Providing Underground Sewerage Scheme (UGSS) to added areas of Kancheepuram City Municipal Corporation

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) REPORT

Kancheepuram City Municipal Corporation

July 2023

LIST OF ABBREVIATIONS

ASI	Archaeological Survey of India
CMD	Chairperson & Managing Director
CRZ	Coastal Regulation Zone
DPR	Detailed Project Report
E&S	Environmental and Social
ESIA	Environmental and Social Impact Assessment Report
ESF	Environmental and Social Framework
ESSA	Environmental and Social Systems Assessment
ESMP	Environmental and Social Management Plan
FI	Financial Institution
GOI	Government Of India
GoTN	Government of Tamil Nadu
GRC	Grievance Redressal Committee
KCMC	Kancheepuram City Municipal Corporation
MA&WS	Municipal Administration and Water Supply
MoEF& CC	Ministry of Environment and Forest & Climate Change
PIA	Project implementation Agency
PCB	Pipe Carrying Bridge
PIU	Project Implementation Unit
PMC	Project Management Consultant
ROW	Right of Way
SEC	Sensitive Environmental Components
STP	Sewerage Treatment Plant
SWM	Solid Waste Management
TNCRUDP	Tamil Nadu Climate Resilient Urban Development Project
TNUIFSL	Tamil Nadu Urban Infrastructure Financial Services Limited
ULB	Urban Local Body
WB	World Bank

Contents

EXECUTIVE SUMMARY

Kanchipeepuram City Municipal Corporation expanded by adding Sevlimedu Town Panchayat, Orikkai, Nathapettai & Thenambakkam Village Panchayats. Existing Underground Sewerage Scheme for Kancheepuram is serving only the Core city whereas there is no UGSS for the Added Areas for Kancheepuram.

Need for the project: Existing underground sewerage system implemented in Kancheepuram covers roughly 28% of the erstwhile Municipal limits with only 111 Km of sewer collection system and treated in Water Stabilization Pond of 14.71 MLD capacity. The added corporation areas do not have underground sewerage schemes. The Kancheepuram City Municipal Corporation intends to extend the Underground sewerage system to all the uncovered areas of the Corporation considering the requirement for the next 30 years.

Proposed Underground Sewerage Scheme to Added areas of Kanchipuram City Municipal Corporation involves the following components: The project area is divided into five sewerage zone.

- Laying of sewer line for a length of 180.423 km
- Construction of 7 Lift Stations (LS)
- Construction of 17 Lift Machine Holes (LMH)
- Construction of 5 Pumping Stations (PS)
- Laying of Pumping mains for 14.101 kilometres
- Construction of Pipe Carrying Bridges (PCBs) for pumping main canal crossings in 5 locations – (3 nos of 24m length crossing, 1 no of 56m length in Vegavathi River, 1 nos 32m length @ Manjal neer kalvai)
- Providing 15652 House Service Connections (includes internal plumbing)
- Proposed 7437 no of Machine Holes
- Construction 36 MLD STP with proposed SBR technology[1]
- The treated effluent will be conveyed through a pumping main for a length of 3.5 km and ultimately disposing into the Vegavathi river.

Environmental and Social Impact Assessment: Based on the above components, an environmental impact assessment report has been prepared in line with the Environmental and Social Systems Assessment (ESSA). ESSA is the draft document prepared for the World Bank assisted Tamil Nadu Climate Resilient Urban Development Program.

An Environmental Climate Change and Social Screening were carried out for this project and provided in the annexure. All the sites and project network sewer line alignments, pumping alignments, disposal are screened for the environmental and social impacts.

The applicable regulatory requirements relating to Environmental, Climate Change and Social were analysed and provided in the third chapter.

[1] Construction of STP is proposed under DBOT Contract basis.

The baseline environmental study on Air, Noise, Groundwater, surface water, soil standard parameters in baseline locations were carried out.

This project doesn't involve acquisition of private land and do not cause permanent/temporary impacts.

An Environmental and Social Management Plan (ESMP) has been prepared to mitigate the impacts identified as per the baseline study. The cost of implementation of ESMP has been included in the bid documents. Environmental Monitoring plan has been included in the contract documents. The contractor to prepare contract/project specific ESMP and implement it through the safeguards personnel included in the contract documents. The PIU/PMC will monitor the implementation of ESMP by the contractor and submit monthly progress reports to PMU/TNUIFSL.

1. INTRODUCTION

1.1 Background of the project

Kancheepuram served as the historical capital of Pallavas during 6th to 8th century AD. Later, it became the citadel of Cholas, Vijayanagar Kings, the Mughals and the British. The town has been the Centre of Tamil learning, culture and of religious importance for centuries. Since time immemorial, the town is known for its fine silk sarees in the country. It is a place of international tourism importance because of the magnificent temples of unique architectural style and beauty, hat heralds the glory of the Dravidian culture. Adi Shankaracharya established his Episcopal seat viz. Kamakotipeetam in Kancheepuram.

Kancheepuram Municipality expanded by adding Sevlimedu Town Panchayat, Orikkai, Nathapettai & Thenambakkam Village Panchayats. Existing Underground Sewerage Scheme for Kancheepuram is serving only the Core city whereas there is no UGSS for the Added Areas for Kancheepuram.

Subsequently, SSG Consultants, Chennai was awarded the above work for the preparation of Detailed Project Report for the Added Areas of Kancheepuram City Municipal Corporation.

