viability and sustainability by determining if the project anticipated financial revenues, net of the capital investment and operating cost and net of taxes, yield a financial internal rate of return (FIRR) that is adequate when compared to the weighted average cost of capital (WACC).

236. The FIRR is estimated in real terms, using 2008 constant prices and based on project capital cost excluding interest and other financing charges during implementation (FCDI). An analysis of the project's estimated financial statements is carried out for the same period to test the project capital structure and debts service capacity, and to identify the subsidy requirement. The financial projections are expressed in nominal terms, taking into account the effects of domestic and foreign inflation and currency fluctuations. The investment and financing plans are based on the assumption that the ADB loans will be supplemented with a contribution from a co-financier.

237. The data input into the analysis include a passenger demand forecast, estimated project investment, and operation and maintenance costs, which are discussed in detail elsewhere in this report. Table 8.4-1 summarizes the project investment plan on which the analysis is based.

Table 8.4-1: Project Investment Plan ($ million)

Table 1: Project Investment Plan ($ million)

Item		Total [a]
A.	**Base Cost** [b]	
	1. Civil works	440.6
	2. E&M systems	174.1
	3. Rollingstock	60.1
	4. Land acquisition and resettlement	115.1
	5. Consulting services	52.2
	6. Incremental administration	20.9
	Sub-total (A)	**862.9**
B.	**Contingencies** [c]	
	1. Physical	70.3
	2. Price	183.8
	Sub-total (B)	**254.1**
C.	**Financial Charge During Implementation** [d]	**128.0**
	Total (A+B+C)	**1,245.0**

[a] Includes local taxes and duties of $ 49.2 million.
[b] at first quarter 2008 prices.
[c] Physical contingencies computed at 5% to 10%of base cost. Price contingencies are computed at 0.8% on foreign exchange costs, and 18.3% in 2008, 10.2% in 2009, 6.5% in 2010, 4.0% in 2011 and 5% from 2012 onwards on local currency costs, for land acquisition and resettlement cost at 8.1% in 2008, 5.1% in 2009, 6.5% in 2010, 4.0% in 2011 and 5% from 2012 onwards.
[d] Includes interest and commitment charges. ADB (OCR): Interest during the 6-year grace period has been computed at the 5-year forward London interbank offered rate, plus a spread of 0.2%. Commitment: 0.15% pa.
ADB (ADF): 7-year grace and 1.0% interest during grace, and 1.5% thereafter. Commitment: no charge.
Co-financier loans: 6-year grace and 4% interest. Commitment: 0.15% pa. Terms based on current market rates and co-financier indications for a medium term outlook.

ADB = Asian Development Bank, ADF = Asian Development Fund, OCR = ordinary capital resources.
Source: Asian Development Bank estimates.

238. The project base case (Base Case) assumes that by the start of project operation HCMC People's Committee will have implemented a reorganization of bus routes to optimize the benefits from the city's public transport, including the new metro Line 2. At the assumed fare of VND4,000 per boarding , the forecast of strong patronage and annual fare revenue in the starting year (2016) yields a fare box ratio (fare revenue divided by operating and maintenance cost) of 1.1 times, or 106%, high relative to international experience. The demand forecast indicates an expectation of high patronage growth, including an assumed 3.5% p.a. average rise in patronage in the period 2025-35, while operating performance also advances strongly over the project life, as indicated by fare box ratios of 3.2 in 2025 and 4.3 in 2035. Based on the anticipated demand and the implied level of fare box recovery of operating cost, the total subsidy requirement for the project in the Base Case is $1,268 million equivalent. Details will be found in Table 8.4-2.

Table 8.4-2: Project level of subsidy: Base Case, and without bus reorganization

Scenario	Revenue and cost recovery indicators				Total subsidy ($ million)
	Year	Daily passenger boardings	Annual fare revenue ($m)[b]	Fare box ratio (times)	
Base Case	2015[a]	104,280	18.7	1.1	1,268
	2025	481,700	95.6	3.2	
	2035	679,500	219.8	4.3	
No bus routes reorganization	2015[a]	58,968	10.8	0.6	1,481
	2025	326,500	64.8	2.2	
	2035	460,560	149.0	2.9	

Source: this study
Notes:
[a] 2016 instead of 2015 for annual fare revenue and fare box ratio
[b] Non-fare revenue is forecast to be equal to 5% of fare revenue

239. Table 8.4-2 also indicates the effects on revenue and cost recovery if the bus routes reorganization does not materialize. The starting year daily patronage and fare revenue drop by 40%, and the fare box ratio falls below 1 but advances to a level which is considered high by comparison with international experience[15]. While the assumed rate of growth in patronage is the same, the effects of lower starting daily boardings are seen in the consistently lower fare box recovery ratio compared to the Base Case. In summary, the total subsidy required, should bus reorganization fail to be implemented, is $1.5 billion, up 17% from the Base Case. This is a substantial increase in the subsidy burden and the project financiers may wish to consider introducing an appropriate mechanism to encourage implementation of the required bus routes reorganization.

8.4.2 Conclusion

240. The project is expected to require a total subsidy of $1,268 million equivalent. This has been derived assuming that the project debt service coverage ratio (operating profit before interest, corporate income tax, depreciation and amortization plus annual subsidy, all divided by debt service) would be maintained at 1.2 times until the loans have been fully repaid. At the D 4,000 fare per boarding, the project shows a consistent recovery of annual operating cost out of fare revenue, beginning with the first year of operation. Having a predominantly underground alignment[16], which makes it more costly to build compared to lines or sections that are predominantly elevated or at-grade, the metro Line 2 has a higher construction cost per kilometer. Where there are significant differences in metro lines' vertical alignment, there is a general need to accept differences in their level of cost recovery under a uniform fare policy, which is necessary for an integrated metro network. The free cash flow in real terms, including capital expenditure on equipment renewal, and additional rolling stock to serve expected demand growth, and including subsidy, yields an after-tax Financial Internal Rate of Return (FIRR) of 6.1%, above the 2.17% WACC. Development of metros as a key transport

[15] For example, Hong Kong MTR has a company-wide fare box ratio in 2007 of around 2 (source: HK MRT 2007 annual report).
[16] Unlike for example Line 1, where the opposite is the case.

mode in major cities is confirmed as a fundamental state policy in the framework Railway Law 2005[17]. The law assigns the responsibility for policy implementation to the provincial and centrally administered city level, and also stipulates GOVN's responsibility to provide support to approved investment in metros. Since the principle of a balanced local budget[18] operates, it is anticipated that HCMC will be assigned a share of the subsidy funding that is within the city's budget resources, with the balance to be funded through the central budget.

8.5 Financing Plan

241. The Government has requested that ADB provide an ADF loan of $20 million and an OCR loan of $500 million to finance a portion of the project cost. The ADF loan, for detailed project design, procurement support, resettlement implementation, and other pre-construction activities, will have a 32 years term, including a grace period of 7 years, an interest rate fixed at 1.0% during the grace period and 1.5% thereafter. The OCR loan, for part of the investment cost, will have a 25 to 30 years term (based on the financial analysis), including a grace period of 6 years, an interest rate determined in accordance with ADB's London interbank offered rate (LIBOR)-based lending facility plus 0.2% and a commitment charge of 0.15% per annum on the undisbursed amount of the loan. The ADB financing represents 41.8% of the total project cost, and will cover part of the civil works activities, most of the consulting services and some resettlement.

242. As mentioned in 8.4.1 above, it is intended that the project will be co-financed from another co-financing source. For illustrative purposes it has been assumed that the Government will seek a loan or loans totalling $625 million. The loan(s) will have a 15 year maturity and a fixed interest rate of 4%. The co-financing will finance all of the rolling stock, all of the electrical and mechanical systems and equipment, some civil works and some consulting services.

243. The remaining cost, about $100 million equivalent, will be financed by Ho Chi Minh City. All the loans will be to the Government of Viet Nam. Counterpart funds will cover the whole incremental administration, land acquisition and part of the resettlement cost.

Table 8.5-1: Summary of Financing Plan (US$ million)

Source	Total	%
Asian Development Bank ADF loan	20.0	1.6
Asian Development Bank OCR loan	500.0	40.2
Co-financing	625.0	50.2
Counterpart funding	100.0	8.0
Total	1,245.0	**100%**

ADF = Asian Development Fund, OCR = Ordinary Capital Resources
Source: Asian Development Bank

244. Of the entire loan proceeds of $1,145 million, GOVN will provide $847 million as a grant and the balance of $298 million will be borrowed by Ho Chi Minh City from Ministry of Finance, through a subsidiary loan agreement, on terms acceptable to, and at the applicable interest rates, of the project lenders to the Government, plus the MOF's lending fee of 20 basis points. To have the sub-loan denominated in Dong, Ho Chi Minh City will pay the appropriate MOF posted swap cost for the Dollar or other loan currency. The financing plan is presented in Table 8.5-1 above.

[17] Railway Law No 35/2005/QH11, Article 56.
[18] Law on the State Budget No 01/2002/QH1, Article 4, 2d.

8.6 Fiscal Measures to Optimise Urban Transport

8.6.1 Objectives and Focus

245. To optimize the benefits of MRT and urban transport in general there is a need for government to identify and take concrete steps in order to increase the likelihood of success in achieving the goal of a liveable city, in which mobility needs are met effectively, efficiently and sustainably. Fiscal measures which can be used for this ultimate goal have different focuses, which should be clearly distinguished. These can include:

- **Eliminating distortions in the urban transport market.** There may be distortions in the urban transport market discriminatory to public transport. These include for example: fuel subsidies, taxes and duties which have the effect of encouraging popular private vehicle ownership; absence or non-collection of fines for breaking safety, road use, and environmental laws and regulations (eg regulations about helmets, traffic, illicit parking, noise and exhaust emission). The distortions should be identified and examined holistically, under a goal of optimizing the use of public transport.
- **Managing road use.** MRT provides an expanded choice for travel and with that the opportunity to introduce fiscal measures to manage excessive road use leading to congestion, poor air quality, high accidents, health issues, high urban maintenance cost etc. These measures could aim at limiting the number of vehicles in a busy area or on specific roads during restricted hours through one of a number of charging methods, eg by the day, for each entry during the day, for the amount of time spent etc. Vehicle tracking and charge collection methods of varying costs are involved. Singapore and London provide frequently studied examples of the measures.
- **Promotion of efficient urban development.** Certain forms of urban development have synergies with public transport eg a compact urban layout based on using MRT and other public transport to serve people's mobility needs. These can be encouraged by tax incentives and/or disincentives. Examples from the international experience should be studied.
- **Value capture.** A benefits tax aims at allowing the community to share in the gain when property increases in value for being adjacent to a new MRT line or lines. With value capture, property owners can be considered to be returning some of their gain as a contribution to the public expense in building the MRT. The idea applies generally to any subsidized urban infrastructure program resulting in improved property values. Examples of the tax can found in countries including USA, UK and Australia.

8.6.2 Urban Transport Fund and Alternatives

246. There is no parallel of a universal cure in designing the fiscal measures referred to above. To be effective, designs need to be based on a careful study of the local context, including fiscal laws and laws governing the management of public finance, besides socio-economic factors. Different options on how the funds collection and disbursement are managed are possible. For example, specific revenues could be earmarked for an urban transport fund account which is managed by a particular unit of city or central government. Alternatively there is no earmarking and the revenues are managed under a centralized state budgetary system. The right choice of options would depend among other things on the adopted public accountability institutions and system of public audit.

Table 8.6-2: Detailed Financing Plan ($ million)

	ADB (OCR)		ADB (ADF)		Co-financier loan		Government of Viet Nam		Total
	Amount	%	Amount	%	Amount	%	Amount	%	**Amount**
A. Investment Cost [a, b]									
1. Civil works	281.1	55.2%	-	0.0%	228.0	44.8%	(0.0)	0.0%	509.1
2. Non-system E&M	-	0.0%	-	0.0%	101.1	100.0%	-	0.0%	101.1
3. E&M systems	-	0.0%	-	0.0%	112.1	100.0%	-	0.0%	112.1
4. Rollingstock	-	0.0%	-	0.0%	68.6	100.0%	-	0.0%	68.6
5. Land resettlement	84.5	59.6%	12.6	8.9%	-	0.0%	44.7	31.5%	141.8
6. Depot	-	0.0%	-	0.0%	44.1	100.0%	-	0.0%	44.1
7. Consulting services	42.6	70.0%	6.1	10.0%	12.2	20.0%	0.0	0.0%	60.8
8. Taxes and duties	23.6	49.9%	0.5	1.0%	-	0.0%	23.2	49.1%	47.3
Sub-total (A)	**431.8**		**19.2**		**566.1**		**67.9**		**1,084.9**
B. Recurrent Costs [a, b]									
1. Incremental administration	-	0.0%	-	0.0%	-	0.0%	30.2	100.0%	30.2
2. Taxes and duties	-	0.0%	-	0.0%	-	0.0%	1.9	100.0%	1.9
Sub-total (B)	**0.0**		**0.0**		**0.0**		**32.0**		**32.0**
C. Financial Charge During Implementation [c]									
1. Interest During Construction	66.7		0.8		55.9		-		123.5
2. Commitment Charges	1.5		-		3.0		-		4.5
Sub-total (C)	**68.2**		**0.8**		**58.9**		**0.0**		**128.0**
Total Disbursement (A+B+C)	**500.0**		**20.0**		**625.0**		**100.0**		**1,245.0**

ADB = Asian Development Bank, ADF = Asian Development Fund, OCR = ordinary capital resources.

[a] at first quarter 2008 prices. Each cost component is inclusive of physical contingency and price contingency.

[b] Physical contingencies computed at 5% to 10% of base cost. Price contingencies are computed at 0.8% on foreign exchange costs, and 18.3% in 2008, 10.2% in 2009, 6.5% in 2010, 4.0% in 2011 and 5% from 2012 onwards on local currency costs, and for land acquisition and resettlement cost at 8.1% in 2008, 5.1% in 2009, 6.5% in 2010, 4.0% in 2011 and 5% from 2012 onwards.

[c] Includes interest and commitment charges. ADB (OCR): Interest during the 6-year grace period has been computed at the 5-year forward London interbank offered rate, plus a spread of 0.2%. Commitment: 0.15% pa.
ADB (ADF): 7-year grace and 1.0% interest during grace, and 1.5% thereafter. Commitment: no charge.
Co-financier loan: 6-year grace and 4% interest. Commitment: 0.15% pa. Terms are based on current market rates and co-financier indications for a medium term outlook.

Source: Asian Development Bank estimates.

9 PROJECT IMPLEMENTATION

9.1 Project Approvals

247. Several national and HCMC level agencies have approval responsibilities for aspects of project implementation as shown in the following Table.

248. Critical to the smooth implementation of the project is to ensure that infrastructure plans, designs and implementation steps can be approved without delay prior to end of Year 1 of project implementation including:

Before Project Implementation Commences

- Feasibility Study and Preliminary Design to be approved as the basis of further project preparation and design;
- Procurement approach (Design – Build) and to proceed to additional design and preparation of tender package;

During Year 1 of Project Implementation

- TOR and commissioning of consultants to prepare this package and Implementation Management Support services during project implementation;
- Approval to proceed with procurement and subsequently award contracts; and
- Approval for necessary steps for timely relocation of utilities and making available land for construction.

249. Once implementation is underway, it will be important to commence early procurement of Rollingstock and other M&E equipment, integrated ticketing and then to procure an operator. The key steps within Years 1 to 3 of the project are:

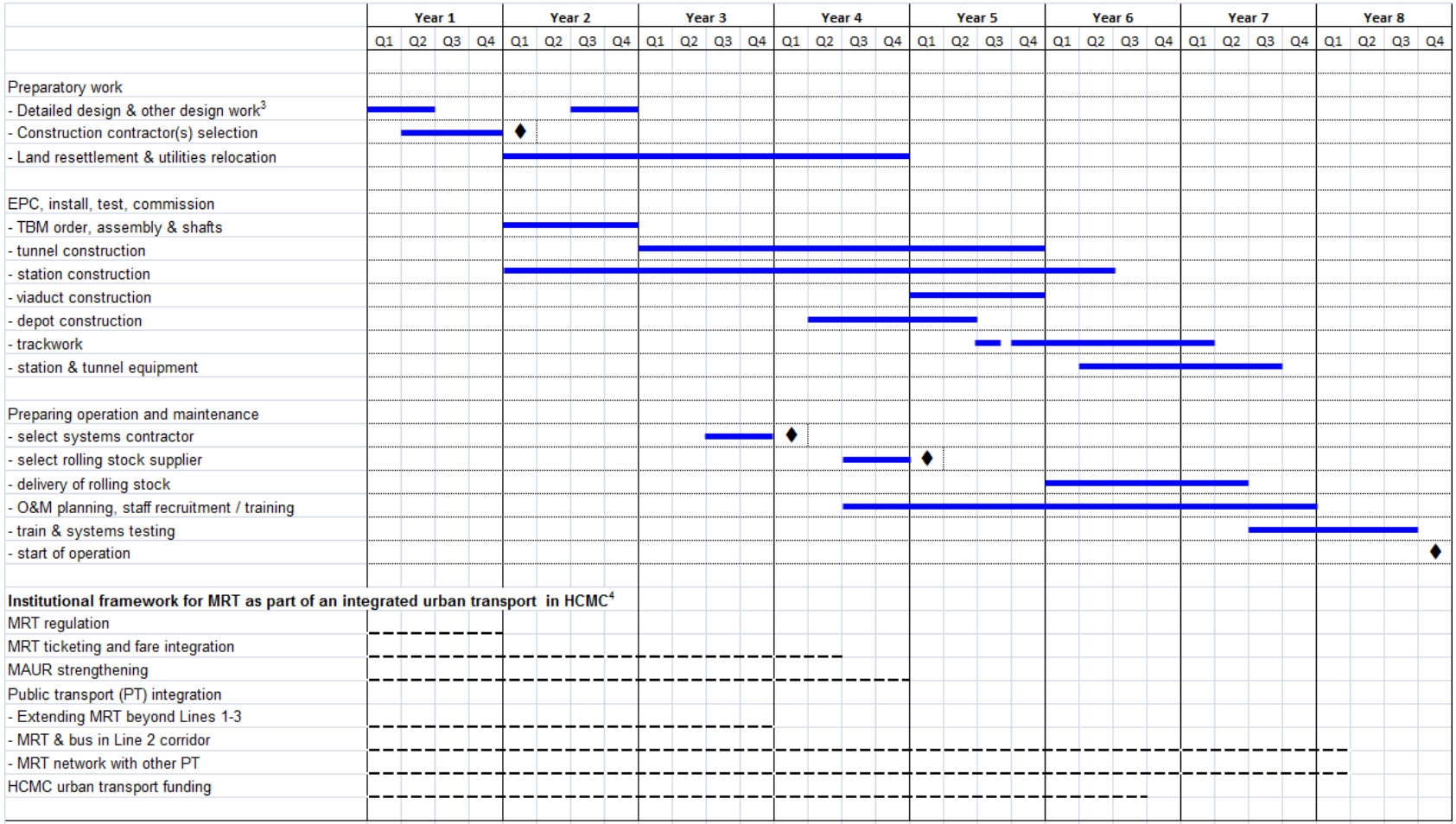
During Year 1 of Project Implementation

- MAUR to prepare Rolling stock and M&E equipment Procurement Plan following Government's and lenders' procedures and obtain relevant approvals;
- MAUR to prepare Line 2 operator procurement plan following Government procedures and obtain approval;
- HCMC PC to approve integrated ticketing and fares TA and commission consultants;

9.2 Implementation Schedule

250. The Project will be implemented over a period of approximately 8 years. The tentative implementation schedule for the Project is shown in Figure 9.2-1.

Figure 9.2-1: Implementation Schedule



Notes:

1 For design and preparation of tender documents for utilities relocation, construction , E&M and train acquisition; for advice in tender evaluation, preferred bids negotiation, contract preparation, and supervision of the CW and E&M and rolling stock contractors. An O&M consultant is under a separate contract from the rest.

[3] For elevated and at grade civil works. Underground section will mostly be design-built. E&M and rolling stock will be based on an engineering design-manufacture approach.

[4] Output of activities under technical assistance topics as listed. The activities go beyond donors' immediate project due diligence and post-investment monitoring & evaluation requirements.

During Year 2 of Project Implementation

- MAUR to obtain approval to commence Rollingstock and M&E equipment procurement;
- HCMC PC to approve recommendations of integrated ticketing and associated procurement package and obtain approval to go to tender;

During Year 3 of Project Implementation

- MAUR to obtain approval to procure a MRT operator.

Table 9.2-1: Key Agencies and Broad Responsibility for Approvals

Stakeholder	Responsibility
National Level	
Ministry of Transport (MOT)	Through its different modal administrations and departments (a) plans, manages and maintains national infrastructure through its different departments and administrations; (b) assists local governments in developing transport plans and selecting transport projects; and (c) manages public bus transport plans by approving cities master plans
Vietnam Railways Administration (VNRA)—under MOT	Plans and manages the development of the sub sector Regulates the sub-sector including national and other rail systems including metro or MRT in cities and provinces. Provides oversight of City and Provincial rail and MRT Master Plans and is charged with approval of technical standards and safety of rail and MRT systems. Main functions of relevance to project: • Informal MRT Master Plan approval • MRT technical standards • MRT safety standards & compliance
Ministry of Finance (MOF)	Arranging of finance from external agencies including IFIs and provision of finance to local governments. Currently, financial planning aspects of future MRT development in Vietnam.
Transport Development Strategy Institute (TDSI)-under MOT	Develops long and medium term transport sector strategies and plans (in collaboration with modal administrations)
Department of Planning and Investment (DPI)-under MOT	Integrates investment plans prepared by modal administrations for submission to MPI for inclusion in the PIP and to MOF for inclusion in the State Budget.
The Ministry of Natural Resources and the Environment (MNRE)	Reviews and approves environmental impact assessments for transport projects.
HCMC PC level	
People's Committee	Approves key issues such as fares, opening and closing of routes, schedules and subsidies.
Transport and Urban Public Works Services' (TUPWS) Transport and Industry Management Department (TIMD); and the Management and Operations Centre for Public Transport (MOCPT).	Develops cities' transport strategies; Plans and manages construction; Maintains urban transport infrastructure; Manages bus transport; Coordinates planning and implementation of traffic management with Police. Main functions of relevance to project: • Transport Strategy • Traffic management and parking • Bus route planning & franchising incl bus-MRT integration • Bus system ticketing
HCMC Management Authority for Urban Railways	Plans / implements rail-based mass transit plans and has responsibility for managing and arranging for operations and maintenance. Main functions of relevance to project: • MRT civil infrastructure development incl land acquisition • MRT rolling stock & E&M supply • MRT ticketing • MRT operations procurement and/or operations directly

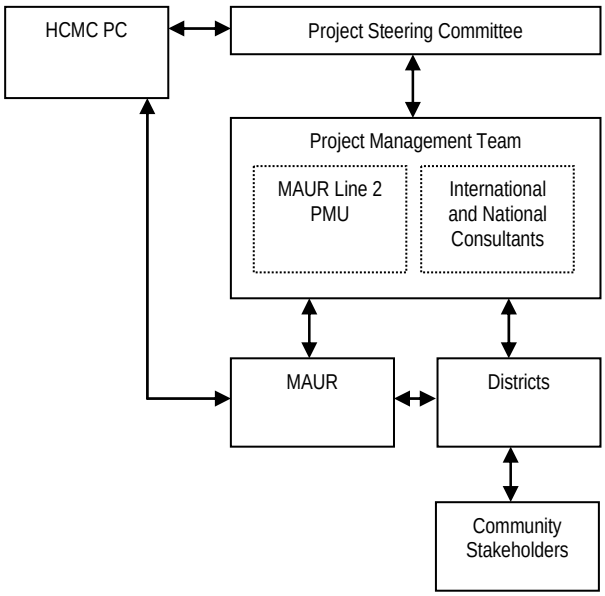
Stakeholder	Responsibility
HCMC Investment Fund (HIFU)	Arrangement of finance through bond issue for counterpart funds, coordination with private sector incl private financial institutions, possible shareholding role in a JV operating entity
Department of Finance (DOF)	Treasury functions such as processing of project-related local expenditures including counterpart payments
District Level and Commune Governments	Relevant district governments through which a project passes will have a role in land acquisition & other facilitation
Urban Planning and Architecture Department (DUPA)	Land Use Master Plan preparation and approval of developments. Land approvals are separately made by the Department of Natural Resources and Environment (DNRE) with little linkage to the Master Plan.
Department of Planning and Investment (DPI)	Investment programming including one year annual budget and five year Public Investment Program (PIP)
Traffic Police under the Public Security Department	Enforces traffic management including the operation of traffic signals in coordination with TUPWS

9.3 Institutional Arrangement and Capacity Building

9.3.1 Project Management

251. The project management team will comprise staff from the MAUR PMU assisted by international and local consultants – see **Figure 9.3-1**. The team will work under the guidance of a project Steering Committee, which will be chaired by HCMC PC. Day-to-day liaison will be maintained with MAUR and also with the Districts and community groups.

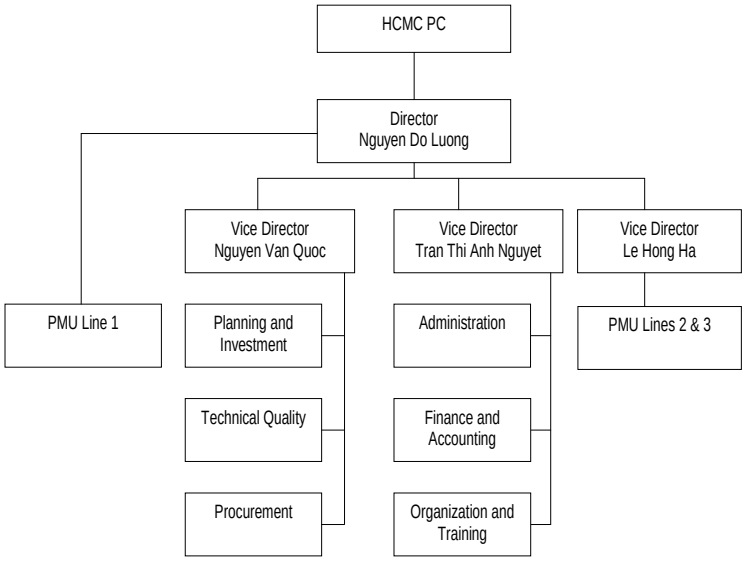
Figure 9.3-1: Project Management Structure



9.3.2 Implementing Agency

252. The Implementing Agency (IA) for the Project will be MAUR. As such MAUR will have overall responsibility for project implementation and formal correspondence with the line ministries, city authorities, ADB and the other funding agencies. The existing organization of MAUR is shown in **Figure 9.3-2**.

Figure 9.3-2: Existing MAUR Organization



253. As shown in **Figure 9.3-2** MAUR has already established a division, or Project Management Unit (PMU), with responsibility for overseeing the development of Metro Lines 2 and 3. It is understood that, once the Line 2 Project moves into implementation, responsibilities for Lines 2 and 3 will be separated and there will be a dedicated PMU for Line 2. The PMU will engage and direct the work of consultants and will procure and direct all contractors. The PMU will be staffed with a full time director, engineers, accountants, social, resettlement and environmental specialists, and other specialists, as may be required. Through MAUR, the PMU will coordinate with the city people's committees and district people's committees on construction works, environmental management, planning and implementation of the land acquisition and resettlement activities.

9.3.3 Capacity Building

254. The proposed Line 2 MRT subway project is very complex from an engineering and ongoing operational point of view. MRT has to operate a network of services and the choice of technical systems such as communications and ticketing need to have a system wide basis. That is, to achieve technical integration and desirable policy outcomes requires thinking now beyond the initial Line 2 project to avoid locking in irreversible decisions that in future could constrain the operation and financial sustainability of MRT as a whole. The Project and Its Components and relevant skills areas are shown in the **Table 9.3-1** below.

Table 9.3-1: Project Components

Components	Description
(1) Line 2 Physical Implementation: • Approvals and prerequisites (eg property acquisition) • Civil Works • Trains/M&E • Ticket Equipment	All physical components of the Line 2 project including relevant procurement options & timing. Also includes consideration of those issues that may impede progress such as land acquisition. And issues such as community liaison.
(2) MRT Operations (whole system): • Ticket System • Concessioning of operations and maintenance • Safety and security systems • Marketing & community engagement	All aspects that affect the ability of MRT to operate as a system and a network of integrated services.
(3) MRT Management (whole system): • Urban transport institutional arrangements including MAUR structure	All aspects that affect appropriate development of appropriate management structures which affect procurement and operational performance plus policy aspects

Components	Description
• MAUR finance management (initial focus on systems to get Line 2 implemented) • Line 2 financial sustainability • MAUR capacity building • Public transport service integration • Urban transport and land use policy, including pricing/taxation issues	for the whole MRT system where necessary commencing with Line 2.
(4) Line 2 Project Support: • Implementation support (ie consultants for assisting in contract supervision, project approvals etc) • Monitoring and evaluation program (including systems for project input auditing as well as output performance) • International Advisory Panel is recommended. It could comprise a five member panel comprising one expert each on civil works, trains/M&E, MRT operations, marketing, and transport policy/institutions that could meet in HCMC twice yearly overlapping with ADB review missions to provide strategic advice and oversight.	Project implementation support for Line 2 and policy implementation including monitoring and evaluation. Support types could include: TA for project management of key components; capacity building; and TA for special studies. The follow up support types could be defined as (a) essential (b) not essential but desirable.

255. An initial assessment of MAUR's management and financial capacities and procedures has been undertaken using the ADB Financial Management Assessment (FMA) questionnaire. MAUR was established in September 2007. It is a young organisation that is still developing its capacity. It has a current staff of 60 and has approval for an establishment of 90 people by end of 2008. At the time of the FMA questionnaire none of the staff had previous experience in the management of ODA projects (other than the short time working with JBIC on Line 1 since March this year). MAUR is now actively undertaking recruitment of people with ODA experience.

256. It is clear that MAUR will require extensive strengthening, particularly in project management skills.

257. Priority needs to be given to those activities which are (a) crucial to the sustained functioning of MAUR, and (b) where the gap between available skills or experience and current requirements is greatest. These are considered to be:

- Financial management and project accounting
- Planning, management and maintenance of metro services
- Planning, management and maintenance of related urban services and infrastructure
- Construction management and supervision
- Management of social and environmental safeguard issues
- Community participation

258. Strengthening MAUR needs to involve a combination of:

- Organizational strengthening: reviewing current organisation structure, and advising on change
- Systems and procedures: designing and introducing new procedures as basis for the delivery of its responsibilities
- Formal specialized training in fundamental aspects of the new tasks
- Structured on-the-job training in conjunction with the delivery of the Project, setting performance targets and monitoring against achieved improvement.

259. On-the-job training will be provided via the project implementation consultancy services including (i) overall project management, budgeting and reporting; (ii) detailed design; (iii) assistance with bid preparation and tendering; and (iv) assistance with contract management.

9.3.4 Options for the Future Institutional Arrangements

260. To some extent the scope of capacity building required in MAUR will depend on the options selected for the future operation of the metro line services. A number of options were discussed in the

PPIAF Working Paper on Implementation Arrangements - Institutional Options, submitted in March 2008. The four options considered are summarised below:

Option 1: Strengthen MAUR

261. This Option 1 requires a strengthened MAUR that goes beyond treating MRT as a series of construction projects ie an Authority for MRT or Metropolitan Transit Authority (MTA). In this option, MAUR would be responsible for ensuring the planning and arrangement of operation for a fully integrated passenger rail system for HCMC. As an Authority MAUR would (a) plan effectively by seeking to meet demand (b) consider the whole of life attributes of proposed MRT; (c) arrange construction and operations (d) procure contractors for construction of civil works; (e) procure services to be operated so that they are all on the same basis; and (f) plan and program works and budgets in a disciplined manner. It would take overall transport policy and transport guidance from TUPWS of which its predecessor organization was a part.

Option 2: Interim Public Transport Authority

262. This option builds on Option 1 and proposes also a high level permanent committee at the PC level most likely chaired by the Chairman of the PC (or the Vice Chairman) to provide strong direction from the top and improve coordination horizontally between TUPWS and MAUR and with other important departments such as Department of Planning and Investment, Department of Finance and Department of Urban Planning and Architecture.

