

EXECUTIVE SUMMARY
OF
FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT
P V NARASIMHA RAO KANTHANAPALLY SUJALA SRAVANTHI
PROJECT
JAYASHANKAR BHUPALAPALLY DISTRICT, TELANGANA



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CONSULTANTS



ENVIRONMENTAL HEALTH & SAFETY CONSULTANTS PVT LTD
13/2, 1ST MAIN ROAD, NEAR FIRE STATION, INDUSTRIAL TOWN,
RAJAJINAGAR, BENGALURU-560 010

NOVEMBER 2018

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**IN
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Project By



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1. Introduction

The proposed scheme involves construction of 1,132 m long barrage near Thupakulagudem village across River Godavari located 3 Km downstream of existing J.Chokka Rao Devadula Lift Irrigation Scheme (JCRDLIS). The proposed project stabilizes and provides irrigation facilities to existing 5,55,310 Ha of command area belonging to J. Chokka Rao Devadula LIS (2,51,310 Ha) and Sri Ram Sagar Project (SRSP) - Stage I & II (3,04,000 Ha). 50 TMC of water will be utilized for stabilizing the existing command area and 50 TMC of water will be utilized for drinking water purpose for enroute villages. The command area is already benefitted by the existing irrigation facilities for the Khariff and bi-seasonal crops and the proposed scheme facilitates irrigation only during Rabi season. Total power required for the proposed project is 1.5 MW which is sourced from Transmission Corporation of Telangana Limited (TSTRANSCO).

The Proposed project has been proposed by the I & CAD Department, Govt. of Telangana to stabilize the existing JCRDLIS and SRSP - Stage I and II and provide irrigation facilities to the areas of Eturnagaram Mandal, Jayashankar Bhupalapally District. This will provide stability to agriculture and thus improving the per capita income and standard of living of the people. Therefore, the need of the proposed scheme is of priority which could meet the demands of the farmers and shall also improve the Irrigation potential and Socio-economic conditions of the region. Government of Telangana has accorded administrative approval for PVNRKSSP vide order No. G.O.Ms.No.14 dated 13.02.2017 and the total cost of the project is 2121 Crores.

The boundary of Eturnagaram Wildlife Sanctuary is located at the close proximity from the proposed barrage. However, no project activities will be carried out in the Eturnagaram WLS. Reserve Forests namely; Nuguru RF and Perur RF is located at the close proximity and 3 Km from the proposed earthen dam. Further, the construction of proposed barrage across Godavari River does not involve any diversion of forest land. However, a submergence of 580.18 Ha of river bed at FRL 77 m. Total of 674.18 Ha of land (94 Ha of private land + 580.18 Ha of river bed area) is required for the proposed project. No forest land is required for the proposed project and does not attract forest clearance.

M/s Environmental Health & Safety Consultants Private Limited, Bengaluru is entrusted by I&CAD Department, GoT, to carry out the Environmental Impact Assessment & Environmental Management Plan studies for P V Narasimha Rao Kanthanapally Sujala Sravathi Project (PVNRKSSP). The Terms of References for the project has been accorded by MoEF&CC, GoI, New Delhi vide letter No. J-12011/24/2010-IA-I dated 03.04.2017

2. Project Description

The proposed project involves stabilization (50 TMC) of the existing command areas of JCRDLIS and SRSP Stage I&II and providing drinking water facilities (50 TMC) for en route villages through the construction of the proposed Thupakulagudem barrage near Thupakulagudem village, Eturnagaram Mandal, Jayashankar Bhupalapally District, Telangana.

- JCR Devadula LIS

J Chokka Rao Devadula Lift Irrigation Scheme (JCRDLIS) project involves lifting water from River Godavari from an elevation of 70 m during monsoon season (June - December) near Gangaram village upto an elevation of 470 m and conveyed through pressurized pipeline. The water conductor system is integrated with eight existing balancing reservoirs and lift the water to the desired elevation in 10 stages to irrigate a command area of 2,51,310 Ha involving the then Warangal, Karimnagar, Nalgonda and Medak Districts of Andhra Pradesh from an Elevation +71 m. to +540 m by utilizing 38.18 TMC of water out of 467.24 TMC water available at Intake point in the river Godavari. Pumping period proposed for 170 days between late June/early July and end of November. Government of Telangana vides G.O.Rt. No; 25, Dt: 21.01.2015 enhanced water allocation to 60 TMC. The total land requirement of JCRDLIS project was 5,610 Ha (inclusive of 344 Ha of forest land) and involved no displacement/ R&R activities. Forest Clearance for 344 Ha of forest lands was issued on 14.09.2005. Environmental clearance for JCRDLIS project was issued by MoEF&CC, New Delhi on 06.12.2005

Table 1 Salient Features of the JCRDLIS project

Utilization	
Source	Godavari River
Location	Latitude 180 - 36'-00" N, Longitude 800 - 21'-00" E
Water to be lifted from river Godavari	38.182 TMC
Water for Agriculture usage (Govt.Memo No: 16444/WRG/2012-6,Dt: 28.03.2013)	35.34 TMC
Water for Non-Agriculture usage	2.842 TMC
Industrial usage	0.012 TMC
Drinking Water usage	2.830 TMC
Power Requirement (Ultimate)	484 MW
Project Cost (Estimated Cost)	Rs. 6016 Crores
Revised Estimate Cost (TAC, CWC, Govt. of India accorded clearance during 106th Meeting held on 16-09-2010)	Rs. 9427.73 Crores was sanctioned Vide G.O. Rt. No: 606, (I&CAD), dt:16.09.2010.

Ayacut	
Ayacut with lifted water through Canals	220048 ha
Ayacut with regenerated water	31262 ha
Source of Funding	Central funding (AIBP): 25%, State funding: 75%
Physical Progress	Phase-I Physically completed. Phase-II Physically completed. Phase-III-Package-I physically completed.

Table 2 Scope of the JCRDLIS project

Sl. No.	Description	Phase-I	Phase-II	Phase-III	Total
1	Water to be lifted (TMC)	5.18	7.25	25.75	38.18
2	Discharge (No of Pumps x Cumecs)	2 x 5 =10 (353 Cusecs)	2 x 7=14 (495 Cusecs)	6 x 8.27=49.60 (1752Cusecs)	73.60 (2600 Cusecs)
3	No. of Lifts (Nos)	4	7	10	-
4	Static Head (Mts)	268	470	510	-
5	Power requirement (MW)	56	123.6	304.4	484

Table 3 Benefitting Districts and Mandals of JCRDLIS project

Districts	Mandals
Warangal	Hasanparthy, Hanamkonda, Dharmasagar, Sangem, Geesukonda, Wardhannapet, Jaffergadh, Ghanpur, Ragnadhapally, Palakurthy, Devaruppala, Lingala Ghanpur, Cherial, Maddur, Bacchanapet, Kondapaka. Jangaon, Nallabelly, Duggondi, Narsampet and Rayaparathi.
Karimnagar	Bheemdevarapally, Elkaturthy, Huzurabad and Maha Mutharam.
Nalgonda	Gundala, Aler and Tirumalagiri.
Medak	Kondapaka and Gajwel.

Table 4 Irrigation potential of JCRDLIS project

Ayacut with Gravity Canals (ha)	Ayacut with ground generated water (ha)	Total Ayacut (ha)	Phase-wise IP Contemplated (ha)				IP Created up to 2015 (Ha)	Balance IP to be created (ha)
			Phase-I	Phase-II	Phase-III	Total		
220048	31262	251310	49655	72544	97849	251310	42760	177288

During the course of time, there was a change in the course of River Godavari due to which boulders and rocky strata exposed near the lift point of JCRDLIS causing reduction in water availability which necessitates P V N Kanthanapally Sujala Sravathi Project. The irrigation potential created upto 2015 is 42,760 ha and in order to achieve the irrigation potential for the balance command area of 177288 ha, the proposed project is essential. The CWC Clearance and its schematic diagram of JCRDLIS are enclosed as Annexure 3 and 4.

- Sriram Sagar Project Stage I & II

The Sri Ram Sagar Project (SRSP), formerly known as the Pochampadu irrigation project has been built on Godavari River. Sriram Sagar Project involves two stages providing irrigation to 3,04,000 Ha of land. This irrigation project is located at Pochampadu village in Nizamabad district of the then Andhra Pradesh (AP). This project has been built to utilize Godavari river water for irrigation and drinking purposes in Telangana. The regions such as Nizamabad, Adilabad, Karimnagar, and Warangal districts of the then state of Andhra Pradesh are covered under this project. The SRSP dam comprises of concrete spillway sections with 42 gates with flanked non-overflow masonry and earthen embankment structures on either sides. The reservoir has a water spread area of about 435 Million square meters (Msqm) at the Full Reservoir Level (FRL) equal to 332.54 m. A flood flow canal (Kakatiya Canal) has been built to utilize flood water and this water is stored in the Lower Manair Reservoir (LMR) which is situated at a chainage of 146 km from the SRSP. The Environmental Clearance for SRSP Stage I and II was obtained on 14.10.1980, 07.07.1995, 24.06.2002 and 14.05.2003 respectively.

Table 5 Salient features of SRSP Stage - I project

SRSP Dam, Pochampad	
Source	Godavari River at Pochampadu Village
Project Location	Pochampad village, Balkonda Mandal, Nizamabad District
Foundation of Stones	26th July, 1963. Laid by the Late Prime Minister of India Pandit. Jawaharlal Nehru
Purpose of Project	Water supply/Power/ Multi-purpose/Irrigation
Completion of Project	1983
Latitude and Longitude	18°-58'N, 78°- 20'E
Gross storage	112 TMC (3172 M.Cum)
Catchment area	91751 Sq. Km (35425 Sqm)
Levels	
Crest Level	(1058 fts) 322.478 Mtrs
MDDL	(1064 fts) 324.307 Mtrs
FRL	(1091 fts) 332.537 Mtrs
MWL	(1093 fts) 333.146 Mtrs

TBL	(1108fts) 337.718	
First Filling (Year/Levels)	(1983/1091Fts) 332.537 Mtrs	
Maximum height of the dam	38 Mtrs	
Length of earth dam	14462.39 Mtrs	
Length of Masonry Dam	957.53 Mtrs	
Area under submergence	453 Sq. Km	
GATES	Spillway	River sluice
Numbers	42	6
Size	50'x33'	8' x 12'
Type	Radial	Vertical
Designed flood (100 yrs)	45,307 Cumecs (16 Lakh cusecs)	
Capacity of Hydel Power House	36 Mega Watts (4x9 MW)	
Lower Manair Dam		
Location	Alugunu (V), Karimnagar (D)	
Latitude	180 - 24' North	
Longitude	790 -20' East	
River/ Basin	Manair /Godavari	
Catchment area	6648 Sq.Km.	
Reservoir Data		
MWL	+ 281.026 M	
FRL	+280.416 M	
MDDL	+276.0042 M	
Sill of Regulator	+ 266.700 M	
TBL	+ 284.378 M	
Capacity of the reservoir		
Gross	24.034TMC	
Live	21.938TMC	
Height of dam above river bed	26.882M – Earth Dam, 40.538 M- Masonry	
Top width of dam	4.27 m	
Length of dam		
Gravity	10.10 Km.	
Composite	0.641 Km.	
Max. Flood discharge	5.00 Lakh Cusecs	
Regulator sluices	4 vents of size 8' ft X 18' ft	
Main canal		
Length of Main canal	(146.00Km to 284Km) = 138Km	