1.2 Existing Under Ground Sewerage Scheme

Kancheepuram is one of the Pilgrimage towns with existing Under Ground Sewerage System for the Core city. It was designed in the year of 1975 for an estimated capacity of 14.71 MLD Waste Stabilization Pond with a cost of Rs.134.00 Lakhs. The Project covers for a length of 64.00 km and it consists of 1152 number of Machine holes. The Under Ground Sewerage System in the Core city is divided into 2 Parts with 4 zones in it. The Two Parts were the West Kancheepuram and the East Kancheepuram with 2 zones in it respectively. The East Kancheepuram zones collect 5.84 MLD and the West Kancheepuram zones collect 8.87 MLD of waste water which is dispersed into the Waste Stabilization Pond located in Nathapettai.

1.3 Need for the project

Existing underground sewerage system implemented in Kancheepuram covers roughly 28% of the erstwhile Municipal limits with only 111 Km of sewer collection system and treated in Water Stabilization Pond of 14.71 MLD capacity. The added corporation areas do not have underground sewerage schemes. The Kancheepuram City Municipal Corporation intends to extend the Underground sewerage system to all the uncovered areas of the Corporation considering the requirement for the next 30 years.

1.4 Project area

The Study Area is entirely about the UGSS to the added areas of Kancheepuram City Municipal Corporation. The salient features are described below.

Kancheepuram Municipality is expanded by adding Sevlimedu Town Panchayat, Orikkai, Nathapettai & Thenambakkam Village Panchayats. Existing Underground Sewerage Scheme for Kancheepuram is only to serve the Core city. Kancheepuram Corporation area is characterised by an undulating terrain with the elevation ranging between 72 m and 90 m above MSL.

Table 1.1 The key location plan of the Kancheepuram City and the Corporation area

Sl.No	Details	Erstwhile municipality	Added areas	Total
1	Area (Sq.km)	11.72	24.42	36.14
2	Population (2011)	164384	69969	234353
3	No of Wards covered	33	18	51

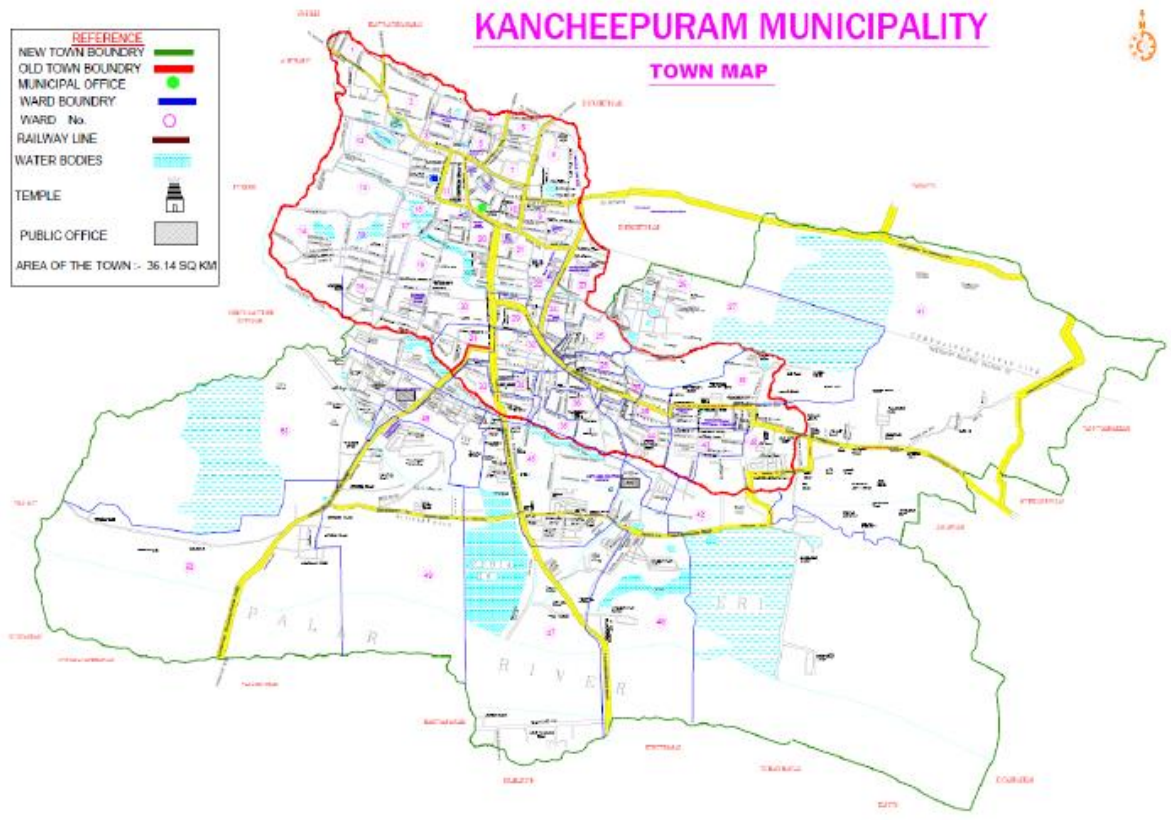


Figure 1.1 Location Plan of Kancheepuram City Municipal Corporation

1.5 Project Location

Kancheepuram district is located on the East Coast of Tamil Nadu and is adjacent to the Bay of Bengal in the east, bounded by Chennai and Thiruvallur district to its north, Vellore in the west, and Villupuram district in the south. Kancheepuram lies between 11 degrees to 12 degrees to the North latitudes and 77 degree and 28 minutes to 78 degrees and 50 minutes to the East longitudes.