Option 3: Integrated Public Transport Authority

263. In this option the proposed Integrated Public Transport Authority would be solely responsible for ensuring the delivery and operation of a fully integrated public transport system (MRT and bus) for HCMC. This option would enable all public transport ticketing and fares to be integrated as long as MRT and bus operating arrangements are consistent. The proposed new Authority would take overall transport policy and transport guidance from TUPWS as for previous options. It would create a new formal structure in which civil works design and procurement and services would be arranged by new Engineering Design and Procurement and Operations Divisions respectively. Care would be taken to ensure that in a single organization (as for Option 1) that policy and operational functions are sufficiently separated to avoid a conflict of interest. Under this option, close links would be developed with TUPWS (as for Options 1 and 2) and with the Department of Planning and Investment, Department of Finance and Department of Urban Planning and Architecture.

264. As a true apex organization the proposed Authority would be staffed by very senior and respected official to direct the organization and cultivate the needed relationships for the new organization to fulfil its potential.

Option 4: Integrated Transport Authority

265. In this option, a wholly integrated Authority would plan the multi-modal network, specify the services, program the investment (including roads, MRT and bus) in conjunction with the PC and Department of Planning and Investment and Department of Finance, and procure the services to be operated so that they are all on the same basis, thus enabling integrated fares and ticketing and integrated investment according to overall need. A close coordinating role with the Department of Urban Planning and Architecture is also envisaged to coordinate land use developments at MRT stations and in conjunction with new road developments. As for Option 3 it is envisaged that very close coordination between DPI and the Authority would exist. An independent rail safety regulator is also envisaged.

266. The options were assessed using the following criteria:

- Clarity of public transport management, eg ability to ensure consistent direction and priorities for public transport, a focus on core functions, involvement of transport users, and the risk of BITA reverting to inertia given its comprehensive role.
- Appropriateness of the institutional structure, eg clear allocation of responsibilities, accountability for outcomes, separation of potentially conflicting functions, links with key partners, and ease of implementation.
- Ability to deliver projects and services, eg businesslike, prepare programs, secure funding, tender, award and supervise concessions.
- Ability to meet passenger needs, eg integration of fares and services, provision of information on services, integration with land use.

267. A summary comparison of the assessed options is shown in **Table 9.3-2**.

Table 9.3-2: Comparison of Institutional Options for Metro Operation and Management

	Existing Arrangements	Option 1 Strengthen MAUR	Option 2 Interim PT Authority	Option 3 Integrated PT Authority	Option 4 Integrated Transport Authority
Clarity of strategic direction					
Ensure consistent directions & priorities	-	✓	✓✓	✓✓	✓✓✓
Focus on core functions	✓	✓	✓	✓✓	✓✓
Involvement of transport users	-	-	✓	✓✓	✓✓
Risk of inertia	-	-	-	×	××
Appropriateness of the institutional structure					
Clear allocation of responsibilities	✓	✓✓	✓✓	✓✓	✓✓
Accountability for outcomes	-	✓	✓	✓✓	✓✓
Separation of conflicting functions	-	✓	✓	✓✓	✓✓
Links with key partners	-	✓	✓✓	✓✓	✓✓✓
Pace/extent of change	na	✓	✓	✓✓	✓✓✓
Ability to deliver projects and services					
Businesslike arrangements	-	✓	✓	✓	✓
Ability to prepare and manage programs	-	✓	✓	✓	✓
Secure funding	-	✓	✓	✓✓	✓✓
Project implementation	-	✓	✓	✓	✓
Concession management	-	✓	✓	✓	✓
Ability to meet passenger needs					
Ticket and fare integration	-	✓	✓✓	✓✓✓	✓✓✓
Marketing and information	-	✓	✓	✓✓	✓✓
Integration of public transport and land use	-	-	-	✓	✓✓
Conclusion	Change needed	Fair for Integrated MRT	Fair for Integrated Bus and MRT	Good for Integrated Bus and MRT	Good for Integrated Transport

268. The four options are not mutually exclusive. An ambitious but realistic target for developmental purposes would to achieve Option 3 – Integrated Public Transport Authority – during the life of the project but this new structure has implications for other units of the PC. As MAUR has only recently been elevated to their current role (from a unit of TUPS) to the same level it is unrealistic to expect to gain early commitment to another major restructuring prior to the commencement of project implementation. As the Strengthening of MAUR ie Option 1, is a necessary first step prior to creation of a Integrated Public Transport Authority, it is proposed that during Year 1 of project implementation

the benefits of an Integrated Public Transport Authority be discussed with policy and decision makers within the PC with the view of gaining their commitment by the completion of project implementation.

9.4 Sources of Finance

9.4.1 Introduction

269. The financing options and issues for Line 2 need to be examined in the context of the logical framework for the project development. The goal or impact—to improve the livability of Ho Chi Minh City through the provision of an integrated urban transport—and the purpose, or outcome—to assist the MAUR deliver a sustainable MRT Line 2 that provides a reliable, safe and attractive urban public transport service—together raise complex challenges going beyond issues of technology. No less important matters relate to identifying alternative approaches in organizing and financing the project delivery, and to understanding their potential to be effective and efficient—that is, produce the outcome and impact while incurring the least cost to the community. These non-technological issues form the focus of the PPIAF assignment which parallels the present feasibility study. The financing plan for the project is described in Section 8.2 of this report.

9.4.2 Financing and Delivery Options

270. The PPIAF study identifies for detailed examination four alternative approaches—including private sector participation and public private partnerships (PPP)—to project development of Line 2: (i) the project is developed by a state-owned enterprise (SOE), with government taking maximum responsibility in project management, financing and service delivery; (ii) the service delivery is by a private sector concessionaire, with government retaining the remaining project responsibility; (iii) the operating concessionaire supplies (ie also finances) the required trains and signaling and communications, and government retains all other responsibility; and (iv) the project is developed as a build-operate-transfer (BOT) concession, where the private sector take the maximum project responsibility, allowing government to play only a monitoring and evaluation role, at least in theory. The key features of the four options are summarized in Table 9.4.1.

9.4.3 The Integrated Transport Test

271. The first three options are consistent with an integrated MRT policy in that government, with the appropriate concession format (ie the Gross Cost concession), ensures it retains control over fare policy and an unencumbered potential to integrate ticketing and other dimensions, physical and financial, bearing on passenger transfer between lines as the MRT network expands and ultimately also across public transport modes. The fourth, the BOT option, fails this test, because it naturally involves a Net Cost contract—ie the BOT concessionaire collects and keeps the fare revenue specified in the concession contract. The BOT concessionaire also requires a payment from government because Line 2 has a funding gap, and unless the concessionaire has a sole monopoly of MRT lines—which would not be in the public interest—it could have little incentive to act to facilitate passenger transfers between lines. As a result the BOT option conflicts with the TA's goal and purpose for Line 2. Details of this assessment appear in the PPIAF report.[19]

9.4.4 Value for Money (VFM) Test

272. The potential cost to the community of the four options is also evaluated and compared in a quantitative value-for-money (VfM) test. It is common experience that government generally faces a lower financing cost compared to the private sector. At the same time, statistical analyses of international transport projects provide well-founded evidence of substantial public sector optimism bias (a propensity for actual cost to exceed forecast or for actual revenue to fall short of forecast) in project capital cost estimates. Now, common experience suggests that, much more than the bureaucratic organization, a private sector enterprise is generally under strong motivation to manage

[19] See in particular PPIAF Institutional Issues and Options Paper

uncertainly in project planning and implementation. Meanwhile, studies of privatized public transport, especially bus, indicate that the private sector can be expected to deliver service at a cost significantly lower than the public sector. Thus, in theory, an MRT project development with an appropriate assignment of responsibility and risk between government and the private sector concessionaire could yield a lower expected cost, risk taken into account, compared to a eg a pure government effort.

Table 9.4-1: Alternative approaches to project development: summary of features

Responsibility and risk	State owned enterprise (1)	Private sector operating concession (2)	Private trains E&M supply w/operating concession (3)	Build-operate-transfer (BOT) (4)
Financing				
Civil works and fixed equipment	Government sourced capital		Government sourced capital	Concessionaire sourced capital
Trains with related systems & equipment			Concessionaire sourced capital	
Passenger service with maintenance of civil works & equipment	Government sourced working capital	Concessionaire sourced working capital	Concessionaire sourced working capital	Concessionaire sourced working capital
Delivery				
Civil works and fixed equipment	Government procures by competitive tender		Government procures by competitive tender	Through Net Cost contract by competitive tender
Trains with related systems & equipment			Through Gross Cost contract by competitive tender	
Passenger service with maintenance of civil works & equipment	Via SOE's contract with government	Through Gross Cost[a] contract by competitive tender		
Payment/funding				
Fare revenue	Revenues collected under a separate arrangement	Paid to government	Paid to government	Concessionaire retains
Other revenue		Paid to government/ shared	Paid to government/ shared	
Payment from government	Gross Cost contract style payment	Concessionaire receives competitively bid payment from government.		Competitively bid external support
Risk				
Investment cost-civil works and fixed equipment	Government transfers some risk to the private sector via the design, construction and equipment supply contracts	Government transfers some risk to the private sector in the design, construction and equipment supply contracts	Government transfers some risk to the private sector in the design, construction and equipment supply contracts	Transferred to private sector, except for agreed indexation
Investment cost-trains & related systems & equipment			Transferred to private sector	
Service operating cost & all maintenance costs	Contracting transfers some risk to SOE but state ownership means ultimate recourse to government	Transferred to private sector, except what is retained through indexation[b] plus the risk of government provided trains not matching operator needs	Transferred to private sector, except what is retained through indexation	
Revenue	Risk transfer to SOE for a similar purpose as in (2)-(3) seems less effective, perhaps because it is realised that government is not likely to let an SOE fail financially	Some patronage risk is transferred to private sector linked to an incentive payment to keep up service quality standards		Transferred to private sector, except for any agreed fare indexation

Source: adapted from PPIAF Institutional Issues and Options paper, this Study
Notes: [a]For a description of the Gross Cost and Net Cost concession forms see Section 2.9 Issues and Options paper, especially Figure 2.2.

[b]In the context of a concession agreement, indexation embodies the principle of allowing the price of a good or service to be adjusted upward or downward to keep its original purchasing power parity.

9.4.5 Test Results

273. A VfM test carried out for the four options indicates that option (iii), private sector trains and train-related systems supply and service operation, incurs the lowest expected cost to the community; with option (ii) the next lowest. The BOT option shows a lower optimism bias than all the other options, but, since it uses the concessionaire's private sector financing for the full project investment, it incurs a maximum premium on the government's financing cost; this option turns out to have the highest expected cost to the community, the SOE option included. Evidently the BOT option is a doubly inappropriate approach to MRT project development. Details of the VfM test methodology, input data and parameters, as well as results can be found in the PPIAF report.[20]

9.4.6 Assumptions and Contingencies

274. It is important to understand what assumptions are necessary for, and what contingencies would invalidate, the VfM test results. These are summarized below.

275. **Market competition.** VfM requires a competitive tender market for the concession and for related sub-contracting of the technology (eg design, construction, systems integration and installation, operation and maintenance in MRT service provision) and financing services to ensure that concession payment of concessionaires and sub-contractors is not in excess of a normal risk-weighted remuneration for effort. This means that an option which has cleared a VfM test could at the procurement stage be facing a market failure (eg only one bidder), threatening its ability to deliver the anticipated VfM . Thus, transition and emerging countries in particular often cannot count on a reliable international supply of private sector financing. The threat of market failure in a specialised field such as MRT concessioning and sub-contracting should not be dismissed lightly.

276. **Financial and services market distortions.** Here are some examples of distortions that can threaten or dilute VfM.

a) Limited recourse financing of a PPP concession promotes VfM because the senior lenders, usually financial institutions regulated by a central bank, will for as long as the debt is outstanding have an interest in the project which is aligned with the authority granting the concession and bring professional skill to the monitoring of the concessionaire's performance. The lenders' incentive to monitor the concessionaire performance is diluted with the lenders' use of credit risk transfer (CRT) products. This practice dilutes the concession authority's effort to share an exposure to the concessionaire's performance level with the senior lenders, minimizing the monitoring cost in the process.

b) Bilateral ODA financing can also introduce distortions in the sub-contracting markets. The tying of an ODA loan to supply of goods and services of a national origin restricts the competitive tendering for the procurement of MRT consulting and construction services and systems supply. An opportunity can be created for vendors to use the concessionary pricing of a loan to build in an additional margin on goods and services. In the long term, the practice can create a situation where, in a narrow field, the potential suppliers tacitly agree to live and let live instead of competing, with adverse effect on supply prices and therefore VfM.

c) Partnering developed over time among financiers and sub-contractors while having a potential to be an effective project risk management tool for a concessionaire can be abused if allowed to develop into a collusive arrangement, which in the end threatens VfM.

277. **PPP procurement capability.** Ability to procure well is important for realising VfM. The balance of opinion, if not of evidence, is that a greater capability is required of the public sector in the procurement of a PPP concessionaire, than a conventional public works procurement. Ad hoc outsourcing for the required skills leads to limited results. For example, legal firms skilled in PPP contracting, forced to make a choice through conflict of interest rules, can tend to opt for working for the concessionaire side rather than government. Institutional capability building is required.

[20] See the PPIAF Financial Model Paper (summarised in Appendix F)

9.5 Risk Identification and Management

278. The financial and economic viability of the Project depends to a large extent on the implementation of other aspects of the HCMC transport strategy. This includes the other metro lines and also includes the implementation and enforcement of policies to promote public transport. Implementation of Line 1 has started and commitment to future lines appears to be strong, so the risk of non-implementation is minimal unless there is a major shift in the region's economic climate.

279. There are risks associated with the effectiveness of the planning and operation of the metro system as a whole, and similarly with other elements of an integrated multi-modal public transport system. There is no certainty over the Government's commitment and ability to enforce pro-public transport policies, and there is a risk that the mode of private transport will continue to increase unchecked.

280. Mitigation for these risks will be through the strengthening of MAUR in terms of its planning, management and operational capacities. This will also depend on the Government's continued support to MAUR.

281. The city's transport strategy includes an increase in the involvement of the private sector as investors and operators. There is a risk that the private sector may be unwilling to take a significant role in public transport infrastructure. Clearly, variations in costs and potential revenues will influence profit margins and thereby the investment decisions of private undertakings.

282. Ridership and revenue forecasts are based on a range of economic assumptions including an underlying average GDP growth rate of 8.5% per annum up to 2025. Mitigation against such risks can probably only be through monitoring trends and adjusting operational investments accordingly. The key assumptions in the model are:

- GDP growth averages 8.5% to 2025
- Committed road schemes are completed
- Road capacity grows by 1% per year
- Bus network similar to today but with very major capacity and service increases to meet and achieve target public transport mode share
- Cars represent 18% of modal split in 2025, motorcycles 38%

283. Social and resettlement risks involve the possibility that compensation, resettlement, and income restoration measures might not be delivered as agreed, thereby disadvantaging affected people and possibly delaying the start of civil works.

284. This risk should be mitigated by ensuring that the consultants and PMU have appropriate and competent specialists to assist in updating and implementing the resettlement plan. MAUR will also engage an independent monitoring organization to supervise implementation of resettlement and compensation.

285. The analysis of risks shows that the economic viability of the investment program remains robust even with adverse changes in anticipated economic growth, and in other key risk factors and assumptions.

APPENDICES

A: FINANCIAL ANALYSIS

B: STATIONS DESCRIPTION

C: CIVIL WORKS, CONSTRUCTION AND ENGINEERING SYSTEMS

D: DETAILED CAPITAL COST ESTIMATES

E: OPERATION AND MAINTENANCE COSTS

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APPENDIX A: FINANCIAL ANALYSIS

FINANCIAL ANALYSIS OF THE PROJECT

A. Introduction

1. The purpose of the financial analysis is to assess the project viability and sustainability, by determining if the project anticipated financial revenues, net of the capital investment and operating cost and net of taxes, yield a financial internal rate of return (FIRR) that is adequate when compared to the weighted average cost of capital (WACC). A rail mass rapid transit project, while requiring large capital investment and significant operating cost, is expected to generate substantial indirect benefit, in addition to the direct benefit perceived in the fare-earning service to passengers and other revenue-generating potential, such as advertising and the station-based real estate. Sustainability and viability have to be viewed in the context of a financial contribution or subsidy from the state to the project revenues, on account of the net social benefits, as indicated in the project economic analysis. The FIRR is estimated in real terms, using 2008 constant prices and based on project capital cost excluding interest and other financing charges during implementation (FCDI). An analysis of the project's estimated financial statements is carried out for the same period to test the project capital structure and debts service capacity, and to identify the subsidy requirement. The financial projections are expressed in nominal terms, taking into account the effects of domestic and foreign inflation and currency fluctuations.

B. Financial Analysis

2. **Assumptions.** The FIRR estimated for the 32-year period 2009-2040 (7 years implementation plus 25 years of operation). The estimation takes into account the project costs, comprised of the capital investment and the cost to operate the service and carry out routine preventive maintenance (O&M cost). In the context of the FIRR analysis, the initial investment cost is made up of the Base Cost in Table A.1, plus physical contingencies. In addition to the initial investment cost, the analysis takes into account the investment required to renew or replace exhausted or expired assets during the 30 year period.

3. **Revenues.** A fare of D4,000 is assumed for the forecast of patronage or demand and fare revenue, treated in detail elsewhere in this report. The current analysis assumes a non-fare revenue from advertising and station-based retail commercial development of an annual total equivalent to 5% of fare revenue, which is approximately the international average for metro systems in operation. This conservative assumption is not intended as a performance target nor to discourage effort. There appears to be some scope for commercial development within and adjacent to stations. It is also expected that advertising, a low-investment source of revenue, would have a good potential to earn income to supplement the fare collection. The potential for commercial development and advertising should be explored in greater detail through a market study.

4. **Subsidy.** The farebox recovery ratio, defined as fare revenue divided by O&M cost, is a standard industry measure of a metro system's ability to recover cost out of its main-source revenue. A farebox ratio below 100% indicates that a system is not recovering operating cost, and hence requires an operating subsidy, as well as a capital subsidy. Long established, operating rail MRT systems in North America, UK and Japan still depend on a capital subsidy[21]. A 2004 study shows that all 14 of the largest US heavy rail MRT systems have farebox ratios of less than 70%[22], and so are continuing to require ongoing operating subsidy. In the present project operating cost, but not capital cost, is fully covered by fare revenue. The project is anticipated to require a total subsidy over the

[21] Sources: Brookings Institutions, 2004, Washington's Metro: Deficit by Design; Babalik-Sutcliffe, E, 2002, Urban rail systems: analysis of factors behind success, Transport Reviews, 22:4, 415-447; House of Commons, Committee of Public Accounts, 2005, London Underground Public Private Partnerships; Japan Railway Construction, Transport & Technology Agency, 2004, Development of Railways and Subsidy Programs in Japan.

[22] Brookings Institutions, *op cit*.

project life of $1,268 million. With this taken into account, the analysis shows an FIRR of 6.1%. The FIRR calculation is shown in Table A.10.

5. The project base case (Base Case) assumes that by the start of project operation HCMC People's Committee will have implemented a reorganization of bus routes to optimize the benefits from the city's public transport, including the new metro Line 2. At the assumed fare of VND4,000 per boarding , the forecast of strong patronage and annual fare revenue in the starting year (2016) yields a fare box ratio (fare revenue divided by operating and maintenance cost) of 1.1 times, or 106%, high relative to international experience. The demand forecast indicates an expectation of high patronage growth, including an assumed 3.5% p.a. average rise in patronage in the period 2025-35, while operating performance also advances strongly over the project life, as indicated by fare box ratios of 3.2 in 2025 and 4.3 in 2035. Based on the anticipated demand and the implied level of fare box recovery of operating cost, the total subsidy requirement for the project in the Base Case is $1,268 million equivalent. Details will be found in Table A.1.

Table A.1 Project level of subsidy: Base Case, and without bus reorganization

Scenario	Year	Revenue and cost recovery indicators			Total subsidy ($ million)
		Daily passenger boardings	Annual fare revenue ($m)[b]	Fare box ratio (times)	
Base Case	2015[a]	104,280	18.7	1.1	1,268
	2025	481,700	95.6	3.2	
	2035	679,500	219.8	4.3	
No bus routes reorganization	2015[a]	58,968	10.8	0.6	1,481
	2025	326,500	64.8	2.2	
	2035	460,560	149.0	2.9	

Source: this study
Notes:
[a] 2016 instead of 2015 for annual fare revenue and fare box ratio
[b] Non-fare revenue is forecast to be equal to 5% of fare revenue

6. Table A.1 also indicates the effects on revenue and cost recovery if the bus routes reorganization does not materialize. The starting year daily patronage and fare revenue drop by 40%, and the fare box ratio falls below 1 but advances to a level which is considered high by comparison with international experience[23]. While the assumed rate of growth in patronage is the same, the effects of lower starting daily boardings are seen in the consistently lower fare box recovery ratio compared to the Base Case. In summary, the total subsidy required, should bus reorganization fail to be implemented, is $1.5 billion, up 17% from the Base Case. This is a substantial increase in the subsidy burden and the project financiers may wish to consider introducing an appropriate mechanism to encourage implementation of the required bus routes reorganization.

7. **WACC.** The weighted average cost of capital (WACC) of 2.17% has been calculated in real terms by removing the effect of domestic and foreign inflation. It is assumed that the project will be financed in the US Dollar currencies by ADB and another co-financing institution, with counterpart funding provided in local currency. ADB and another co-financing institution will provide US currency loans. With the above taken into account, the WACC is computed in Table A.2.

8. The FIRR of the project after tax is 6.13%, which exceeds the WACC of 2.17%. The net present value of the after-tax cash flows including subsidy, when discounted at WACC, is $577 million. The included total subsidy, discounted at WACC, is $944 million. The sensitivity analysis is summarized in Table A.3 which also shows for each scenario the required total subsidy, in net present value discounted at WACC. With the subsidy put in place, the project FIRR is above WACC for each scenario.

[23] For example, Hong Kong MTR has a company-wide fare box ratio in 2007 of around 2 (source: HK MRT 2007 annual report).

Table A.2: Weighted Average Cost of Capital Calculation

Source	Amount ($ million)	Weight (%)	Nominal Cost (%)	Corporate Tax rate (%)	Tax-adjusted Nominal Cost (%)	Inflation Rate (%)	Real Cost (%)	Composite Cost (%)
ADB (OCR) loan	500.0	40%	4.30%	28.00%	3.10%	0.8%	2.28%	0.91%
ADB (ADF) loan	20.0	2%	1.50%	28.00%	1.08%	0.8%	0.28%	0.00%
Co-financier loan	625.0	50%	4.15%	28.00%	2.99%	0.8%	2.17%	1.09%
Equity	100.0	8%	9.8%	28.00%	7.06%	5.0%	1.96%	0.16%
Total	**1,245.0**	**100%**						
Weighted Average Cost of Capital (WACC)								**2.17%**

ADB = Asian Development Bank, ADF = Asian Development Fund, OCR = ordinary capital resources.
Source: Asian Development Bank

Table A.3 Sensitivity Analysis

Scenario	FIRR (%)	NPV of Free Cash Flow ($ million)	NPV of Subsidy ($ million)
Base case	6.13%	577	944
10% increase in capital investment	5.42%	523	959
10% increase in O&M cost	6.15%	578	964
10% reduction in Fare	6.11%	571	957

FIRR = financial internal rate of return, NPV = net present value,
O&M = operation and maintenance
Source: Asian Development Bank

C. Financial Projections

9. Projected financial statements comprising balance sheet, income and cash flow statements for the years coinciding with the period of FIRR analysis have been prepared for a notional investor representing the EA, when ring-fenced from activities which are not part of the project.

10. **Assumptions.** The projections are in nominal terms, with domestic inflation assumed to be 18.3% in 2008, 10.2% in 2009, 6.5% in 2010, 4% in 2011, and 5% from 2012 onwards, based on ERD forecast of Vietnam headline or Consumer Price Index (CPI) inflation, except in the case of land and resettlement cost, to which an estimate of core inflation (ie CPI minus food and fuel food price elements), of 8.1% and 5.1% respectively, is assumed to apply in the years 2008-2009[24]. The foreign inflation rate is assumed to be 0.8%. An exchange rates of $1= D16,000 is assumed for currency translations. A corporate income tax rate of 28%, based on the current tax law, is assumed to apply. Based on GOVN revenue law and regulations, a value-added tax (VAT) of 10% is applied to construction and consulting services such as detailed design and supervision, depot, light and earthing/protection, and some general items of incremental administration. VAT at 5% applies to fixed equipment including pumps, heating, ventilation and airconditioning, escalator and elevator. All other items including rolling stock and resettlement attract zero VAT. Imported items for the project are all duty-exempt.

[24] Based on International Monetary Fund, 2006, Vietnam: Selected Issues, staff paper, which reports that during January 2002-April 2006 average core inflation is half average headline inflation.

Table A.4 Project Investment Plan

Item		Total [a]
A.	**Base Cost [b]**	
	1. Civil works	440.6
	2. E&M systems	174.1
	3. Rollingstock	60.1
	4. Land acquisition and resettlement	115.1
	5. Consulting services	52.2
	6. Incremental administration	20.9
	Sub-total (A)	**862.9**
B.	**Contingencies [c]**	
	1. Physical	70.3
	2. Price	183.8
	Sub-total (B)	**254.1**
C.	**Financial Charge During Implementation [d]**	**128.0**
	Total (A+B+C)	**1,245.0**

[a] Includes local taxes and duties of $ 49.2 million.
[b] at first quarter 2008 prices.
[c] Physical contingencies computed at 5% to 10%of base cost. Price contingencies are computed at 0.8% on foreign exchange costs, and 18.3% in 2008, 10.2% in 2009, 6.5% in 2010, 4.0% in 2011 and 5% from 2012 onwards on local currency costs, for land acquisition and resettlement cost at 8.1% in 2008, 5.1% in 2009, 6.5% in 2010, 4.0% in 2011 and 5% from 2012 onwards.
[d] Includes interest and commitment charges. ADB (OCR): Interest during the 6-year grace period has been computed at the 5-year forward London interbank offered rate, plus a spread of 0.2%. Commitment: 0.15% pa.
ADB (ADF): 7-year grace and 1.0% interest during grace, and 1.5% thereafter. Commitment: no charge.
Co-financier loans: 6-year grace and 4% interest. Commitment: 0.15% pa. Terms are based on current market rates and co-financier indications for a medium term outlook.

ADB = Asian Development Bank, ADF = Asian Development Fund, OCR = ordinary capital resources.

Source: Asian Development Bank estimates.

11. The fare rate of D4,000 per boarding is assumed to include an applicable VAT of 10% and to be indexed to domestic inflation. No real increase in fare is assumed during the project time frame. The annual O&M cost comes from engineering estimates and represents the annual metro running cost plus recurrent maintenance. Major periodic maintenance, treated as a capital expense, is assumed for rolling stock, which undergoes a refurbishment at the midlife point after 15 years. O&M cost and capital spending to refurbish or replace equipment during the project life are indexed respectively to domestic or foreign inflation. Assets are assumed to be replaced at the end of their economic life, with a capital spending allowance in the projections for replacement of E&M systems and equipment (other than rolling stock) after 15 years. Depreciation is taken in a straight line, over the economic life of the assets as follows: 100 years—underground civil structure; 50 years—above ground civil structure; 30 years—track and power system, rolling stock; 15 years—tunnel and station fixed equipment and signaling and communications; nil depreciation—land.

12. It has been assumed that ADB will be the primary lending agency for the project, contributing just under 50% of the loan proceeds. It is anticipated that the project will be co-financed from another source, for illustrative purposes it has been assumed that this will be a loan of $625 million. The loan will have a 15 year maturity and a fixed interest rate of 4%. The market fund will finance all of the rolling stock, all of the electrical and mechanical systems and equipment, some civil works and some consulting services. An illustrative financing plan is shown in Table A.5.

Table A.5 Financing Plan

($ million)

Source	Total	%
Asian Development Bank ADF loan	20.0	1.6
Asian Development Bank OCR loan	500.0	40.2
Co-financier – Market Fund loan	625.0	50.2
Counterpart funding	100.0	8.0
Total	1,245.0	**100%**

ADF = Asian Development Fund, OCR = Ordinary Capital Resources
Source: Asian Development Bank

13. **Projected financial statements**. Financial statements are estimated based on the condition that the annual subsidies, which commence in 2016, are sufficient to ensure a debt service coverage ratio (annual operating profit before interest, tax, depreciation and amortization plus subsidy if any, all divided by annual debt service) of 1.2 times throughout the debt servicing period. Thus subsidies have to meet any farebox recovery shortfall, equipment and systems refurbishment and replacement cost, required additions to the rolling stock fleet, and repayment of loan principal and interest. The resulting projected financial statements are summarized in Table A.6 and shown in detail in Table A.9.

Table A.6 : Summary forecast financial statements of the project
($million)

	2016	2018	2020	2022	2024	2025
Revenue	19.7	32.2	47.3	63.9	86.4	100.4
Depreciation	23.7	23.7	23.7	25.3	25.3	25.3
Interest	40.8	38.4	33.1	27.4	21.2	17.9
Net operating profit / (loss)	(64.4)	(52.9)	(36.5)	(20.1)	3.3	17.5
Subsidy	48.8	125.6	114.4	102.2	85.0	74.0
Accumulated cashflow	8.2	53.1	50.1	95.0	139.9	112.5
Total Assets	1,229.4	1,226.9	1,224.3	1,218.6	1,212.9	1,210.0
Loan	1,145.0	999.6	843.9	677.0	498.0	403.6
Equity	84.4	227.2	380.4	541.6	714.9	806.4
Debt Service	40.8	112.3	112.3	112.3	112.3	112.3
DSCR (Debt Service Coverage Ratio)	1.20	1.20	1.20	1.20	1.20	1.20
DER (Debt to Equity ratio)	13.6	4.4	2.2	1.3	0.7	0.5
Working ratio	0.9	0.6	0.5	0.4	0.3	0.3

Source: Asian Development Bank estimates.

D. GOVN and HCMC Shared Project Financing and Subsidy Support

14. Vietnam's commitment to developing metros as a national, and not merely municipal, priority is confirmed in the framework Railway Law 2005, Article 56, 1.

15. Considerations of public interest are involved in the decision on how GOVN and HCMC PC as state organizations share in and deliver funding support to the project. Under the Railway Law, the People' Committee of HCMC as a centrally administered city is assigned responsibility for investment, construction, management and exploitation of a metro in the city (Article 55). On the principle that any task assignment to a local government must be accompanied by an appropriate resourcing solution (to ensure the local government can balance its budget)[25], the Railway Law provides that the central government is responsible: i) to provide partial funding support towards investment in an approved metro project which is financed from the state budget (Article 56, 3, b); and ii) every year to include an amount in the state budget to support the expenses of urban public transport including metros (Article

[25] Law on the State Budget No. 01/2002/QH1, Article 4, clause 2d and Decree No 60/2003/ND-CP, Article 5, clause 2c.

56, 4). This sets the context for the respective administrative responsibility of GOVN and HCMC to secure resources to develop the city metros.

16. The Railway Law's stipulation that the city should provide part of the 'funding support' towards the investment cost of a metro creates an important incentive, through being put a risk for a share of the investment, for the city to take ownership of the project and manage it effectively and efficiently. This incentive may be sharpened by ensuring that HCMC funds those elements of the project investment where (i) the city is best able to manage the cost, such as land acquisition and resettlement, besides incremental administrative cost, and (ii) are immediately related to the operation of the metro, for which the city will be held accountable by the HCMC travelling public—the elements include trains and signaling and communications and also depot. The funding requirement will need to be at a level the city can afford in terms of city budgetary resources. These considerations form the basis for the sharing of the responsibility in financing and subsidy support described below.

17. Table A.7 summarizes a proposed sharing of the project financing between the central government and HCMC. Through its counterpart funding and sub-borrowing, HCMC is assumed to be responsible for financing principally rolling stock and signaling and communications, depot, land and resettlement, and incremental administration. In this scenario, against HCMC counterpart funding of $100 million, GOVN, out of its total borrowing of $1,145 million, makes available to the city $847.4 million as a grant and $297.6 million equivalent as a sub-loan in the local currency.