Distributaries	54 Nos.
Maximum flood discharge	3.50 lakh cusec (computed)
Area irrigated	
Command area (ha)	392000
Components of SRSP Stage I	<p>Sri Ram Sagar Project dam a gravity dam with FRL + 332.54M (1091 ft) and TBL+337.72 M across the river Godavari near Pochampadu (v) with original reservoir capacity of 112 TMC and now revised to 90.313 TMC after allowing for siltation and sedimentation.</p> <p>Lower Manair dam a balancing reservoir across Manair River with FRL+280.416M (+920 ft) and TBL+284.378M with reservoir capacity 680.648 Mm³ 24.074 TMC.</p> <p>Kakatiya canal from Km. 0.0 to Km.146.0 and its Distributory system from D5 to D94 up to LMD and from km 146.0 to Km.284.0 with distributaries DBM/1 to DBM/31 and from Km.234.0 to Km.284.0.</p> <p>Saraswathi canal from km 0.0 to km 47.0 and its Distributory system.</p> <p>Laxmi canal up to Km 3.50 and its Distributory system.</p>
Source of Funding	The Sriram sagar project (Stage-I) was cleared by the planning commission and central water commission in august 1964 and the government of Andhra Pradesh accorded Administrative sanction to the project estimate for Rs. 40.00 crores vide G.o.Ms.No.361 (PWD. Irrigation Project Wing) dt: 27.11.1964.
Cost of the Project	<p>a) Original Cost (1964): Rs. 40.13 Crores</p> <p>b) Revised Estimated Cost (S.S.R. 92-93): Rs. 1519.15 Crores</p> <p>c) Updated cost: Rs. 3600 Crores</p>

Table 6 Scope of SRSP Stage - I project

Sl. No.	Stages	Details
1	SRSP Stage I	The project is envisaged to irrigate an ayacut of 391994 ha covering four Districts viz, Nizamabad, Adilabad, Karimnagar and Warangal. Sriramasagar Project through Kakatiya canal, Laxmi canal and Saraswathi canal.
2	LMD	The Kakatiya canal at KM 146.000 is dropped in to Manair Reservoir and then it take off from the

Sl. No.	Stages	Details
		Lower Manair Dam. From Lower Manair Dam, the Kakatiya Canal travel up to Km 284.00 (end of Stage -1) and KM 284.00 to km 346.00 (Stage -II) and have been constructed not only to irrigate the ayacut in the Districts of Karimnagar, Warangal, Nalgonda and Khammam but also to cater to the needs of drinking water to the people of Warangal and Karimnagar Municipal Corporations Especially during Summer Season.

Table 7 Benefitting Districts and Mandals of SRSP Stage I project

District	Mandal	District	Mandal
Nizamabad	Balkonda	Warangal (Old)	Huzurabad
	Mortad		Venavanka
	Armoor		Kesavapatnam
	Kammarpalli		Jammikunta
Karimnagar	Ibrahimpattanam		Kamalapur
	Mallapur		Yelkaturti
	Metpalli		Hanamkonda
	Raikal		Hasanparthy
	Korutla		Atmakur(DBM-30,31,37&38)
	Kathlapur		Shayampet
	Medipalli		Parkal
	Jagtial		Mogullapalli
	Sarangapur		Kamalapur (KNR)
	Dharmapuri		Gesugonda
	Gollapalli		Regonda
	Medipalli		Chityal
	Peddapally		Bhupalpalli
	Velgatoor		Narsampet
	Dharmaram		Duggondi
	Julapalli		Nallabelli
	Ramagundam		Mulugu
	Peddapally		Ghanpur
Kalvasirampur	Venkatapur		
Mutharam	Narsampet		
Manthani	Chennaraopet		

District	Mandal	District	Mandal
	Kamanpoor		Guduru
	Karimnagar		Nekkonda
	Choppadandi		Kesamudram
	Ramadugu		Sangem
	Eligaid		Nellikuduru
	Odela		Kesamudram
	Sultanabad		Mahaboobabad
	Thimmapur		Nekkonda
	Manakodur		Parvathagiri
	Veenavanka		Narsimulapet
	Shankarapatnam		Maripeda
	Jammikunta		Korvi
	Huzurabad		Dornakal
	-		Kharmman
	-		Wardhannapet

Table 8 Salient features of SRSP Stage - II project

Source	Sri Rama Sagar Project on Godavari River.
Location	Pochampad (V), Balakonda (M), Nizamabad District
Latitude	16 55' to 17 52'
Longitude	75 15' to 80 10'
Components	Canal and Distributory System.
Source of Funding	Central Assistance (AIBP) and State Government in 1:3 proportions
Cost of the Project	Rs: 1043.14 Cr
Budget for this year	Rs: 40.00 Cr
Expenditure Incurred	Rs: 944.22 Crores
Physical Progress	Works currently under progress are: Package 52 : Lining Works Package 53,54,55,58 : Earth Work and Structures
Starting Location:	
Village	Illanda
Mandal	Wardhannapet
District	Warangal
Hydraulic Particulars @ Km 284.00 on Kakatiya Main Canal	
Required Discharge	95.00 Cumecs (3355 Cusecs)
Design Discharge	123.01 Cumecs (4344 Cusecs)
Bed Width	16.76 m
F.S.D.	4.34 m

F.B.	0.90 m
Side slopes	1 ½:1 / 2:1
Bed fall	1 in 9500
Value of 'n	0.018
Velocity	1.216 m/sec
Top Width of Banks	7.750/4.00 m
Command area (ha)	178066
Intensity	109.00 %

Scope of SRSP Stage - II project

- Excavation and Lining of Kakatiya Main Canal from Km.284.00 to 346.00.
- Excavation of 13 Nos. of Distributaries with minor's, sub-minors and field channels
- Distributaries are DBM-54,55,56,57, 59,60,61,63,65,67,68,70,71& TE. The DBM-60, 69 & 71 are the Branch Canals.
- Formation of Mylaram Balancing Reservoir.
- Formation of Bayyanna Vagu Balancing Reservoir.

Table 9 Benefitting Mandals of SRSP Stage - II project

Sl. No	District	Mandal
1	Warangal	Kodakandla
		Thorrur
		Maripeda
		Narsimhulapeta
		Wardhanapet
		Raiparthy
		Parvathagiri
2	Khammam	Thirumalayapalem
		Nelakondapally
		Mudigonda
		Kusumanchi
		Khammam (r)
3	Nalgonda	Thirumalagiri
		Thungathurthy
		Jagireddy gudem
		Noothanakallu
		Atmakur (s)

Sl. No	District	Mandal
		Suryapet
		Chevumula
		Mothey
		Penpahad
		Nadigudem
		Munagala
		Garedepally

The ultimate average irrigation potential created under SRSP Stage-I between 2000-01 to 2015-16 is 236000 ha in Khariff season and 231000 ha during Rabi season against the total command area of 392000 ha. Similarly, under SRSP Stage-II, the ultimate irrigation potential created is 161043 ha against the contemplated 178066 ha. This is mainly because of erratic rainfall, severe droughts and change in cropping pattern by the farmers leading to failure of water conveyance to tail end farmers. Hence, out of 570066 ha in both Stage-I and II, an area of 304000 ha is suffering ayacut which need irrigation facilities through the proposed project.

- Proposed P V Narasimha Rao Kanthanapally Sujala Sravanthi Project (PVNRKSSP)

The project envisages construction of 1,132 m long barrage across Godavari River near Thupakulagudem village, Eturnagaram Mandal, Jayashankar Bhupalapally district to raise the water level in the River Godavari to stabilize the existing command areas of 5,55,310 Ha of Devadula LIS and Sri Ram Sagar Project Stage I and II. 50 TMC of water shall be utilized for stabilizing the existing command area and 50 TMC of water shall be utilized for drinking purpose by the villages in the en route cities, towns and villages. The command area is already endowed by the existing irrigation facilities for the Khariff and bi-seasonal crops and the proposed scheme also facilitates irrigation during Rabi season.

The project site is approachable by road and the nearest village is Thupakulagudem at a distance of 400 m. The nearest railway station is at Mancherial District at a distance of 106 km. The nearest airport is Hyderabad at a distance of 255 km. The National highway NH-202 passes through the project area and serves as important means of commuting. The salient features of the project along with Command area map is given below;

Table 10 Salient features of PVNRKSSP project

1	Name of the project	P V Narasimha Rao Kanthanapally Sujala Sravathi Project
2	Type of project	Stabilizing the existing command areas of JCRDLIS (2,51,310 Ha) and SRSP stage -I&II (3,04,000 Ha) and providing drinking water facilities to the en

		route villages.
4	River	Godavari
5	Latitude and Longitude of the proposed barrage	Left Bank Coordinates: 18° 35' 19.43" N, 80° 23' 49.13" E Right Bank Coordinates: 18° 35' 02.94" N, 80° 23' 14.46" E
6	Water Utilization	50 TMC for stabilizing the existing command areas (JCRDLIS and SRSP Stage I&II) and 50 TMC of water for drinking purpose for en route villages.
7	Command Area	5,55,310 Ha - J. Chokka Rao Devadula LIS (2,51,310 Ha); Sri Ram Sagar Project (SRSP) - Stage I & II (3,04,000 Ha).
8	Districts benefitted	Jayashankar Bhupalapally, Nalgonda and Khammam
9	Cost of the Project	2,121 Crores
10	Land required for Project	94 Ha of private land
11	Forest Land requirement	Nil
12	Submergence	580.18 Ha of river bed area alongside River Godavari near the proposed barrage at FRL: 77 m
13	R & R	Nil
14	Power requirement	1.5 MW Source- TSTRANSCO
15	B.C Ratio	1.53
Barrage storage		
1	High Flood Level (HFL)	+83 m
2	Pond level	+77 m
3	Minimum draw down level	Not Applicable
4	Dead Storage level	Not Applicable
5	Free board	2 m
Head works		