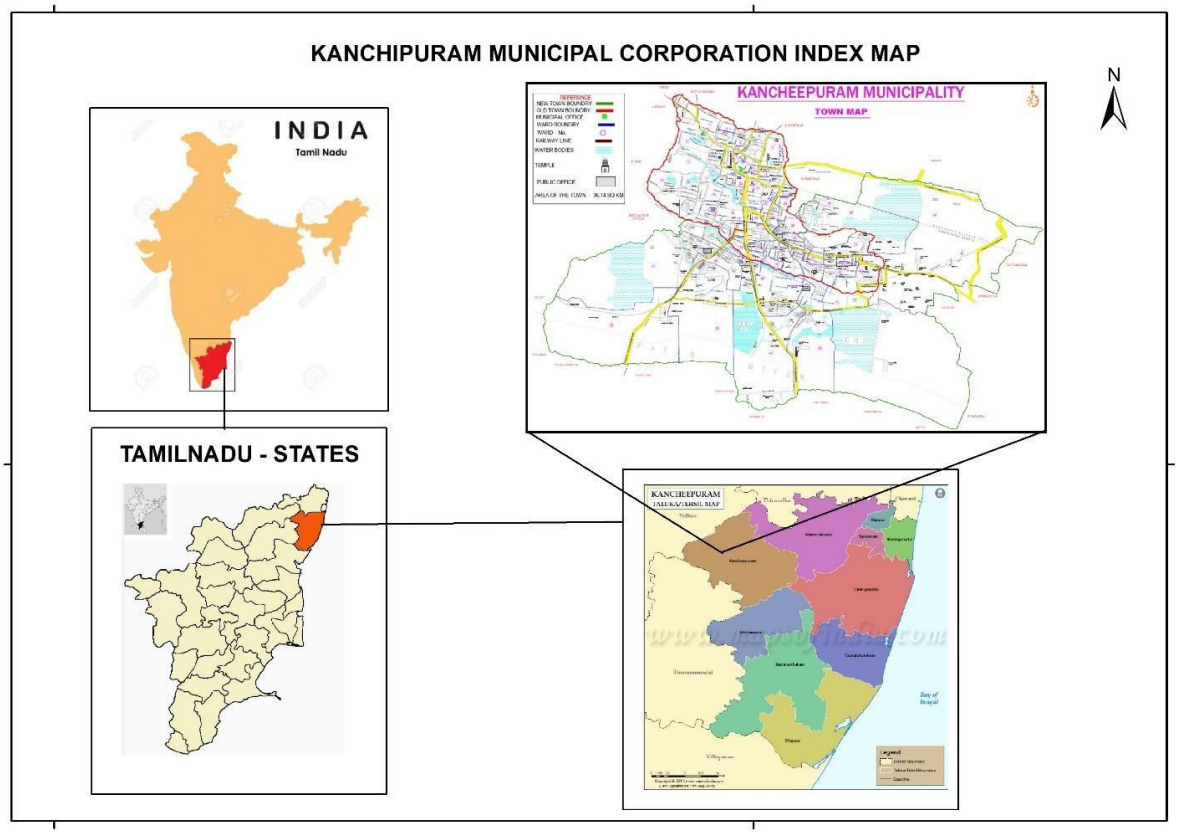


Figure 1.2 Kancheepuram Index Map

1.6 Proposed Under Ground Sewerage Scheme

The Existing UGSS in Kancheepuram City Municipal Corporation consists of 4 Zones (Zone-1, Zone-2, Zone-3 & Zone-4). The newly Proposed UGSS which covers the Added areas is designed into 5 zones which are named as Zone-5, Zone -6, Zone - 7, Zone-8 & Zone - 9. Zone 5 covers parts of Sevlimedu and Orikkai. Zone 6 covers parts of Orikkai and Thenambakkam. Zone 7 covers Parts of Thenambakkam and Nathapettai and Zone 8 covers parts of Nathapettai and Zone 9 covers parts of Nathapettai. The Ultimate demand for the UGSS designed for the Added areas of Kancheepuram City Municipal Corporation is 17.15 MLD.

2. DESCRIPTION OF THE PROJECT

Proposed Underground Sewerage Scheme to Added areas of Kanchipuram City Municipal Corporation involves the following components:

- Laying of sewer line for a length of 180.423 km
- Construction of 7 Lift Stations (LS)
- Construction of 17 Lift Machine Holes (LMH)
- Construction of 5 Pumping Stations (PS)
- Laying of Pumping mains for 14.101 kilometres
- Construction of Pipe Carrying Bridges (PCBs) for pumping main canal crossings in 5 locations – (3 nos of 24m length crossing, 1 no of 56m length in Vegavathi River, 1 nos 32m length @ Manjal neer kalvai)
- Providing 15652 House Service Connections (includes internal plumbing)
- Proposed 7437 no of Machine Holes
- Construction 36 MLD STP with proposed SBR technology[2]
- The treated effluent will be conveyed through a pumping main for a length of 3.5 km and ultimately disposing into the Vegavathi river.

2.5 Sewerage Zones

Zone – 5

Zone – 5 consists of 5 LMH,1 Lift Station and 1 Sub-pumping Station (SPS-5). The Collection system covers for a length of 44.270 km. Pumping main of 200 mm Diameter C.I pipe has been used for a length of 1071 m from LS-5A to SPS-5. Pumping main of 400 mm Diameter C.I pipe has been used for a length of 2100 m from SPS-5 to SPS-6.