Table A.7: GOVN and HCMC share of project financing

Item	Cost	HCMC Counterpart funding		On-lending from GOVN		Grant from GOVN	
		$	% of Cost Category	$	% of Cost Category	$	% of Cost Category
A. Base Cost							
1. Civil works	367.2	-		-		367.2	100.0%
2. Non-system E&M	79.0	-		-		79.0	100.0%
3. E&M systems	92.6	-		44.3	47.8%	48.3	52.2%
4. Rollingstock	60.1	-		60.1	100.0%	-	0.0%
5. Land resettlement	115.1	36.3	31.5%	78.8	68.5%	-	0.0%
6. Depot	33.3	-		33.3	100.0%	-	0.0%
7. Consulting services	47.4	-		-		47.4	100.0%
8. Incremental administration	19.0	19.0	100.0%	-		-	0.0%
9. Taxes and duties	49.2	25.1	51.1%	3.6	7.3%	20.5	41.7%
Sub-total (A)	862.9	80.3	9.3%	220.1	25.5%	562.4	65.2%
B. Contingencies	254.1	19.6	7.7%	46.9	18.5%	187.6	73.8%
C. Financing Charge During Development	128.0	0.0	0.0%	30.6	23.9%	97.4	76.1%
Total Project Costs	**1,245.0**	**100.0**	8.0%	**297.6**	23.9%	**847.4**	68.1%
% Total Project Costs	**100%**		**8.0%**		**23.9%**		**68.1%**

Source: Asian Development Bank estimates.

18. The project revenue is assumed to be composed of fare collection, charges for advertizing on metro moveable and immoveable properties and collection of rental on metro real estate. Under the VN state budget law, such revenues are part of the exclusive local government revenue portion[26]. They are therefore not required to be shared with the central government. Based on the proposed share of the financing between GOVN and HCMC as described above, projected financial statements for the EA as project owner on behalf of HCMC PC can be calculated that indicate an expected subsidy requirement on the part of HCMC. The projections imply a split of the total required state

[26] Article 22 paragraphs 1 n) and o) of the Decree No. 60/2003 ND-CP on Implementation of the Law on the State Budget (No 01/2002/QH1)

subsidy whereby the central government is responsible for $1,109 million and HCMC PC $159 million. See Table A.8, which also summarizes the terms of the on-lending.

Table A.8: Central and local budget subsidy sharing

Fare per boarding[a] (VND)	Central budget (GOVN) subsidy ($ million)	Local budget (HCMC) subsidy ($ million)	Terms for GOVN on-lending to HCMC	
4,000	1,109	159	Amount:	$298m equivalent denominated in VND
4,000+10%	1,093	155	Purpose:	To finance rolling stock, signaling & communications, depot, LAR balance (75%), plus related taxes, duties, contingencies and FCDD
4,000-10%	1,124	162	Term:	32 years including 8 years grace
			Interest:	4.15% plus 0.2% MOF on-lending fee plus $ /VND exchange risk premium of 1.5%[b]

Source: this study
Notes:
a In 2007 constant prices
b Based on an assumed formula, whereby the VND denominated sub-loan interest rate equals the highest ODA US$ borrowing rate (4.15%), plus a 0.2% MOF administration fee, plus 1.5%

20. Setting the central government grant to one side, HCMC's required share of the subsidy at $159 million, equating to 1.4 times above the cost of land and resettlement, is sufficient to pay off the sub-loan ($298 million) and leave the city in debt-free possession of an operating metro system worth on a reasonable valuation more than the combined $159 million subsidy and the $100 million counterpart funding. That this is possible is indicative of the size of the contribution from fare revenue towards the project capital costs. HCMC's expected share of the project's required subsidy reaches an annual peak of $28.1 million equivalent during the early years of service operation. As an indication of relative magnitude and therefore affordability, this may be compared to the city's annual expenditure, which ran to almost $900 million equivalent in nominal value in 2004[27].

21. Detailed project financial statements for MAUR/HCMC appear in Table A.11.

22. **Conclusion.** The project is expected to require a total subsidy of $1,268 million equivalent. This has been derived assuming that the project debt service coverage ratio (operating profit before interest, corporate income tax, depreciation and amortization plus annual subsidy, all divided by debt service) would be maintained at 1.2 times until the loans have been fully repaid. At the D 4,000 fare per boarding, the project shows a consistent recovery of annual operating cost out of fare revenue, beginning with the first year of operation. Having a predominantly underground alignment[28], which makes it more costly to build compared to lines or sections that are predominantly elevated or at-grade, the metro Line 2 has a higher construction cost per kilometer. Where there are significant differences in metro lines' vertical alignment, there is a general need to accept differences in their level of cost recovery under a uniform fare policy, which is necessary for an integrated metro network. The free cash flow in real terms, including capital expenditure on equipment renewal, and additional rolling stock to serve expected demand growth, and including subsidy, yields an after-tax Financial Internal Rate of Return (FIRR) of 6.1%, above the 2.17% WACC. Development of metros as a key transport mode in major cities is confirmed as a fundamental state policy in the framework Railway Law 2005[29]. The law assigns the responsibility for policy implementation to the provincial and centrally administered city level, and also stipulates GOVN's responsibility to provide support to approved investment in metros. Since the principle of a balanced local budget operates, it is anticipated that HCMC will be assigned a share of the subsidy funding that is within the city's budget resources, with

[27] UNDP 2006, Paying for urban infrastructure and services: a comparative study of municipal finance in Ho Chi Minh City, Shanghai, and Jakarta.
[28] Unlike for example Line 1, where the opposite is the case.
[29] Railway Law No 35/2005/QH11, Article 56.

the balance to be funded through the central budget. Analysis suggests that a $159 million would be appropriate and affordable as HCMC's share of the total subsidy.

Table A.9: Forecast Financial Statements of the Project (2009-2025) ($ million)

Item			2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
A. Income Statement																			
Revenue			0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.7	26.5	32.2	39.4	47.3	55.0	63.9	74.3	86.4	100.4
VAT to revenue			0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.6	3.2	3.9	4.7	5.5	6.4	7.4	8.6	10.0
O&M costs			0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.6	18.7	19.8	21.0	22.2	23.5	24.9	26.4	28.0	29.6
Operating profit			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	5.1	9.2	14.5	20.3	25.9	32.6	40.4	49.8	60.7
Depreciation			0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.7	23.7	23.7	23.7	23.7	25.3	25.3	25.3	25.3	25.3
Interest (ADB OCR)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.9	17.9	17.3	16.7	16.1	15.4	14.7	14.0	13.2	12.4
Interest (ADB ADF)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2
Interest (Co-financier)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.6	22.6	20.8	18.8	16.8	14.6	12.4	10.1	7.7	5.3
Profit before tax			0.0	0.0	0.0	0.0	0.0	0.0	0.0	(64.4)	(59.4)	(52.9)	(45.0)	(36.5)	(29.7)	(20.1)	(9.2)	3.3	17.5
Corporate tax			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net operating profit / (loss)			**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**(64.4)**	**(59.4)**	**(52.9)**	**(45.0)**	**(36.5)**	**(29.7)**	**(20.1)**	**(9.2)**	**3.3**	**17.5**
Subsidy		1,267.7						0.0	0.0	48.8	129.6	125.6	120.2	114.4	108.8	102.2	94.3	85.0	74.0
B. Cashflow Statement	initial	Total																	
Operating income			0.0	0.0	0.0	0.0	0.0	0.0	0.0	(64.4)	(59.4)	(52.9)	(45.0)	(36.5)	(29.7)	(20.1)	(9.2)	3.3	17.5
Depreciation			0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.7	23.7	23.7	23.7	23.7	25.3	25.3	25.3	25.3	25.3
Net cashflow from operation			0.0	0.0	0.0	0.0	0.0	0.0	0.0	(40.7)	(35.7)	(29.2)	(21.3)	(12.8)	(4.4)	5.2	16.1	28.6	42.8
Equity	100.0	100.0	9.7	25.5	20.6	8.2	12.0	13.1	11.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loan	1,017.0	1,017.0	21.2	150.9	147.6	155.0	207.9	229.6	104.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Investment cost	1,117.0	1,576.9	30.9	176.4	168.2	163.2	219.9	242.7	115.7	0.0	0.0	0.0	0.0	47.9	0.0	0.0	0.0	0.0	49.8
Debt repayment		1,145.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	71.4	73.9	76.5	79.2	82.0	84.9	87.9	91.1	94.4
Subsidy		1,267.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.8	129.6	125.6	120.2	114.4	108.8	102.2	94.3	85.0	74.0
Net Cashflow			**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**8.2**	**22.5**	**22.5**	**22.5**	**(25.4)**	**22.5**	**22.5**	**22.5**	**22.5**	**(27.4)**
Accumulated cashflow			**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**8.2**	**30.6**	**53.1**	**75.5**	**50.1**	**72.5**	**95.0**	**117.4**	**139.9**	**112.5**
C. Balance Sheet																			
Current assets			0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.2	30.6	53.1	75.5	50.1	72.5	95.0	117.4	139.9	112.5
Fixed assets			31.3	212.9	391.9	571.8	815.6	1,090.5	1,245.0	1,245.0	1,245.0	1,245.0	1,245.0	1,292.9	1,292.9	1,292.9	1,292.9	1,292.9	1,342.7
Accumulated depreciation			0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.7	47.4	71.2	94.9	118.6	143.9	169.2	194.6	219.9	245.2
Net fixed assets			31.3	212.9	391.9	571.8	815.6	1,090.5	1,245.0	1,221.2	1,197.5	1,173.8	1,150.1	1,174.3	1,148.9	1,123.6	1,098.3	1,073.0	1,097.5
Total Assets			**31.3**	**212.9**	**391.9**	**571.8**	**815.6**	**1,090.5**	**1,245.0**	**1,229.4**	**1,228.1**	**1,226.9**	**1,225.6**	**1,224.3**	**1,221.5**	**1,218.6**	**1,215.7**	**1,212.9**	**1,210.0**
Loan			21.6	177.7	336.2	507.9	739.6	1,001.5	1,145.0	1,145.0	1,073.6	999.6	923.1	843.9	761.9	677.0	589.1	498.0	403.6
Equity			9.7	35.2	55.7	63.9	75.9	89.0	100.0	84.4	154.6	227.2	302.5	380.4	459.5	541.6	626.7	714.9	806.4
Total Liabilities and Equity			**31.3**	**212.9**	**391.9**	**571.8**	**815.6**	**1,090.5**	**1,245.0**	**1,229.4**	**1,228.1**	**1,226.9**	**1,225.6**	**1,224.3**	**1,221.5**	**1,218.6**	**1,215.7**	**1,212.9**	**1,210.0**
			0.0	(0.0)	0.0	0.0	0.0	(0.0)	0.0	0.0	0.0	(0.0)	0.0	(0.0)	0.0	0.0	0.0	(0.0)	(0.0)
DSCR (Debt Service Coverage Ratio) [1]										1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
DER (Debt to Equity ratio) [3]			2.2	5.1	6.0	7.9	9.7	11.3	11.5	13.6	6.9	4.4	3.1	2.2	1.7	1.3	0.9	0.7	0.5
Working ratio [3]										0.9	0.7	0.6	0.5	0.5	0.4	0.4	0.4	0.3	0.3
Subsidy requirement		1,267.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.8	129.6	125.6	120.2	114.4	108.8	102.2	94.3	85.0	74.0

Source: Asian Development Bank estimates.
[1] DSCR: Debt Service Coverage Ratio = (operating profit + subsidy) / debt service
[3] DER: Debt to Equity ratio = Debt / Equity
[3] Working ratio = O&M cost / Revenue

Table A.9 (Continued): Forecast Financial Statements of the Project (2026-2040) ($ million)

Item	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
A. Income Statement															
Revenue	109.1	118.6	128.9	140.1	152.2	165.4	179.8	195.4	212.3	230.7	250.8	272.5	296.2	321.8	349.8
VAT to revenue	10.9	11.9	12.9	14.0	15.2	16.5	18.0	19.5	21.2	23.1	25.1	27.3	29.6	32.2	35.0
O&M costs	31.4	33.2	35.1	37.1	39.3	41.4	43.7	46.1	48.7	51.3	54.2	57.2	60.3	63.6	67.1
Operating profit	66.9	73.6	80.9	88.9	97.7	107.5	118.1	129.7	142.4	156.3	171.5	188.1	206.2	226.0	247.6
Depreciation	27.0	27.0	27.0	27.0	27.0	34.8	34.8	34.8	34.8	34.8	36.8	36.8	36.8	36.8	36.8
Interest (ADB OCR)	11.6	10.8	9.9	8.9	8.0	7.0	5.9	4.8	3.7	2.5	1.3	0.0	0.0	0.0	0.0
Interest (ADB ADF)	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Interest (Co-financier)	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Profit before tax	25.4	35.7	43.9	52.9	62.6	65.5	77.2	90.0	103.8	118.9	133.4	151.3	169.4	189.2	210.9
Corporate tax	0.0	0.6	12.3	14.8	17.5	18.4	21.6	25.2	29.1	33.3	37.3	42.4	47.4	53.0	59.0
Net operating profit / (loss)	**25.4**	**35.1**	**31.6**	**38.1**	**45.1**	**47.2**	**55.6**	**64.8**	**74.8**	**85.6**	**96.0**	**108.9**	**122.0**	**136.2**	**151.8**
Subsidy	67.9	49.2	49.2	49.2	49.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B. Cashflow Statement															
Operating income	25.4	35.1	31.6	38.1	45.1	47.2	55.6	64.8	74.8	85.6	96.0	108.9	122.0	136.2	151.8
Depreciation	27.0	27.0	27.0	27.0	27.0	34.8	34.8	34.8	34.8	34.8	36.8	36.8	36.8	36.8	36.8
Net cashflow from operation	52.4	62.1	58.6	65.0	72.1	82.0	90.4	99.6	109.6	120.4	132.8	145.7	158.8	173.0	188.6
Equity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Investment cost	0.0	0.0	0.0	0.0	302.1	0.0	0.0	0.0	0.0	43.2	0.0	0.0	0.0	0.0	16.9
Debt repayment	97.8	25.7	26.6	27.5	28.5	29.5	30.6	31.7	32.8	34.0	35.2	0.9	0.9	1.0	1.0
Subsidy	67.9	49.2	49.2	49.2	49.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net Cashflow	**22.5**	**85.6**	**81.3**	**86.8**	**(209.3)**	**52.5**	**59.9**	**67.9**	**76.8**	**43.2**	**97.6**	**144.8**	**157.8**	**172.1**	**170.8**
Accumulated cashflow	**135.0**	**220.6**	**301.8**	**388.6**	**179.3**	**231.8**	**291.7**	**359.6**	**436.4**	**479.6**	**577.2**	**721.9**	**879.7**	**1,051.8**	**1,222.5**
C. Balance Sheet															
Current assets	135.0	220.6	301.8	388.6	179.3	231.8	291.7	359.6	436.4	479.6	577.2	721.9	879.7	1,051.8	1,222.5
Fixed assets	1,342.7	1,342.7	1,342.7	1,342.7	1,644.8	1,644.8	1,644.8	1,644.8	1,644.8	1,688.0	1,688.0	1,688.0	1,688.0	1,688.0	1,704.9
Accumulated depreciation	272.2	299.1	326.1	353.1	380.1	414.9	449.7	484.5	519.3	554.1	590.9	627.6	664.4	701.2	738.0
Net fixed assets	1,070.5	1,043.6	1,016.6	989.6	1,264.7	1,229.9	1,195.1	1,160.3	1,125.5	1,133.9	1,097.1	1,060.4	1,023.6	986.8	966.9
Total Assets	**1,205.5**	**1,264.2**	**1,318.4**	**1,378.2**	**1,444.1**	**1,461.8**	**1,486.8**	**1,520.0**	**1,561.9**	**1,613.5**	**1,674.3**	**1,782.3**	**1,903.3**	**2,038.6**	**2,189.4**
Loan	305.8	280.1	253.6	226.1	197.6	168.1	137.5	105.9	73.1	39.1	3.8	2.9	1.9	1.0	0.0
Equity	899.7	984.0	1,064.9	1,152.2	1,246.5	1,293.7	1,349.3	1,414.1	1,488.8	1,574.5	1,670.5	1,779.4	1,901.4	2,037.6	2,189.4
Total Liabilities and Equity	**1,205.5**	**1,264.2**	**1,318.4**	**1,378.2**	**1,444.1**	**1,461.8**	**1,486.8**	**1,520.0**	**1,561.9**	**1,613.5**	**1,674.3**	**1,782.3**	**1,903.3**	**2,038.6**	**2,189.4**
	(0.0)	(0.0)	(0.0)	0.0	(0.0)	(0.0)	0.0	(0.0)	0.0	0.0	(0.0)	0.0	(0.0)	0.0	0.0
DSCR (Debt Service Coverage Ratio) [1]	1.20	3.36	3.56	3.78	4.02	2.94	3.23	3.54	3.89	4.27	4.69	189.72	208.00	227.97	249.78
DER (Debt to Equity ratio) [3]	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Working ratio [3]	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Subsidy requirement	67.9	49.2	49.2	49.2	49.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: Asian Development Bank estimates.
[1] DSCR: Debt Service Coverage Ratio = (operating profit + subsidy) / debt service
[3] DER: Debt to Equity ratio = Debt / Equity
[3] Working ratio = O&M cost / Revenue

Table A.10: Financial Internal Rate of Return ($ million)

Year	Costs					Revenue [c]	Subsidy [d]	Free Cash flow
	Capital Investment [a]	O&M Cost	VAT	Corporate Tax [b]	Total			
2009	(28.9)	0.0	0.0	0.0	(28.9)	0.0	0.0	(28.9)
2010	(153.6)	0.0	0.0	0.0	(153.6)	0.0	0.0	(153.6)
2011	(140.4)	0.0	0.0	0.0	(140.4)	0.0	0.0	(140.4)
2012	(134.5)	0.0	0.0	0.0	(134.5)	0.0	0.0	(134.5)
2013	(180.9)	0.0	0.0	0.0	(180.9)	0.0	0.0	(180.9)
2014	(194.9)	0.0	0.0	0.0	(194.9)	0.0	0.0	(194.9)
2015	(99.9)	(11.8)	0.0	0.0	(111.7)	0.0	0.0	(111.7)
2016	0.0	(11.9)	(1.3)	0.0	(13.3)	13.3	48.8	48.9
2017	0.0	(12.0)	(1.7)	0.0	(13.7)	17.1	129.6	132.9
2018	0.0	(12.1)	(2.0)	0.0	(14.1)	19.7	125.6	131.2
2019	0.0	(12.3)	(2.3)	0.0	(14.6)	23.1	120.2	128.7
2020	(43.5)	(12.4)	(2.6)	0.0	(58.5)	26.3	114.4	82.2
2021	0.0	(12.5)	(2.9)	0.0	(15.4)	29.1	108.8	122.6
2022	0.0	(12.6)	(3.2)	0.0	(15.8)	32.3	102.2	118.6
2023	0.0	(12.7)	(3.6)	0.0	(16.3)	35.7	94.3	113.7
2024	0.0	(12.8)	(4.0)	0.0	(16.8)	39.6	85.0	107.8
2025	(43.5)	(12.9)	(4.4)	0.0	(60.8)	43.8	74.0	57.0
2026	0.0	(13.0)	(4.5)	0.0	(17.6)	45.3	67.9	95.7
2027	0.0	(13.1)	(4.7)	(0.2)	(18.0)	46.9	49.2	78.1
2028	0.0	(13.2)	(4.9)	(4.6)	(22.7)	48.6	49.2	75.1
2029	0.0	(13.3)	(5.0)	(5.3)	(23.7)	50.3	49.2	75.8
2030	(196.9)	(13.4)	(5.2)	(6.0)	(221.5)	52.0	49.2	(120.3)
2031	0.0	(13.5)	(5.4)	(6.0)	(24.9)	53.9	0.0	29.0
2032	0.0	(13.6)	(5.6)	(6.7)	(25.8)	55.7	0.0	29.9
2033	0.0	(13.6)	(5.8)	(7.4)	(26.8)	57.7	0.0	30.9
2034	0.0	(13.7)	(6.0)	(8.2)	(27.8)	59.7	0.0	31.9
2035	(34.8)	(13.8)	(6.2)	(8.9)	(63.7)	61.8	0.0	(1.9)
2036	0.0	(13.8)	(6.4)	(9.5)	(29.7)	64.0	0.0	34.2
2037	0.0	(13.9)	(6.6)	(10.3)	(30.8)	66.2	0.0	35.4
2038	0.0	(14.0)	(6.9)	(11.0)	(31.8)	68.5	0.0	36.7
2039	0.0	(14.0)	(7.1)	(11.7)	(32.8)	70.9	0.0	38.1
2040	(13.1)	(14.1)	(7.3)	(12.4)	(46.9)	741.9	0.0	695.0
Total	(1,265.0)						1,267.7	
	Financial Internal rate of Return (FIRR)							**6.13%**
	Net Present Value (NPV) of Free Cash flow@ WACC 2.17%							**577**
	Net Present Value (NPV) of Subsidy							**944**

( ) = negative, FIRR = financial internal rate of return, O&M = operation and maintenance, VAT = value added tax, WACC = weighted average cost of capital.

Analysis period: 7 years construction + 25 years of revenue service

[a] Only base cost and physical contingencies, (includes replacement and refurbishment of initial assets and additional rollingstock).

[b] Corporate tax 28%, assuming five years loss carry-forwards relief.

[c] in Y2040 (last year of analysis period) residual value of the project assets (fixed assets less accumulated depreciation) is included.

[d] Assuming that subsidy is not subject to tax (corporate tax).

Source: Asian Development Bank

Table A.11 MAUR (on behalf of HCMC PC) Projected Financial Statements (2009-2025)

Item		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
A. Income Statement																		
Revenue		0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.7	26.5	32.2	39.4	47.3	55.0	63.9	74.3	86.4	100.4
VAT to revenue		0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.6	3.2	3.9	4.7	5.5	6.4	7.4	8.6	10.0
O&M costs		0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.6	18.7	19.8	21.0	22.2	23.5	24.9	26.4	28.0	29.6
Operating profit		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	5.1	9.2	14.5	20.3	25.9	32.6	40.4	49.8	60.7
Depreciation [1]		0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.8	25.8	25.8	25.8	25.8	27.4	27.4	27.4	27.4	27.4
Interest (On-lending) [1]		0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.4	17.4	17.1	16.7	16.3	15.9	15.4	15.0	14.5	14.0
Profit before tax		0.0	0.0	0.0	0.0	0.0	0.0	0.0	(43.2)	(38.1)	(33.7)	(28.0)	(21.8)	(17.4)	(10.3)	(2.0)	7.8	19.3
Corporate tax		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net operating profit / (loss)		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**(43.2)**	**(38.1)**	**(33.7)**	**(28.0)**	**(21.8)**	**(17.4)**	**(10.3)**	**(2.0)**	**7.8**	**19.3**
LG Subsidy	159.0						0.0	0.0	20.8	22.9	18.9	28.1	22.3	16.7	14.6	14.6	0.0	0.0
B. Cashflow Statement		**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Operating income		0.0	0.0	0.0	0.0	0.0	0.0	0.0	(43.2)	(38.1)	(33.7)	(28.0)	(21.8)	(17.4)	(10.3)	(2.0)	7.8	19.3
Depreciation		0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.8	25.8	25.8	25.8	25.8	27.4	27.4	27.4	27.4	27.4
Net cashflow from operation		0.0	0.0	0.0	0.0	0.0	0.0	0.0	(17.3)	(12.3)	(7.9)	(2.2)	4.0	10.0	17.1	25.5	35.3	46.8
Equity		8.3	16.0	19.8	13.0	18.0	27.7	50.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grant from GOVN		3.2	114.4	125.7	157.9	184.4	196.9	64.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
On-lending Loan		20.4	53.9	39.0	16.1	50.4	62.6	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Investment cost		31.3	181.6	179.0	179.9	243.7	275.0	154.4	0.0	0.0	0.0	0.0	47.9	0.0	0.0	0.0	0.0	49.8
On-lending IDC		0.6	2.8	5.5	7.1	9.0	12.3	15.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
On-lending Debt repayment		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	6.3	6.7	7.1	7.5	7.9	8.4	8.9	9.4
LG Subsidy	159.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.8	22.9	18.9	28.1	22.3	16.7	14.6	14.6	0.0	0.0
Net Cashflow		**0.0**	**(0.0)**	**0.0**	**(0.0)**	**(0.0)**	**(0.0)**	**0.0**	**3.5**	**4.7**	**4.7**	**19.3**	**(28.6)**	**19.3**	**23.8**	**31.7**	**26.4**	**(12.5)**
Accumulated cashflow		**0.0**	**(0.0)**	**(0.0)**	**(0.0)**	**(0.0)**	**(0.0)**	**(0.0)**	**3.5**	**8.2**	**12.8**	**32.1**	**3.5**	**22.7**	**46.5**	**78.2**	**104.5**	**92.1**
C. Balance Sheet		**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Current assets		0.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	3.5	8.2	12.8	32.1	3.5	22.7	46.5	78.2	104.5	92.1
Fixed assets		31.9	216.3	400.8	587.8	840.5	1,127.9	1,298.1	1,298.1	1,298.1	1,298.1	1,298.1	1,346.0	1,346.0	1,346.0	1,346.0	1,346.0	1,395.8
Accumulated depreciation		0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.8	51.7	77.5	103.4	129.2	156.7	184.1	211.6	239.0	266.4
Net fixed assets		31.9	216.3	400.8	587.8	840.5	1,127.9	1,298.1	1,272.2	1,246.4	1,220.6	1,194.7	1,216.8	1,189.3	1,161.9	1,134.4	1,107.0	1,129.4
Total Assets		**31.9**	**216.3**	**400.8**	**587.8**	**840.5**	**1,127.9**	**1,298.1**	**1,275.7**	**1,254.6**	**1,233.4**	**1,226.8**	**1,220.2**	**1,212.1**	**1,208.4**	**1,212.6**	**1,211.5**	**1,221.4**
On-lending Loan		20.4	74.3	113.3	129.4	179.8	242.4	297.6	297.6	291.6	285.3	278.6	271.5	264.0	256.1	247.7	238.8	229.3
Grant from GOVN		3.2	117.7	243.4	401.3	585.7	782.7	847.4	847.4	847.4	847.4	847.4	847.4	847.4	847.4	847.4	847.4	847.4
Equity		8.3	24.3	44.1	57.1	75.0	102.8	153.1	130.7	115.5	100.7	100.8	101.3	100.6	104.9	117.5	125.4	144.7
Total Liabilities and Equity		**31.9**	**216.3**	**400.8**	**587.8**	**840.5**	**1,127.9**	**1,298.1**	**1,275.7**	**1,254.6**	**1,233.4**	**1,226.8**	**1,220.2**	**1,212.1**	**1,208.4**	**1,212.6**	**1,211.5**	**1,221.4**
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DSCR (Debt Service Coverage Ratio)									1.20	1.20	1.20	1.82	1.82	1.82	2.02	2.35	2.13	2.60
DER (Debt to Equity ratio)		2.4	3.1	2.6	2.3	2.4	2.4	1.9	2.3	2.5	2.8	2.8	2.7	2.6	2.4	2.1	1.9	1.6
Working ratio									0.9	0.7	0.6	0.5	0.5	0.4	0.4	0.4	0.3	0.3
LG Subsidy requirement	159.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.8	22.9	18.9	28.1	22.3	16.7	14.6	14.6	0.0	0.0
Debt service amount		0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4
Farebox ratio		-	-	-	-	-	-	-	1.06	1.35	1.55	1.79	2.03	2.22	2.44	2.68	2.94	3.23

[1] Differences between this table (MAUR) and Table A.11-4 "Forecast Financial Statements of the Project" are from the on-lending interest and IDC (interest during construction), which having a flow through effect to depreciation and assets.

Table A.11 (continued) MAUR (on behalf of HCMC PC) Projected Financial Statements (2026-2040)

Item	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
A. Income Statement															
Revenue	109.1	118.6	128.9	140.1	152.2	165.4	179.8	195.4	212.3	230.7	250.8	272.5	296.2	321.8	349.8
VAT to revenue	10.9	11.9	12.9	14.0	15.2	16.5	18.0	19.5	21.2	23.1	25.1	27.3	29.6	32.2	35.0
O&M costs	31.4	33.2	35.1	37.1	39.3	41.4	43.7	46.1	48.7	51.3	54.2	57.2	60.3	63.6	67.1
Operating profit	66.9	73.6	80.9	88.9	97.7	107.5	118.1	129.7	142.4	156.3	171.5	188.1	206.2	226.0	247.6
Depreciation [1]	29.1	29.1	29.1	29.1	29.1	36.9	36.9	36.9	36.9	36.9	38.9	38.9	38.9	38.9	38.9
Interest (On-lending) [1]	13.4	12.8	12.2	11.6	10.9	10.1	9.4	8.5	7.7	6.8	5.8	4.8	3.7	2.5	1.3
Profit before tax	24.3	31.6	39.6	48.3	57.8	60.4	71.8	84.2	97.8	112.6	126.8	144.4	163.7	184.6	207.4
Corporate tax	0.0	7.4	11.1	13.5	16.2	16.9	20.1	23.6	27.4	31.5	35.5	40.4	45.8	51.7	58.1
Net operating profit / (loss)	**24.3**	**24.3**	**28.5**	**34.8**	**41.6**	**43.5**	**51.7**	**60.7**	**70.4**	**81.1**	**91.3**	**104.0**	**117.8**	**132.9**	**149.4**
LG Subsidy	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B. Cashflow Statement	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Operating income	24.3	24.3	28.5	34.8	41.6	43.5	51.7	60.7	70.4	81.1	91.3	104.0	117.8	132.9	149.4
Depreciation	29.1	29.1	29.1	29.1	29.1	36.9	36.9	36.9	36.9	36.9	38.9	38.9	38.9	38.9	38.9
Net cashflow from operation	53.4	53.4	57.6	63.9	70.7	80.4	88.6	97.6	107.4	118.0	130.2	142.9	156.7	171.8	188.3
Equity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grant from GOVN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
On-lending Loan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Investment cost	0.0	0.0	0.0	0.0	302.1	0.0	0.0	0.0	0.0	43.2	0.0	0.0	0.0	0.0	16.9
On-lending IDC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
On-lending Debt repayment	10.0	10.5	11.2	11.8	12.5	13.2	14.0	14.8	15.7	16.6	17.6	18.6	19.7	20.9	22.1
LG Subsidy	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net Cashflow	**43.5**	**42.8**	**46.4**	**52.0**	**(243.9)**	**67.2**	**74.6**	**82.7**	**91.7**	**58.2**	**112.6**	**124.3**	**137.0**	**151.0**	**149.3**
Accumulated cashflow	**135.5**	**178.4**	**224.8**	**276.9**	**32.9**	**100.1**	**174.7**	**257.4**	**349.1**	**407.3**	**519.9**	**644.2**	**781.2**	**932.1**	**1,081.4**
C. Balance Sheet	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Current assets	135.5	178.4	224.8	276.9	32.9	100.1	174.7	257.4	349.1	407.3	519.9	644.2	781.2	932.1	1,081.4
Fixed assets	1,395.8	1,395.8	1,395.8	1,395.8	1,698.0	1,698.0	1,698.0	1,698.0	1,698.0	1,741.1	1,741.1	1,741.1	1,741.1	1,741.1	1,758.0
Accumulated depreciation	295.5	324.6	353.8	382.9	412.0	448.9	485.8	522.7	559.7	596.6	635.5	674.4	713.3	752.2	791.1
Net fixed assets	1,100.3	1,071.2	1,042.1	1,013.0	1,286.0	1,249.1	1,212.1	1,175.2	1,138.3	1,144.6	1,105.6	1,066.7	1,027.8	988.9	966.9
Total Assets	**1,235.8**	**1,249.6**	**1,266.9**	**1,289.8**	**1,318.9**	**1,349.1**	**1,386.8**	**1,432.6**	**1,487.4**	**1,551.8**	**1,625.5**	**1,710.9**	**1,809.0**	**1,921.1**	**2,048.3**
On-lending Loan	219.4	208.8	197.7	185.8	173.3	160.1	146.1	131.2	115.5	98.9	81.3	62.7	43.0	22.1	0.0
Grant from GOVN	847.4	847.4	847.4	847.4	847.4	847.4	847.4	847.4	847.4	847.4	847.4	847.4	847.4	847.4	847.4
Equity	169.0	193.3	221.8	256.6	298.2	341.6	393.3	454.0	524.4	605.5	696.8	800.8	918.6	1,051.6	1,200.9
Total Liabilities and Equity	**1,235.8**	**1,249.6**	**1,266.9**	**1,289.8**	**1,318.9**	**1,349.1**	**1,386.8**	**1,432.6**	**1,487.4**	**1,551.8**	**1,625.5**	**1,710.9**	**1,809.0**	**1,921.1**	**2,048.3**
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DSCR (Debt Service Coverage Ratio)	2.86	3.15	3.46	3.80	4.18	4.60	5.05	5.55	6.09	6.69	7.33	8.04	8.82	9.67	10.59
DER (Debt to Equity ratio)	1.3	1.1	0.9	0.7	0.6	0.5	0.4	0.3	0.2	0.2	0.1	0.1	0.0	0.0	0.0
Working ratio	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
LG Subsidy requirement	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Debt service amount	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4
Farebox ratio	3.32	3.41	3.50	3.59	3.69	3.80	3.92	4.03	4.16	4.28	4.41	4.54	4.68	4.82	4.96

[1] Differences between this table (MAUR) and Table A.11-4 "Forecast Financial Statements of the Project" are from the on-lending interest and IDC (interest during construction), which having a flow through effect to depreciation and assets.