1	Location of the barrage	200 Km downstream of SRSP
2	Total length of barrage (m)	1,132 m
3	Spillway bays	927 m
4	Sluice bays	205 m
5	Maximum height of spillway crest above deepest foundation	11 m
6	Length of bay	15 m
7	Crest level (EL m) for Spillway	+71.00 m
8	Crest Level For Under Sluice	+70.00 m
9	Number of gates in Spillway bays	48
10	Number of gates in Under Sluice bays	11
11	Type of gates	Radial lift
12	Size of gate for Spillways (m)	15 x 14
13	Size of gate for Under sluice (m)	15 x 15
14	Type of energy dissipation arrangement	Hydraulic jump on cistern floor
15	Maximum discharging capacity (Cumec)	8,50,000
16	Tail water (EL – M) Maximum: Minimum:	+87.25 m +69.0 m
17	Under Sluice bays	11 Nos. on right side of barrage

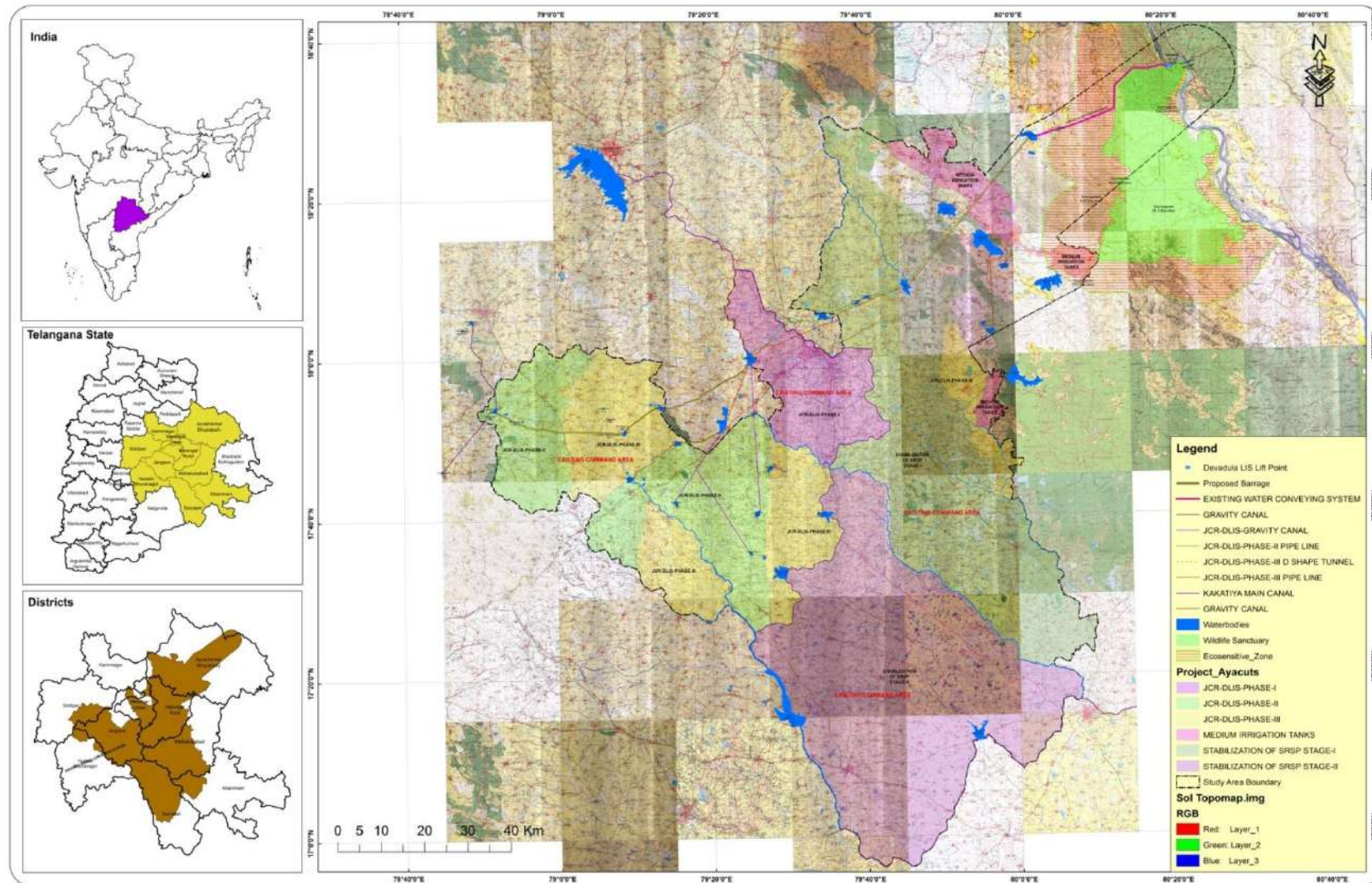


Fig 1 Location map of P V Narasimha Rao Kanthanapally Sujala Sravathi Project on SoI toposheet

2.1 Need for the project

The proposed project is deprived of the existing irrigation facilities such as JCRDLIS and SRSP Stage I & II. At present, there is no barrage built downstream of the intake channel and hence there is no pondage for drawing the water. Therefore, Telangana Government has proposed to take up this flagship project, by proposing a barrage along River Godavari to create a pondage with an operational pond level of 77 m downstream of the intake channel of JCRDLIS and the proposed barrage will stabilize the existing command areas of 2,51,310 Ha of Devadula Lift Irrigation Scheme and 3,04,000 ha of SRSP stages I & II. Further, the project will also provide 50 TMC of drinking water facility to en route cities, towns and villages.

2.2 Water availability

The net water availability at Thupakulagudem barrage site for the present purpose considering utilization under ongoing and planned projects are as mentioned below.

Table 11 Net availability of water at Thupakulagudem barrage site

Units	75% dependable flow at Perur reduced pro rata	Utilization under ongoing projects	Utilization under planned projects	Net Availability at 75% dependability
MCM	43450.6	10312.9	21602.8	11535.0
TMC	1534.7	364.3	763.0	407.4*

* - Excluding water requirement of Kaleshwaram Lift Irrigation Scheme

2.3 Command area of the project

The command area of 5,55,310 Ha includes all the benefitting villages falling under the existing command areas of JCR DLIS and SRSP S-I & II. The benefitting villages are spread across Jayashankar Bhupalapally, Nalgonda and Khammam Districts of Telangana. The command area villages are deprived of irrigation only during Rabi season which shall be made available by the proposed project.

Table 12 Benefitting Mandals of PVNRKSSP

Sl.No.	Name of the project	No. of Districts	No. of Mandals	No. of villages
1	JCRDLIS	8	37	364
2	SRSP Stage-I	3	11	81
3	SRSP Stage-II	3	7	73

As per the National Water Policy, drinking water facilities must be given a major priority. From the studies, it can be concluded that the proposed project supports 50 TMC of drinking water needs of the command area for about 6 decades for all the en route villages of the existing command areas. Therefore, the proposed project is said to have a major positive impact on the social lifestyle and economic aspects of the people in the benefitting districts.

2.4 Structural components of the project

- Spillway Radial Gates

It is proposed to provide 48 sets of Radial Type gates of (15000*14000) mm for Spillways. The gates shall be designed for height of 14 m. corresponding to Pond level and checked for HFL in accordance with the provision contained in IS 4623-2000. Each gate shall be operated with the help of downstream suspension Rope drum Hoist of 280 tons (Tentative) capacity. The regulation of discharge from this gate has been envisaged. The skin plate shall consist of stainless steel plate of minimum 12.0 mm thickness clad through Mill Cladding Process.

Table 13 Salient features of spillway radial gates

Sl.No.	Particulars	Remarks
1	Deck Level	EL 90.0 m
2	HFL	EL 83.0 m
3	Pond Level	EL 77.0 m
4	Crest Level	EL 71.0 m
5	Sill Level	EL 71.0 m
6	Top of opening	EL 85.3 m
7	C. L. Trunnion	EL 88.75 m
8	Clear Width of Opening	15.0 m
9	Radius of Gate up to inside of skin plate	22.0 m
10	Water Head on sill	14.0 m
11	Total No. of opening	48 Nos.
12	Total No. of gate required	48 Nos.
13	Types of gates proposed	Radial Type Gates
14	Position of Skin plates and sealing	Upstream
15	Skin Plate	Structure steel clad with stainless steel plate of 6 mm thickness mill/explosion clad
16	Mode of operation	D/s suspension Rope drum hoist of adequate capacity
17	Operation	Regulation of discharge
18	Design Standard	IS 4623, IS:800, IS 6938
19	Approximate Weight of Gate	190 tons
20	Approximate Weight of Embedded Parts	70 tons
21	Hoist Capacity	280 tons
22	Approximate Wt. of Hoist Bridge	30 tons
23	Approximate Wt. of Walkaway Bridge	7.5 tons

2.5 Land Requirement

The proposed project requires a total land of 674.18 Ha including 94 Ha of private (patta) land for implementation of the project and 580.18 Ha of river bed area (submergence area). There is no submergence of private land and hence there is no R&R due to the project. The required land will be acquired as per the Right to Fair Compensation and Transparency in Land Acquisition Rehabilitation and Resettlement Act, 2015.

2.6 Submergence of River bed area

The proposed project involves submergence of 580.18 Ha of river bed area alongside River Godavari near the proposed barrage at an FRL of 77 m.

2.7 Existing cropping pattern details

The command area is already being benefitted by the existing irrigation facilities (JCR Devadula LIS and SRSP Stage I and II) for the Khariff and bi-seasonal crops and the proposed scheme facilitates irrigation only during Rabi season. Therefore, out of 100 TMC of water required for the proposed project, 50 TMC of water shall be utilized for stabilizing the existing command areas during Rabi season when there is deficiency of water for irrigation.

2.8 Benefit cost ratio

The benefit cost ratio has been worked out to be 1.53 which involves construction of barrage and its components.

3. Description of baseline environment

In order to assess the baseline environmental status, 10 Km radius from the main project components were considered. The construction activities will be restricted only to barrage location and there is no new works envisaged in the command area. However, to understand the baseline status, command area also considered for the study. The data was collected for three seasons (July 2017 - March 2018). In addition to the baseline environmental monitoring, field inspection in the study area, collection of primary and secondary information for all the environmental components and discussions with the officials and local public were conducted by the experts.

3.1 Physical Environment

3.1.1 Topography

The proposed project is located in Deccan plateau of India. Topography is relatively mild to medium slopes.

3.1.2 Ambient air quality

The results of ambient air quality reveal that, PM₁₀ was in the range between 40-70 µg/m³ and whereas PM_{2.5} was in the range between 11-25 µg/m³. SO₂ and NO₂ are in the range between 3.89-5.64 µg/m³ and 9.52-34.82 µg/m³ respectively. The air quality index in the study area is found to be satisfactory for PM₁₀ and good for PM_{2.5} and gases (SO₂ and NO₂).