Zone – 6

Zone – 6 consists of 4 LMH,3 Lift Stations (LS-6A, LS-6B & LS-6C) and 1 Sub-pumping Station (SPS-6). The Collection system covers for a length of 44.270 km. Pumping main of 500 mm Diameter C.I pipe has been used for a length of 2400 m from SPS-6 to MPS-7. Pumping main of 200 mm Diameter C.I pipe has been used for a length of 45 m from LS-6A to SPS-6. Pumping main of 200 mm Diameter C.I pipe has been used for a length of 50 m from LS-6B to LS-6C. Pumping main of 200 mm Diameter C.I pipe has been used for a length of 105 m from LS-6C to SPS-6.

Zone – 7

Zone – 7 consists of 6 LMH,3 Lift Stations (LS-7A,LS-7B & LS-7C) and 1 Main-pumping Station (MPS-7). The Collection system covers for a length of 54.153 km. Pumping main of 700 mm Diameter C.I pipe has been used for a length of 3725 m from MPS-7 to STP. Pumping main of 200 mm Diameter C.I pipe has been used for a length of 55 m from LS-7A to MPS-7. Pumping main of 200 mm Diameter C.I pipe has been used for a length of 40 m from LS-7B to MPS-7. Pumping main of 200 mm Diameter C.I pipe has been used for a length of 400 m from LS-7C to MPS-7.

[2] Construction of STP is proposed under DBOT Contract basis.

Zone – 8

Zone – 8 consists of 2 LMH and 1 Sub-pumping Station (SPS-8).The Collection system covers for a length of 23.834 km. Pumping main of 400 mm Diameter C.I pipe has been used for a length of 3500 m from SPS-8 to STP.

Zone – 9

Zone – 9 consists of 1 Main-pumping Station (MPS-9).The Collection system covers for a length of 13.437 km. Pumping main of 200 mm Diameter C.I pipe has been used for a length of 100 m from MPS-9 to STP.