APPENDIX B: DETAILED STATION DESCRIPTIONS

Detailed Description of Stations and their Locations

1. Ben Thanh:

Ben Thanh station is at Km 0+500.02 and located at the west of Ben Thanh market, right underground of 23/09 park. The urban rail Line 1 (under construction) Ben Thanh – Suoi Tien has an underground station at the square area of Ben Thanh market west. Therefore, Ben Thanh station will be an interchange station between the urban rail Line 1 and Line 2. Following the design of Ben Thanh station for the Line 1, its platform level is at -16.31m elevation, so the Line 2's platform level must be at least at -25m elevation (about 27m in depth to the ground level). Ben Thanh station for the Line 2 will have 3 levels in total including Concourse, Intermediate, and Platform levels. Its top track is at -25m elevation, that is to say 27m below ground level.

On the surface, Ben Thanh station is constrained by the urban rail Line 1 (Ben Thanh – Suoi Tien) and New World Hotel, so the length of the station is designed appropriatly to minimize impacts to the above mentioned developments both at construction and operation periods. The station is 175m in length and 21m in width (excluding areas used for ventilation shafts and cooling tower).

Ben Thanh station for the Line 2 is an interchange station with the Line 1 in the short run and with the Line 4 in further future). To facilitate passengers to access the station in front of Ben Thanh market and 23/09 park, 6 entrances and exits are proposed at two ends of station (including direct connecting entrances to the concourse level of Ben Thanh station for Line 1 and to existing bus terminal). Entrances are arranged with stairs, escalators at appropriate sidewalks widths, a lift for wheelchair and heavy luggage persons provided at 23/09 park area.

However, to have a better interchange between 3 urban rail lines 1, 2 and 4 at Ben Thanh area, Ben Thanh station should consist of a common structure for at least line 1 and 2 with provision for line 4. In that case, each platform is located to optimize interchange passengers flow.

For this purpose, Ben Thanh should be designed and constructed through a separate project and individual contract. In that case, the depth of platform might be raised to ease passengers' access.

2. Tao Dan

Tao Dan station is at Km 1+165.38 on Cach Mang Thang 8 road, 665m northern-west far from Ben Thanh station. The rail profile from Ben Thanh to Tao Dan continues at deep underground to avoid buldings' foundations at the corner of Ly Tu Trong and Cach Mang Thang 8. The foundations are about 290m from Tao Dan station, so it is designed at -14.6m elevation (connecting profile to the station is at maximum gradient of i=5%), with 19.67m depth from ground level to top track level.

Due to the platform depth, 3 levels are proposed as Concourse, Intermediate, and Platform levels. Technical rooms are all at 3 levels, so the station is 175m in length (compared with 193m length of standard 2-level stations) and are 21m in width (excluding areas used for ventilation shafts and cooling tower).

The station is located in front of Tao Dan Cultural Park and beside Trong Dong Outdoor Theatre on Cach Mang Thang 8 road, District 1 where large amount of people usually gather. Passengers can access the station via 4 entrances provided, two locations each side. Two entrances have both stairs and upward escalators. A lift to concourse level is available too.

3. Dien Bien Phu

Dien Bien Phu station is at Km 2+320.72 on Cach Mang Thang 8 road, 1155m northern-west far from Tao Dan station. The station is under the roundabout of Dan Chu 6-leg intersection which is proposed as a standard station, having concourse and platform levels with 193m x 21m dimension. It is at -11m top track elevation with 15m depth from ground level to top track level.

To facilitate for passengers accessibility, 6 entrances and exits are designed. 4 out of total 6 entrances have both stairs and escalators. Entrances and exits are at both southern-east and northern-west ends of the station. Because this is a big 6-leg intersection, to make it easy for passengers from directions, two more entrances and exits are provided at the corners of Vo Thi Sau- Ly Chinh Thang

and 3/2 road-Nguyen Thuong Hien. Wheelchair users and persons with heavy luggage can access the station via a lift proposed at the northern-west left of the station.

4. Hoa Hung

Hoa Hung station is at Km 3+204.68 on Cach Mang Thang 8 road, District 10, 884m northern-west far from Dien Bien Phu station. Hoa Hung station is surrounded by a high density residential area and designed as a standard station with concourse and platform levels, having an underground dimension of 193m x 21m. It is at -11m top track elevation, with 15.15m depth from ground level to top track level.

Four entrances and exits are designed along sidewalks at both southern-east and northern-west ends of the station, in which two locations have stairs and escalators at the same time. Wheelchair users and persons with heavy luggage can access to concourse level via a lift provided at the northern-west of the station.

Hoa Hung station serving for national rail system is located on the right of the Hoa Hung urban rail station. At present, this Hoa Hung station is still in use for inter-province rail lines, especially for the national north-south rail line. According to the approved Ho Chi Minh city urban rail master plan by the Prime Minister at Decision 101/QD-TTg, this Hoa Hung national rail station is planned to be an elevated interprovince rail station. Ho Chi Minh city's People Committee has been proposing the Prime Minister (agreed in principle) to shift Hoa Hung interprovince rail station's function to Di An and Suoi Tien stations. The rail line going through the existing station would be for an urban rail station. Therefore, in the future, to interchange passengers between Hoa Hung station of Line 2 with the existing Hoa Hung station, an underground or on ground connecting section would be proposed (depend on actual resettlement conditions) and in accordance with the existing Hoa Hung station's construction option.

5. Le Thi Rieng

Le Thi Rieng station is at Km 4+343.78 on Cach Mang Thang 8 road, District 10, 1139m northern-west far from Hoa Hung station, in front of Le Thi Rieng park. The station is designed as a standard one with concourse and platform levels, having underground dimension of 193m x 21m. Le Thi Rieng station is at -13m top track elevation, with 16.09m depth from ground level to top track level.

Four entrances and exits are designed along sidewalks at both southern-east and northern-west ends of the station, in which two locations have stairs and escalators at the same time. Wheelchair users and persons with heavy luggage can access to concourse level via two lift provided at the northern-west end of the station.

6. Pham Van Hai

Pham Van Hai station is at Km 5+183.65 on Cach Mang Thang 8 road, Tan Binh District, 840m northern-west far from Le Thi Rieng station. The station is surrounded by a high density residential area and designed as a standard one with concourse and platform levels, having underground dimension of 193m x 21m. Pham Van Hai station is at -13m top track elevation, with 17.55m depth from ground level to top track level.

Four entrances and exits are designed along sidewalks at both southern-east and northern-west ends of the station, in which two locations have stairs and escalators at the same time. Wheelchair users and persons with heavy luggage can access to concourse level via two lift provided at the northern-west end of the station.

7. Hoang Van Thu

Hoang Van Thu station is at Km 5+960.75 on Truong Chinh road, Tan Binh District, 777m northern-west far from Pham Van Hai station. Hoang Van Thu station is proposed to connect to a turnout track tunnel in case of emergency and designed as a standard one with concourse and platform levels,

having underground dimension of 193m x 21m. Hoang Van Thu station is at -12m top track elevation, with 16.10m depth from ground level to top track level.

Four entrances and exits are designed along sidewalks at both southern-east and northern-west ends of the station, in which two locations have stairs and escalators at the same time. Wheelchair users and persons with heavy luggage can access to concourse level via two lift provided at the northern-west end of the station.

8. Nguyen Hong Dao

Nguyen Hong Dao station is at Km 7+174.67 on Truong Chinh road, Tan Binh District, 1214m northern-west far from Hoang Van Thu station. The station is surrounded by a high density residential area and designed as a standard one with concourse and platform levels, having underground dimension of 193m x 21m. Nguyen Hong Dao station is at -11m top track elevation, with 16.20m depth from ground level to top track level.

Four entrances and exits are designed along sidewalks at both southern-east and northern-west ends of the station, in which two locations have stairs and escalators at the same time. Wheelchair users and persons with heavy luggage can access to concourse level via two lift provided at the northern-west end of the station.

9. Cong Hoa

Cong Hoa station is at Km 8+293.15 on Truong Chinh road, Tan Binh District, 1118m northern-west far from Nguyen Hong Dao station. The station is located near the intersection between Truong Chinh and Cong Hoa road. It is surrounded by a high density residential area and designed as a standard one with concourse and platform levels, having underground dimension of 193m x 21m. Cong Hoa station is at -13m top track elevation, with 18.24m depth from ground level to top track level.

Four entrances and exits are designed along sidewalks at both southern-east and northern-west ends of the station, in which two locations have stairs and escalators at the same time. Wheelchair users and persons with heavy luggage can access to concourse level via two lift provided at the northern end of the station.

10. Truong Chinh 1

Truong Chinh 1 station is at Km 9+135.67 on Truong Chinh road, Tan Binh District, 843m north far from Cong Hoa station. It is the final underground station of the Metro Line 2 from Ben Thanh to Tham Luong. According to previous studies, the station has been proposed to be elevated. Because its location is within take-off and landing limitation area of Tan Son Nhat airport (a limited elevation is not more than 12m within the area, so if Truong Chinh 1 elevated station is proposed, its top roof elevation would be 17 – 18 m).Furthermore, if an at grade station is proposed, the train headway of less than 3 minutes would impose tight fences Therefore, the station is proposed to be underground. The existing Truong Chinh cross section is 60m with a 4m central median. The station is located all under the existing road cross section and designed as a standard one with concourse and platform levels, having underground dimension of 193m x 21m. Truong Chinh 1 station is at -11m top track elevation, with 15.68m depth from ground level to top track level.

Four entrances and exits are designed along sidewalks at both southern and northern ends of the station, in which two locations have stairs and escalators at the same time. Wheelchair users and persons with heavy luggage can access to concourse level via two lift provided at the northern end of the station.

11. Tham Luong

Tham Luong station is at Km 10+077.20 on Truong Chinh road, Tan Binh District, 942m north far from Truong Chinh 1 station. Tham Luong elevated station is located at the intersection of Truong Chinh road and the entrance to Tan Binh Industrial Zone. A large amount of workers works here daily, so the station here would create favorable conditions for surrounding people to use the urban rail line. On the

other hand, as Truong Chinh road has a wide cross section, the station has also a function as a foot bridge to cross the road for pedestrians

Tham Luong station is elevated, having concourse and platform levels with a standard dimension of 140m x 27.4m.. It is at +15.5m top track elevation, with 12.12m distance to existing ground level. Its concourse level is at +10.3m to ensure the minimum clearance height to the structure bottom of 4.8m.

Platforms are of the side type and have a minimal width free of stairs of 3,50 m

Tham Luong is the present terminal station but its accesses have been designed to accommodate traffic induced by the eventual extension to An Suong.

Four entrances and exits are designed along sidewalks at both ends of the station, in which two locations have stairs and escalators at the same time. Two remaining have stairs and lifts. Passengers can access to the concourse level via foot bridges connected to four entrances. The foot bridges' elevation is in accordance with the concourse level.

At the concourse level, four toll-gate locations are proposed at both ends. At the paid area, passengers go up to platform level via 6 locations in which have 2 individual stairs, 2 locations of both stairs and escalators and the other 2 of lifts.

APPENDIX C: CIVIL WORKS, CONSTRUCTION & ENGINEERING SYSTEMS

Civil Works, Construction and Engineering Systems

1. This Appendix describes the key design features of the preliminary engineering for civil works, including construction needs and engineering systems.

Design Principles and Criteria

2. The key underlying design criteria and principles for the civil works are summarised below:

- The likelihood and constraints of future extensions of the line at either end
- The need to minimise visual and noise intrusion along the dense urban corridor of the line (both during operation and construction)
- The need to provide a system with reasonable operating headways, and at reasonable investment cost, to serve both initial and future patronage demands
- The need to provide cars of sufficient size and capacity to meet long term demands, whilst being able to meet the tight alignment constraints through the dense urban areas
- A modern system using trains with or without drivers, but with ATP (Automatic Train Protection), ATS (Automatic Train Supervision), and ATO (Automatic Train Operation).
- For underground stations, to set the platform level as shallow as possible for passenger convenience, whilst keeping tunnels in suitable soil layers
- The need to optimise the alignment to minimize impacts on properties and hence the resettlement cost
- Adopting construction methods to avoid traffic and utilities diversions and optimize construction time
- Using twin tunnels to raise as high as possible the rail level in stations and to limit settlement under buildings and utilities
- Using “U” shape structure for elevated sections to limit the visual impact of the viaduct in the street and optimize the construction cost and schedule
- Use of a Tunnel Boring Machine (TBM) to avoid traffic and utilities diversions and optimize construction time
- Using the cut and cover method of construction for stations with the top-down method (ensuring the street always has at least one lane in each direction operational)
- Use of diaphragm walls as permanent structures for stations to optimize transverse dimensions, balance buoyancy and facilitate the top down method

Design Standards for Civil Works

3. The following international design standards and guidelines have been used as the basis for design of the civil works (elevated and underground structures). Relevant Vietnamese standards have also been adopted as appropriate.

- AASHTO – American Association of State Highway and Transportation Officials, for structural and geotechnical design.
- ASTM codes
- ACI 318_95 – American Concrete Institute
- UIC – International Union of Railways
- AWS – American Welding Society
- Uniform Building Code - UBC 97- ICBO
- CIRIA – Construction Industry Research and Information Association
- NFPA 130 standard version 2007
- Bowles, J. E. “Foundation Analysis and Design.” Mc Graw Hill, 1996.

- Recommendations of AFPS (French Paraseismic Association) 90
- Liquefaction analysis from SPT tests – NCEER workshop

4. As no specific code or standard exists for tunnel calculations, the design the tunnel structures was based on the following:

- ITA (International Tunnelling Association) recommendations,
- French Tunnelling Association (AFTES) recommendations. AFTES is a corporate member of ITA.
- British Tunnelling Society

Tunnels

5. As mentioned in Chapter 4, twin tunnels (bitube) have been chosen mainly for decreasing the risks of excavation and the value of settlement under buildings.

6. The tunnel has an inner diameter of 6.05 m, including a tolerance of 0.20 m on the diameter, that is to say that the theoretical clearance is 5.85 m and is secured. The lining is 0.30 m thick and the external diameter of tunnel is 6.65 m. It consists of 6 segments, including the key. The segments are 1.5 m long.

7. The twin tunnels will be generally 10.5m apart (between centrelines), widening to 16.5m at stations. The depth of the rail level below ground varies between 15m and 27m. This arrangement is made for reducing the influence of the tunnel on existing friction piles supporting buildings.

8. Twin bored tunnels are proposed for the project. It is estimated that two tunnel boring machines (TBM's) would be required, to accommodate tunnels of outer diameter 6.65m.

Cross Passages and Water Chambers

Water Chambers

9. Each inter station is equipped with a pumping chamber to collect oozing water from lining and eventual water from fire fighting (stand pipe). This pumping chamber of a storage capacity of 15 m3 is implemented close to the deepest point of the inter station in a gallery linking both tunnels and called “cross passage”.

10. Water collected from each track bed gutter is stored in the chamber and then pumped to the sewage network through a vertical casing . The cross passage gallery is vaulted, 2,5 m high and 3 m wide. Its length varies from 4 to 10 m (see drawings)

Cross Passages for Safety

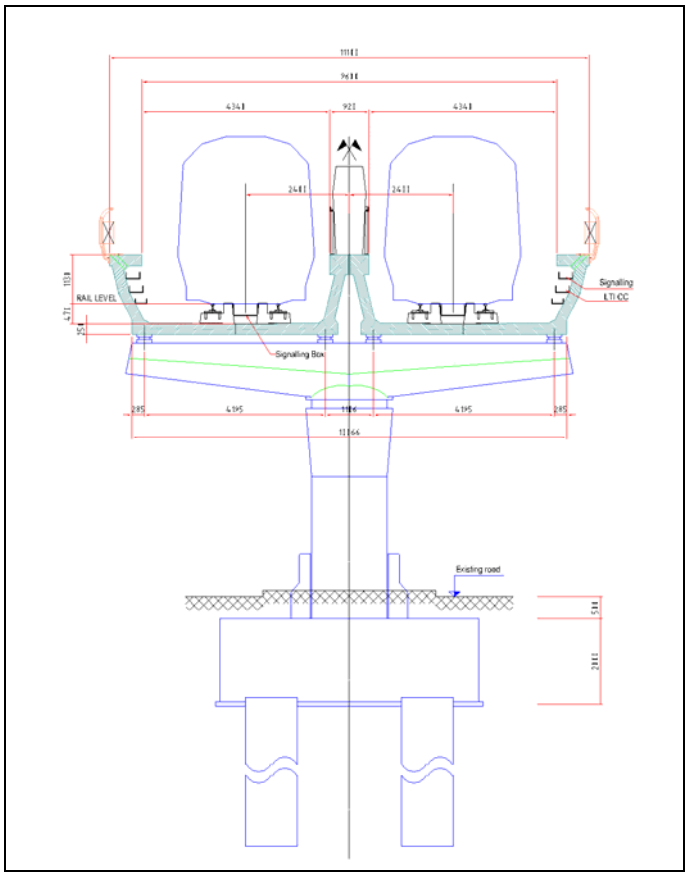
11. For the inter stations longer than 762 m, a gallery cross passage with the same dimensions as here above is implemented each 244 m for passengers escape (see drawings)

12. One of these cross passages is equipped with a pumping chamber as well. There are in total 18 cross passages on the line.

Viaducts

13. Viaducts are proposed to be constructed using the “U-shape” structure which has been successfully adopted for Metro projects in several countries. The typical cross section of the viaduct is shown in Figure C-2.

Figure C-2: Typical Viaduct Cross Section showing Double ‘U’



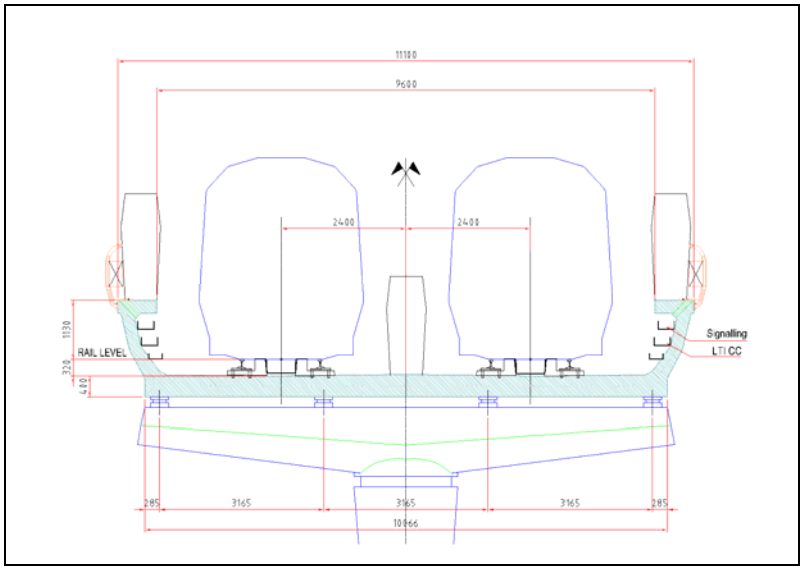
14. With the U-shape viaduct, trains run within the structural box which gives a number of advantages over conventional viaducts where the tracks run on top of a structural box:

- Track level is lower, meaning that stations are lower and hence more convenient for passengers
- The outer walls of the structure provide noise protection (much research has been devoted to the optimum shape of the structure for noise suppression)
- The visual impact of the elevated rail is much lower than with a conventional viaduct

15. There are two main sections of viaduct for the initial project: the northern section of the line at Tham Luong of around 1,670m, and the connection to the depot of around 800m. The main design features of these viaducts are summarized as follows:

- the viaduct is kept as thin as possible to optimize the station platform level and minimize visual impact
- minimum clearance under elevated structure is 4.8m above roads, and 2.1m for pedestrians (in stations)
- simple support spans of 25m long as an average for optimizing the structure and to fit the width of the main cross roads
- double prestressed "U" shape girders, except in the crossover zones, to optimize visual aspects, construction time and cost
- large prestressed "U" for crossover section (see figure C-3 below)
- pre-stressed design of pier caps for minimizing height
- generally single columns of 2m/ 1.75m diameter, supported by four 40m deep bored piles of 1,2m diameter (depth of foundation to be adjusted following results of further geotechnical surveys)
- abutment of the main line viaduct is set when rail level is at 4,80 m above ground level and consists of a retaining wall founded on 4 bored piles – the ramp consists of technical backfill soil confined inside two longitudinal retaining walls, founded on bored piles.

Figure C-3: Typical Viaduct Cross Section showing large single 'U'

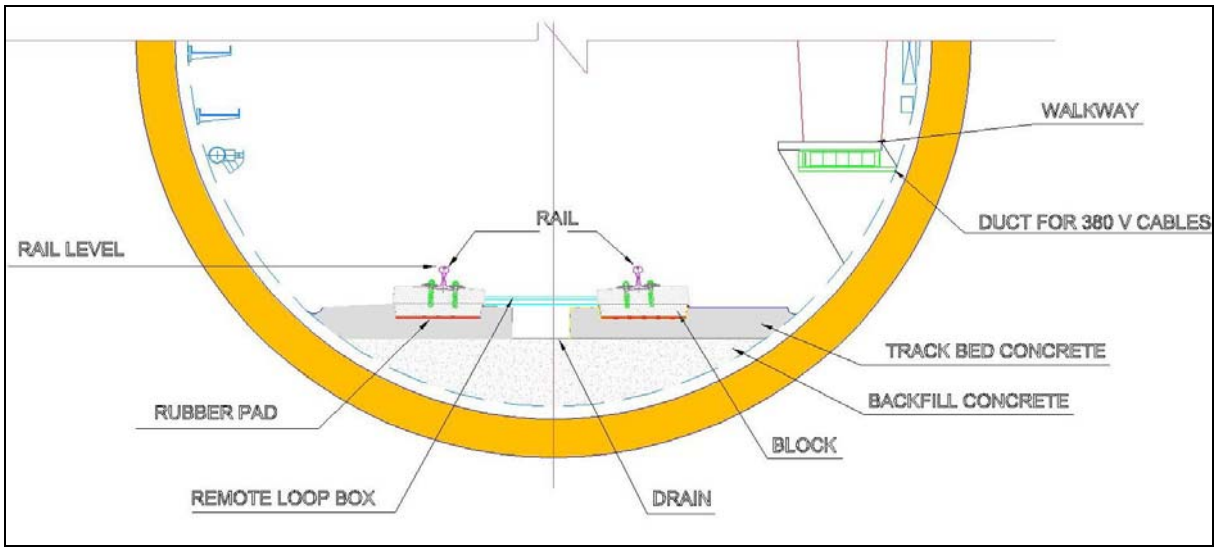


16. A particular point is the crossing of the existing Tham Luong road bridge along its axis. For this purpose, rail level is raised to 14.5m above ground level to keep the road clearance on the bridge. The columns are inserted in the gap between the two slabs of the bridge.

Track

17. The track is designed for standard steel-on-steel operation, with standard gauge 1.435m, maximum axle load 16 tons, and other rolling stock characteristics as above. Non-ballasted slab tracks are recommended for all sections, in view of the heavy demands of the Metro system, tight curves, and the need to minimize maintenance requirements. Track construction of STEDEF type, as it would be in the tunnel, is shown diagrammatically in Figure C-4.

Figure C-4: Track Arrangement in Tunnel



Special Design Issues

Transition Section from Underground to Elevated

18. The transition zone is to the west of Truong Chinh station. It has a double purpose: to raise the tracks to ground level and then ramp to the viaduct; and to transform two single tracks spaced at 16.5 m to a double track open cut tunnel. Key features include:

- two single track cut and cover frames, 5m inner width,
- one double track cut and cover frame with a separation wall, 14.5 m overall inner width,
- a double track frame, with an inner width decreasing from 11m to 10.6 m,
- an open cut “U” shape structure with an inner width of 10,35 m until the top of the raft reaches ground level.

Crossover

19. One crossover on the East side of Hoang Van Thu station is implemented for reversing trains behind or before a temporary terminus in case of disruption of a portion of the line. It allows the operator to use Hoang Van Thu or Pham Van Hai as a temporary terminus.

20. It has a connection between the two tracks with 2 switches. This crossover is a cut and cover “box” similar to a station.

21. One crossover is implemented behind Tham Luong station to allow reversing train for daily operation as the crossover at the end of the viaduct for connection to depot is too far from Tham Luong.

Garage behind Ben Thanh

22. Since Ben Thanh is the terminus station, it is necessary to reverse trains behind or before the terminus. It is not possible to locate a crossover between Ben Thanh and Tao Dan due to the curves. It is also impossible to put it at the extremity of Ben Thanh station due to line 1. Therefore the twin tunnels have to cross line 1 and Ben Thanh square and the garage is located in the axis of Ham Nghi street.

23. The garage encompasses two side tracks for the eventual extension of the line to the Saïgon river, and two turnouts leading to a "Y" track. This last track allows trains to reverse direction. The whole length of the Work is 225 m (inner dimension), and part of the garage on Ben Thanh side will be used as launching shaft for the TBM. A ventilation and escape chimney is also set on the Ham Nghi side.

Garage behind Tham Luong

24. Tham Luong station is the terminus at the other end of the line. So, trains must be reversed before or behind Tham Luong. They cannot be reversed before Tham Luong station as the connection to depot is behind Tham Luong. Furthermore, trains on main line must be reversed for accessing to the viaduct connecting depot (it was not possible to orientate the junction westwards because of Tham Luong bridge). This crossover cannot be used for reversing trains in everyday operation but is dedicated to reversing maneuvers for access to the garage.

25. With these constraints and the fact that the bearing of the tracks cannot be changed because of the fixed bearing of Tham Luong bridge, the whole system is 225 m long.

Construction Needs and Issues

Bored Tunnel Construction

26. As noted earlier, it was determined at an early stage that cut-and-cover construction method would not be practical, and it was concluded that bored tunneling, using tunnel boring machines (TBM), would be the most feasible method of construction. Two options exist for bored tunnels: twin single-track tunnels, or a single larger tunnel accommodating double-tracks.

27. This finding was based on a detailed analysis of the relative benefits of the twin or single bored tunnels.

28. Analysis was also carried out of the time schedule for TBM construction for the actual proposed tunnels. The anaylsis was based on extensive experience for TBM construction, and takes account of all key variables such as time for launch shafts, tunnel excavation and lining, station crossings, assembly & dismantling, etc. It is estimated that using two TBM's a construction period of around 3.5-4 years will be required for the tunnels.

29. Analysis was carried out to ensure that the impact of the construction of the tunnels on existing piles for adjacent buildings was within acceptable parameters.

Elevated Structures Construction

Main line and main portion of the connection to depot

30. The viaduct consists, for the main line and for the typical span of the connection to the depot, of double "U" shape girders simply supported on columns with piled foundations. Erection of these "U" shape precast girders is very quick (at least one 25 m span per day when the erection cruise speed is reached and a six months period for preparation, installation and testing of the precasting plant must be added).

Crossover and particular portion of the connection to the depot

31. In the crossover portion and on the turn out area of the connection to depots, it is not possible to use double "U" frame because of the turn outs. For these portions a single enlarged "U" is set. Construction of spans of this large "U" is carried out with precast segments with the help of a launching girder.

Junction between the Main line and the Connecting viaduct to depot

32. The deck of this particular part which is supported by piled porticoes is cast on site.

Elevated Station

33. The elevated station is constructed after achievement of the on line viaduct which runs along the station. The columns of the viaduct are designed to support the concourse slab. The side platforms are supported by piled columns independent from the viaduct.

Ramp

34. The ramp for the main line and for the viaduct connecting to depot consists of a large "U" on two side retaining walls which are founded on piles.

Cut and Cover Stations Construction

Constraints

35. All the stations are under busy trafficked streets and their width is usually larger than the right of way. To minimize the ground allocation to construct the stations and consequently the resettlement of residents, the typical station is compact (inner dimensions 21m x 193 m) and has Diaphragm walls as permanent structure .

36. To minimize traffic hindrances, a two lanes (one for each direction) is maintained during the most delicate phases of the construction and then the previous four lanes (two for each direction) are restored for most of the construction period

Principles of Construction

37. The following are key points in the principles guiding the construction of cut and cover stations:

- All Stations have two levels (platform and concourse levels) except Tao Dan and Ben Thanh (which will be built by others) which have 3 levels.
- The bottom of the excavation is 19 m below ground level for the typical station, 29 m for Ben Thanh and 23 m for Tao Dan
- The main principle of construction is to use diaphragm walls as a permanent structure and to concrete the top slab before excavating underneath.
- As it is here above mentioned, the top slab is concreted by half to maintain a two lane traffic.
- For some stations like Dien Ben Phu or Ben Thanh, construction of top slab will be more divided
- Another principle of construction is to support the top slab and the concourse slab with pre-founded column (starposts) on Diaphragm walls foundation.
- The peripheral Diaphragm walls and the Diaphragm walls beneath the columns help to counterbalance the buoyancy of the station .
- The thickness of the Diaphragm walls is 1.20 m for typical station and locally 1.50 m for Tao Dan and Ben Thanh

Influence of the Station on the Aquifers

Deep Aquifer

38. Diaphragm walls toes are embedded on top of the impervious layer D which is at about 35/40 m below Ground Level. There is therefore no interference of the works on the aquifer beneath this impervious barrier.

Superficial Aquifer

39. Water which is pumped for excavation consists only of the water of the box and from some leakage through the Diaphragm walls. There is no water table drawdown in the superficial aquifer which could be damageable for existing buildings.

40. For permanent Works, a sand drain will be set outside of the Diaphragm wall and along their perimeter to maintain an equal level upstream and down stream as we did in similar cases. This drain will be set only after an investigation of superficial water level gradient during further studies.

Cut and cover Crossover close to Station Pham Van Hai

41. This crossover is attached to the Station and has the same constraints as the station.It is therefore built with the same top down method with pre-founded columns

Transition Zone Between Underground and Elevated after Station Truong Chinh 1

42. As the street is much larger in this portion, few lanes will be interrupted. It is therefore not necessary to use a top down method and temporary diaphragm walls or secant piles are used for most of the works as follows from Truong Chinh 1 tympanum (see drawings for details):

- 2 single track frames constructed within a screen of temporary Diaphragm walls,
- 1 double track frame with a partition wall constructed within a screen of temporary Diaphragm walls,
- 1 double track frame with a barette wall with two permanent Diaphragm walls for reason of buoyancy
- 1 pumping station with two permanent Diaphragm walls for reason of buoyancy
- 1 “U” shape frame with two permanent Diaphragm walls for reason of buoyancy
- 1 “U” shape frame on piles till the ramp

Garage Before Station Ben Thanh

43. The garage and reverse facility has the particularity to include on Ben Thanh side, the TBMs’ launching shaft. As for the transition zone here above, the reverse facility and garage does not need a top down method. The whole Works is constructed within a screen of temporary Diaphragm walls. A permanent transverse diaphragm wall separates the TBMs launching shaft on Ben Thanh side from the remaining parts of the Works. When the 3 tracks frame with its ventilation and escape chimney on Ham Nghi side is concreted, the area is backfilled to ground level. So, the launching shaft for the TBMs remains open, protected from the backfilling by the transverse diaphragm wall. Then the TBMs are hauled in the launching shaft and the area above the backfilled garage is used as a site for servicing the TBMs. After achievement of TBMs’boring, the launching shaft is backfilled.