3.1.3 Ambient Noise levels

The results of ambient noise levels were compared with Residential standards and results reveal that, the noise levels in the study area ranging from 42.16 to 53.58 dB(A) for day time and 34.48 to 42.72 dB(A) for night time. Overall, the noise levels in all the seasons were observed to be well within the CPCB standards.

3.1.4 Seismicity

The proposed barrage and command area falls in zone-III (Moderate Damage Risk Zone). Hence, probabilities of earthquake occurrence are very less.

3.1.5 Geology and Minerals

The main rock type observed in the command area is Sandstone, Breccia, Conglomerate along with few clay beds, Limestone beds of Chikiyala Formation and Sandstone, Siltstone, Clay, Limestone beds of Kota formation belongs to Upper Gondwana Group of Meso-proterozoic age and Sandstone of Albaka Formation belonging to Pakhal supergroup, Shale of Lakkavaram Formation belonging to Mulugu group of Meso-proterozoic age along with Unclassified of Sullavai Group of rocks.

3.1.6 Soil types

They belong to 3 orders, namely Inceptisols, Entisols and Vertisols. Of the total area of Telangana, 27% is covered with Alfisols, 25% by Inceptisols, 16% by Entisols, 15% by Vertisols, 8% by Ultisols, 5% by Aridisols and 1% by Mollisols. The major soil forms found in the Jayashankar Bhoopalapalle district are red gravelly clay soil; red clay soil; lateritic gravelly clay soil; lateritic clay soil; medium deep black soil; non-saline and saline alluvo-colluvial soil; brown forest soil. The major minerals found in the district are limestone; white quartz; kaolin; kyanite; manganese. Various soil types abound, including chalkas, red sandy soils, dubbas, deep red loamy soils, and very deep black cotton soils that facilitate planting mangoes, oranges and flowers.

From the overall results of physico-chemical analysis of the soil samples, it is noticed that the soil pH values range between 5.58 and 8.76 and most of the values belong to soil reaction index II & III which shows that the soils of the study area are under the Neutral to alkaline range. The electrical conductivity of the soil samples were observed to be in the range between 27.4 and 905 µmhos/cm. Based on the rating chart of soil tests, all the soil samples

belong to normal i.e., salt index I. whereas organic carbon content of soil sample were observed to range from 0.12 to 0.72 percent. As per the nutrient index, the organic carbon in all soil samples was at low except for medium level in Peddapalle. However, most soil sample are having low nutrient index and phosphorus has high nutrient index.

3.1.7 Hydrogeology

The study area and its environs in the 10.0 Kms buffer zone is underlain with Sandstone, Breccia, Conglomerate with few clay beds and Limestone beds. These rocks are having of primary to medium porosity. However, weathering, fractures, joints and fault zones act as conduits for movement and storage of groundwater and yield water in abstraction structures. The main source of recharge is precipitation. Groundwater occurs under phreatic conditions in weathered zone and under semi-confined to confined conditions in joints and beddings of carbonate rocks. Surface water occurrence is negligible and tanks were observed to be dry during pre monsoon period. Alluvium is confined to major rivers with thickness ranging between 3.0 to 8.0 mts.

Water table generally follows the topography of the study area and is at greater depths in the water divide area and topographic heights but occurs at shallow depth in the valleys and low lying terrain and therefore groundwater moves down and follows the gradient from the higher to lower elevations i.e. from recharge area to discharge areas. The general flow direction of groundwater in the study area is towards South.

3.1.8 Surface Water

- Monsoon season (July 2017 - September 2017)

pH was in the range of 7.02 - 8.14 at Rajulakota Palli and Chokkarao cheruvu respectively. Total Hardness in the surface water was in the range of 58 mg/L - 244 mg/L at Mylaram cheruvu and Musi reservoir respectively, Dissolved oxygen was found to be 4 mg/L - 5.5 mg/L at Rajulakota Palli and Mylaram cheruvu respectively. Highest values of conductivity and chloride were found to be 1021 μ S/cm and 160.5 mg/L respectively at Musi reservoir. Due to improper sanitation and utilization of River water for various domestic purposes Total Coliform and E-coli was found at all locations in the range of 10-84 MPN/100ml and <1.8 MPN/100ml respectively.

- Post-monsoon season (October 2017 - December 2017)

pH was in the range of 6.91 - 7.9 at Chali Vagu Project and several locations respectively. Total Hardness in the surface water was in the range of 46 mg/L - 590 mg/L at Chokkarao cheruvu and Chali Vagu respectively, Dissolved oxygen was found to be 4.4 mg/L - 5.7 mg/L at Chokkaraoplle and downstream of Godavari River respectively. Highest values of conductivity and chloride were found to be 1800 μ S/cm and 272.96 mg/L respectively at Chali Vagu. Due to improper sanitation and utilization of river water for various domestic purposes Total Coliform

and E-coli was found at all locations in the range of 4-120 MPN/100ml and <1.8-21 MPN/100ml respectively.

- Pre-monsoon season (January 2018 - March 2018)

pH was in the range of 7.13 - 9 at Chokkaraoplle and upstream of Godavari River respectively. Total Hardness in the surface water was in the range of 72 mg/L - 416 mg/L at Mylaram cheruvu and Musi reservoir respectively, Dissolved oxygen was found to be 1.2 mg/L - 6 mg/L at Noonegudem cheruvu and upstream of Godavari River respectively. Highest values of conductivity and chloride were found to be 2370 μ S/cm and 404.98 mg/L respectively at Musi reservoir. Due to improper sanitation and utilization of river water for various domestic purposes Total Coliform and E-coli was found at all locations in the range of 12-3900 MPN/100ml and <1.8-550 MPN/100ml respectively.

3.1.9 Ground Water

- Monsoon season (July 2017 - September 2017)

The ground water quality analysis results reveal that, the Total Hardness was found to be in the range of 148 mg/L - 1080 mg/L at Vastakondur and Gundala village respectively. Electrical Conductivity was found to be in the range of 616 ms/cm - 6280 ms/cm at Jallepalli village and Kamalapura village respectively. Total Coliform was to be in the range of <1.8-2 MPN/100 ml at all locations.

- Post-monsoon season (October 2017 - December 2017)

The ground water quality analysis results reveal that, the Total Hardness was found to be in the range of 102 mg/L - 874 mg/L at Gundala village and Gadepally village respectively. Electrical Conductivity was found to be in the range of 328 ms/cm - 2530 ms/cm at Neermala village and Dharmasagara village respectively. Total Coliform and E- coli was found to be <1.8-2 MPN/100ml at all locations.

- Pre-monsoon season (January 2018 - March 2018)

The ground water quality analysis results reveal that, the Total Hardness was found to be in the range of 146 mg/L - 900 mg/L at Komuravelli village and Medaramatla village respectively. Electrical Conductivity was found to be in the range of 716 ms/cm - 5950 ms/cm at Mathpally village and Kamalapura village respectively. Total Coliform was to be in the range of <1.8-4 MPN/100ml at all locations.

3.1.9 Land use assessment

The results indicate that the buffer zone is dominated by crop lands followed by forest and water bodies. It also includes built-up and scrub land. The ground truth survey revealed that the major crops cultivated in the region are rice and cotton. The other crops include maize, sorghum, pulses, groundnut, green gram, red gram, bajra, and bengal gram.

Table 14 Land use and Land cover data of study area

Sl. No.	LULC Types	Area (Sq. Km)	Area (Ha)	Percentage (%)
1	Built-up	265.17	26517	2.10
2	Agriculture Plantation	23.15	2315	0.18
3	Crop Land	9814.03	981403	77.62
4	Forest	1564.88	156488	12.38
5	Land With & Without Scrub	48.97	4897	0.39
6	Scrub Forest	240.61	24061	1.90
7	Water bodies	687.67	68767	5.44
Total		12644.49	1264449	100.00

3.2 Biological Environment

3.2.1 Flora and Fauna

The proposed project involves construction of the barrage across River Godavari which facilitates irrigation throughout the existing command area for Rabi season. The command area of the proposed project is already irrigated with healthy vegetation and fresh water tanks supporting various floral and faunal species.

- Project site (Near proposed Barrage)

Near barrage site, a total of 39 tree species were recorded during the study. In addition to this, 76 species of herbs, 10 species of shrubs and 7 species of climbers were recorded during Monsoon season. A total of 34 species of herbs, 10 species of shrubs and 4 species of climbers were recorded during Post Monsoon season. Similarly, 62 species of herbs, 10 species of shrubs and 5 species of climbers were recorded during Post Monsoon season. All the species recorded were common to the region and no RET species were observed during the study.

Similarly, in barrage site a total of 29 avifaunal species and 46 butterfly species were recorded during monsoon season, 29 avifaunal species and 34 butterfly species were recorded during Post monsoon season and 61 avifaunal species and 34 butterfly species were recorded during the Pre monsoon season. Jerdon's courser, Finn's weaver, Purple wood pigeon, Black necked stork, Black tailed godwit and Darter oriental are the avifaunal species belonging to Critically Endangered, Vulnerable and Near Threatened category as per IUCN conservation status, 2017. Common Buzzard, Indian peafowl, Shikra and Jerdon's courser are the avifaunal species belonging to Schedule I of Wildlife (Protection) Act, 1972. Butterflies such as Common pierrot, Blue pea, Common gull and Common crow are the only species belonging to Schedule I, II and IV of Wildlife (Protection) Act, 1972. All other species are common to region.

- Command area

In Command area, a total of 26 tree species were recorded during the study. In addition to this, 85 species of herbs, 13 species of shrubs and 10 species of climbers were recorded during Monsoon season. A total of 57 species of herbs, 13 species of shrubs and 7 species of climbers were recorded during Post Monsoon season. Similarly, 69 species of herbs, 13 species of shrubs and 9 species of climbers were recorded during Post Monsoon season. All the species recorded were common to the region and no RET species were observed during the study.

Similarly, in Command area a total of 61 avifaunal species and 34 butterfly species were recorded during monsoon season, 29 avifaunal species and 20 butterfly species were recorded during Post monsoon season and 60 avifaunal species and 34 butterfly species were recorded during the Pre monsoon season.

Mega faunal species such as sloth bear, wild boar, fox, barasingha, nilgai, sambar deer, jungle cats etc are the commonly recorded species in the study area due to the presence of Mahadevpur Reserved Forest nearby. As per IUCN Conservation status, 2017 two vulnerable species namely, sambar deer and sloth bear were recorded. Of which, Sloth bear and Sambar Deer belongs to Schedule-I and Schedule-III of Wildlife (Protection) Act, 1972 respectively. However, no such mega faunal species were recorded during the study.

- Aquatic ecology

Detailed limnological and Fisheries investigations were carried-out in the Godavari river. Totally 105 fish species were recorded.