Figure 2.1 Existing and Proposed Zones of KCMC

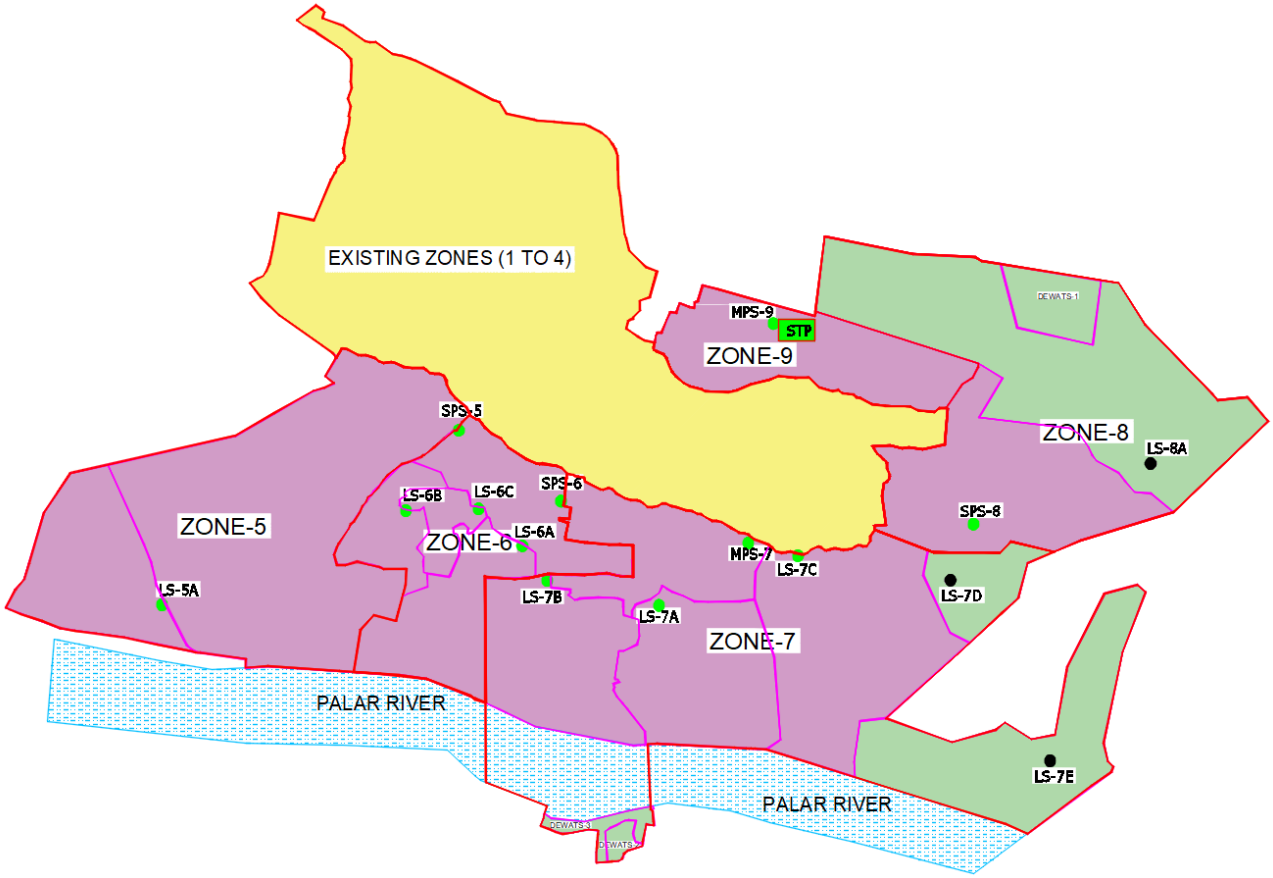


Figure 2.2 Flow chart of the Proposed UGSS in added areas of KCMC

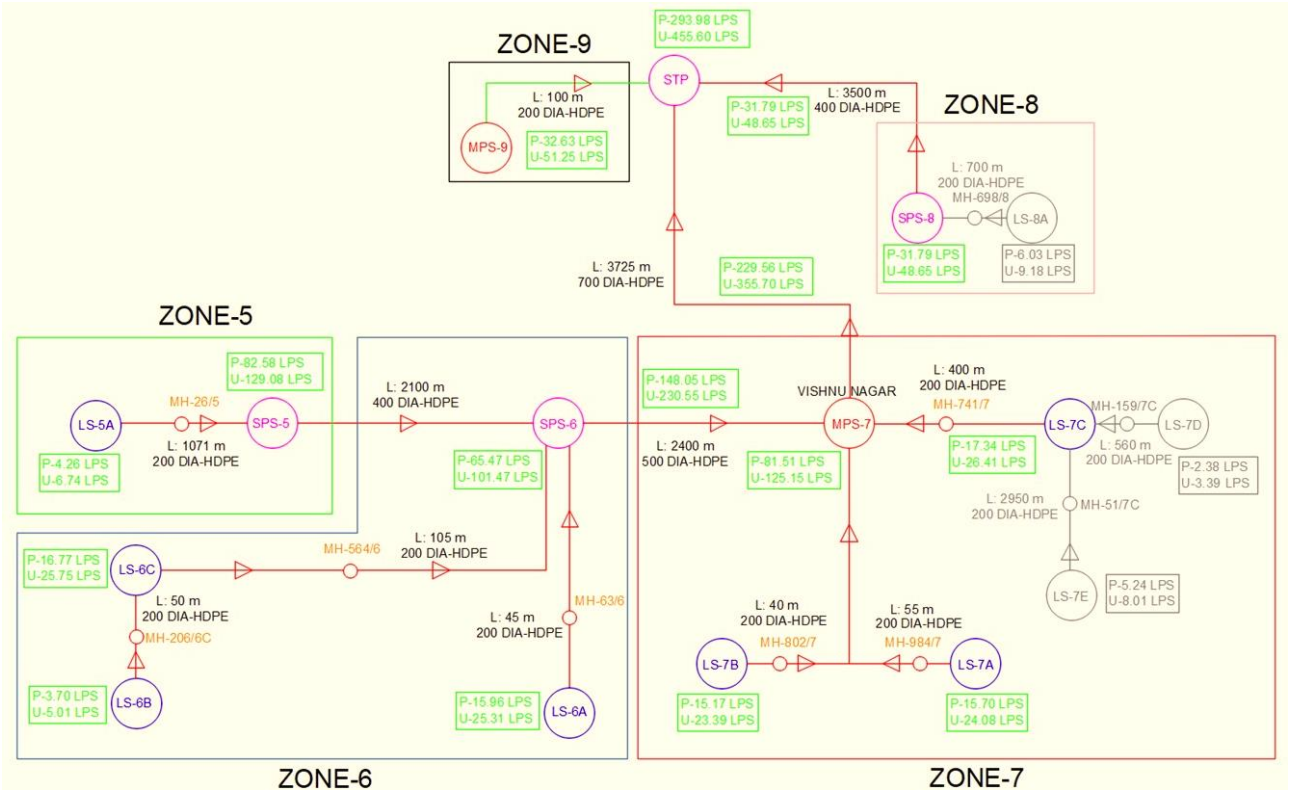


Table 2.1 Proposed pumping station location

Sl.No	Zone No & PS	Proposed Pumping station location
1	5 (SPS)	Near Collectorate ground
2	6 (SPS)	Near Temple City 5th Cross Street
3	7 (MPS)	Near Vishnu Nagar
4	8(SPS)	Near Pachaiyappas College
5	9 (MPS)	Near Nathapettai WSP

Details of the Lift stations and Lift Machine holes are listed below,

Table 2.2 Details of Lift Stations

S.No	Zone No	Lift Station	Location (Ward No)	Flow (LPS)	
				Present	Ultimate
1	Z5	LS-5A	42	4.26	6.74
2	Z6	LS-6B	44	3.70	5.01
3	Z6	LS-6C	45	16.77	25.75
4	Z6	LS-6A	45	15.96	25.31
5	Z7	LS-7B	46	15.17	23.39
6	Z7	LS-7A	47	15.70	23.39
7	Z7	LS-7C	51	17.34	26.41

Table 2.3 Details of Lift Machine holes

Sl. No	LMH	Flow	
		Present	Ultimate
1.	21L/5	0.866	1.355
2.	148L/5	4.121	6.453
3.	285L/5	4.864	4.864
4.	1097L/5	8.028	12.513
5.	1149L/5	3.235	5.041
6.	12L/6A	1.164	1.860
7.	29L/6A	5.011	7.963
8.	203L/6	9.922	15.211
9.	711L/6	9.337	14.369
10.	43L/7A	7.231	11.090

11.	172L/7A	5.249	8.055
12.	366L/7A	3.661	5.624
13.	47L/7B	11.713	18.066
14.	279L/7B	4.589	7.083
15.	42L/7	11.327	17.442
16.	115L/8	0.920	1.408
17.	652L/8	15.374	23.502