Settlement

44. From the computer modeling of the tunnels and from our experience in excavation behind diaphragm walls with buildings close to the excavation, we consider that settlements will be less than 20 mm. Therefore the following values of allowable settlement should be specified in the Construction Contract:

- Usual building: maximum settlement:25 mm, maximum differential settlement: 1/500 (this indicator is more important for damage), maximum upheaval: 10 mm
- Particularly sensitive building to be listed in the Contract: maximum settlement:20 mm, maximum differential settlement: 1/600, maximum upheaval: 10 mm
- Street & pavement: maximum settlement:30 mm, maximum differential settlement: 1/400 , maximum upheaval: 10 mm
- Particularly sensitive utilities listed in the Contract: usual building condition or particular condition

45. A detailed study of the influence of tunnel on existing piles should be performed before tendering to determine which piles need a mandatory protection with a screen of micro-piles or similar.

Engineering systems

Signaling Systems

46. The purpose of the Signalling and Control system is to ensure safe and reliable automatic operation of the complete LRT system, including Operating Control Centre (OCC) support functions. The proposed signalling and control system is known as Automatic Train Control (ATC) system. This ATC system includes trackside and onboard equipment with dedicated software to provide all functions for automatic train protection (ATP), automatic train operation (ATO), and automatic train supervision (ATS):

- ATP shall provide the primary protection for passengers, personnel and equipment against hazards of operations. ATP initiates braking for: safe train separation: approaching end of track; temporary speed restriction (on request from OCC); emergency braking.
- ATO shall control the operations that otherwise would be performed by a train driver. This includes: motion control; station stopping; door opening; etc.
- ATS shall provide the overall supervision and control of the traffic including status information for the central operator. This includes: train supervision; train tracking; automatic traffic management and regulation.

47. Communication between onboard and wayside ATC systems shall be supported by continuous, high capacity and bi-directional data communications.

Power Systems

48. As noted in Chapter 4, the proposed power supply system has yet to be determined. It is envisaged that power will be drawn from the HCMC network. A computerized simulation should be carried out to ascertain accurately the pattern of projected power demands. Traction power will also be provided at the Depot. The medium voltage cable network is extended throughout the Depot with the medium voltage cable installed underground in suitable duct or covered trough.

49. Auxiliary power supplies will be fed from the auxiliary power substation. The station auxiliary supply is designed to supply the different service loads according to a certain hierarchy (importance of the continuity of supply). Auxiliary power will also be provided at the passenger stations and within the Depot for general purposes such as lighting, machinery etc.

50. An Uninterruptible Power Supply system (UPS) will be provided in the passenger stations and in the Depot to support essential functions of the equipment installed for the project without interruption, when normal power supply is lost. A stand-by power supply will be provided to support the operation of essential functions of the equipment installed in the Depot, when normal power supply is lost.

Low Voltage Systems (Communications and Control)

51. A centralised control system covering different subsystems for traffic, traction, power, electromechanical facilities, etc is a fundamental requirements for the Metro line. Such centralisation facilitates:

- Instantaneous overall view of events through having all useful information of all kinds gathered in a single location,
- Immediate and judicious decision making, through permanent presence of personnel who, though small in number, are highly qualified,
- Rapid execution of the measures to be taken through direct remote control of certain equipment units and a full telecommunication network providing links with the operational and technical personnel concerned, as well as outside links (with the Police for instance).

52. Telecomunications systems will be required for systems such as:

- Data transmission network,
- Radio communication subsystem,
- Telephone subsystem,
- Closed Circuit Television,
- Fire detection,
- Voice recording,
- Clock system,
- Dynamic display,
- Station public address,
- Station intercom.

Building Services

53. Building services requirements for the system covers a very wide and extensive subject area including the following main areas:

- Lighting – including public areas, tunnels, etc, and emergency lighting requirements and provisions
- Fire extinguishing systems – including fire detection systems, automatic extinguisher systems, sprinkler systems, fire management panels
- Lifts and escalators
- Water supply, drainage and sewage
- Technical rooms
- Ventilation and air-conditioning systems (including emergency ventilation systems)

APPENDIX D: DETAILED CAPITAL COST ESTIMATES

Basis of the Cost Estimates

Cost estimates are based on the following provisions and guidelines :

- Decree 99/2007/ND-CP dated 13 June 2007 of the Government on Management of investment cost for construction of works. Decree 03/2008/ND-CP dated 07 January 2008 of the Government on amendment, supplement to some articles of Decree 99/2007/ND-CP dated 13 June 2007 of the Government on Management of investment cost for construction of works.

- Circular 05/2007/BXD dated 25 July 2007 providing guidance on estimates and management of investment cost for construction of works.

- Circular 09/2007/TT-BXD guiding the determination and management of cost for foreign consultants employment in construction activities in Vietnam.

- Decree 166/2007/N§-CP dated 16 November 2007 of the Government of Vietnam specifying the general minimum salary.

- Quantities calculated following the feasibility study report of the Metro line 2 project from Ben Thanh to Tham Luong (excluding Ben Thanh station). Synthetic unit prices were made based on quantities on scope and structure of each work item with local prices of Ho Chi Minh City. Some synthetic unit prices were taken from transportation works of Vietnam or some others were referred from foreign works for similar metro construction works. Unit prices of equipment to be imported for construction (and operation) purposes were made with location of construction works taken into account (included taxes, transport fees, storage, checking...).

- Synthetic civil work unit prices for infrastructure costs were made and adjusted on the basis of direct costs for labour and machine according to guidelines of Circular 03/2008/TT-BXD dated 25 January 2008 of Ministry of Construction. General costs, profit and taxes were estimated following Circular 05/2007/TT-BXD dated 25 July 2007 “Providing guidance on estimates and management of cost for construction of works” of Ministry of Construction. VAT tax was based on Decree 158/2003/ND-CP dated 10 December 2003 of the Government specifying in details implementation of the Law on value added tax and the Law on amendment, supplement to some articles of the Law on value added tax. Components of these unit prices were made based on the followings:

- Cost estimate norm for construction of works no.1776/BXD-VP dated 16 August 2007 of Ministry of Construction and other specialized norms of Ministry of Transport and Ministry of Construction.

- Basic construction unit prices of Ho Chi Minh City area promulgated together with Decision 104/2006/QD-UBND dated 14 July 2006 of Ho Chi Minh City People’s Committee.

- Labour unit price applied on the basis of salary factor, salary allowances and Payroll A1.8 promulgated together with Decree 205/2004/ND-CP dated 14 December 2004 of the Government with minimum salary level of 540.000VND/month.

- Construction materials prices were taken according to Notice on prices of construction materials in Ho Chi Minh City area Quarter I/2008 of Inter-departments of Finance-Construction of Ho Chi Minh City People’s Committee.

- Other civil work costs including auxiliary structures and temporary works to serve for construction of main work items were calculated in percentage (%) on the basis of civil work costs of main work items.

- Other civil work costs are assumed to be 3% of main construction cost and will be under civil work cost estimates.

- Detail design cost is assumed to be 2.5% of total civil work costs (including main civil work and other civil work).

- Supervision Services cost is assumed to be 5.0%.

- Project management cost and other costs include: general management cost of the project; costs for project appraisal and design verification, appraisal of total construction cost, cost for preparation of bidding documents; appraisal charges and fees, audit fees; cost for verification and approval of final accounts and other costs in project implementation phases.

- Project management and Consultancy cost rates were based on Norm no. 1751/BXD-VP dated 14 August 2007 of Ministry of Construction on norm for project management and consultancy cost.

- Contingencies cost including contingencies for arising quantities and price contingencies is assumed to be 10% of total construction cost, equipment cost and other cost of the Project following the above calculation.

- Other documents in effect at the time of estimating costs.

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COST ESTIMATES
First Quarter 2008 prices

Cost item	Financial Costs in USD Local	Foreign	Total
Civil works			
Underground	206.51	137.67	344.19
Above ground	20.84	2.32	23.16
Total civil works	**227.35**	**139.99**	**367.34**
Non-system Electrical and Mechanical			
Track supply and lay-out	8.66	10.59	19.25
Turnouts	1.08	3.24	4.32
Power delivery system	1.06	4.25	5.31
Fire fighting	0.88	2.65	3.54
Pumping	0.66	1.55	2.21
Ventilation and smoke exhaust	4.44	10.36	14.81
Heating, ventilation, airconditioning (HVAC)	1.11	3.33	4.44
Escalator	1.79	10.13	11.92
Elevator	0.83	4.72	5.55
Lighting	2.29	5.34	7.62
Total non-system E&M	**22.81**	**56.16**	**78.97**
System Electrical and Mechanical			
SAE IV, OCC, SCADA	0.62	5.55	6.17
Data transmission, telecoms, public announcement	1.14	10.30	11.44
Radio	0.62	5.61	6.24
Traction power (sub-stations & cables)	2.27	12.86	15.13
Aux voltage transformers & high voltage station	1.24	7.04	8.28
Earthing/protection	0.16	0.90	1.06
Signalling and automated train control (ATC)	6.64	37.64	44.28
Total system E&M	**12.70**	**79.89**	**92.59**
Rolling Stock			
Rolling stock	0.00	57.24	57.24
Spare parts for rolling stock	0.00	2.86	2.86
Total rolling stock	**0.00**	**60.10**	**60.10**
Depot civil and equipment			
Depot civil works and equipment, mobile and fixed	11.66	21.65	33.30
Total depot civil and eqipment	**11.66**	**21.65**	**33.30**
Ticketing System*	**0.00**	**0.00**	**0.00**
Automatic fare collection (AFC)	0.00	0.00	0.00
Ticket stock (smart card & token)	0.00	0.00	0.00
Total ticketing system	**0.00**	**0.00**	**0.00**
Total civil works and equipment	**274.52**	**357.79**	**632.31**
Pre-investment stage costs			
Detail design (2.5% of CW & equip)	3.16	12.65	15.81
Supervision (5% of CW and equip)	9.48	22.13	31.62
Other general items (3.0% of CW and equip)	18.97	0.00	18.97
Total pre-investment stage costs	**31.62**	**34.78**	**66.39**
Resettlement costs			
Land compensation	85.74	0.00	85.74
Other compensation and resettlement costs	29.34	0.00	29.34
Total land compensation and resettlement	**115.08**	**0.00**	**115.08**
Total costs without contingencies	**421.21**	**392.57**	**813.78**
Physical contingencies			
Civil works and equipment	27.45	35.78	63.23
Pre-investment stage costs	3.16	3.48	6.64
Resettlement costs	11.51	0.00	11.51
Total physical contingencies	**42.12**	**39.26**	**81.38**
Total costs with contingencies	**463.33**	**431.83**	**895.16**
VAT	**49.19**		**49.19**
TOTAL	**512.53**	**431.83**	**944.35**

(Not including price contingencies and financing costs)

COST ESTIMATES - CIVIL WORKS
First Quarter 2008 prices
(before discount)

	QUANTITY	PRICE(USD)	TOTAL (USD)
TBM AND GALERIES			
GC	6966.00	17,006.00	118.46 MUSD
Aménagement			
UNDERGROUND STATIONS			
CW typical station	8	17,888,617.87	143.11 MUSD
CW Tao Danh	1	18,769,600.97	18.77 MUSD
finishing	9	2,704,737.55	24.34 MUSD
OA			
TT COMPRIS			
small cross passages	16	88,323.86	1.41 MUSD
large cross passage	2	176,647.72	0.35 MUSD
CUT&COVER			
	1	9,745,258.22	9.75 MUSD
OPEN TUNNEL			
	1	2,300,501.92	2.30 MUSD
VIADUC RACCORDEMENT	2513	6,909.84	17.36 MUSD
AT GRADE	169	700.00	0.12 MUSD
VIADUC			
ELEVATED STATION			
gc	1	3,701,700.00	3.70 MUSD
AMNGT	1	1,973,700.00	1.97 MUSD
CROSS OVER	1	11,101,798.80	11.10 MUSD
GARAGE REAR STATION	1	14,586,138.54	14.59 MUSD

Total **367.34 MUSD**

COST ESTIMATES SYSTEMS AND ROLLING STOCK						
First Quarter 2008 prices (before discount)						
		Line 2 in 2015				
Component	Ratio	estimate MUSD	Underground (Stations,Cross over, garage, Bored and Cut & Cover Tunnel)	Aerial (Viaduct, At grade, Open Cut)	Other significant unit	
		2008	9.44	2.818		MUSD
			km	km		item
Track supply and lay-out	per linear km (single track)	0.61 to 0.84	15.80	3.45	-	19.25
Turn outs	single turn out (one unit)	0.27	-	-	4.32	4.32
Power delivery system	per linear km (single track)	0.18	3.40	1.01	0.90	5.31
Fire fighting	per linear km	0.22 to 0.37	3.32	0.22	-	3.54
Pumping	per station	0.22	2.21	-	-	2.21
Ventilation & smoke exhaust	per station	1.48	14.81	-	-	14.81
HVAC	per station	0.49	4.44	-	-	4.44
Escalator	per station	0.28	-	-	11.92	11.92
Elevator	per station	0.19	-	-	5.55	5.55
AFC	per station	1.17	-	-	-	
Ticket stock (smart cart and Token)	per line	1.23	-	-	-	
SAE IV - PCC - SCADA	per line	6.17	-	-	6.17	6.17
Data trans - télécom - PA	per line	11.44	-	-	11.44	11.44
Radio	per line	6.24	-	-	6.24	6.24
Traction power (sub-stations for line + cables)	per linear km	1.23	11.65	3.48	-	15.13
Auxiliary Voltage Transformers + High voltage station	per station	0.68	6.79	0.68	0.81	8.28
Earthing / Protection	per linear km	0.09	0.82	0.24	-	1.06
Lighting	per station	0.24 to 0.74	7.38	0.24	-	7.62
sig + ATC	per linear km	3.70	34.92	9.36	-	44.28
			-	-	-	
Rolling Stock	6 cars train	9.54	-	-	57.24	57.24
Spare parts for Rolling Stock	5% of train cost		-	-	2.86	2.86
			-	-	-	
Workshop RoSto + Fixed Eq./ depot / with CW & track	20 trains	30 to 45.50	-	-	33.30	33.30
						264.97

TBM

Item No.	Description of work	Unit	Quantity	In $ Unit Price	In $ Total Price
	SECTION (01)				
	WORK SITES				
1.1	Preparation and installation of ancillary facilities and Work Site equipment. Dismantling and removal of ancillary facilities and Work Site equipment.	Lump sum			**4,686,319.69 $**
1.2	Maintenance of Work Site Equipment.	Lump sum			**1,170,000.00 $**
	SECTION (02)				
	TBM INSTALLATION AND DISMANTLING				
2.1	Transport, on site assembly and launching of a TBM.	Lump sum			**1,909,350.50 $**
2.2	Disassembly and removal of a TBM.	Lump sum			**790,545.35 $**
	SECTION (03)				
	TUNNEL EXCAVATION				
3.1	Excavation of the circular tunnel having external diameter equal to 6.8m. Price includes depreciation of 80% of TBM purchasing price and 90% of auxiliary equipment, excavation and precast lining having thickness 30cm.				
	Rate per linear meter	m	**13932**	7,520.58 $	**104,776,720.56 $**
3.2	Supply and casting of reinforced concrete of grade (35) of minimum cement content 400 kg/m3 for second stage concrete (until 600mm under the track level)				
	Rate per linear meter	m^3	**17286**	138.41 $	**2,392,468.83 $**
3.3	Stand by costs of one TBM .				
	Rate per day	day		6,938.63 $	
	SECTION (04)				
	CONSOLIDATION FOR TBM ENTERING AND LEAVING THE STATION				
4.1	Consolidation for TBM entering and leaving the station.				
	Rate per cubic meter	m^3	**22000**	124.00 $	**2,728,000.00 $**
				TOT:	**118,453,404.93 $**

Rate $/m = 8,502.25 $ For one tunnel
8,503.00 $

SYNTHESIS OF FOLDER TYPICAL STATION & FOLDER BEN THANH TAO DAN

TYPICAL STATION

	QUANTITIES	UNIT	UNIT PRICE VND	AMOUNT
GENERAL				
Site Installation	Lumpsum			
Excavation existing pavement, thickness 120mm and concrete curb	695	m3	106,585	74,055,397
Excavation existing base and subbase layer, thickness 300mm	1,737	m3	106,585	185,138,492
Excavation soil layer under side walks	304	m3	39,210	11,918,951
Remove of existing concrete and brick side walks	290	m3	97,933	28,351,488
Remove of unused soil (including transpotation fee)	3,025	m3	35,429	107,180,955
Site Installation			**0**	
Installation of bungalows and fencing in street	1	LS	45,000,000	45,000,000
Installation of equipments in site	1	LS	90,000,000	90,000,000
Diaphragm walls Works			0	
guide wall Main box & Accesses & Ventilation	1,028	ml	1,800,000	1,850,400,000
diaphragm wall Main box Excavation Thickness 1.20 m	17,920	m²	3,212,640	57,570,508,800
diaphragm wall Main box Excavation Thickness 1.50 m	0	m²	3,212,640	
diaphragm wall Main box Concrete	22,579	m3	801,000	18,085,939,200
			0	
barrettes Main box Excavation Thickness 1.20 m	13,680	m²	3,212,640	43,948,915,200
barrettes Main box concrete	10,558	m3	801,000	8,456,589,540
kingpost Main box including backfilling*	385,624	kg	40,500	15,617,772,000
SMWalls Accesses & Ventilation Excavation	4,044	m²	3,212,640	12,990,901,642
SMWalls Accesses & Ventilation Steel profiles kept in place	127	Tons	27,000,000	3,429,000,000
Excavation & Backfilling			0	
excavation Main box	79,857	m3	90,000	7,187,130,000
excavation Accesses & Ventilation	7,361		108,000	794,993,684
TOTAL Excavation spoil for transport to depot	87,218	m3	54,000	4,709,774,842
Backfilling for Main box	9,815	m3	114,821	1,126,937,865
Backfilling for Accesses & Ventilation	2,640	m3	114,821	303,127,704
Shoring & Strutting			0	
Strutting for excavation main box	238	Tons	27,000,000	6,418,205,204
Strutting for excavation accesses and ventilation	44	Tons	27,000,000	1,187,179,200
Structure formwork & concrete			0	
Form work on earth Main box roof slab (10 cm of lean concrete)	4,203	m²	93,739	393,983,336
Formwork Main box concourse slab (10 cm of lean concrete)	4,203	m²	93,739	393,983,336
Formwork Main box intermediate slab (10 cm of lean concrete)	0		0	
Formwork for Platform	2,509	m²	225,000	564,525,000
Vertical Formwork for columns	2,561	m²	270,000	691,596,591
Vertical formwork Main box Corbell for raft	560	m²	225,000	126,000,000
vertical formwork for Accesses & Ventilation	1,332	m²	225,000	299,794,737
horizontal form work for Accesses & Ventilation	560	m²	225,000	126,000,000
Concrete Main box roof slab	4,684	m3	801,000	3,752,125,902
Concrete Main box concourse slab	2,942	m3	801,000	2,356,622,100
Concrete Main box raft	6,305	m3	801,000	5,049,904,500
Concrete Main box Corbell for raft	492	m3	801,000	394,284,240
Concrete for platform	502	m3	801,000	401,941,800
Concrete Main box for columns	791	m3	801,000	633,810,708
Concrete for Accesses and Ventilation	1,471	m3	801,000	1,177,891,579
Steel Reinforcement			0	
Steel for Dwalls of Main box	2,795,520	kg	14,175	39,626,496,000
Steel for Barrettes of main box	1,005,480	kg	14,175	14,252,679,000
Steel for Main box structure	1,353,720	kg	15,354	20,785,016,880
Steel for Accesses & Ventilation	117,642	kg	15,354	1,806,276,884
Sand wells for Main box	1,311	ml	900,000	1,179,900,000
Demolition of concrete in Main box			0	
Demolition of Diaphrag walls for Dwalls cap	538	m3	1,080,000	581,040,000
Démolition of tunnel résevation in side walls	185	m3	1,080,000	199,800,000
Waterproofing			0	
Waterproofing PVC sheet for Main box (top slab & raft	9,560	m²	206,910	1,978,059,600
Waterproofing PVC sheet for accesses & ventilation	3,300	m²	206,910	682,803,000
Lean concrete for backfilling below trackbed	1,783	m3	945,000	1,684,935,000
Reinstatement of street, pavement	6,145	m²	0	
Improvement new pavement	6,145.49	m²	266,998	1,640,830,547
Improvement new sidewalk and curb	1,544.00	m²	116,236	179,468,230
Improvement new drainage system (pipe)	694.80	lm	1,215,000	844,182,000
Rehabilitation of existing menholes	4.00	each	9,491,400	37,965,600
Rehabilitation of existing catch basin	8.00	each	2,844,900	22,759,200
Rehabilitation of existing trench drain	600.00	Lm	223,650	134,190,000
TOTAL				**286,217,885,934**
				17,888,618 US$

	QUANTITIES	UNIT	UNIT PRICE VND	AMOUNT
	Lumpsum			
	630	m3	106,585	67,148,676
	1,575	m3	106,585	167,871,690
	276	m3	39,210	10,807,339
	263	m3	97,933	25,707,308
	2,743	m3	35,429	97,184,804
			0	
	1	LS	45,000,000	45,000,000
	1	LS	90,000,000	90,000,000
			0	
	943	ml	1,800,000	1,696,500,000
	5,680	m²	3,212,640	18,247,795,200
	10,800	m²	4,015,800	43,370,640,000
	24,167	m3	801,000	19,357,606,800
			0	0
	11,700	m²	3,212,640	37,587,888,000
	7,334	m3	801,000	5,874,650,145
	405,542	kg	40,500	16,424,467,200
	4,126	m²	3,212,640	13,254,676,295
	127	Tons	27,000,000	3,429,000,000
			0	
	86,966	m3	90,000	7,826,940,000
	6,403	m3	108,000	691,503,158
	93,369	m3	54,000	5,041,915,579
	8,936	m3	114,821	1,025,996,340
	1,980	m3	114,821	227,345,778
			0	0
	1,078	Tons	27,000,000	29,106,000,000
	44	Tons	27,000,000	1,187,179,200
			0	
	3,685	m²	93,739	345,426,741
	3,685	m²	93,739	345,426,741
	3,685		93,739	345,426,741
	2,275	m²	225,000	511,875,000
	2,702	m²	270,000	729,452,978
	515	m²	225,000	115,875,000
	1,213	m²	225,000	272,952,632
	560	m²	225,000	126,000,000
	4,265	m3	801,000	3,416,042,322
	3,685	m3	801,000	2,951,685,000
	5,528	m3	801,000	4,427,527,500
	453	m3	801,000	362,853,000
	455	m3	801,000	364,455,000
	835	m3	801,000	668,685,537
	1,397	m3	801,000	1,118,870,526
			0	
	2,386,743	kg	14,175	33,832,080,000
	698,490	kg	14,175	9,901,095,750
	1,661,107	kg	15,354	25,504,636,878
	111,747	kg	15,354	1,715,769,095
	1,150	ml	900,000	1,035,000,000
			0	
	575	m3	1,080,000	621,432,000
	185	m3	1,080,000	199,800,000
			0	0
	8,571	m²	206,910	1,773,425,610
	3,300	m²	206,910	682,803,000
	1,540	m3	945,000	1,455,300,000
	5,666	m²	0	0
	5,666	m²	266,998	1,512,799,858
	1,400.00	m²	116,236	162,730,260
	630.00	lm	1,215,000	765,450,000
	4.00	each	9,491,400	37,965,600
	8.00	each	2,844,900	22,759,200
	600.00	Lm	223,650	134,190,000
				0
				0
				300,313,615,479
				18,769,601

BITUBE:STANDARD CROSS PASSAGE & SPECIAL CROSS PASSAGES

DEFINITION	QUANTITY	UNIT	UNIT PRICE VND	AMOUNT
Length of standard cross passage , closely spaced tunnel (10,50 m)	4	m		
Length of cross passage with remotely spaces tunnel (16,50 m)	9.75	m		
Inner width of Gallery	3	m		
Width of excavation (including struts and props)	4.6	m		
Inner height of cross passage	2.5	m		
Inner section of gallery	5	m²		
Thickness of raft	0.5	m		
Thickness of walls	0.5	m		
Thickness of vault	0.4	m		
Thickness of profile for ceiling support	0.16	m		
Spacing of support	1.2	m		
Height of excavation (including struts and props)	3.56	m		
Weight of support of gallery	2646	kg		
Section of excavation	16.376	m²		
Section for grouting	69	m²		
Section of concrete	46			
Standard CP closely spaced tunnel (without pumping room)				
Volume of excavation	**82**	**m3**		
Volume of grouting for Standard CP	**276**			
Pumping room	34	m3		
Excavation for drainage pipes	8	m3		
CP with pumping room (closely spaced tunnel=	**124**	**m3**		
Special CP remotely spaced tunnel (without pumping room)				
Volume of excavation	**160**	**m3**		
Volume of grouting for Special CP (remotely spaced tunnel)	160	**m3**		
Pumping room for remotely spaced CP	77	m3		
Excavation for drainage pipes	24	m3		
CP with pumping room (remotely spaced tunnel)	**261**	**m3**		
SIZING OF THE WORKS				
1 STANDARD CP WITHOUT PUMPING CHAMBER				
Site installation in tunnel	1	Unit	270,000,000	270,000,000
Temporary support of bored tunnels (HEB 220)	4004	kg	27,000	108,108,000
Volume of Grouting	276	m3	1,576,800	435,196,800
Demolition of lining	12	m3	1,080,000	12,960,000
Volume of excavation	82	m3	540,000	44,280,000
Spoil to depot	94		54,000	5,076,000
Abandonned support for gallery	2646	kg	27,000	71,442,000
Form work	38	m²	270,000	10,260,000
Concrete	184		959,999	176,639,890
Reinforcement	11040	kg	14,175	156,492,000
Waterproofing	66	m²	206,910	13,656,060
				1,304,110,750
2 CP +PUMPING CHAMBER				
STANDARD CP				1,304,110,750
Volume of grouting	25	m3	1,576,800	39,420,000
Volume of excavation	42	m3	270,000	11,340,000
Spoil to depot	42	m3	54,000	2,268,000
Abandonned Steel for Gallery	500	kg	27,000	13,500,000
Formwork	38	m²	270,000	10,260,000
Concrete	9	m3	959,999	8,639,995
Reinforcement	900	kg	14,175	12,757,500
Waterproofing	50	m²	206,910	10,345,500
Purchase of Pipe Diameter 300 mm and boring from Ground level	20	m	27,000	540,000
				109,070,995
			Exchange rate:	**16,000 VND/US$**
TOTAL CP +PUMPING CHAMBER				1,413,181,744
				88,324 US$ **SMALL CROSS PASSAGE**
3 CP +PUMPING CHAMBER				
Volume of excavation	261			
Volume of Reference for Standard CP	124			
ratio on standard CP	2			
COST				2,826,363,488
				176,648 US$ **LARGE CROSS PASSAGE**

CROSS OVER ON LINE (HUANG VAN TU)

DEFINITION	QUANTITY	UNIT	COMMENTS
Spacing of tracks	16.5	m	
Distance of track axis to wall in cross over	2.96	m	Takes into account R 160 of switch and the evacuation platform along the wall
Distance of track axis to wall for TBM breaking in & out	4.55		TBM Outre diameter (6,8 m)+ 1 m + 0,15 m for Dwalls location uncertainty
Inner width of the cross over	23	m	larger than the station which is 21 m (distance of track axis 2,25 m)
Inner width at the "Mickey's ear"	26		The same as the station which is 26 m)
Inner length of cross over	132	m	the technical rooms area of HUANG VAN TU on the Cross over side (44 m) encompasses the tracks for the Cross over and consequently reduces the Cross over length.for 44 m
Inner perimeter of the Cross over	322	m	
Inner surface of the Cross over	3126	m²	
Depth of rail from Ground Level	15.5	m	The same as the station
Depth of excavation	19	m	
Volume of excavation	59,394	m3	
Extra volume of HUONG VAN TU	1672	m3	The extra volume is due to the increase of width from 21 to 23 m on the 44 m dedicated to the cross over
TOTAL Volume	61,066		
Volume of typical Station	**87,218**	m3	
Comparaison with typical station	0.7	%	
RATIO LE CAIRE	181.8	US$	
Cost of Cross over with ratio Le Caire	**11,101,799**	US$	

SYNTHESIS OF GARAGE

	QUANTITIES	UNIT	UNIT PRICE	AMOUNT
GENERAL			VNT	
Site Installation	Lumpsum			
Excavation existing pavement, thickness 120mm and concrete curb	882	m3	106,585	94,008,146
Excavation existing base and subbase layer, thickness 300mm	2,205	m3	106,585	235,020,366
Excavation soil layer under side walks	515	m3	39,210	20,173,699
Remove of existing concrete and brick side walks	368	m3	97,933	35,990,231
Remove of unused soil (including transpotation fee)	3,969	m3	35,429	140,615,717
Installation of bungalows and fencing in street	1	LS	45,000,000	45,000,000
Installation of equipments in site	1	LS	90,000,000	90,000,000
CONCRETE WORKS				
Diaphragm walls Works				
Guide wall Main box & Accesses & Ventilation	506	m	1,800,000	910,161,000
Diaphragm wall Main box Excavation Thickness 1.20 m	21,237	m²	3,212,640	68,227,124,818
Diaphragm Walls Main box Concrete	25,485	m3	801,000	20,413,090,908
Excavation & Backfilling				
Excavation Main box and Accesses & Ventilation box	107,774	m3	90,000	9,699,662,581
Excavation spoil for transport to depot	107,774	m3	54,000	5,819,797,549
Backfilling for Main box	62,774	m3	114,821	7,207,828,256
Shoring & Strutting				
Strutting for excavation main box	1,431	Tons	27,000,000	38,649,728,636
Structure formwork & concrete				
Form work on earth of Cut and Cover roof slab (10 cm of lean concrete)	4,195	m²	93,739	393,257,368
Horizontal formwork for Cut and Cover structure	3,633	m²	225,000	817,489,665
Vertical formwork for Cut and Cover structure	9,207	m²	225,000	2,071,669,527
Vertical formwork for Accesses and Ventilation box	2,176	m²	225,000	489,540,065
Horizontal form work for Accesses and Ventilation box.	618	m²	225,000	139,006,125
Lean concrete for backfilling below track bed	2,098	m3	945,000	1,982,258,177
Concrete for Cut and Cover raft	3,566	m3	801,000	2,856,120,381
Concrete or Cut and Cover roof slab	3,985	m3	801,000	3,191,721,823
Concrete for Cut and Cover side walls	3,588	m3	801,000	2,873,925,471
Slabs and staircases Concrete in the accesses and ventilation box	1,803	m3	801,000	1,443,816,034
Concrete for side walls in the accesses and ventilation box	1,741	m3	801,000	1,394,210,104
Steel Reinforcement				
Steel for Dwalls	2,038,761	kg	14,175	28,899,432,072
Steel for Cut and Cover structure	1,701,220	kg	15,354	26,120,527,979
Steel for accesses and ventilation box	167,887	kg	15,354	2,577,733,799
Demolition of concrete in Main box				
Demolition of tunnel résevation in side walls	235	m3	1,080,000	254,016,000
Waterproofing				
Waterproofing PVC sheet for Main box (top slab & raft)	12,091	m²	206,910	2,501,800,620
Waterproofing PVC sheet for accesses & ventilation	1,367	m²	206,910	282,834,135
REINSTATEMENT OF STREET, PAVEMENT				
Improvement new pavement	7,350.00	m²	266,998	1,962,432,360
Improvement new sidewalk and curb	1,960.00	m²	116,236	227,822,364
Improvement new drainage system (pipe)	882.00	m	1,215,000	1,071,630,000
Rehabilitation of existing menholes	4.90	each	9,491,400	46,507,860
Rehabilitation of existing catch basin	9.80	each	2,844,900	27,880,020
Rehabilitation of existing trench drain	735.00	m	223,650	164,382,750
TOTAL				**233,378,216,605**
				14,586,139

Cut and Cover

	QUANTITIES	UNIT	UNIT PRICE	AMOUNT
			VND	
GENERAL				
Site Installation	Lump sum			
Excavation existing pavement, thickness 120mm and concrete curb	938	m3	106,585	100,019,552
Excavation existing base and sub base layer, thickness 300mm	2,346	m3	106,585	250,048,879
Excavation soil layer under side walks	587	m3	39,210	22,998,017
Remove of existing concrete and brick side walks	559	m3	97,933	54,705,150
Remove of unused soil (including transportation fee)	4,430	m3	35,429	156,931,604
Installation of bungalows and fencing in street	1	LS	45,000,000	45,000,000
Installation of equipments in site	1	LS	90,000,000	90,000,000
			Sub total	719,703,202
CONCRETE WORKS				
2.1. Cut & Cover, temporary Diaphragm Wall, chainage 9+203 to 9+379				
Diaphragm Walls Works				
Guide walls	704	ml	1,800,000	1,267,920,000
Diaphragm wall, Excavation Thickness 1.00 m	14,088	m²	3,212,640	45,259,672,320
diaphragm wall Main box Concrete	14,088	m3	801,000	11,284,488,000
Excavation & Backfilling				0
Excavation	42,209	m3	90,000	3,798,799,263
Backfilling for Main box	25,936	m3	114,821	2,978,051,518
Shoring & Strutting				0
Strutting for excavation main box	547	Tons	27,000,000	14,757,596,334
Structure formwork & concrete				0
Form work on earth Main box raft(10 cm of lean concrete)	2,184	m²	93,739	204,691,357
Horizontal form work for the Cut and Cover box	9,104	m²	225,000	2,048,483,250
Vertical form work for the Cut and Cover box	1,761	m²	225,000	396,225,000
Concrete Cut and Cover roof slab	1,310	m3	801,000	1,049,457,384
Concrete Cut and Cover raft	1,310	m3	801,000	1,049,457,384
Concrete Cut and Cover side walls	2,599	m3	801,000	2,081,988,036
Steel Reinforcement				0
Steel for Diaphragm Walls	1,127,040	kg	14,175	15,975,792,000
Steel for Main box structure	235,833	kg	15,354	3,620,979,882
Waterproofing				0
Waterproofing PVC sheet	9,545	m²	206,910	1,974,955,950
Lean concrete for backfilling below track bed	881	m3	945,000	832,072,500
			Sub total	108,580,630,177
2.2. Cut & Cover, Permanent Diaphragm Wall, chainage 9+379 to 9+437				
Diaphragm walls Works				
Guide walls	241	ml	1,800,000	434,160,000
Diaphragm wall, Excavation Thickness 0.60 m	1,208	m²	3,212,640	3,881,511,648
Diaphragm wall, Excavation Thickness 0.80 m	4,100		3,212,640	13,173,109,056
diaphragm wall Main box Concrete	4,005	m3	801,000	3,208,197,240
Excavation & Backfilling				0
Excavation	7,092	m3	90,000	638,309,630
Backfilling for Main box	1,228	m3	114,821	141,027,712
Shoring & Strutting				0
Strutting for excavation main box	84	Tons	27,000,000	2,281,479,547
Structure formwork & concrete				0
Form work on earth Main box raft(10 cm of lean concrete)	721	m²	93,739	67,603,153
Horizontal form work for the Cut and Cover box	749	m²	225,000	168,508,350
Concrete Cut and Cover roof slab	749	m3	801,000	599,889,726
Concrete Cut and Cover raft	749	m3	801,000	599,889,726
Concrete Cut and Cover side walls	593	m3	801,000	475,274,952
Steel Reinforcement				0
Steel for Diaphragm walls	280,367	kg	14,175	3,974,199,390
Steel for Main box structure	250,944	kg	15,354	3,852,994,176
Coupler Dowels f25	846	each	234,000	197,964,000
Waterproofing				0
Waterproofing PVC sheet	1,643	m²	206,910	339,864,573
Lean concrete for backfilling below track bed	313	m3	945,000	295,316,989
			Sub total	34,329,299,867

Cut and cover (cont.)