3.2.2 Protected Areas

Eturnagaram WLS (80,600 Ha) is located at the close proximity (< 5 Km) from the proposed barrage in Eturnagaram village in Bhoopalpally district of Telangana. According to Champion and Seth classification (1968), the forest type in Eturnagaram WLS is Tropical Dry Deciduous Forest with unique climbers and dominant tree species such as *Tectona grandis*, *Terminalia arjuna*, *Bambusa vulgaris*, *Madhuca sp.*, *Terminalia sp.* and *Pterocarpus marsupium*. A perennial river known as "Dayyam Vagu" divides the sanctuary into almost two parts. Major faunal attractions of this Sanctuary includes Tiger, Panther, Gaur, Sambar, Chital, Nilgiri Black buck and reptiles such as Mugger crocodiles, Cobra, Python and Krait.

4. Anticipated Environmental Impacts & Mitigation Measures

Due to the activities of the project, there will be potential impacts on the environment of varying magnitude. Most of the impacts are likely to occur during the construction phase of the project. The following section reveals the prediction of impacts due to the project on the physical, biological and social environment. Impacts have been assessed based on the information collected from the primary and secondary data.

4.1 Impacts during Construction phase

4.1.1 Ambient Air Quality

4.1.1.1 Anticipated impacts

The construction of the project is expected to complete by 2 years. The initial site clearing will be followed by site preparation activities, which include;

- Grading
- Excavation of footings and foundations,
- Backfilling operations

Excavation work at site causes disturbance due to the emission of particulate matter in the construction area. Fugitive dust emissions from the construction of the project will result from:

- Air pollution (dust) due to various construction activities, movement of vehicles will pose health concerns to the construction work force in terms of respiratory problems.
- Dust entrained during site preparation and grading/excavation at the construction site
- Dust entrained during onsite travel on paved and unpaved surfaces
- Dust entrained during aggregate and soil loading and unloading operations and
- Wind erosion of areas disturbed during construction activities.

Combustion emissions during construction will result from:

- Exhaust from the Diesel construction equipment used for site preparation, grading, excavation, trenching and construction of onsite structures.
- Exhaust from water trucks used to control construction dust emissions.
- Exhaust from Diesel-powered welding machines.
- Exhaust from pickup trucks and Diesel trucks used to transport workers and materials around the construction site.
- Fugitive emissions from various construction activities including blasting will pose health concerns (respiratory problems) on the neighbouring village residents (Thupakulagudem).
- Exhaust from Diesel trucks used to deliver concrete, fuel, and construction supplies to the construction site.
- Air quality of the region will also get affected due to the movement of vehicles to and from the site carrying construction material brought by truck.

4.1.1.2 Mitigation measures

- The following mitigation measures will be proposed to control exhaust emissions from the diesel heavy equipment/transport vehicles and potential emissions of fugitive dust during construction of the project:
- Unpaved roads and disturbed areas in the project construction site to be watered as frequently as necessary to prevent fugitive dust emissions. The frequency of watering can be reduced or eliminated during periods of precipitation.
- The vehicle speed limit restricted to 15-20 kmph within the construction site.
- The construction site entrances posted with visible speed limit signs.
- PPEs like nose mask will be provided to the construction work force.
- Construction equipment vehicle tires inspected and washed as necessary to be cleaned free of dirt prior to entering paved roadways.
- Gravel ramps of at least 20 feet in length provided at the tyre washing/cleaning station.
- Paved exits from the construction site to prevent track out to public roadways.
- Paved roads within the construction site swept at least once daily (or less during periods of precipitation) on days when construction activity occurs to prevent the accumulation of dirt and debris.
- Vehicles used to transport solid bulk material on public roadways and having the potential to cause visible emissions to be provided with a cover, or the materials sufficiently wetted and loaded onto the trucks in a manner to provide at least one foot of freeboard.
- Any construction vehicle not meeting the emission norms standards (PUC) not being allowed within the construction site and emission certificate made mandatory for the same and this is strictly enforced on the transport contractors to abide by the same.
- Water sprinkling (3 times a day) will be done in all the dust generating activities like site clearing, levelling, excavation, material handling etc to suppress the dust.
- Errection of the barricades along the periphery of the construction sites.
- Controlled blasting with water sprinkling will be adopted to suppress the dust generation.
- Vehicles delivering loose and fine materials like sand and fine aggregates covered by tarpaulin sheets to reduce spills on roads so as to avoid fugitive emissions.
- DG sets engaged in the construction site equipped with suitable stack height.

- Monthly Ambient Air Quality Monitoring will be carried out to assess the pollution load during construction phase.
- During excavation, regular water sprinkling will be undertaken to avoid fugitive dust.

The expected increase in concentration will be (60.4 $\mu\text{g}/\text{m}^3$ + 48.5 $\mu\text{g}/\text{m}^3$) in the core area thereby causing discomfort in breathing, eye and nose irritation to the labours. With the water sprinkling activity, covering of vehicles delivering loose materials with tarpaulin sheets will reduce the GLC of particulate matter from the project to 31.7 $\mu\text{g}/\text{m}^3$. However the GL concentration in the study area will be in the range of 19.77 $\mu\text{g}/\text{m}^3$ to No effect zone.. GLC of 0.11 $\mu\text{g}/\text{m}^3$, 0.4 $\mu\text{g}/\text{m}^3$, 0.05 $\mu\text{g}/\text{m}^3$ can be observed in the Devadula, Thupakulagudem and Chandrupatla respectively.

As per the model isopleths (with mitigation), the maximum incremental concentration of 31.7 $\mu\text{g}/\text{m}^3$ is expected in the core zone of the project, if the mitigation measures are implemented resulting in the total concentration of 92.1 $\mu\text{g}/\text{m}^3$ within the standard of CPCB. This dust is expected to be depositing on 3,42,300 trees (considering 700 trees / ha). However, this concentration does not affect the transpiration of these trees. A M. Farmer (1993) argued that, trees shall have the capacity to withstand the dust concentration in the range of 25-100 $\mu\text{g}/\text{m}^3$. The Study area GLC observed to be in the range of 13.02 $\mu\text{g}/\text{m}^3$ to No effect, resulting in no damage to human health of the neighbouring population. GLC of 0.08 $\mu\text{g}/\text{m}^3$, 0.32 $\mu\text{g}/\text{m}^3$ and 0.03 $\mu\text{g}/\text{m}^3$ can be observed in the Devadula, Thupakulagudem and Chandrupatla respectively. Hence, this impact is very minimum.

4.1.2 Ambient Noise Level

4.1.2.1 Sources of noise pollution

- During construction phase, various sources of noise pollution arise due to Concrete Batch Plant, Crane, Generator, Tractor, Welder, Vibrating Hopper etc.,
- Other source of noise pollution includes movement of vehicles for unloading of construction materials, fabrication, handling of equipments.
- Construction activities are expected to produce noise levels in the range of 80 – 95 dB (A).

4.1.2.2 Mitigation measures

- DG sets will be placed on the rubber cushion padding, enclosed and maintained well in good condition. It will be encased and barricaded & taken to all places where it will be used. This reduces the noise level in and around the source by at least 4 dB (A). Mobile DG sets are more advantageous and preferred here.

- Ear plugs will be provided to all employees and laborers while working, irrespective of the noise levels as protection, to receive the noise and as well as exposure of the same for a longer period.
- Barricades will be provided around the construction areas. Speed limit of vehicles will be restricted to 15-20 kmph in and around the construction site. No honking boards will be displayed within the construction areas.
- During construction time, possible chances of number of trucks coming to the project area is more carrying construction debris and other materials, muck etc and the drivers of these vehicles will be instructed with sign boards and not to use shrill horns for any purpose and cover the material without any spillage.
- Silent Zone boards will be installed at all places where human activities are there along with proper training to them to handle various equipments, tools and other related items.
- The noise levels will be monitored periodically (monthly) in the project area.
- Construction activities will be carried out only between 6 am to 6 pm and completely suspended during night time to avoid psychological distress on people of Thupakulagudem village and avifauna in the buffer zone.
- Supervisory staff will be checked and monitored to ensure the workers to follow all the above said measures while at work.
- Controlled blasting will be employed during drilling and blasting to avoid vibrations which can affect structures of Thupakulagudem village and burrow animals and reptiles.

4.1.3 Water Environment

4.1.3.1 Sources of water pollution

- Improper treatment of sewage from labour camps leads to infiltration into the subsurface soil and finally affects the quality of ground water. Labour camp is expecting to generate 30 KLD of sewage (considering 75 lpcd for 400 labors) which is anticipated to pollute ground water in an area of 2 ha from the source at 60-70 m bgl. Further, the source of pollution is at a distance of 500 m to the Thupakulagudem village. Hence, the chances of pollution to drinking water will be nil.
- Improper management of domestic solid waste from labour camps & dumping near water bodies leads to surface water pollution.
- There will be creation of unaesthetic conditions in the site, attracts mosquitoes/flies, thereby chances of deteriorating the health of the workers in unhygienic conditions and it also affects people of Thupakulagudem village.

- Improper disposal of construction debris, used oil, diesel for DG sets, etc will result in Godavari River water contamination leads to decrease in DO levels and morbidity of aquatic life.
- Improper management of excavated earth (42,52,579.12 cum) and dumping of muck, boulders into the nearby river will create turbidity of water and in turn affects river water quality and aquatic life.

4.1.3.2 Mitigation Measures

- The sewage generated from the labor camps will be treated in mobile STP installed at site. Solid waste from labour camps will be collected in different bins and handed over to nearby municipal authorities.
- There will be no open discharge of sewage from labor camps and the labor camps will be provided with sufficient bathrooms and toilets. Prevention of possible water logging areas through soil filling. Periodical health check-ups (6 monthly once) will be conducted for labors and also to Thupakulagudem village people.
- Construction debris will be reused at site; used oil generated from the DG sets will be stored separately and handed over to TSPCB authorized recyclers. Further, the leakages of oil spills from machinery shall be collected in leak proof barrels and then disposed off to TSPCB authorized dealers.
- During construction of barrage, the river course and the point of contact will be provided with sand bags and rock boulders.
- Implementing Muck Disposal Plan: Further excavated earth will be fully utilized for various construction works such as inspection path, stabilization of embankment, land levelling.

4.1.4. Soil Environment

4.1.4.1 Sources of soil pollution

- Temporary loss of soil will be envisaged during the construction phase as construction site, temporary offices, labour camps, stockyards will be located on 26 ha of agriculture lands.
- Improper disposal of Solid waste generated from labour camp (180 Kgs/day) during construction phase will create leaching problems thereby affecting soil biota and ground water. Further, it also creates un-aesthetic conditions to Thupakulagudem village people.
- Leakage of used oil from DG sets on the land will impact the soil biota. Oil spill affects plants negatively by creating conditions which makes essential nutrients like nitrogen, Oxygen etc needs for plant growth unavailable to them from the spilled affected soil.