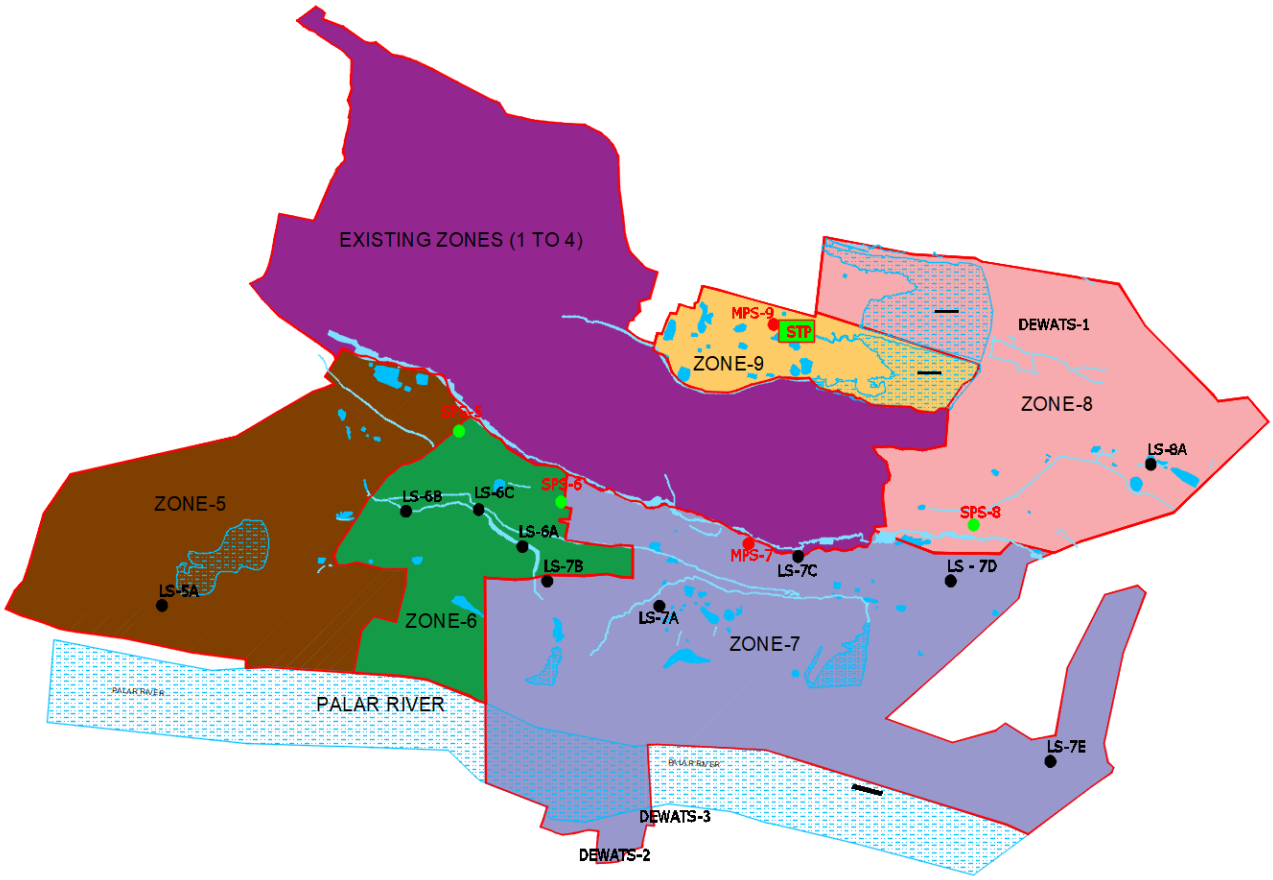


Figure 2.3 Location of Lift Station, Sub Pumping Station and Main Pumping Station.

The Reasons for the Provision of Lift Stations are as follows,

Table 2.4 Reasons for provision of Lift Stations

Sl.No.	ZONE NO.	LIFT STATION	REASON FOR PROVISION OF LIFT STATION
1	5	5A	Isolated Packet
2	6	6A	Canal crossing
3	6	6B	Canal crossing
4	6	6C	Canal crossing
5	7	7A	Canal crossing
6	7	7B	Canal crossing
7	7	7C	Canal Crossing

2.7 Pumping Station

The details of pumping station and their present and Ultimate flow are given in the table below

Table 2.5 Details of Pumping Station - Added Areas

S. NO.	ZONE NO	PUMPING STATION	LOCATION (WARD NO)		FLOW (LPS)
PRESENT					ULTIMATE
1	Z-5	SPS-5	44	82.58	129.08
2	Z-6	SPS-6	48	148.05	230.55
3	Z-7	MPS-7	51	229.56	355.70
4	Z-8	SPS-8	26	31.79	48.65
4	Z-9	MPS-9	22	32.63	51.25

2.7.1 Details of Pumping Main

The Details of Pumping Main in the proposed UGSS in Added areas of KCMC are as follows,

- The sewage from the Sub pumping station SPS-5 will be pumped directly to the Sub Pumping Station SPS-6 through 400mm C.I pipe for a length of 2100m.
- The sewage from the Sub pumping station SPS-6 will be pumped directly to the Main Pumping Station MPS-7 through 500mm C.I pipe for a length of 2400m.
- The sewage from the Main pumping station MPS-6 will be pumped directly to the STP through 700mm C.I pipes for a length of 3725m.
- The sewage from the Main pumping station MPS-9 will be pumped directly to the STP through 200mm C.I pipes for a length of 100m.
- The sewage from the Main pumping station SPS-8 will be pumped directly to the STP through 400mm C.I pipes for a length of 3500m.

2.8 Sewage Treatment Plant

The sewage Treatment Plant shall be designed for a quantity of 36 MLD including the sewage generation projected in the core city as well as the added areas for the Ultimate year 2055.The Ultimate projection of sewage generation is 42 MLD and intermediate is 36 MLD. Hence considering the size of the units required the STP shall be designed for 36 MLD.