2.3. U shape, permanent Diaphragm walls, chainage 9+437 to 9+494

Diaphragm Walls Works				
Guide walls	219	ml	1,800,000	394,560,000
Diaphragm wall, Excavation Thickness 0.80 m	3,211	m²	3,212,640	10,316,686,579
diaphragm wall Main box Concrete	2,569	m3	801,000	2,057,788,224
Excavation				0
Excavation	4,144	m3	90,000	372,997,296
Shoring & Strutting			0	0
Strutting for excavation main box	69	Tons	27,000,000	1,870,258,346
Structure formwork & concrete				0
Form work on earth Main box raft(10 cm of lean concrete)	655	m²	93,739	61,437,028
Vertical form work for the Cut and Cover box	219	m²	225,000	49,320,000
Concrete for side walls	594	m3	801,000	475,819,632
Concrete for raft	454	m3	801,000	363,800,102
Steel Reinforcement				0
Steel for Diaphragm walls	205,522	kg	14,175	2,913,273,216
Steel for raft and side walls	157,232	kg	15,354	2,414,140,128
Coupler Dowels f25	768	each	234,000	179,712,000
Waterproofing				0
Waterproofing PVC sheet	1,135	m²	206,910	234,937,201
Lean concrete for backfilling below track bed	486	m3	945,000	459,490,941
			Sub total	22,164,220,693

2.4. U shape, chainage 9+494 to 9+575.65

Drilled shaft				
Excavation and concrete, diameter 1.00 m	442	ml	6,480,000	2,864,160,000
Excavation				
Excavation	5,008	m3	90,000	450,738,733
Shoring & Strutting				
Strutting for excavation main box	47	Tons	27,000,000	1,264,210,649
Structure formwork & concrete				
Form work on earth Main box raft(10 cm of lean concrete)	972	m²	93,739	91,157,751
Vertical form work for the U shape box	870	m²	225,000	195,753,825
Concrete U shape box side walls	647	m3	801,000	518,429,308
Concrete for Raft	778	m3	801,000	623,157,238
Steel Reinforcement				
Steel for drilled shaft	62,238	kg	14,175	882,222,607
Steel for raft and side walls	213,780	kg	15,354	3,282,381,989
Waterproofing				
Waterproofing PVC sheet	1,810	m²	206,910	374,498,948
Lean concrete for backfilling below track bed	486	m3	945,000	459,490,941
			Sub total	11,006,201,988

REINSTATEMENT OF STREET, PAVEMENT

Improvement new pavement (Cut&Cover)	4,962	m²	266,998	1,324,842,091
Improvement new pavement (U shape)	816	m²	266,998	217,870,042
Improvement new sidewalk and curb (C&C)	1,891.20	m²	116,236	219,825,334
Improvement new sidewalk and curb (U shape)	1,088.00	m²	116,236	126,464,659
Improvement new drainage system (pipe)	1,340.64	lm	1,215,000	1,628,877,600
Rehabilitation of existing manholes	8.00	each	9,491,400	75,931,200
Rehabilitation of existing catch basin	15.00	each	2,844,900	42,673,500
Rehabilitation of existing trench drain	1,117.20	lm	223,650	249,861,780
			Sub total	3,886,346,206
			Total VND	**180,686,402,134**
			Total US$	**12,045,760**

APPENDIX E: OPERATION AND MAINTENANCE ORGANISATION AND COSTS

1 INTRODUCTION

This appendix presents a calculation of the operation and maintenance cost for Ho Chi Minh City line 2 project based on likely organizational arrangements. This cost is estimated from SYSTRA's experience in similar technical systems and based on an accurate methodology described in the next chapter.

The cost estimates do not include:

- The equipment renewal cost
- Any financial depreciation
- Vietnamese exceptional costs in subcontracting or shipping
- Insurance cost
- Marketing cost

2 METHODOLOGY

The operation and maintenance cost is the sum of:

- Staff cost
- Electricity cost
- Consumable cost
- Material cost

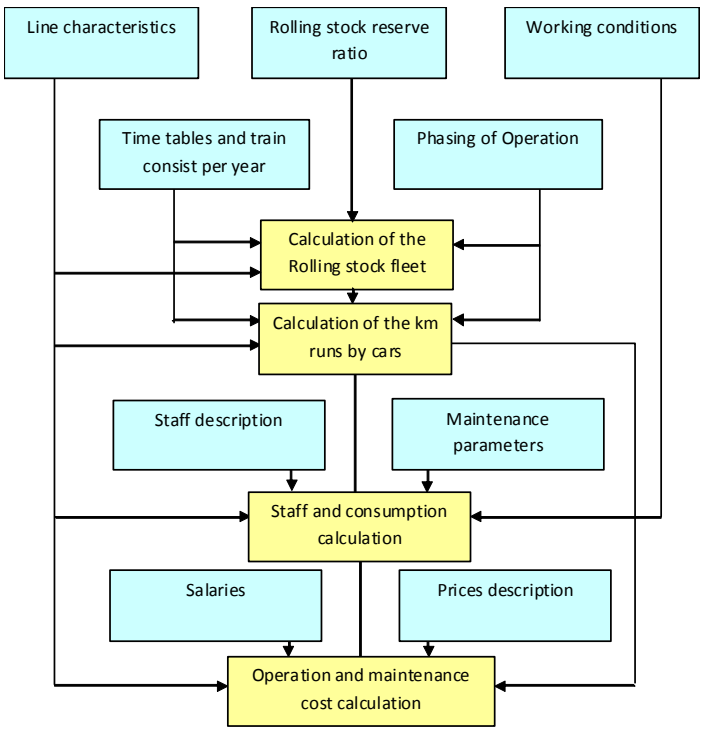
From the passengers forecast, we calculate the following items:

- the number of necessary trains in operation, and then the global train number considering operation and maintenance reserve
- the number of drivers
- the rolling stock maintenance staff
- the traction energy consumption from the future transportation production

From the fixed installation description, we calculate:

- stations and supervision operation staff
- stations and wayside maintenance staff
- fixed equipment energy consumption

The cost calculation process is shown in the diagram below.

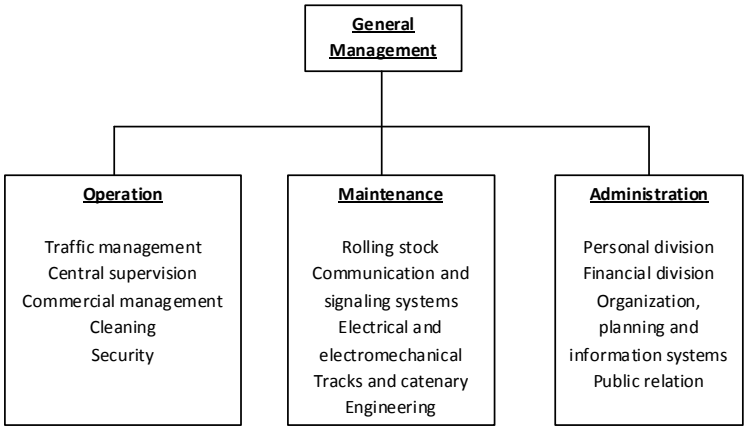


3 OPERATION AND MAINTENANCE ORGANIZATION

3.1 Global Organization

The proposed metro line 1 organization is defined according to the following operational department:

- General Management
- Operation
- Maintenance
- Administration



3.2 The General Management Department

The general management is made of the general manager with his or her assistants, and a safety and quality group.

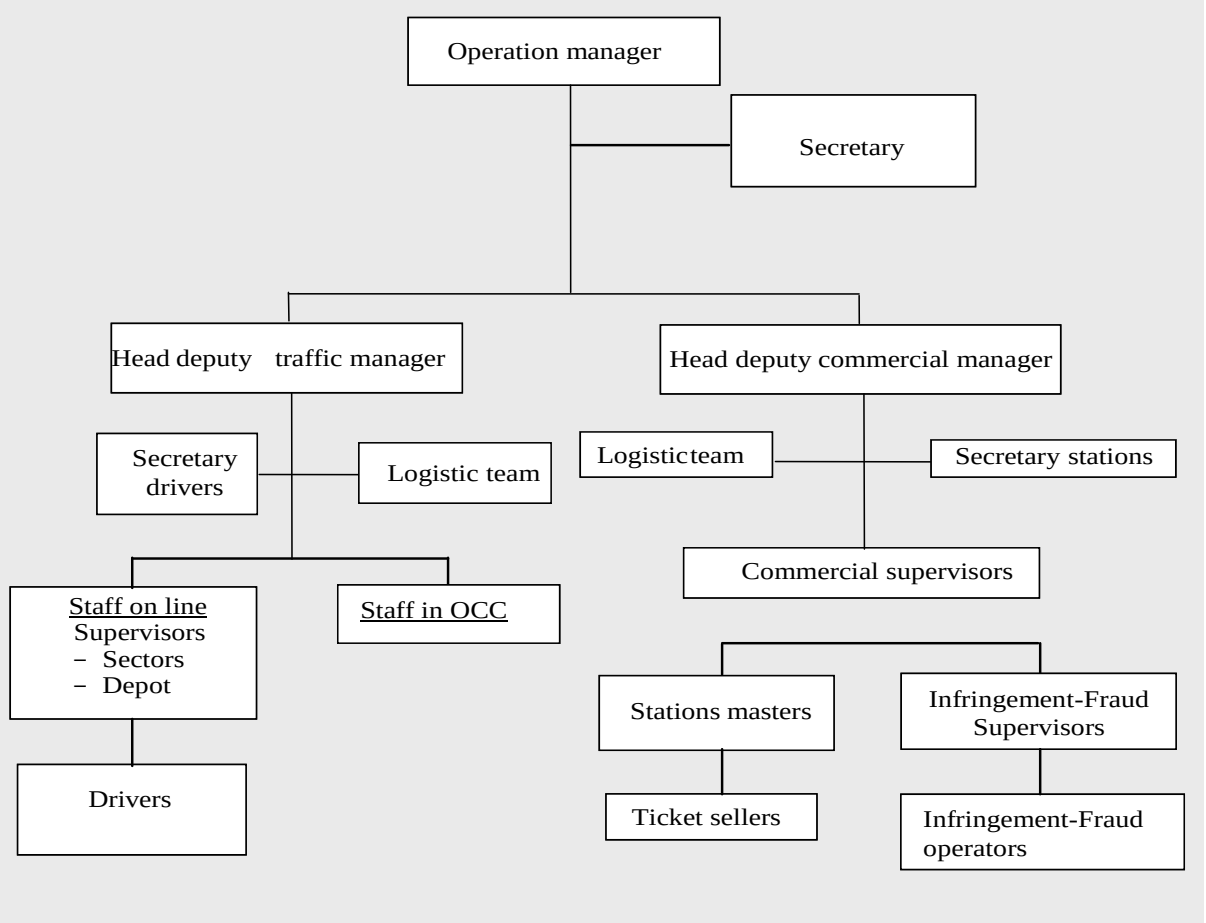
3.3 The Operation Department

3.3.1 Operation Global Organization

This leads to perform the following activities:

- Management of the drivers
- Management of the OCC staff
- Management of the stations
- Management of the stations staff
- Management of the operating data collection
- Management of the station policy
- Management of the employees' organization

Operation Department Organization

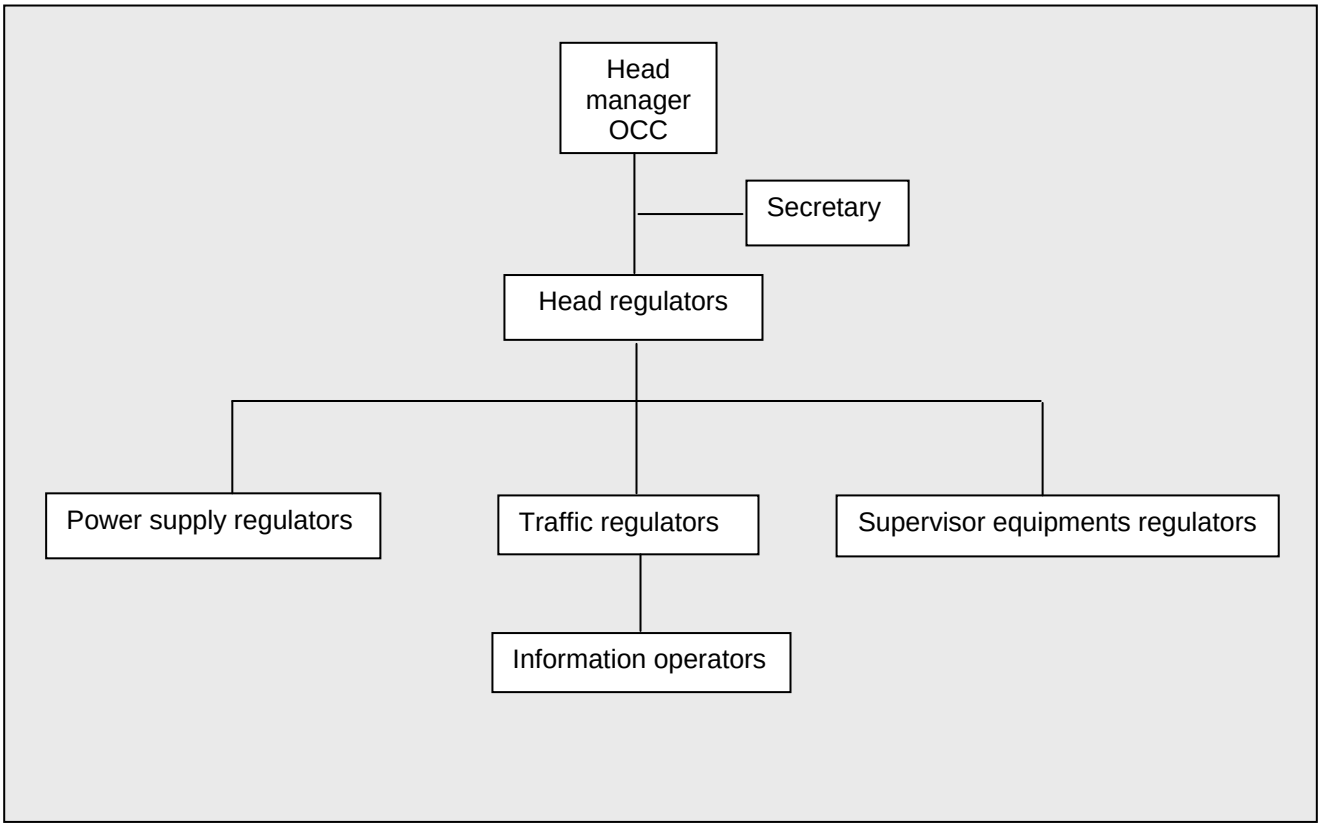


3.2.2 Staff Organization in OCC

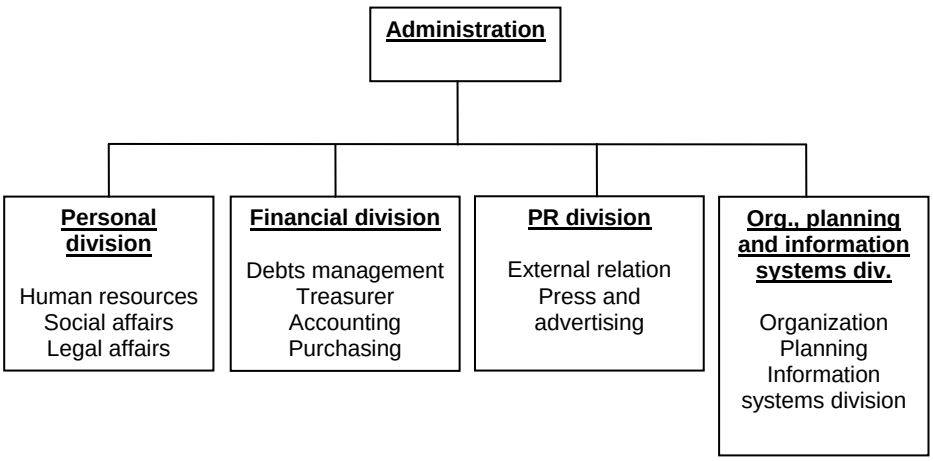
The type of staff so as to ensure the daily operational functioning of the OCC is as follows:

- Head manager of OCC and his secretary
- Head regulators
- Traffic regulators
- Power supply regulators
- Supervisor equipment regulators
- Information operators

OCC Organisation



3.3 The Administration Department



3.4 The Maintenance Department

3.4.1 Main assumptions in maintenance staff calculation

In the maintenance staff estimation, we apply the following principles:

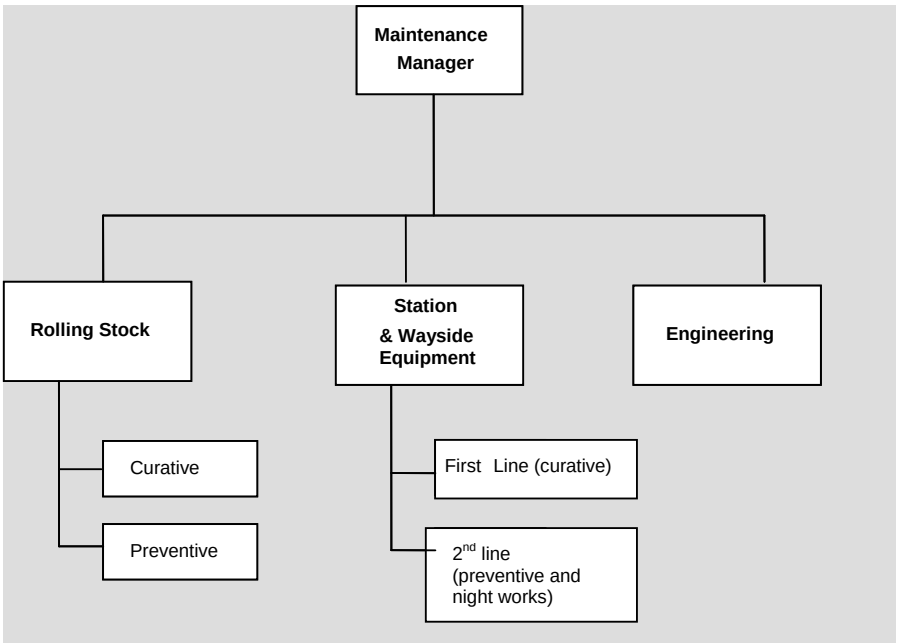
- The operation staff is lightly involved in the maintenance process: vehicle reconfiguration by drivers, equipment reset or restarts by station staff. This is fundamental to guarantee the availability of the transit system. These operations are strictly documented by procedures and do not require any special tool equipment
- The maintenance division groups all the maintenance activity: rolling stock, wayside and stations equipment and maintenance engineering.
- The maintenance team is internal and sized to produce the first levels of maintenance. This structure allows the operator to control the maintenance activity (corrective and preventive) and its reactivity.
- The heavy patrimonial maintenance is contracted
- The line replaceable units fixing or electronic modules is contracted, for such a system the number of annual failure is low and does not justify the creation of an internal workshop for this activity.
- The computers maintenance is contracted
- The purchasing and contracts management will be under the responsibility of the engineering team

3.4.2 Maintenance general organization

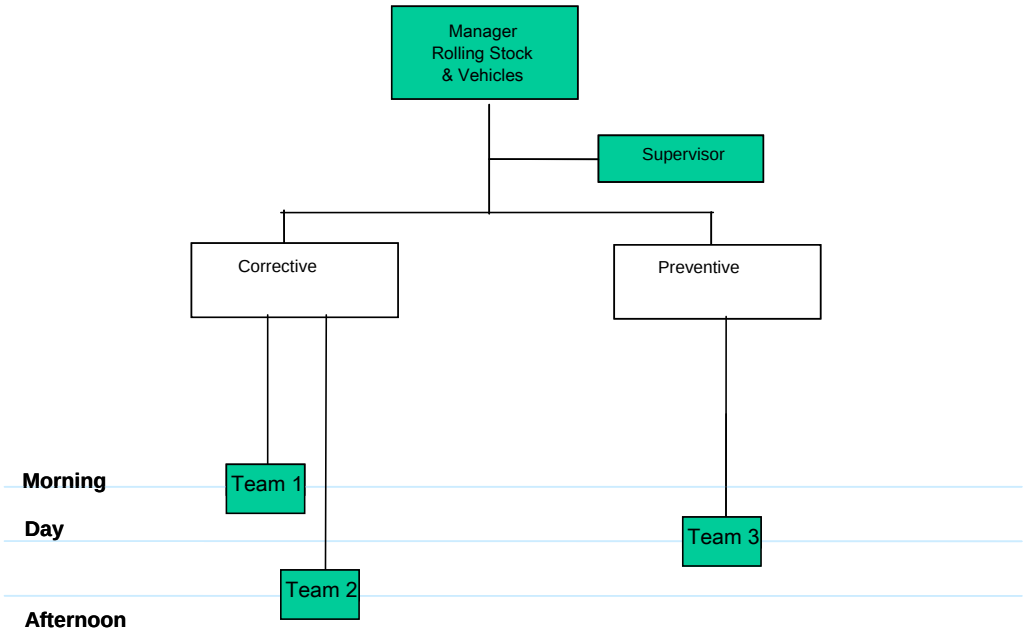
This department leads to perform the following activities:

- Rolling stock (passenger trains and maintenance vehicles) maintenance
- Stations & Wayside equipment maintenance
- Engineering

Maintenance Department Organization



3.4.3 Rolling Stock Maintenance



The team performs the preventive and corrective maintenance (Level 1 & 2) on the rolling stock equipment and maintenance vehicles in adherence with the maintenance plan and procedures. The team is in charge of providing Vehicles with the defined level of performance (availability, reliability and safety) to operation. The team is also responsible for the maintenance of vehicles used for track or tunnel maintenance.

Field of Technical Skill :

- Rolling stock
- Maintenance vehicles
- Onboard ATO/ATP
- Onboard Communication equipment

Detailed staffing for the Rolling Stock maintenance team:

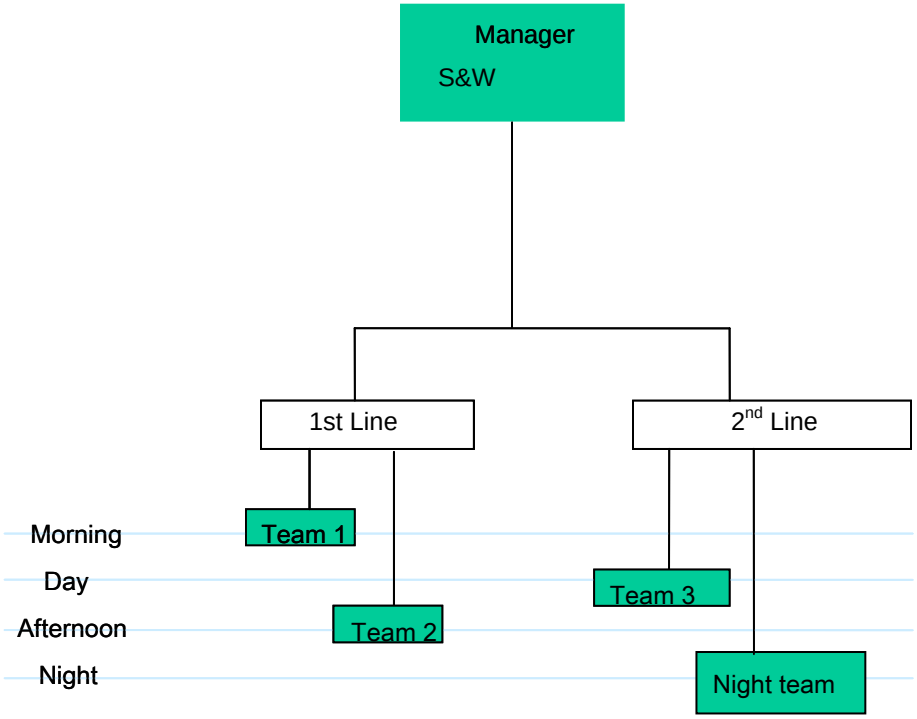
One maintenance manager and one maintenance supervisor.
Team 1: 1 team leader, 3 technicians
Team 2: idem team 1
Team 3: 2 team leaders, 4 technicians and 4 workers

The staff numbers in 2025 and 2035 is adapted to the number of cars in operation.

Global staffing for the Rolling Stock maintenance team:

Category (see chapter 4.2)	Number of staff 2015 (12 3car-trains)	Number of staff 2025 (14 6car-trains)	Number of staff 2035 (19 6car-trains)
Cat 2	6	11	12
Cat 4	10	21	25
Cat 6	4	6	8

3.4.4 Stations and Wayside Maintenance



The maintenance group is in charge of the maintenance of the entire wayside and stations equipment, it is divided in groups:

- Teams 1 and 2: these groups are responsible of the continuity of service they are in charge of repairing failed equipment such as the impact on availability is as low as possible. They work early in the morning and late in the evening to cover the operation period. If no corrective maintenance is needed these teams are available to produce preventive maintenance.
- Team 3 is mainly in charge of producing the preventive maintenance, and is available for corrective maintenance if needed. This team includes a special competency for structure inspection.
- Night team: this team works out of operation hours and is dedicated to tracks and wayside equipment. They can be called on heavy failures during the day.

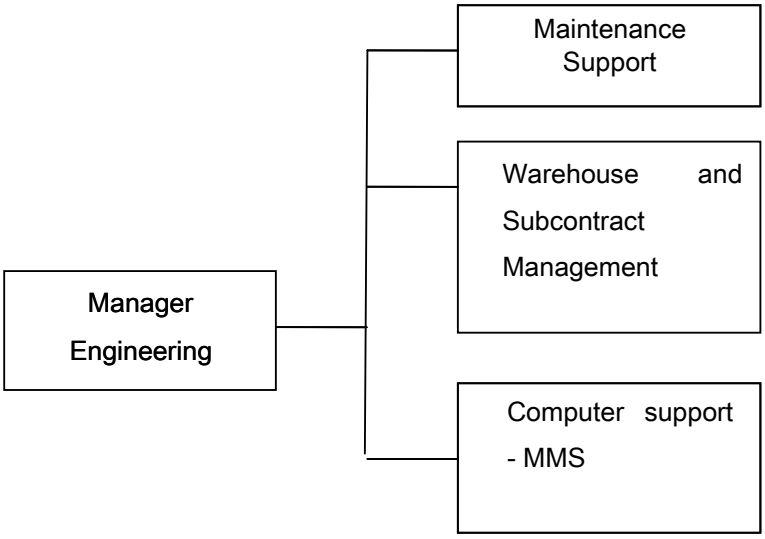
Detailed staffing for the stations and wayside maintenance team:
One maintenance manager.
Team 1: 2 team leader, 6 technicians
Team 2: idem team 1
Team 3: 2 team leaders, 6 technicians and 6 workers
Night team: 3 team leaders, 12 technicians and 10 workers

Global staffing for the stations and wayside maintenance team:

Category (see chapter 4.2)	**Number of staff**
Cat 2	10
Cat 4	26
Cat 5	10
Cat 6	10

3.4.5 Maintenance Engineering

This department supports Maintenance Division and all technical studies of the company.



The activities of maintenance support are:

- To define maintenance policy to improve technical and economic productivity
- To organize and analyze feedback of experience
- To organize training sessions for maintenance staff
- To manage subcontract maintenance and manage the spares purchasing
- To support maintenance teams in computer maintenance and administrate the MMS database
- To support maintenance teams in complex technical problems
- To elaborate and update maintenance procedures
- To manage equipment renewal and projects

Detailed staffing for the maintenance engineering team:
One maintenance engineering manager.
Warehouse: 2 team leader, 2 technicians and 2 workers
Maintenance engineering : 9 team leaders

Global staffing for the maintenance engineering team:

Category (see chapter 4.2)	Number of staff
Cat 2	12
Cat 4	2
Cat 6	2

4 OPERATION AND MAINTENANCE COSTS

4.1 Cost Estimation Principles

The operation and maintenance cost is the sum of the following costs:

- Staff costs: cost estimation for the whole staff: administrative, operation, maintenance and engineering.
- External costs: cost of electricity, outsourced activities, procurement and consumable.

4.2 Annual Personal Costs

The annual personal cost is calculated following the previously described organization and our experience in operation and maintenance staffing. The staff is split in 6 categories:

Category	Description	Annual Salary
1	Employees in managing position	6,485 USD
2	Administrative and managerial clerks, OCC supervisors, engineers, team leaders	5,650 USD
3	Drivers	5,089 USD
4	Station supervisors, skilled workers	3,724 USD
5	Secretaries, drivers, platform ticket controller, security staff	2,767 USD
6	Unskilled workers	2,523 USD

4.3 External costs

4.3.1 Pre operational costs

The pre operational cost includes:

- The price of workshops equipment: tools, computers, safety equipment, consumable
- The MMS cost: hardware, software and configuration to the transit system

4.3.2 Electricity cost estimation

Trains consumption

The trains' consumption is the sum of:

- Traction consumption
- Onboard auxiliary equipment consumption, this consumption is function of the time when trains are switched on

We have based our estimates on the consumption rates of similar trains.