4.1.4.2 Mitigation Measures

- Restoration of 26 ha of land utilized as construction site, temporary offices, workers camps, stockyards will be undertaken soon after the completion of barrage construction.
- Scientific disposal of solid waste will be undertaken and handed over Eturnagaram Mandal panchayat.
- Maintenance and period repairs of machineries will not be taken up in the project site vicinity. Maintenance of DG sets will be done at the vendors place and will not take up near project site.
- Storm water drainages and underground drainage of seepage water from construction area will be provided with retention tanks to hold for at least 2 hours and periodic cleaning of silt collected in the tanks.

4.1.5 Land use assessment

4.1.5.1 Impacts

- The construction of barrage across the river and submergence of 674.18 ha leads to permanent change in land use.
- Present rain fed area will be converted into irrigated area. Hence, possibility of Salinization will be expecting in an area of 830 ha.
- Providing irrigation, Tank filling and drinking water increases employment opportunities, ground water recharge, enhances local biodiversity and health benefits to the project benefitting districts.
- Application of Inorganic fertilizers in the command area will impact on the intrinsic nutrient availability of soil, soil biota, resulting to decline in productivity/yield of soil which in turn changes the agricultural land use pattern in the command area.
- Disturbance to the natural flow of Godavari River is anticipated because of construction of barrage.
- The present command of JCRDLIS and SRSP are suffering command area of existing irrigation schemes and deprived of irrigation facilities and could not achieve the targets due to scarce water availability. Drinking water demand is also not met.

4.1.5.2 Mitigation Measures

- Treatment of saline and sodic soils will be undertaken in consultation with Agricultural Department.

- Agricultural training programmes will be conducted to the farmers in the command area in association with agricultural department, Govt., of Telangana. Organic farming practices will be promoted.
- To ensure natural flow of water, gated arrangements provision will be made.
- The proposed barrage in the scheme will stabilize the existing schemes there by change in Land use pattern from rain fed to irrigated system. There is also provision of drinking water supply (50 TMC) in the scheme.

4.1.6 Impact on Solid & Hazardous Environment

4.1.6.1 Impacts

- Solid Waste of 180 Kg/day (0.45 Kgs/day/person) will be generated from the labour colony like kitchen waste, garbage, plastic waste, etc. Improper management of solid waste from the labour colony & irregular practice in disposal of waste leads to spread of infectious diseases and un-aesthetic condition.
- Improper storage of solid waste leads to leachate formation of 13.86 Cu.m/year which will affect the surface water quality and aquatic life.
- Indiscriminate plastic waste disposal on land makes the land infertile due to its impervious nature and also affects wild animals of adjacent Eturnagaram WLS.
- Improper management in storage of muck, excavated earth & Boulders will affect the natural flow of water and will result in turbid condition (1 km u/s and d/s of barrage area) of Godavari River affecting aquatic life. Sometimes muck moves along with the runoff creating landslides which leads to sedimentation and also affects yields of neighboring farmers.
- 50 l/annum of used oil is anticipated from the DG Sets of capacity 2 x 500 KVA. Improper storage and disposal affects surface water quality and aquatic life.
- 200 liters of paint is required during construction phase and the improper disposal of containers affects surface water quality and aquatic life.
- Welding electrodes and unused iron components including scrap of 105 tonnes (2% of total steel requirement) is anticipated during construction activities. Improper handling of these affects surface water quality and aquatic life.

4.1.6.2 Mitigation Measures

- Solid and hazardous wastes generated will be stored in the leak proof bins. Scientific segregation of solid waste at site and regular disposal to Eturnagaram Mandal municipal authority's landfills. Storage area 5 m x 5 m will be covered with zinc sheets and the ground will be covered with impervious layer to avoid leachate run off. Pest

control will be done periodically (quarterly once) in and around labour camps and project site office areas.

- Monthly surface water quality testing as per IS 10500 Drinking Water Quality Standards and quarterly study of aquatic life. Cost has been worked out accordingly.
- Plastic waste will be segregated at source and handed over to TSPCB authorized recyclers.
- Water sprinkling will be done 3 times a day to avoid fugitive emissions and the excavated earth and muck will be stored in designated areas at lower contours.
- Used oil generating from the DG sets and paint containers will be handed over to authorized recyclers.
- Implementation of muck disposal plan.
- Generated muck from the project will be stored and covered with the green mesh in the designated place along with construction of bunds around it and will be reused later.
- The leftovers of welding electrodes and iron components will be handed over to the nearby engineering works centre so as to remould and reuse them for making other iron works.

4.1.7 Impact on Hydrology & Geology

4.1.7.1 Impacts

- Geological Environment: As the proposed project site i.e., Barrage is proposed over the Godavari River the litho unit covering is Sandstone and Shale to store water for strengthening the existing Devadula LIS upstream so that water is available continuously to the project command area. As such there is no disturbance or alteration to the local Geology.
- Seismic tectonics: Seismic activity with respect to the proposed barrage was studied at the possibility during the post project scenario. It was observed that no major earth quakes occurred in the region during the past 49 years. However, the recent recorded major earth quake of magnitude 6.2 on Richter scale to the project site was in Ausa, Maharashtra during 1993. The seismic zoning map has been referred to know the zone in which the project site is located. The proposed project site is falling in Zone-III which has very moderate risk of damage.
- Changes in hydraulic regime: During the construction phase, no severe affect on a water availability and hydrology is anticipated. Based on the Detailed Project report of WAPCOS Limited for I&CAD Telangana the required water of 100 TMC is available.

- Due to flooding, soil erosion and increasing sedimentation leads to submergence of adjacent lands of 462 ha of villages Thupakulagudem, Gangaram, Thimmaigudem, Venchepally and Mukunur and adjacent forest area.
- Impact on structural stability and breaching of barrage.

4.1.7.2 Mitigation Measures

- The maximum flood recorded between 1966-2015 was in the year of 1986 with a discharge of 62,889 cumecs with a water level of 87.42 m. Hence, the occurrence of flood is not frequent. The gates will be operated during high flood season to release downstream. However, suitable emergency action plan will be initiated to restore the area. In order to avoid soil erosion and sedimentation, CAT plan will be implemented (Chapter-9).
- Sub-surface exploration has revealed the occurrence of bed rock below the sand cover is 3.5m to 8.5m and the rock is dark grey schistic Quartzite or Quartzo-schistic rock, in the center of the river bed, the rock is hard and massive, but highly fractured, with low core recovery noted as maximum as 65%, which is good to be tied up the barrage.

4.1.8 Impact on Biological Environment

4.1.8.1 Impacts

- Eturnagaram Wildlife Sanctuary is located at a close proximity from the proposed barrage (<5 Km). However, no rare, threatened, endangered plant species were recorded during the study and all the other species recorded were common to the region. Avifaunal species such as Shikra, Jerdon's courser, Indian peafowl, Common buzzard and Booted eagle; butterfly namely Common pierrot and mammals such as Black buck, Four horned antelope, Indian wolf and Sloth bear were recorded during the study in the project site as well as in the command area which belongs to Schedule I of W(P)A, 1972.
- About 30 ha of land have been identified for carrying out construction activities close to the River Godavari. Out of which, 26 ha are agricultural lands and remaining area is waste land followed by riparian land. Totally, 800 trees of different girth size (<30 cm is 700 and >30 cm is 100) will be removed.
- The proposed project does not involve the diversion of forest land, hence there will be minimum impact on the biological environment and there is no scope for forest clearance.
- Emission of dust is expected during vehicular movements for transportation of construction material or construction waste during construction phase which would reduce the photosynthetic activity in plants by its deposition on the foliage.

- Mobilization of machineries and workers during construction phase will create disturbance to the mega-faunal species/ wildlife due to the presence of Eturnagaram WLS.
- Construction activities will affect the aquatic biota of River Godavari upto 1 Km and reptiles and burrow animals upto 1 Km due to vibrations generated from machineries and disturbance in the river bed area
- Emission of dust is expected during vehicular movements for transportation of construction material or during construction phase which would reduce the photosynthetic activity of 3, 42,300 trees plants by its deposition on the foliage.
- During the construction of barrage across Godavari River, fish species move towards certain safe locations. However, minor impacts on fish species will be anticipated on either side of the barrage upto 100 m.
- Construction activities will affect the aquatic biota of River Godavari due to vibrations generated from machineries and disturbance in the river bed area.
- While undertaking the construction of the barrage across the River Godavari and related components, controlled blasting and such; other measures are to be adopted. The extracted produce-earth, muck, boulders, etc are normally dumped, as a routine practice in such exercises very close to the lotic water bodies; result being the flow of water in the system gets altered affecting the aquatic life-fish species present in their migration exercises for feed, feeding, breeding and recruitment needs for sustenance and propagation.
- Fish species, as a result of certain changes in the environment at the site, may get locked-up in water-holding pools where these strive to sustain their biological needs. Suggestions to be incorporated have been listed in the Environmental Management Plan.
- There will not be any type of 'Negative' impact/s on the quality and status of the river water during the operation phase.
- Since the present human settlement/ village is located close to the envisaged project site, the quality of the river water getting affected causing medical problems could be in marginal limits during the construction phase. However, the labour force and others being assembled at the spot/locality in large numbers for the execution of the envisaged project offers opportunities for the spread of communicable health disorders, the prevalence of which may get affected/impacted for days to come.
- While constructing the barrage and related facilities, considerable quantum of rocks, boulders, earth, etc. being extracted which, as a normal/usual practice in such situations, are dumped in close location. In order to prevent the sliding back into the water body affecting normal flow regime, are to be secure appropriately quiet away from the river in particular. Also, screens of desirable mesh-sizes depending upon the

height and width etc to cover advantage points are to be installed in order to maintain normal biological processes of aquatic life fish species prevailing.

- There will not be any adverse impact/s on the aquatic life- fish species in particular habitat in the biotope on the implementation of the suggestions made. Flow of river water, as envisaged, to the riparian part of the lotic water body at the site will be maintained quite adequately to keep the pools and such other water- holding facilities harbored with fish species to sustain their biological needs.