Description	Intermediate Population	Sewage generated in MLD	Ultimate Population	Sewage generated in MLD
Core City	203336	22.37	223484	24.58
Added Areas	126606	13.93	155901	17.15
Total	**329942**	**36.29**	**379385**	**41.73**

2.8.1 Sequential Batch Reactor

The Sewage Treatment Plant shall be designed to treat the raw sewage in a single stage fully automatic Plant based on Cyclic Activated Sludge Technology. However, designs are not done as this under the scope of the DBOT contractor.

2.8.2 Treatment Philosophy

Stilling Chamber

Raw sewage from Pumping Station shall be taken into a Stilling Chamber from where it shall be taken into downstream Fine Screens. The function of the Stilling Chamber is to reduce the incoming velocity.

Fine Screening Channels

Adequate Nos. of Mechanical along with Manual (standby) Fine Screens shall be provided upstream of treatment units for fine screening of sewage. The Fine Screens shall screen out most of the floating and oversized material more than 6mm size such as plastic debris, weeds, paper, cloth, rags etc which could foul the downstream treatment units. The Fine Screens shall be inclined Bar Screen of stainless steel flats. The screenings shall be dropped on a Conveyor provided above the top of the screen channel. The screening material as collected will drop automatically into a wheelbarrow for its disposal.

De- Gritting

Screened Sewage will gravitate to Grit Separator Tank for removal of grit and small inorganic particulate matter of specific gravity above 2.65 and particle size above 150 microns. The Grit Separator Tank shall be of RCC construction complete with mechanical internals and square in size.

The grit separated shall be properly collected and be transferred for disposal. The de-gritted sewage shall flow through open channels from the Grit Separators and confluence into a single channel of suitable width.

SBR/Cyclic Activated Sludge Process

Primary treated sewage shall be fed into the Cyclic Activated Sludge Process/SBR Process Basins for biological treatment to remove BOD, COD and Suspended Solids. It provides the highest treatment efficiency possible in a single step biological process.

SBR system is operated in a batch reactor mode. This eliminates all the inefficiencies of the continuous processes. A batch reactor is a perfect reactor, which ensures 100% treatment. Two modules are provided to ensure continuous treatment. The complete process takes place in a single reactor, within which all biological treatment steps take place sequentially. No additional settling unit, Secondary Clarifier is required. The complete biological operation is divided into cycles. Each cycle is of 3 – 5 hrs duration, during which all treatment steps take place.

Explanation of Cyclic Operation

A basic cycle comprises:

- Fill-Aeration (F/A)
- Settling (S)
- Decanting (D)

These phases in a sequence constitute a cycle, which is then repeated.

A Typical Cycle: During the period of a cycle, the liquid is filled in the C-Tech basin up to a set operating water level. Aeration Blowers are started for aeration of the effluent. After the aeration cycle, the biomass settles under perfect settling conditions. Once settled the supernatant is removed from the top using a DECANTER. Solids are wasted from the tanks during the decanting phase

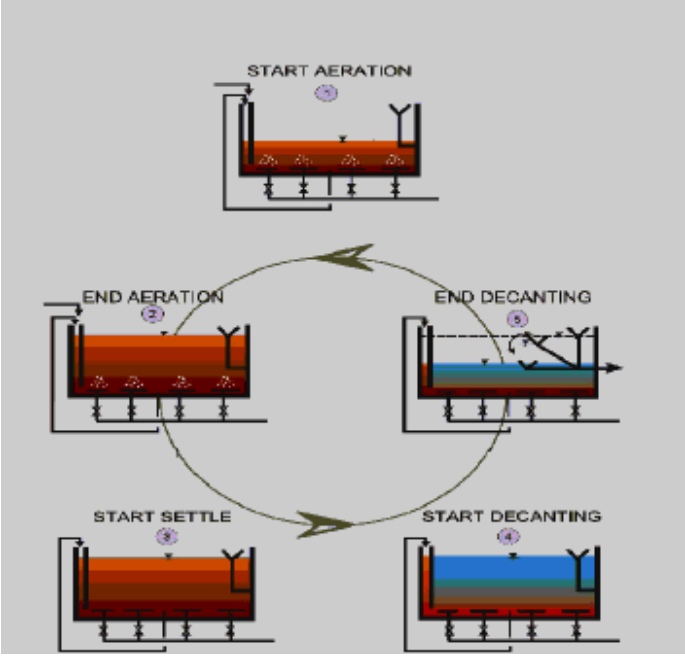


Figure 2.4 Process Cycle

These phases in a sequence constitute a cycle, which is then repeated.

Chlorination System

Treated sewage from SBR basins will be collected in a Chlorination Tank where disinfectant will be added for disinfection at suitable dosing rate. Baffle walls shall be provided in the tank to facilitate hydraulic mixing of treated sewage. Adequate reaction time shall be considered while selecting the chlorination tank volume to ensure proper disinfection of treated sewage. Treated Sewage after Chlorine Contact tank can be reused for various non-potable purposes such as Gardening, Washing cars etc.

Sludge Handling System

The sludge from the SBR / Cyclic Activated Sludge Process basins is withdrawn through sludge withdrawal system and collected in the Sludge Sump. Minimum of 6 hrs hold-up volume shall be provided. The sludge shall be then pumped to Solid Bowl Centrifuge for dewatering of sludge.

Centrifuge Feed Pumps shall be of positive displacement type screw pumps. Dewatering Polyelectrolyte shall be dosed online prior to centrifuge feed. The dosing system shall include one Solution Preparation and one Solution Dosing Tank of minimum 8 hrs. Capacity equipped with Slow Speed Mixers and metering type Positive Displacement Pumps. The sludge in form of wet cake from Centrifuges will be collected and disposed off.