Stations and Depot consumption

For underground stations, the required power supply is currently estimated as follows:

- Station and tunnel ventilation 300 kW
- Pumps and auxiliary equipment 50 kW
- Railway ventilation 120 kW
- Cool air production 200 kW
- Lighting 120 kW
- Escalators and lifts 100kW
- Signaling and communication 10 kW

Total **950 kW**

For elevated stations: the required power supply is estimated as follows:

- Technical and staff rooms ventilation 50 kW
- Pumps and auxiliary equipment 50 kW
- Lighting 60 kW
- Escalators and lifts 100kW
- Signalling and communication 10 kW

Total **270 kW**

For depot, we consider a total power consumption of 1 MWh.

Electricity price
We assumed that the electricity was bought under 110kV:

With voltage supplied of more than 110 KW	785 VND/KWH	Offpeak hours *04:00 to 18:00*
	425 VND/KWH	Low hours *22:00 to 04:00*
	1590 VND/KWH	Peak hours *18:00 to 22:00*

From the transport production in normal days, Saturday, Sundays and national holidays, we calculate a weighted average price for 1MWh: 862,279 VND (57USD).

For station power consumption, the time weighted price is for 1MWh: 931,250 VND (62USD)

4.3.1 Consumable cost

We consider in this category all expenses in relation with staff : safety equipment, paper, office supplies, power supply for administrative and maintenance buildings (lighting, power, air conditioning).
From our experience, this cost estimation is assumed to be 15% of staff cost.

4.3.2 Material costs

This item includes all the material pieces to be bought for the maintenance activity, the outsourced maintenance for specific equipment such as electronic parts, optical fiber components or computers.

This category includes all the necessary material and fluids to operate and maintain the system: lubrification material, sand, water and detergents

The estimated amounts are elaborated from our costs database considering various similar systems (infrastructure, trains and fixed equipment).

4.4 Costs Summary 2015-2024

With price reference: year 2007

4.4.1 Annual Personnel cost

Department	Sub department	Sub total	Cat 1	Cat 2	Cat 3	Cat 4	Cat 5	Cat 6
General Management								
	General Managers office	**2**	**1**				**1**	
	Assistants	**2**		**2**				
	Quality and Safety	**2**		**2**				
	Sub total	**6**	**1**	**4**		**0**	**1**	**0**
Administration								
	Personal division	**19**	**1**	**5**		**10**	**3**	
	Financial division	**12**	**1**	**6**		**3**	**2**	
	Organisation, planning and information systems	**14**	**1**	**6**		**5**	**2**	
	Public relation division	**5**	**1**	**2**		**1**	**1**	
	Sub total	**50**	**4**	**19**		**19**	**8**	**0**
Maintenance								
	Maintenance management	**5**	**1**	**2**				**2**
	Rolling stock	**20**		**6**		**10**		**4**
	Warehouse	**6**		**2**		**2**		**2**
	Stations & Wayside equipment	**52**		**10**		**26**	**8**	**8**
	Engineering	**10**		**10**				
	Sub total	**93**	**1**	**30**		**38**	**8**	**16**
Operation								
	Operation management	**4**	**1**	**2**			**1**	
	Traffic and Commercial Departments	**226**		**8**	**31**	**53**	**71**	**63**
	Ticket sellers	**161**						**161**
	Cleaning (incl. Depot)	**123**						**123**
	Security (incl. Depot)	**117**					**117**	
	Sub total	**631**	**1**	**10**	**31**	**53**	**189**	**347**
	Total	**780**	**7**	**63**	**31**	**110**	**206**	**363**
	Annual Salary		6 485 USD	5 650 USD	5 089 USD	3 724 USD	2 767 USD	2 523 USD
	Total Staff Cost	**2 454 595 USD**	45 395 USD	355 950 USD	157 759 USD	409 640 USD	570 002 USD	915 849 USD

4.4.1 Annual electricity cost

Electricity cost	Consumption (MWh)	local	foreign	Total
Traction power	13 377.32			
Auxiliary consumption (auxiliary consumption, 15 hours a day)	3 011.25			
Underground Stations (950kW each) 1500 Kw with air conditionning	69 350.00			
Elevated station (270 kW each)	1 971.00			
Depot, maintenance and administrative buildings (1 MW)	7 300.00			
MW-h Price Traction and Auxiliary		**57 USD**	**0 USD**	**57 USD**
MW-h Price for stations and building		**62 USD**	**0 USD**	**62 USD**
Total electricity cost		**5 823 155 USD**	**0 USD**	**5 823 155 USD**

4.4.1 Annual Operation and Maintenance cost

Costs	local	foreign	Total	VAT
Annual staff cost	2 454 595 USD		2 454 595 USD	
Electricity cost estimation	5 823 155 USD		5 823 155 USD	
Consumable cost	368 189 USD		368 189 USD	
Material cost	864 794 USD	2 017 853 USD	2 882 647 USD	10%
VAT	288 265 USD		288 265 USD	
Total Annual cost	9 798 998 USD	2 017 853 USD	11 816 851 USD	

4.5 Costs Summary 2025-2034

4.5.1 Annual Personal cost

Department	Sub department	Sub total	Cat 1	Cat 2	Cat 3	Cat 4	Cat 5	Cat 6
General Management								
	General Managers office	2	1				1	
	Assistants	2		2				
	Quality and Safety	2		2				
	Sub total	6	1	4		0	1	0
Administration								
	Personal division	19	1	5		10	3	
	Financial division	12	1	6		3	2	
	Organisation, planning and information systems	14	1	6		5	2	
	Public relation division	5	1	2		1	1	
	Sub total	50	4	19		19	8	0
Maintenance								
	Maintenance management	5	1	2				2
	Rolling stock	38		11		21		6
	Warehouse	6		2		2		2
	Stations & Wayside equipment	52		10		26	8	8
	Engineering	10		10				
	Sub total	111	1	35		49	8	18
Operation								
	Operation management	4	1	2			1	
	Traffic and Commercial Departments	228		8	33	53	71	63
	Ticket sellers	161						161
	Cleaning (incl. Depot)	123						123
	Security (incl. Depot)	117					117	
	Sub total	633	1	10	33	53	189	347
	Total	800	7	68	33	121	206	365
	Annual Salary		6 485 USD	5 650 USD	5 089 USD	3 724 USD	2 767 USD	2 523 USD
	Total Staff Cost	2 539 033 USD	45 395 USD	384 200 USD	167 937 USD	450 604 USD	570 002 USD	920 895 USD

4.5.2 Annual electricity cost

Electricity cost	Consumption (MWh)	local	foreign	Total
Traction power	28 549.05			
Auxiliary consumption (auxiliary consumption, 15 hours a day)	3 285.00			
Underground Stations (950kW each) 1500 Kw with air conditionning	69 350.00			
Elevated station (270 kW each)	1 971.00			
Depot, maintenance and administrative buildings (1 MW)	7 300.00			
MW-h Price Traction and Auxiliary		**57 USD**	**0 USD**	**57 USD**
MW-h Price for stations and building		**62 USD**	**0 USD**	**62 USD**
Total electricity cost		**6 711 043 USD**	**0 USD**	**6 711 043 USD**

4.5.3 Annual Operation and Maintenance cost

Costs	local	foreign	Total	VAT
Annual staff cost	**2 539 033 USD**		**2 539 033 USD**	
Electricity cost estimation	**6 711 043 USD**		**6 711 043 USD**	
Consumable cost	**380 855 USD**		**380 855 USD**	
Material cost	**885 176 USD**	**2 065 412 USD**	**2 950 588 USD**	**10%**
VAT	**295 059 USD**		**295 059 USD**	
Total Annual cost	**10 811 166 USD**	**2 065 412 USD**	**12 876 578 USD**	

4.6 Costs Summary 2035-

4.6.1 Annual Personnel cost

Department	Sub department	Sub total	Cat 1	Cat 2	Cat 3	Cat 4	Cat 5	Cat 6
General Management								
	General Managers office	**2**	**1**				**1**	
	Assistants	**2**		**2**				
	Quality and Safety	**2**		**2**				
	Sub total	**6**	**1**	**4**		**0**	**1**	**0**
Administration								
	Personal division	**19**	**1**	**5**		**10**	**3**	
	Financial division	**12**	**1**	**6**		**3**	**2**	
	Organisation, planning and information systems	**14**	**1**	**6**		**5**	**2**	
	Public relation division	**5**	**1**	**2**		**1**	**1**	
	Sub total	**50**	**4**	**19**		**19**	**8**	**0**
Maintenance								
	Maintenance management	**5**	**1**	**2**				**2**
	Rolling stock	**45**		**12**		**25**		**8**
	Warehouse	**6**		**2**		**2**		**2**
	Stations & Wayside equipment	**52**		**10**		**26**	**8**	**8**
	Engineering	**10**		**10**				
	Sub total	**118**	**1**	**36**		**53**	**8**	**20**
Operation								
	Operation management	**4**	**1**	**2**			**1**	
	Traffic and Commercial Departments	**235**		**8**	**40**	**53**	**71**	**63**
	Ticket sellers	**161**						**161**
	Cleaning (incl. Depot)	**123**						**123**
	Security (incl. Depot)	**117**					**117**	
	Sub total	**640**	**1**	**10**	**40**	**53**	**189**	**347**
	Total	**814**	**7**	**69**	**40**	**125**	**206**	**367**
	Annual Salary		6 485 USD	5 650 USD	5 089 USD	3 724 USD	2 767 USD	2 523 USD
	Total Staff Cost	**2 600 248 USD**	45 395 USD	389 850 USD	203 560 USD	465 500 USD	570 002 USD	925 941 USD

4.6.2 Annual electricity cost

Electricity cost	Consumption (MWh)	local	foreign	Total
Traction power	35 120.07			
Auxiliary consumption (auxiliary consumption, 15 hours a day)	4 380.00			
Underground Stations (950kW each) 1500 Kw with air conditionning	69 350.00			
Elevated station (270 kW each)	1 971.00			
Depot, maintenance and administrative buildings (1 MW)	7 300.00			
MW-h Price Traction and Auxiliary		**57 USD**	**0 USD**	**57 USD**
MW-h Price for stations and building		**62 USD**	**0 USD**	**62 USD**
Total electricity cost		**7 151 726 USD**	**0 USD**	**7 151 726 USD**

4.6.3 Annual Operation and Maintenance cost

Costs	local	foreign	Total	VAT
Annual staff cost	2 600 248 USD		2 600 248 USD	
Electricity cost estimation	7 151 726 USD		7 151 726 USD	
Consumable cost	390 037 USD		390 037 USD	
Material cost	925 941 USD	2 160 529 USD	3 086 471 USD	10%
VAT	524 700 USD		524 700 USD	
Total Annual cost	11 592 652 USD	2 160 529 USD	13 753 182 USD	

APPENDIX F: SUMMARY FINANCIAL MANAGEMENT ASSESSMENT OF MAUR

DRAFT FINANCIAL MANAGEMENT ASSESSMENT OF

MANAGEMENT AUTHORITY FOR URBAN RAILWAYS (MAUR)

A. General Overview

The Management Authority for Urban Railway (MAUR) was established by HCMC PC Decision in September 2007, under the HCMC Peoples' Committee[30]. MAUR will be the Implementing Agency for the proposed project.

According to the Decision MAUR's responsibilities include (i) providing consultancy to the PC on master planning of the urban metro, (ii) development of the urban railway network according to the transport planning up to 2020, (iii) building detailed programs, plans and implementation schedules of component projects, and to organize effective management, operation, use of project resources.

The Decision gives MAUR the opportunity to manage and operate urban railway lines of the city. According to the Decision, in principle it can be an investor, and can carry out the role and function of a direct partner to foreign partners in transactions relating to projects. It can associate with or join domestic or foreign organizations or employ experienced experts in order to train, improve professional knowledge in the fields of project management and operation.

MAUR is allowed to establish project management units and subsidiaries to manage and operate projects when they are brought into use, and to employ qualified organizations which have experience and financial capability for the management and operation of urban railway lines when construction is completed.

B. Flow of funds

The Project will be co-financed by ADB, supported by another financier. The ADB's share will be financed by a mix of loans from the Asian Development Fund (ADF) and from the Ordinary Capital Resources (OCR). The HCMC PC will finance the MAUR operation fees, project preparation, administration, resettlement and all taxes and duties. The contingencies and commitment fees will be paid by ADB and co-financier.

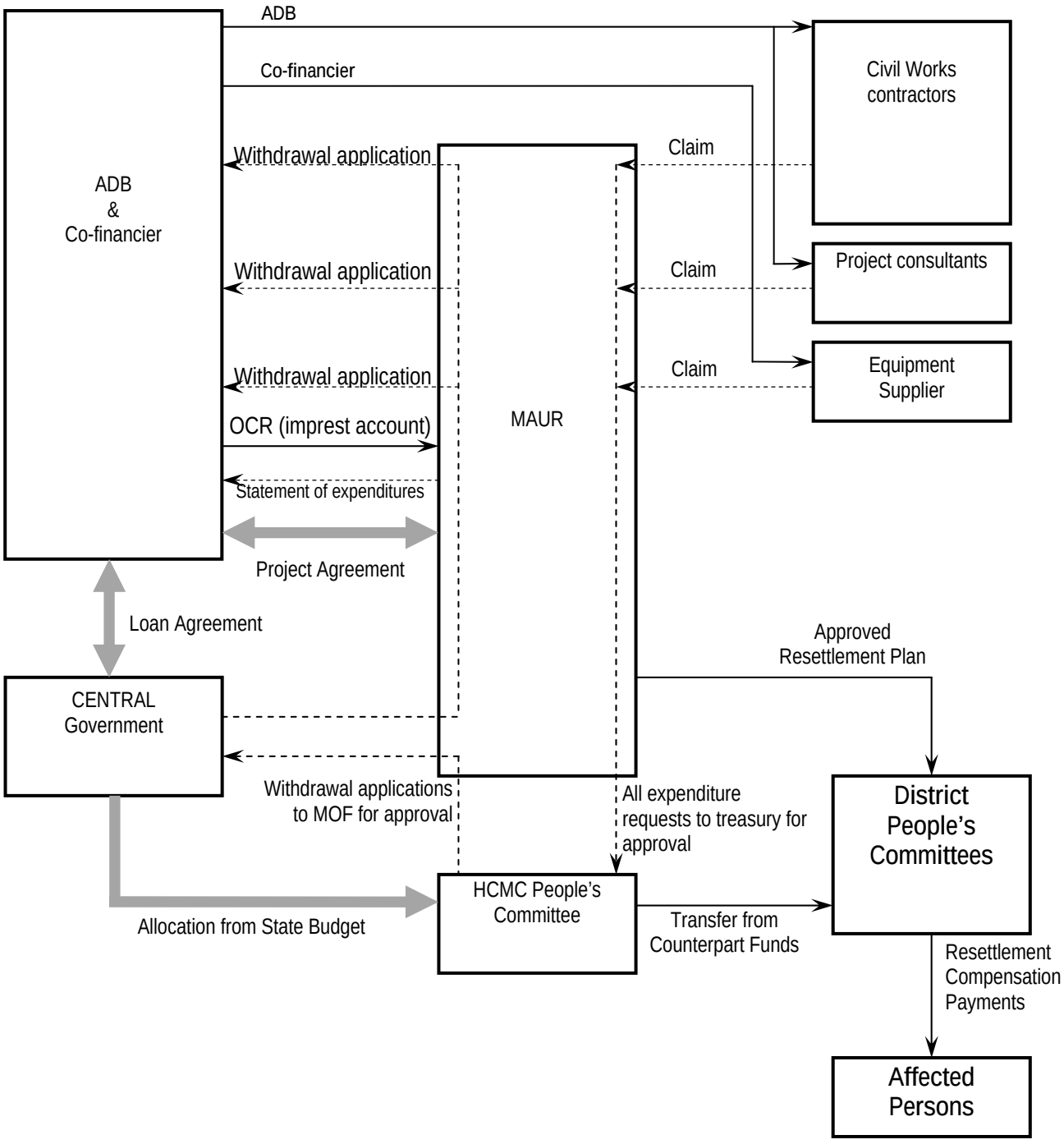
The arrangements for the flow of funds are yet to be determined. Under GoV guidelines on financial management of ODA programs, (Circular 108/2007/TT-BTC of Ministry of Finance), the mode of transfer will be determined in the project investment decision. The anticipated general fund flow arrangement is shown in Figure A. NOTE: At this stage any particular requirements of another financier have not been incorporated.

Under the loan, foreign and local equipment will be paid directly to the contractors. This could be through commitment or direct payment procedures. Other payments could be through reimbursement or imprest procedures.

The arrangements for expenditures not covered by the loan need investigation. Normally ADB would expect MAUR to establish a separate bank account for receiving necessary fund transfers. However MAUR currently operate an account in HCMC Treasury Department, and all expenditures are controlled by the Treasury Department.

[30] Decision 119/2007/QD-UBND on Establishment of The Management Authority for Urban Railways under the City People's Committee

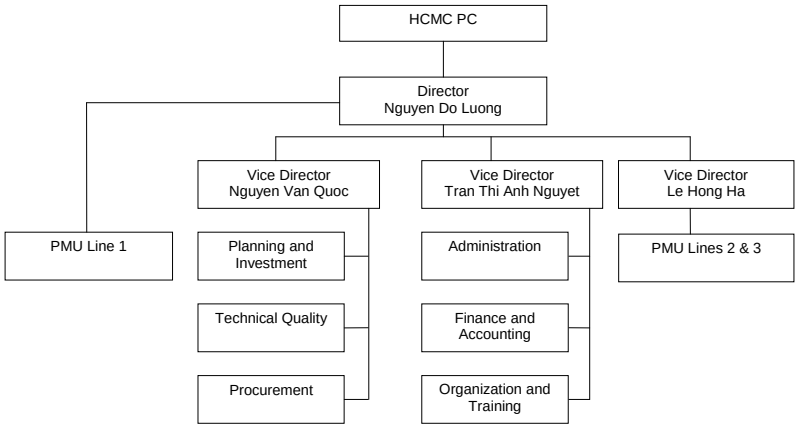
Figure A: Possible Funds Flow Arrangement



C. Staffing and Accounting Policies, Budgeting Systems and Payments

MAUR is headed by a Director, and there are three Deputy Directors who have responsibilities for specific activities. At present MAUR have about 60 staff and plan to recruit more staff to fill an approved establishment of 90 staff by the end of 2008. MAUR has 8 divisions (see Figure B), including two Project Management Unit (PMU) divisions. PMU1 covers the JBIC project (Metro Line 1). The other PMU has responsibility for overseeing the development of Metro Lines 2 and 3. It is understood that, once the Line 2 Project moves into implementation, responsibilities for Lines 2 and 3 will be separated and there will be a dedicated PMU for Line 2.

Figure B : Existing Organization Structure MAUR



MAUR is still in the process of defining responsibilities and procedures for each division. Four divisions have already prepared these and Finance and Accounting have a draft awaiting internal approval.

Most MAUR staff have no previous experience in implementation of externally-financed projects. The exceptions are the people in PMU1 and Finance& Accounting Division who have worked on the JBIC Project since the middle of February 2008. MAUR have indicated that they are actively recruiting new staff with previous ODA project experience.

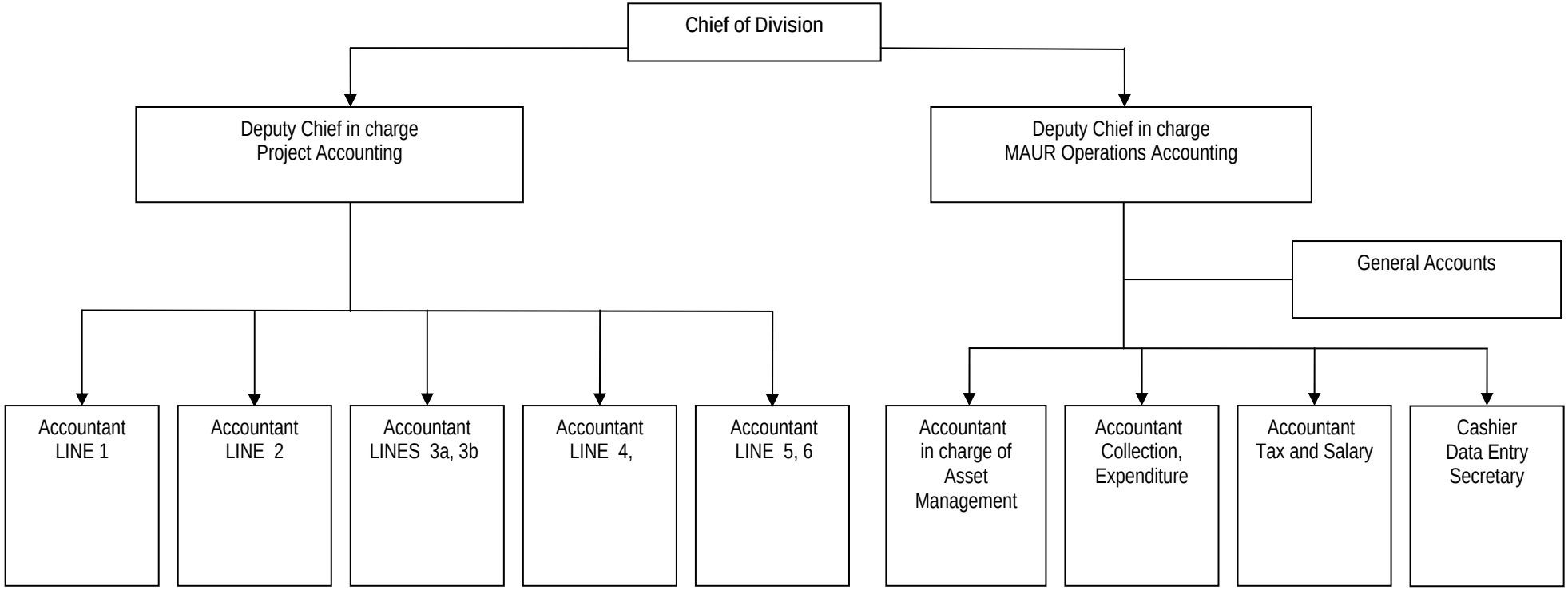
The Finance and Accounting Division currently has 6 staff. The Chief and Deputy Chief are government employees, and the other four people have 1-year contracts subject to review and subsequent long-term contracts. All of the staff have a background in economics and/or finance. It is intended that the Division will have 9 people at the end of 2008. the proposed organisation of the expanded division is shown in Figure C.

As MAUR has been established only since September 2007 there is not much practical evidence of its capabilities in financial management. MAUR is following the accounting system for project owners as set out in Decision No. 214/2000/QD-BTC of Ministry of Finance. Accounting vouchers, bank account, chart of account and financial statements are coded and classified by the project components, categories of expenditure, and sources of funds. If properly applied the system satisfies the following FMA criteria:

(i) Controls are in place concerning the preparation and approval of transactions
(ii) The chart of accounts is adequate to properly account for and report on project activities and disbursement categories
(iii) The General Ledger and subsidiary ledgers are reconciled and in balance
(iv) All accounting and supporting documents are retained on a permanent basis in a defined system that allows authorized users easy access.

From the information provided it is not yet possible to ascertain if the internal arrangements of MAUR allow for the segregation of duties in transaction, payment and reconciliation.

Figure C: Proposed Organisation of Finance and Accounting Division



MAUR provided a blank example of a budgeting table. This indicates that planned budget amounts, major physical estimates, and project progress are included. The MAUR key staff in charge of budgeting know the requirements of the monitoring and evaluation system following the reporting mechanisms for the implementation of ODA programs and projects as set out in Decision 803/2007/QD-BKH of Ministry of Planning and Investment.

The comparison of actual expenditures and budgets is done monthly by MAUR and Treasury Department. Variations need to be approved in advance. Project budgets will be prepared by MAUR annually with the participation of Planning & Investment, Finance & Accounting, and PMU Divisions. These will then be submitted to DPI for review before HCMC PC approval. A Deputy Director is in charge of MAUR budget preparation.

There is inadequate history to assess the payment system. MAUR will follow the payment procedures set out in Decree 214/2000/QD-BTC, which include the invoice-processing procedures in which invoices are stamped, dated, reviewed and approved, and clearly marked for account code assignment.

D. Policies and Procedures, Cash and Bank

At present MAUR uses the accounting system following Decision No. 214/2000/QD-BTC of MoF. They plan to move towards Vietnam Accounting Standards (VAS) once they have new accounting software developed and installed. Staff responsibilities in the Finance and Accounting Division are defined in the draft of internal arrangements that is awaiting approval. Staff accountability is in accordance with general GoV policies and procedures.

Accounting principles, policies and procedures are covered by Decision No. 14/2000/QD-BTC and only MoF can has the right to change these principles. The financial management and related administrative activities are covered by guidelines on financial management of ODA projects as set out in Circular108/2007/TT-BTC of MoF. Policies regarding conflict of interest and related party transactions are covered in the Anti-Corruption Law.

Deputy Director, Ms Tran thi Anh Nguyet is the authorized signatory on the bank accounts. MAUR maintain an up-to-date cashbook, recording receipts and payments. MAUR have two collections, project management fees, and receipts from selling bidding documents. The first uses the bank account and does not involve cash. The second involves cash collections which reportedly are sent to the bank immediately. MAUR has a number of accounts (by projects and categories) and the accountants undertake reconciliation with Treasury Dept of the HCMC PC monthly. Unusual items are reviewed by the Department of Finance before HCMC PC decides how to allocate them.

E. Safeguard Over Assets

The requirement of safeguards to protect assets from fraud, waste and abuse are addressed in Part IV, Asset management procedures of the Circular108/2007/TT-BTC of MoF. MAUR keep subsidiary records of fixed assets and stocks up to date and reconciled with control accounts. MAUR also undertake periodic physical inventories of fixed assets and stocks as required in the Decision No. 214/2000/QD-BTC and Circular 108/2007/TT-BTC of MoF.

F. Internal Audit External Audit

At present MAUR does not have arrangements for undertaking internal audits.
MAUR plan to engage an external auditor to audit the financial statement report for the year 2008. The terms of reference for auditing services have not yet been prepared.

G. Financial Reporting and Monitoring

MAUR prepared a financial statement report for 2007, but this was for only the four from MAUR's establishment in September 2007 to the end of the calendar year. The statement follows the requirements of Decision No. 214/2000/QD-BTC of MoF. The intention is to complete annual reports by February of the following year. These will be submitted to HCMC PC.

MAUR are following the reporting mechanisms for the implementation of ODA programs and projects as set out in Decision 803/2007/QD-BKH of Ministry of Planning and Investment. This Decision also provides for the use of the Aligned Monitoring Tool which allows users and lending agencies access to monitor the project.

GoV procedures should allow MAUR financial reporting to link the financial information with the project's physical progress, and to compare actual expenditures with budgeted and programmed allocations. The financial reports thus prepared should be useful to MAUR's management team for decision making.

H. Information system

The financial system of MAUR is not yet computerized. There is a proposal to engage a software company to set up the accounting system and this is anticipated to happen in June/July 2008.

I. Conclusion and Recommendation

MAUR is a very young agency with only embryonic procedures and little track record in project management. However, as a GoV agency, MAUR will be bound to follow the regulations and procedures set out in the various statutes and guidelines referred to above, and several of these are specific to ODA projects. This gives some assurance that procedures will meet the necessary accounting and reporting standards.

MAUR is actively addressing its staff's lack of track record in the management of ODA projects by recruiting new staff with that experience. Nevertheless staff will require some training in the procedures for administering the ADB loan.

The development and installation of an accounting software package will be key to MAUR's ability to administer the project effectively. This will also require training.

In general MAUR appears to have the potential to be a fit and proper body to administer the proposed ADB loan for the Project.

APPENDIX G: SUMMARY OF PPIAF REPORTS AND FINDINGS

1. The PPIAF Technical Assistance

ADB mobilized a grant from the Public Private Infrastructure Advisory Facility (PPIAF) to optimize private sector participation in MRT 2 and 3, and to assist the HCMC PC to develop appropriate short term and longer term implementation and management arrangements for MRT in the context of wider urban transport

The objectives of the PPIAF technical assistance (TA) therefore included developing (i) a framework for considering private sector participation in implementation and operation of the Project; (ii) a value-for-money analysis for implementation approaches that involve varying degrees of private sector participation, (iii) a detailed financial model reflecting the preferred approach and measuring the performance of the project from the points of view of the government and private sector participants; and (iv) a stakeholder feedback and a description of necessary institutional and contractual arrangements given the preferred implementation approach.

This PPIAF TA draws on detailed information on project costs, patronage and revenue prepared by consultants undertaking the PPTA. The results of its work were presented in conjunction with the work of the PPTA to ensure an integrated and complete business case that the HCMC PC and ADB can use to direct implementation and ongoing operations.

This summary of the PPIAF TA draws upon the following reports, working papers or other outputs prepared by the TA:

Table 1.1: Activities and Outputs

Activity	Principal Outputs
1. Framework for Considering Private Sector Participation (PSP) – Options Development	• **Issues and Options for Private Sector Participation & Concession Template Working Paper** – Vietnamese and English language versions (April 2008).
2. Risk and Value-for-Money Analysis	• **Financial Modeling Working Paper & Model** – Vietnamese and English language versions (June 2008).
3. Financial Analysis: Financing Plan & Financial Model	• **Financial Modeling** – as above
4. Stakeholder Feedback and Implementation Arrangements	• **Inception Report** – English language version only (March 2008) • **Stakeholder Feedback and Implementation Arrangements: Institutional Options Working Paper** – Vietnamese and English language versions (March 2008). • **Stakeholder Engagement Plan** – English language version only (March 2008) – Informal document. • **Fares and Ticketing Working Paper** – Vietnamese and English language versions (June 2008).

2. Activity 1: Framework for Considering Private Sector Participation (PSP) – Options Development

Under this Activity, in accordance with the ToR for the TA, various opportunities to use the private sector for implementing and operating rail mass rapid transit (MRT) in HCMC had to be considered. The English language version of the Working Paper prepared for the TA which is entitled "Issues and Options for Private Sector Participation and Concession Template" provides full details of the work carried out which is summarized below.

Options for private sector participation were considered with a broader view than any individual MRT line in HCMC because the ultimate objective of the government is a substantial increase in the use of public transport in the city, which in turn requires an integrated public transport system. The use of the private sector is not addressed from an ideological perspective, but rather as a means for securing the delivery of high quality MRT at the lowest possible cost to the community.

The Working Paper notes that the private sector has been involved in MRT in nearby countries in recent years: always for implementation of infrastructure; often for the operation of services; and to a lesser extent for investment in MRT assets. It also notes general experience that the cost of public sector operation of public transport is higher than with private sector operation, and that there is a general worldwide trend to make greater use of the private sector for the operation of public transport.

Consideration was given to the range of factors that affect the manner in which the private sector could be involved. These factors have two broad influences. The first is the extent to which the private sector could provide finance for implementation of the MRT. In this respect, it appears that the current approach to MRT in HCMC is likely to result in fare and related revenue that will, at best, cover operating costs and make a small contribution to capital costs. Accordingly, the government will need to eventually pay the private sector for most of the cost of any capital that the private sector might provide in the first instance to implement the project. While the cost of capital to the private sector is generally more expensive than the cost of capital for the government, the report notes that this may be offset by lower costs that result from the transfer of manageable risk to the private sector and the incentive for the private sector to better integrate assets and operations to reduce life-cycle costs.

The second influence is on the form of the agreement between the government and the organization that is to operate the MRT system (called the concessionaire). It is essential that such an agreement be in place, irrespective of whether the concessionaire is a government or a private organization. It is common for such agreements to have a term of around 30 years or so, especially where the concessionaire contributes capital investment. There is also a need for the agreement to include conditions that provide the operator with the incentive to undertake their tasks in a manner that meets the government's objectives for MRT in HCMC.

There has been a tendency in the past to use a form of agreement wherein the concessionaire keeps fare and other revenue for the MRT line to which the contract pertains and uses the revenue to cover its costs. The government may need to provide supplementary financing if the revenue available to the concessionaire is insufficient to met the costs. This approach, called a Net Cost form of concession, has major limitations. In particular it does not facilitate operation of an integrated public transport system and reduces the flexibility of the government to develop the transport system and modify its urban transport policies over the term of the concession. An

alternative approach, called a Gross Cost form of concession, is strongly recommended. Under it, revenue from fares accrues to the government, which in turn pays the concessionaire for the services that the concessionaire provides. Refer Table 2.1 for a summary of the features of each approach.