4.1.8.2 Mitigation Measures

- Conservation plan for schedule I species will be implemented in the operation phase.
- Restoration of vegetation will be carried out to compensate (26 ha) the land identified for carrying out construction activities as well as along the left and right bank of the proposed barrage by carrying out plantations at the ratio of 1:3 so as to improve the ecological environment.
- Periodic sprinkling of water (3 times a day) to the plants for alongside the access roads to the construction site will reduce the deposition of dust on the foliage and thus retaining their photosynthetic activities.
- Utilization of modern equipments during construction phase can produce less sound and vibrations reducing the disturbances to the faunal species including avifauna and wildlife. Construction activities shall be carried out only during the day time so as to reduce the impacts on the nocturnal animals and other mega-faunal species.
- It is proposed to construct the temporary structure to arrest the flow by using rock boulders to avoid turbidity of water and modern technology such as controlled blasting will be used to minimise the vibrations not beyond 100 m.
- Screens of desirable mesh sizes depending upon the height and width to cover advantage points will be installed in order to maintain normal biological processes of aquatic life and fish species prevailing.
- Appropriate measures will be taken with utmost caution and at desired levels to stall flow of the medium suspecting to hold any harmful/un-hygienic extraneous content in order to maintain the quality, potability and related nature of the lotic system.
- The people: work force, business establishments, etc. must shift away from their temporary dwellings and commitment arrived at earlier itself i.e., prior to the establishment of the project envisaged to minimize the spread of communicable health disorders.
- After the commissioning of the project, limnological and fisheries investigations need to be organised for a period of 3-5 years (on quarterly basis) at least to assess the

overall picture on the physico-chemical features of the river water at the site and close-by areas, biological aspects such as plankton biomass, benthic/littoral faunistic elements, aquatic vegetation, exotic fish, if present so as to introduce corrective measures to sustain normal ecological features and to introduce effective technical measures based on the data generated during the course of the studies.

4.2 Impacts during Operation phase

4.2.1 Impacts

- Failure of this project would result in socio-economic sufferings, no assured water for agriculture and farmers would largely experience drought like situations to a greater extent.
- No severe affect on a water availability and hydrology is expected in the downstream areas due to construction of barrage. 100 TMC of water for the proposed project is available and the clearance has been sought. In addition to this, water flows will not be affected as Maner, Pranahita and Indravathi are major contributors to River Godavari.
- Construction of barrage will affect the migratory paths of aquatic fauna of River Godavari leading to depletion of fish population.
- Abstraction of 100 TMC of water will reduce the water availability in the river causing impacts on fish germplasm (aquatic life).
- As the agricultural practices flourish with availability of water, usage of pesticides and application of fertilizers will naturally increase which leads to soil quality deterioration.
- The recharge to aquifer will be boosted once extensive agriculture is practiced a portion of water will be infiltrated in to ground recharging the aquifers. In addition to this, artificial recharge of the aquifers by construction of suitable harvesting structures like farm ponds, nala bunds, check dams and also desilting of tanks.
- As the drawal of water is minimized, the water table will rise and many of the borewell will yield substantial water.
- During the operation phase, no medical/health problems to the residents and the migrant labour, business force on contract for the envisaged project work could be forecast now.

4.2.2 Mitigation measures

- The project has been planned due to persistent demands of local people keeping in view of water availability at Godavari River. As such, failure will not be anticipated due to water availability.
- Special Land Acquisition Officers for this project will be engaged to resolve the matters related to land acquisitions and compensations.

- Restrictions on time, method and rate of application of fertilizers and pesticides will be imposed to avoid surface run-off and leaching on to the groundwater regime.
- The construction of barrage does not affect the migratory paths of the fishes as the sluice gates of the barrage provide an access for the fishes to cross the barrier.
- Minimum environmental flow (e-flow) will be maintained during lean season and as per the Global Environmental Flow Calculator Model (GEFC) results reveal that, 64% of the river condition will be maintained 'natural', 39% with slightly modified condition and there will be minimum seriously modified (7%) and critically modified condition (4%).
- Desired medical facilities are to be organised to meet any emergency.

5. Environmental Monitoring Program

The purpose of the monitoring programme is to ensure that the objectives of the project is achieved through the mitigation measures and result in desired benefits to environment and local population of the region.

Table 15 Environmental Monitoring Plan for construction phase (2 years)

Environmental Parameters	Parameters to be Monitored	Frequency of Monitoring	Locations	Responsibility	Estimated Cost in Rs.
Surface water quality of Godavari River	pH, Temperature, EC, TDS Alkalinity, TH, DO, BOD, COD, NO ₃ , PO ₄ , Cl, SO ₄ , Na, K, Ca, Mg, Silica, Oil & grease and Total Coliform	Monthly once	Near Proposed Barrage Site, Downstream and Upstream of Godavari River (3 Nos.)	Irrigation & CAD Department Govt. of Telangana	19,560/-
Ground water quality	pH, Temperature, EC, TDS Alkalinity, TH,NO ₃ , PO ₄ , Cl, SO ₄ , Na, K, Ca, Mg, Silica, Oil & grease &Total Coliform	Monthly once	Near Labour Camp (1 No.)	Irrigation & CAD Department Govt. of Telangana	4,670/-
Soil Quality	pH, EC, Mg, Ca, Alkalinity, Cl, Na, K, Organic Carbon, PO ₄ , SAR, N and Salinity	Monthly once	Near Proposed Barrage (1 No.)	Irrigation & CAD Department Govt. of Telangana	5,470/-
Air Quality	PM ₁₀ , PM _{2.5} , NO ₂ and SO ₂	Monthly once	Near Proposed Barrage (1 No.)	Irrigation & CAD Department Govt. of Telangana	10,500/-
Noise Levels	Leq Day, Leq Night in dB(A)	Monthly once until completion	Near Proposed Barrage (1 No)	Irrigation & CAD Department Govt.	7,000/-

Environmental Parameters	Parameters to be Monitored	Frequency of Monitoring	Locations	Responsibility	Estimated Cost in Rs.
		of construction works		of Telangana	
Sub-Total / month					47,200/-
Sub-Total A - For 24 months					11,32,800/-
Aquatic life	Limnological and biological studies	Six monthly once until completion	Near Proposed Barrage (1 No.)	Irrigation & CAD Department Govt. of Telangana	1,00,000/-
Health check ups	Spirometry, Pulse Oxymetry, Blood Test, Lung Function Test, Eye test, Physical fitness tests	Six monthly once until completion	Labor camps (1 No.)	Irrigation & CAD Department Govt. of Telangana	1,50,000/-
Sub-Total / 6 months					2,50,000/-
Sub-Total B - For 24 months					10,00,000/-
Total (A+B)					21,32,800/-

Table 16 Environmental Monitoring Plan for operation phase (3 years)

Environmental Parameters	Parameters to be Monitored	Frequency of Monitoring	Locations	Responsibility	Estimated Cost in Rs.
Surface water quality of Godavari River	pH, Temperature, EC, TDS, Alkalinity, TH, DO, BOD, COD, NO ₃ , PO ₄ , Cl, SO ₄ , Na, K, Ca, Mg, Silica, Oil & grease, & Total Coliform	Quarterly once	Near Proposed Barrage Site, Downstream and Upstream of Barrage (3 Nos.)	Irrigation & CAD Department Govt. of Telangana	19,560/-
Soil Quality	pH, EC, Mg, Ca, Alkalinity, Cl, Na, K, Organic Carbon, PO ₄ , SAR, N and Salinity	Quarterly once	Near Barrage Site (1 No.)	Irrigation & CAD Department Govt. of Telangana	5,470/-
Sub-Total /3 months once					25,030/-
Sub-Total A-for 3 years					3,00,360/-
Aquatic life	Limnological and biological studies	6 Monthly once for 3 years	Near Proposed Barrage Site (1 No.)	Irrigation & CAD Department Govt. of Telangana	1,00,000/-
Sub-Total /6 months once					1,00,000/-
Sub-Total B-for 3 years					6,00,000/-
Total (A+B)					9,00,360/-

6. Social Impact Assessment

The proposed project requires a total land of 674.18 Ha including 94 Ha of private (patta) land for implementation of the project and 580.18 Ha of river bed area (submergence area). There is no submergence of private land and hence there is no R&R due to the project. The required land will be acquired as per the Right to Fair Compensation and Transparency in Land Acquisition Rehabilitation and Resettlement Act, 2015.

The District Collector fixes up the market value of the land in each village considering the land transactions in the area for the last three years and on mutual discussion with the land owners. Realistic cost estimation can be done only on the basis of this. But to work out rough estimation of the cost, the market value of the land estimated by the Irrigation Department (8,64,500/- per ha) is considered.

Table 17 Cost Estimates of land

Total land required for the project (ha)	Compensation already paid as per LA, 1894		Balance land to be acquired as per RFC&TLA, 2013	
	Extent (ha)	Amount in Crores	Extent (ha)	Amount in Crores
94	65	18.03	29	2.53

As per ToRs, Telangana State Pollution Control Board has conducted Environmental Public Consultation at Zilla Parishad High School, Eturnagaram, Jayashankar Bhupalapally District on 27.09.2018. The proposed project received a positive response from the public during the Environmental Public Consultation.

7. Project Benefits

Ecological benefits:

- No forest land required for implementation of the scheme.
- The project involves felling of 800 trees. The restoration activities involving plantation of tree species in the ratio of 1:3 along the left and right bank side of the proposed barrage and the restoration of construction site will be carried out to improve the ecological activities of faunal species.
- Construction of barrage across River Godavari acts as a reservoir thereby supporting proliferation of fish species.

Techno-economical benefits:

- Existing irrigation schemes will be stabilized by providing assured water for irrigation.
- Providing Drinking water is essential as per National Water Policy, 2012. In this direction, this project aims at providing drinking water to a large no. of villages, which has lot socio-economic concern.
- Agricultural linkages will be considerably improved.
- The project improves total farm output and hence raises farm income.
- Project improves yields through reduced crop loss due to erratic, unreliable or insufficient rainfall.
- Extensive agricultural production supplies raw materials to the nearby small scale industries thereby increasing the economy in the region.

Social benefits:

- Health benefits to the people towards use of safe drinking water.
- Altogether, 518 villages will be benefitted directly under the scheme.
- Direct employment opportunities for 400 members (50 Technical and 350 construction laborers) will be provided during construction phase. Further, indirectly labor opportunities will be substantially improved since larger area will be brought under irrigation. It improves fodder crops and in turn dairy farming in the command area.
- The project requires a total land of 674.18 ha, of which, 94 ha of private/patta land and 580.18 ha of river bed area alongside River Godavari near the proposed barrage for implementation of the scheme and does not envisage rehabilitation and resettlement.

8. Environmental Management Plan

EMP provides a delivery mechanism to address the adverse environmental impacts of a project during its execution, to enhance project benefits, and to introduce standards of good practice to be adopted for all project related work.