Table 2.1: Summary of Net Cost and Gross Cost Concession Models

	Net Cost	Gross Cost
Infrastructure	Government provides civil infrastructure. Concessionaire provides trains and related items such as train control & communications systems and depot equipment.	
Risk sharing	Concessionaire assumes all patronage risk, and shares extra profits (if any) with the Authority.	Risk is shared between the Authority and concessionaire. Optimum sharing of risk will minimise the concession cost.
Revenue	Concessionaire keeps revenue	Fare revenue is given to the Authority
Services	Concessionaire determines services to be provided on the basis of profitability.	Authority sets service standards and the concessionaire determines services based on these standards.
Payments	Concessionaire meets costs from its own revenue. Additional payments may be needed from the government if concessionaire's revenue is too low.	Authority pays the concessionaire for services provided according to rates set on the basis of competitive tendering and quantity/quality of service provided.
Authority role	Authority invites tenders & establishes a concession; has only a small role thereafter; difficult to vary contract conditions.	Authority invites tenders and establishes a concession; has a continuing major role in managing the concession agreement; can vary conditions when needed.

Source: Consultant

The Working Paper describes how this form of concession can be implemented to give the concessionaire (or any other operator) the incentive to provide good quality services that meet the needs of passengers at the lowest possible cost and with the least need for detailed management of the concession contract by the government.

Four possible implementation options were considered. All four were subject to value-for-money analysis as described in Section 3 of this report, to indicate the potential cost to the government of delivering Line 2 of the MRT system and the provision of services on the line over the long term. The results of this analysis will be presented in a separate report. The options are:

- Government financing, implementation and operation of the MRT.
- Government financing and implementation of all MRT assets, and engagement of a concessionaire to operate MRT services.
- Government financing and implementation of MRT civil infrastructure, and engagement of a concessionaire to finance and provide trains and related electrical and mechanical equipment and systems, and to operate MRT services.
- Private sector financing, implementation and operation of the MRT.

Key features of each of these four options are shown in Table 2.2.

Table 2.2: Features of Delivery and Financing Models

	Public Enterprise	**Public Implementation with Operating Concession (PIOC)**	**Train Supply and Operating Concession (TSOC)**	**Build, Operate & Transfer (BOT)**
Delivery of:				
Civil Infrastructure and Fixed Equipment	Delivered through competitively tendered contracts to the government.			Delivered through competitively tendered *Net Cost* contract to the government.
Trains, train control and communications, and depot equipment	Delivered through competitively tendered contracts to the government.		Delivered through a competitive tendered *Gross Cost* concession.	
Train services and infrastructure maintenance	Contract negotiated with an SOE.	Competitively tendered *Gross Cost* contract.		
Risk Transfer				
	Transfer of risk from the government is limited to the extent allowed in construction and equipment supply contracts. The government retains risk associated with operations through its ownership of the operator.	As for the Public Enterprise option but can transfer operating risk to the concessionaire. Some patronage risk can be transferred through the *Gross Cost* concession. The government retains operating risk related to mismatch between trains it provides and concessionaire needs.	The government transfers more risk to the concessionaire than in the PIOC option because the concessionaire purchases trains and can therefore bear more risk for operations because they have more control over service quality.	Transfers the greatest amount of risk from the government, but the government loses flexibility for change in policy and for public transport network integration.
Finance				
Civil Infrastructure and Fixed Equipment	Capital provided by the government.		Capital provided by the government.	Capital provided by the concessionaire. The government will need to pay for costs as specified in the contract (to cover both capital and O&M costs net of fare revenue, where fare revenue will be much less than the costs).
Trains, train control and communications, and depot equipment	Capital provided by the government.		Capital provided by the concessionaire. The government pays for costs as specified in the contract (to cover both capital and O&M costs).	
Train services and infrastructure maintenance	The government pays all costs incurred by the SOE, including working capital	The government pays for operating and maintenance costs as specified in the contract.		
Fare revenue	The government retains fare and other revenue (or pays SOE the difference between costs and revenue if the SOE retains the revenue).	Fare revenue accrues to the government.		Concessionaire retains fare and other revenue.

Source: Consultant

The Gross Cost form of concession is recommended for the first three options. A Net Cost form of concession is appropriate for the last option to allow the concessionaire to manage its greater financial exposure in a way that minimizes its risks. In all four cases, the government will eventually pay for the total cost of implementing and operating MRT. However, the total cost to the government will vary. This occurs because the four options involve different ways of allocating and managing MRT responsibilities, and hence the incentive and capacity for those involved to manage the associated financial, engineering, operational and patronage risks.

The report draws general conclusions about the relative merits of the four implementation/-financing options, but does not unequivocally recommend any particular approach. Rather, the

intention of developing and assessing the options is to provide understanding that can help the government with its consideration of an arrangement that is appropriate for HCMC.

Two other key recommendations are made. The first is that there should eventually be at least two companies involved in the operation of MRT in HCMC. This puts competitive pressure on each operator to improve its performance so that they are not seen to be inferior to the other operator(s). It also provides data that the government can use to benchmark the performance of the operators so that it can provide feedback to the operators on opportunities for improved performance. Finally, it provides the government with flexibility in the event that one operator fails to perform, with the capacity for another of the operators to take over in the short term if that should become necessary. The second recommendation is that international competitive tendering should be used to select the concessionaire, with the likelihood that a foreign party will form a consortium with a local enterprise. This will bring international experience and expertise to support the development of world class MRT in HCMC and provide a sound basis for developing domestic skills in MRT.

Finally, the report presents an outline of a concession agreement and discusses the actions needed to select a concessionaire and establish and manage a contract.

3. Activities 2 and 3: Financial Modeling and Value for Money

Introduction.

Part of the PPIAF assignment has involved the development of a financial model capable of being used in MRT network planning and in project preparation of the HCMC Line 2. The model is used to perform two tasks: (i) a value-for-money (VfM) analysis of MRT project development options identified in the assignment issues and options analysis for private participation in the development of Line 2; and (ii) financial analysis of the HCMC Line 2. The second task, ie financial analysis of Line 2, is reported in the PPTA study documentation. A technical paper responding to the PPIAF terms of reference describes the financial model and the VfM analysis carried out of development options for Line 2. The VfM analysis is summarized in the following paragraphs.

Financing and delivery options.

The Issues and Options study identifies for detailed examination four alternative approaches—including private sector participation and public private partnerships (PPP)—to project development of Line 2: (i) the project is developed by a state-owned enterprise (SOE), with government taking maximum responsibility in project management, financing and service delivery; (ii) the service delivery is by a private sector concessionaire, with government retaining the remaining project responsibility; (iii) the operating concessionaire supplies (ie also finances) the required trains and signaling and communications, and government retains all other responsibility; and (iv) the project is developed as a build-operate-transfer (BOT) concession, where the private sector take the maximum project responsibility, allowing government to play only a monitoring and evaluation role, at least in theory.

Value for money (VFM) test.

The potential cost to the community of the four options is evaluated and compared in a quantitative value-for-money (VfM) test. It is common experience that government generally faces a lower financing cost compared to the private sector. At the same time, statistical analyses of international transport projects provide well-founded evidence of substantial public sector optimism bias (a propensity for actual cost to exceed forecast or for actual revenue to fall short of forecast) in project capital cost estimates. Now, common experience suggests that, much more than the bureaucratic organization, a private sector enterprise is generally under strong motivation to manage uncertainly in project planning and implementation. Meanwhile, studies of privatized public transport , especially bus, indicate that the private sector can be expected to deliver service at a cost significantly lower than the public sector. Thus, in theory, an MRT project development with an appropriate assignment of responsibility and risk between government and the private sector concessionaire could yield a lower expected cost, risk taken into account, compared to a eg a pure government effort.

Test results.

A VfM test carried out for the four options indicates that option (iii), private sector trains and train-related systems supply and service operation, incurs the lowest expected cost to the community; with option (ii) the next lowest. The BOT option shows a lower optimism bias than all the other options, but, since it uses the concessionaire's private sector financing for the full project investment, it incurs a maximum premium on the government's financing cost; this option turns out to have the highest expected cost to the community, the SOE option included.

Evidently the BOT option is a doubly inappropriate approach to MRT project development. Details of the VfM test methodology, input data and parameters, as well as results can be found in the Financial Model paper.

Assumptions and Contingencies.

It is important to understand what assumptions are necessary for, and what contingencies would invalidate, the VfM test results. These are summarized below.

Market competition. VfM requires a competitive tender market for the concession and for related sub-contracting of the technology (eg design, construction, systems integration and installation, operation and maintenance in MRT service provision) and financing services to ensure that payment of concessionaires and sub-contractors is not in excess of a normal risk-weighted remuneration for effort. This means that an option which has cleared a VfM test could at the procurement stage be facing a market failure (eg only one bidder), threatening its ability to deliver the anticipated VfM . Thus, transition and emerging countries in particular often cannot count on a reliable international supply of private sector financing. The threat of market failure in a specialised field such as MRT concessioning and sub-contracting should not be dismissed lightly.

Financial and services market distortions. Here are some examples of distortions that can threaten or dilute VfM.

a) Limited recourse financing of a PPP concession promotes VfM because the senior lenders, usually financial institutions regulated by a central bank, will for as long as the debt is outstanding have an interest in the project which is aligned with the authority granting the concession and bring professional skill to the monitoring of the concessionaire's performance. The lenders' incentive to monitor the concessionaire performance is diluted with the lenders' use of credit risk transfer (CRT) products. This practice dilutes the concession authority's effort to share an exposure to the concessionaire's performance level with the senior lenders, minimizing the monitoring cost in the process.

b) Bilateral ODA financing can also introduce distortions in the sub-contracting markets. The tying of an ODA loan to supply of goods and services of a national origin restricts the competitive tendering for the procurement of MRT consulting and construction services and systems supply. An opportunity can be created for vendors to use the concessionary pricing of a loan to build in an additional margin on goods and services. In the long term, the practice can create a situation where, in a narrow field, the potential suppliers tacitly agree to live and let live instead of competing, with adverse effect on supply prices and therefore VfM.

c) Partnering developed over time among financiers and sub-contractors while having a potential to be an effective project risk management tool for a concessionaire can be abused if allowed to develop into a collusive arrangement, which in the end threatens VfM.

PPP procurement capability. Ability to procure well is important for realising VfM. The balance of opinion, if not of evidence, is that a greater capability is required of the public sector in the procurement of a PPP concessionaire than in a conventional public works procurement. Ad hoc outsourcing for the required skills leads to limited results. For example, legal firms skilled in PPP contracting, forced to make a choice through conflict of interest rules, can tend to opt for working for the concessionaire side rather than government. Institutional capability building is required.

4. Activity 4: Stakeholder Feedback and Implementation Arrangements

4.1 Key Tasks

Key tasks carried out under this Activity were:

- Stakeholder analysis;
- Concession Template;
- Analysis of institutional options; and
- Fares and ticketing analysis and options.

The outputs of these tasks are

- **Stakeholder Feedback and Implementation Arrangements: Institutional Options Working Paper** – Vietnamese and English language versions (March 2008).
- **Stakeholder Engagement Plan** – English language version only (March 2008) – Informal document;
- **Concession Template** – refer Section 2;
- **Fares and Ticketing Working Paper** – Vietnamese and English language versions (June 2008).
- **Other capacity, likely legal and procurement requirements** recognizing the PPIAF team did not have any legal resources available to them (covered variously in all outputs).

4.2 Key Stakeholders

A list of identified core stakeholders within HCMC is shown in Table 4.1. This list is based on the information contained in the Working Paper entitled "Stakeholder Feedback and Implementation Arrangements: Institutional Options." While several stakeholders at national and HCMC levels have been identified the most important are shown in bold text in Table 4.1. IFIs or other bilateral donors have been excluded from the Table.

Table 4.1: Identified Key Stakeholders

Stakeholder	Responsibility
National Level	
Ministry of Transport (MOT)	Through its different modal administrations and departments (a) plans, manages and maintains national infrastructure through its different departments and administrations; (b) assists local governments in developing transport plans and selecting transport projects; and (c) manages public bus transport plans by approving cities master plans

Stakeholder	Responsibility
Vietnam Railways Administration (VNRA)—under MOT	Plans and manages the development of the sub sector Regulates the sub-sector including national and other rail systems including metro or MRT in cities and provinces. Provides oversight of City and Provincial rail and MRT Master Plans and is charged with approval of technical standards and safety of rail and MRT systems. Main functions of relevance to project: • Informal MRT Master Plan approval • MRT technical standards • MRT safety standards & compliance
Ministry of Finance (MOF)	Arranging of finance from external agencies including IFIs and provision of finance to local governments. Currently, financial planning aspects of future MRT development in Vietnam.
Transport Development Strategy Institute (TDSI)-under MOT	Develops long and medium term transport sector strategies and plans (in collaboration with modal administrations)
Department of Planning and Investment (DPI)-under MOT	Integrates investment plans prepared by modal administrations for submission to MPI for inclusion in the PIP and to MOF for inclusion in the State Budget.
The Ministry of Natural Resources and the Environment (MNRE)	Reviews and approves environmental impact assessments for transport projects.
HCMC PC level	
People's Committee	Approves key issues such as fares, opening and closing of routes, schedules and subsidies.
Transport and Urban Public Works Services' (TUPWS) Transport and Industry Management Department (TIMD); and the Management and Operations Centre for Public Transport (MOCPT).	Develops cities' transport strategies; Plans and manages construction; Maintains urban transport infrastructure; Manages bus transport; Coordinates planning and implementation of traffic management with Police. Main functions of relevance to project: • Transport Strategy • Traffic management and parking • Bus route planning & franchising incl bus-MRT integration • Bus system ticketing
HCMC Management Authority for Urban Railways	Plans / implements rail-based mass transit plans and has responsibility for managing and arranging for operations and maintenance. Main functions of relevance to project: • MRT civil infrastructure development incl land acquisition • MRT rolling stock & E&M supply • MRT ticketing • MRT operations procurement and/or operations directly
HCMC Investment Fund (HIFU)	Arrangement of finance through bond issue for counterpart funds, coordination with private sector incl private financial institutions, possible shareholding role in a JV operating entity
Department of Finance (DOF)	Treasury functions such as processing of project-related local expenditures including counterpart payments
District Level and Commune Governments	Relevant district governments through which a project passes will have a role in land acquisition & other facilitation
Urban Planning and Architecture Department (DUPA)	Land Use Master Plan preparation and approval of developments. Land approvals are separately made by the Department of Natural Resources and Environment (DNRE) with little linkage to the Master Plan.
Department of Planning and Investment (DPI)	Investment programming including one year annual budget and five year Public Investment Program (PIP)
Traffic Police under the Public Security Department	Enforces traffic management including the operation of traffic signals in coordination with TUPWS

4.3 Transport Agencies and Functions in HCMC

The HCMC PC is the key agency responsible for planning and delivery (ie here referring to regulation, purchasing of services and oversight, and construction of infrastructure) of public transport, such as bus, mass rapid transit and supporting land use and transport management functions. Within the PC the following agencies have key roles for urban transport:

- **Transport and Urban Public Works Services (TUPWS)** which is responsible for preparation of city transport strategies, the planning and management of construction, maintaining urban transport infrastructure, planning and managing bus transport; and coordinating planning and implementation of traffic manage¬ment with Police. For planning and regulation of urban public transport (bus/ other) the Management and Operations Centre for Public Transport (MOCPT) of TUPWS is the most important agency;

- **Management Authority for Urban Railways (MAUR)** – plans and implements rail based mass transit infrastructure and responsible for operations;

- **Urban Planning and Architecture Department (DUPA)** – Land Use Master Plan preparation and approval of developments. The process of planning is normative and appears not to reflect market preferences nor what is optimal in terms of infrastructure and social services provision. Land approvals are separately made by the Department of Natural Resources and Environment (DNRE) with little linkage to the Master Plan. Similarly infrastructure planning is made with little reference to the Master Plan. In addition, even for individual building and more major developments there are no specific standards or guidelines providing certainty to developers on how much Gross Floor Area (GFA) they can build or other conditions such as building set back and building form;

- **Department of Planning and Investment** – investment promotion, coordination of investment including development of development assistance from IFIs and bilateral sources; and

- **Department of Finance** – treasury, budget, investment planning and arrangement of sources of finance.

4.4 Key Laws

National and city legislation governs the present provision of public transport services, currently mainly bus, in HCMC. The laws of most relevance to urban rail or urban MRT are:

- Railway Law 2005 (NA Order No. 35/2005/QH11); and

- HC PC Decree 119/ 2007/QD-UBND establishing the Management Authority for Urban Railways.

Railway Law

Within cities the Railway Law 2005 defines relevant types of urban railway as including metro or MRT using a wide variety of technologies. Authority for planning urban railway networks is given to People's Committees (Articles 14 and 15). Master Plans shall be prepared covering a detailed

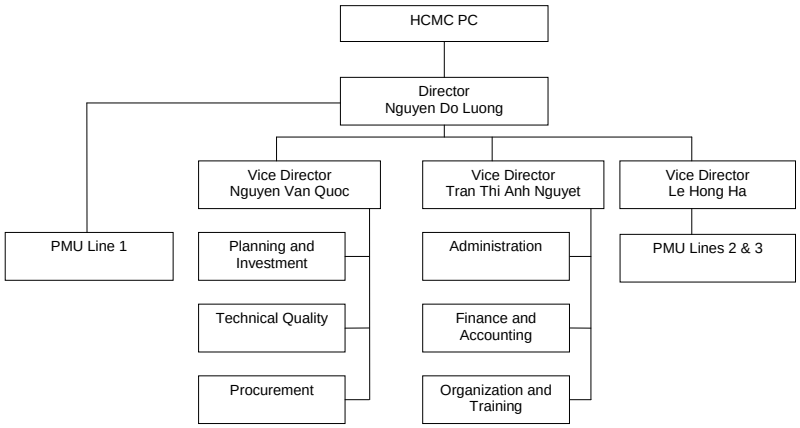
period of 10 years and less definitive further 10 year period. Fare setting is the responsibility of the PC.

Decree 119/ 2007/QD-UBND establishing Management Authority for Urban Railways, HCMC

The Urban Railway Management Unit (known as the Management Authority for Urban Railways) was established in September 2007 by Decree 119. The Authority replaced the previous Urban Railway Management Division under TUPWS. MAUR is also under the guidance of Central Ministries – branches and Departments – branches of the city.

The current MAUR structure is shown in Figure 4.1. With new responsibilities for management of operations and maintenance, the number of staff in MAUR is increasing. It is also understood that it is proposed to revise the current structure of MAUR in the near future to better reflect the management and operational functions.

Figure 4.1: Current Structure of MAUR



Source: MAUR

4.5 Institutional Options

Given the previous discussion, the alternative arrangements for an Authority relate primarily to the scope of its functions rather than to the underlying functions themselves. On this basis, four options for improved institutional arrangements for HCMC are identified:

- **Option 1: Strengthen the Management Authority for Urban Railways (MAUR);**
- **Option 2: Interim Public Transport Authority using increased PC level coordination between bus and MRT**;
- **Option 3: Integrated Public Transport Authority. Refer Figure 4.2**. In this option the proposed Integrated Public Transport Authority would be **solely responsible for**

ensuring the delivery and operation of a fully integrated public transport system (MRT and bus) for HCMC; and

- **Option 4: Integrated Transport Authority**. In this option, **a wholly integrated Authority would plan the multi-modal network, specify the services, program the investment (including roads, MRT and bus)**.

The options are capable of progressive implementation and a summary of their features is shown in Table 4.2. A worthwhile and practical option is Option 3 which is illustrated in Figure 4.2. In addition to developing integrated bus and MRT services this option would enable all public transport ticketing and fares to be integrated as long as MRT and bus operating arrangements are consistent.

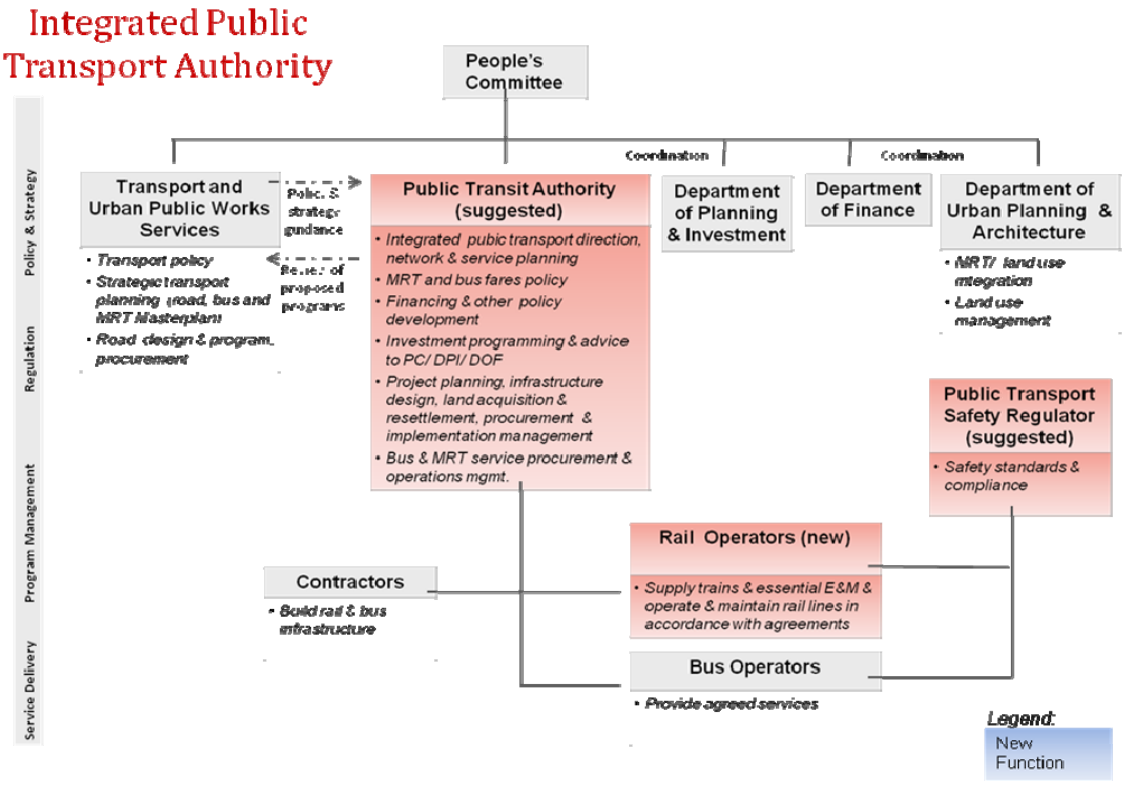
Table 4.2: Improvement Options

Feature	Option 1: Strengthen MAUR	Option 2: Interim PT Authority	Option 3: Integrated PT Authority	Option 4: Integrated Transport Authority
Integration of public transport in HCMC (1)			Increasing integration ⇗	
Introduction				
Transport outcome	Fairly good MRT integration possible	Fairly good MRT integration more likely	Fully integrated PT system more probable	Fully integrated public transport system
Description	Minimum change to current institutional responsibilities.	As for Option 1 but improved direction & coordination	Strong direction and purpose for PT	Strong direction and purpose for transport & land use
Examples from other places	Hong Kong & Singapore in the 1980s	Bangkok in 1990s	Melbourne and Brisbane, Australia	Hong Kong, Singapore
Benefits for customers	Ease of use of MRT with integrated ticketing and easy interchanging where MRT lines intersect possible	Ease of use of MRT with integrated ticketing and easy interchanging where MRT lines intersect. Integration with buses likely.	Passengers able to use the PT system as though it was a single system, with fares, tickets, marketing and presentation integrated. Physical integration good.	As for Option 3 but better integration with land use and road network.
Agency responsibilities				
Transport policy & planning (2)				
Urban planning	DUPA	DUPA	DUPA	DUPA
Transport policy	TUPWS	TUPWS	TUPWS	Integrated Transport Authority
Strategic trans-port planning	TUPWS	TUPWS	TUPWS	Integrated Transport Authority
Financing policies	DPI & DOF	DPI & DOF	DPI, DOF with advice of Integrated PT Authority	DPI, DOF with advice of Integrated Transport Authority
Fares policy and service standards	MAUR for MRT; TUPWS/ MOCPT for bus	MAUR for rail; TUPWS/ MOCPT for bus	Integrated PT Authority for MRT and bus	Integrated Transport Authority for MRT and bus
Regulation (3)				
Safety standards	Independent regulator; TUPWS for bus	Independent regulator; TUPWS for bus	Independent regulator; Integrated PT Authority for bus	Independent regulator; Integrated Transport Authority for bus

Feature	Option 1: Strengthen MAUR	Option 2: Interim PT Authority	Option 3: Integrated PT Authority	Option 4: Integrated Transport Authority
Environmental standards	DNRE	DNRE	DNRE	DNRE
Economic regulation[5]	MAUR	MAUR/ Interim PT Authority	Integrated PT Authority	Integrated Transport Authority
Public transport program management[4]				
Program coordination & direction	MAUR	MAUR	Integrated PT Authority	Integrated Transport Authority
Project planning & feasibility studies	MAUR	MAUR	Integrated PT Authority	Integrated Transport Authority
Investment programming & financing approval	MAUR/ DPI/DOF/ PC	MAUR/ DPI/DOF/ PC	Integrated PT Authority / DPI/DOF/ PC	Integrated Transport Authority / DPI/DOF/ PC
Project design	MAUR	MAUR	Integrated PT Authority	Integrated Transport Authority
Environmental & other approvals	MAUR/ DNRE	MAUR/ DNRE	Integrated PT Authority/ DNRE	Integrated Transport Authority/ DNRE
Tendering	MAUR	MAUR	Integrated PT Authority	Integrated Transport Authority
Contract management	MAUR	MAUR	Integrated PT Authority	Integrated Transport Authority
Infrastructure maintenance	MRT operators/ concessionaires (for operations)	MRT operators/ concessionaires (for operations)	MRT operators/ concessionaires (for operations)	MRT operators/ concessionaires (for operations)
MRT service design	MAUR	MAUR	Integrated PT Authority	Integrated Transport Authority
Concession preparation and management	MAUR	MAUR	Integrated PT Authority	Integrated Transport Authority
Service delivery				
Rail services	Operators/ Concessionaires	Operators/ Concessionaires	Operators/ Concessionaires	Operators/ Concessionaires
Bus services	Operators	Operators	Operators	Operators
Ticketing and fare collection	Single contract under PC	Single contract under PC	Single contract under Integrated PT Authority	Single contract under Integrated Transport Authority
Marketing	Operators	Operators	Integrated PT Authority and operators	Integrated Transport Authority and operators

Source: Consultant

Figure 4.2: Key lines of responsibility for Option 3 – "Integrated Public Transport Authority"



Source: Study Team

4.6 Fares and Ticketing

An objective for rail mass rapid transit (MRT) in HCMC is that it be convenient to use and free of artificial barriers that could be imposed if MRT lines and their method of operations were to be done on a "standalone" basis.

A Working Paper prepared for this project presents a discussion of the policy issues regarding fares and ticketing systems and recommends an approach to secure both integrated fares and an integrated ticketing system primarily for MRT, but also for other public transport, as MRT will rely on an integrated public transport system to maximize its performance.

Fare policy and an associated ticketing system are essential to the success of MRT and the broader public transport system. Fare policy is vital because:

- financially, it affects the number of people who will use MRT, which in turn influences fare revenue, MRT operating costs and, ultimately, the viability of MRT lines;
- socially, the absolute level affects the affordability of public transport to people, while alternative fare structures have differential, and thus distributional, effects on the community;
- technically, it influences the form of operating concessions, and the design of the MRT system in general and the ticket system in particular; and

- for the remainder of transport system, the level and structure of MRT fares affects the use made of other public transport and the amount of private travel, with consequences for the transport system and community as a whole.

A policy objective for HCMC, as it is in most cities that seek to provide an attractive public transport system, should be:

- an integrated ticket and fare system for MRT and, ultimately, the bus system also; and
- uniform fares for modes of similar quality.

It will be exceptionally difficult, perhaps impracticable, to implement an integrated ticketing system with each public transport operator supplying their own equipment. Accordingly, there is a universal movement towards integrated ticketing and fare systems that are managed centrally rather than by individual service providers. It is recommended that such an approach is essential for HCMC.

Moving towards implementation of such a system requires an appropriate framework in which all necessary studies and activities can be undertaken. While it is not essential that the fare structure and level be confirmed before commencing the process of planning an integrated ticketing system, an early decision will provide clarity and direction to future work. In any event, establishing the fare structure and level is essential to the development of future MRT lines in HCMC, and is thus a matter than needs urgent attention. Accordingly, it is recommended that work commence as soon as possible to examine a range of fare structures and levels, and identify the option that best balances MRT financial viability and social obligations.

Experience elsewhere suggests that a practical way forward to implementation of an integrated ticket system is to commence with a high level working group that should:

- recommend a preferred fare structure and level;
- prepare a functional specification for the ticketing system, identify a preferred technology, and estimate likely capital and ongoing operating and maintenance costs;
- recommend arrangements for an integrated procurement contract that covers both implementation and ongoing operation and maintenance of the ticket system, and which also considers possible private sector financing of capital costs;
- recommend institutional arrangements for the management of fares and ticketing for MRT in HCMC following implementation of a new integrated ticket system; and
- present a program for implementation of the recommendations that describes activities, costs, schedules and agency responsibilities for government consideration and approval.

It is recommended that this working group should comprise representatives of the PC's Management Authority for Urban Rail (MAUR), Transport and Urban Public Works Services (TUPWS), Department of Planning and Investment (DPI) and Department of Finance or could be an embryonic form of the Integrated Public Transport Authority.

Representatives of organizations and the community who will be affected by the proposals should be invited to participate, either as members of a steering committee or an advisory panel.

A period of about 12 months will be required for the working group to undertake the above tasks to the necessary level of detail.

Following a positive decision on the working group's report, it is recommended that the government organization that is to be responsible for managing the ticket and fare system should be established (at least in the form of a "project office"), and required to prepare:

- bidding documents;
- plans to implement the procurement process, including tender assessment, award and management procedures; and
- plans for operation of integrated ticketing across the entire MRT system, including current lines, bus and other modes.

This work is likely to take a further six to twelve months, and will permit the government to proceed to formalization of institutional arrangements, implementation of the ticketing system and its ongoing operation. Based on experience in other cities, it is expected that it will then take about three to four years to tender, contract, deliver, install and commission the ticketing system, including establishing arrangements for delivery, sale and use of new smartcard-type tickets and management of fare revenue.

Finally, responsibility for developing a suitable integrated ticketing and fare policy to support an integrated MRT and public transport system for HCMC rests with the Management Authority for Urban Rail (MAUR) in the first instance. The thinking needed to develop an appropriate ticketing system and fare policy cannot be outsourced to others.

4.7 Building Technical and Managerial Capacity

Depending on the option eventually chosen, with the exception of Option 4 (Integrated Transit Authority) the proposed agency will have a key role in working to efficiently and effectively connect high level transport policy and plan making done by TUPWS to detailed implementation.

DPI will continue to have an important role in overseeing the performance of the transport sector in terms of fiscal monitoring, but would also benefit from having a stronger MAUR or Integrated Public Transport Authority to provide economic regulation and technical management of MRT (and/or bus) investment programming and management of annual MRT operating budgets, and desirably for other public transport.

Economic regulation and oversight involves issues of pricing including fares, subsidies (and community service obligations), competition, concessioning including compliance supervision and requires skills in economics and to associated legal and financial impacts.

Technical supervision of rail MRT and public transport investments and their integrated operation including ticketing requires high level knowledge and skills in:

- interpreting transport policy and master plans prepared by TUPWS and central government's MOT and providing appropriate feedback and advice;
- translating these policies and plans into appropriate forward work programs that can result in timely and efficient implementation of MRT, other public transport improvements and reforms, and integrative systems;

- providing appropriate advice to TUPWS/ DPI/ DOF/ DUPA and other agencies as required; and
- appropriate coordination with the Department of Natural Resources and Environment.

While the PC is acting to strengthen MAUR (under Options 1 and 2) or if it intends to create an Integrated Public Transport Authority (Option 3) or an Integrated Transport Authority (Option 4) it should be careful to match the skills and capabilities of the people to be engaged and /or transferred to the desired new organization and its structure taking full account of the needed capabilities in high level economic and technical supervision and oversight.