Integrated approach during project planning, design, construction and operation work acts as a better tool for implementation of Environmental Management Plan. The EMP measures include mitigation or enhancement measures as appropriate to the nature of impacts and are explained in the following sections. These include:

- Catchment area treatment plan
- Command area development
- Green belt development
- Reservoir Rim treatment
- Fisheries conservation and management plan
- Muck disposal plan
- Restoration of quarry sites and landscaping
- Groundwater management plan
- Public health delivery system and provision of drinking water supply to local community
- Sanitation and Solid Waste Management Plan in labour camps
- Local Area Development Plan
- Environmental Safeguards during construction activities
- Environmental monitoring programme

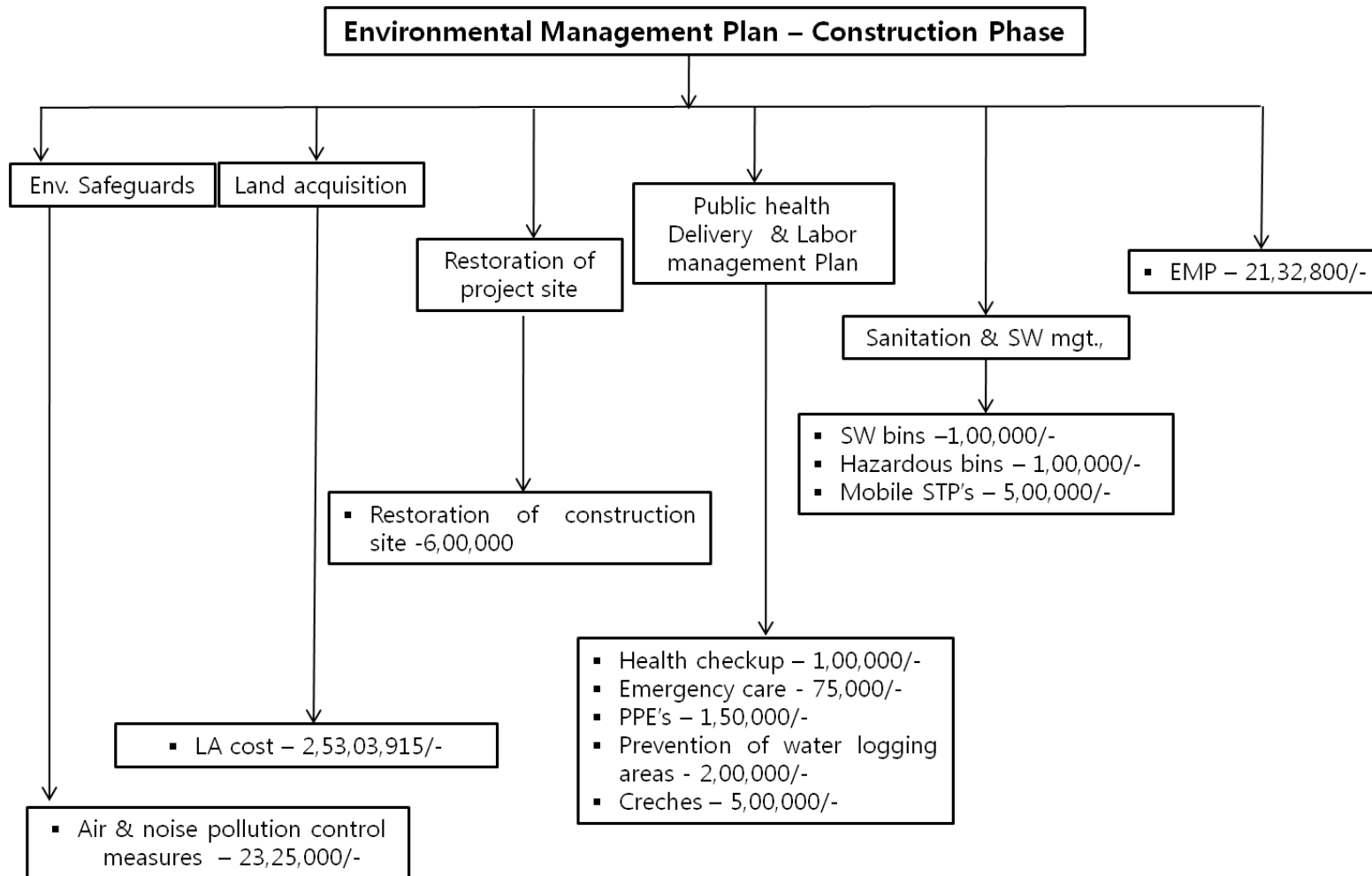


Fig. 2 Environmental Management Plan flow chart – for Construction phase

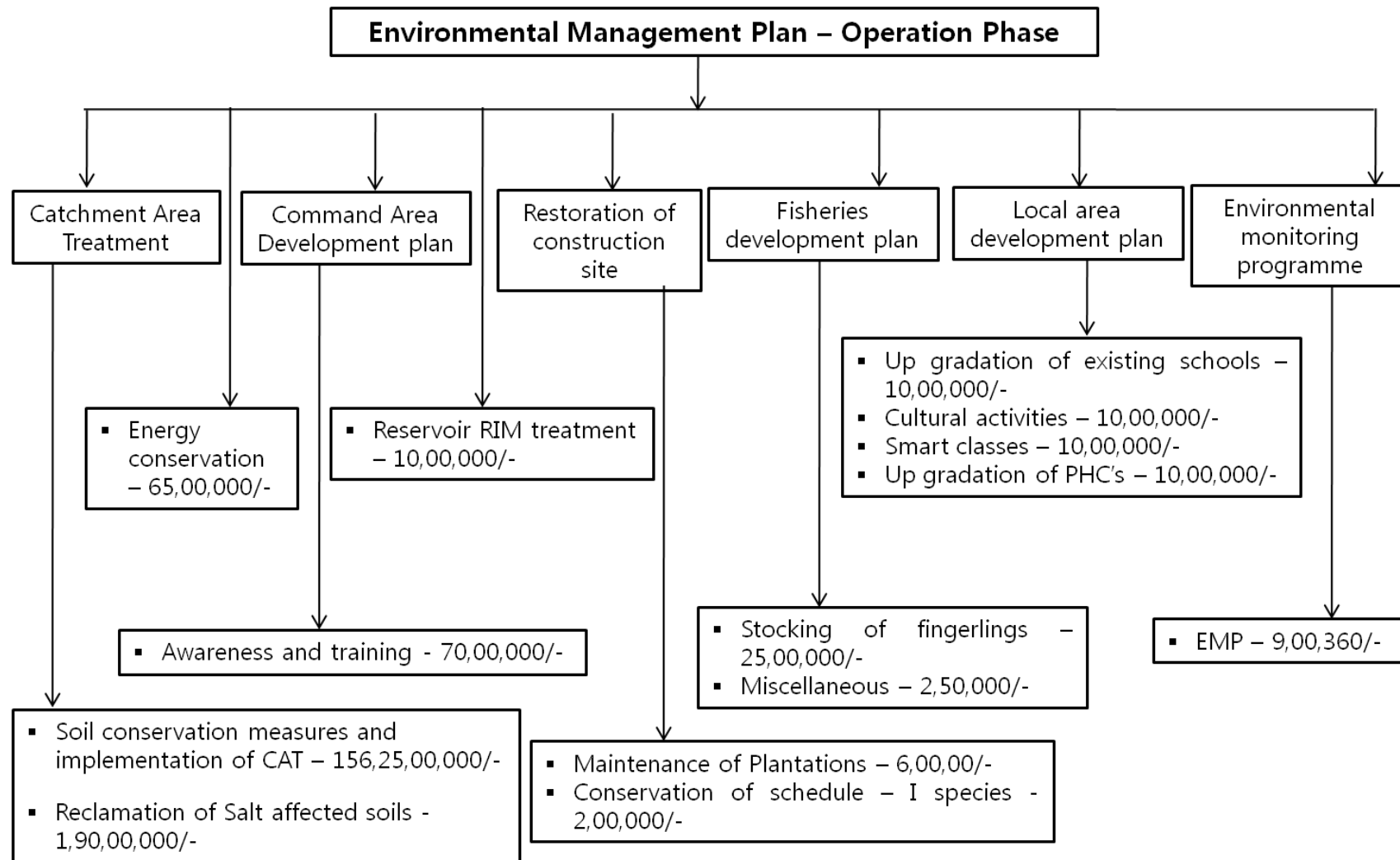


Fig. 3 Environmental Management Plan flow chart – for Operation phase

8.1 Environmental safeguards

During construction phase of the proposed project following measures will be taken to control Air, Noise and Water pollution.

Table 18 Environmental safeguards during construction phase

Sl. No.	Item wise activity	Anticipated pollution (Importance of concern)	Proposed Environment safeguards	Frequency	Cost	Implementing agency
1	Site clearing/ leveling	Air pollution due to dust	Water sprinkling	3 times a day	4,00,000/-	I & CAD department, Telangana
2	Excavation works / foundation works / cut and fill works		Water sprinkling, erecting of barricades construction sites	3 times a day	5,00,000/-	
3	Road formation works		Water sprinkling	3 times a day	2,50,000/-	
4	Construction vehicles movement	Air pollution due to dust	Water sprinkling	3 times a day	2,00,000/-	
5	Loading and unloading works		Water sprinkling	3 times a day	2,00,000/-	
6	Erection works/fabrication works/concreting works	Air pollution due to dust and noise pollution	Water sprinkling and erection of barricades	3 times a day	2,00,000/-	
7	Stacking of excess excavated earth	Air pollution due to dust	Water sprinkling, covering by green mesh/ sheets	3 times a day	3,00,000/-	
8	Operation of temporary DG sets (2 × 500 KVA)	Air and noise pollution	Provision of stack and acoustic enclosed for DG	--	25,000/-	
9	Operation of heavy earth movers		Water sprinkling, barricading and temporary fencing	3 times a day	2,50,000/-	
Total					23,25,000/-	

8.2 Cost estimates for implementation of EMP

The total amount to be spent for implementation of Environmental Management Plan (EMP) is as follows.

Table 19 Cost for Implementing Environmental Management Plan

Sl. No.	Particulars	Cost in Rs.
A. Construction Phase		
1	Environmental safeguard measures to control air, noise and water pollution	23,25,000/-
2	Land acquisition	2,53,03,915/-
3	Restoration of construction site (Green belt development)	6,00,000/-
4	Public health delivery system	10,25,000/-
5	Sanitation and Solid waste management plan	7,00,000/-
6	Environmental monitoring programme	21,32,800/-
	Total	320,86,715/-
B. Operation Phase		
1	Catchment area treatment plan	158,15,00,000/-
2	Command area development	70,00,000/-
3	Local area development plan	40,00,000/-
4	Restoration of construction site (Green belt development)*	8,00,000/-
5	Fisheries conservation and management plan	27,50,000/-
6	Environmental monitoring programme*	9,00,360/-
7	Reservoir RIM Treatment	10,00,000/-
8	Energy conservation measures	65,00,000/-
	Total	160,44,50,360/-