Interconnection of various units shall be made through piping or RCC channels. Piping will be preferred over RCC channel wherever possible

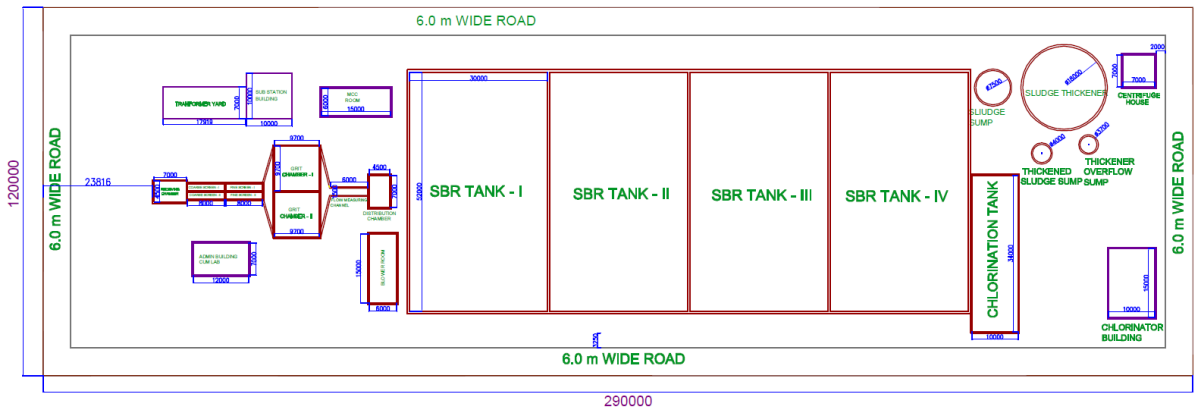


Figure 2.5 Proposed STP Layout

Treated Effluent Disposal

The treated effluent is proposed to be conveyed for 3.5 km through pipeline and be disposed into Vegavathi river , following the CPCB prescribed norms for disposal of treated effluent.

1.1.1 Climate Resilience:

Climate Resilient Report with check list is provided in the Annexure -4.

Energy Efficiency:

- To optimize the power consumption, the Variable Frequency Drive (VFD) for pumps would be proposed in all SPS.
- Around 40-50% of energy consumption can be reduced by adopting VFD starter instead of conventional starter. Power calculation is attached in Annexure 11
- LED lamp are proposed to be used in all SPS.

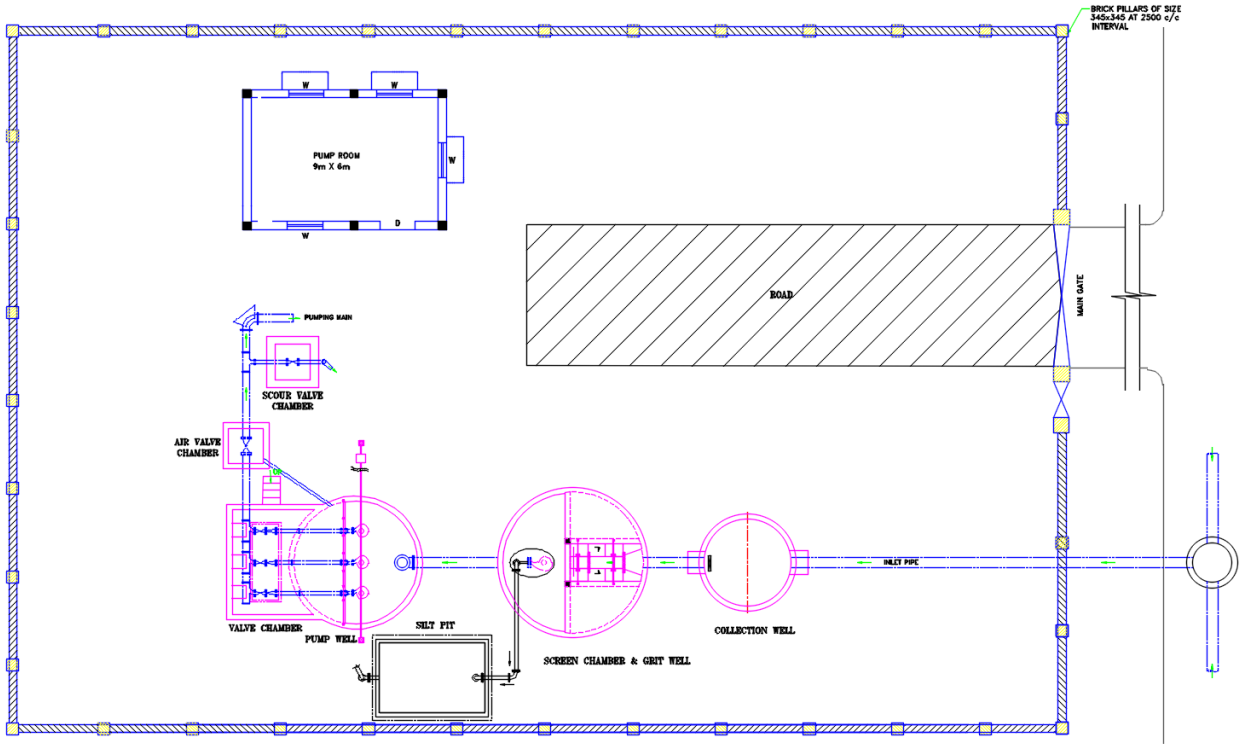
Emission Reduction:

- DG sets provided in the project are as per standards for emission as prescribed by pollution control board
- To reduce noise pollution DG sets are provided with acoustic enclosure.

Flood

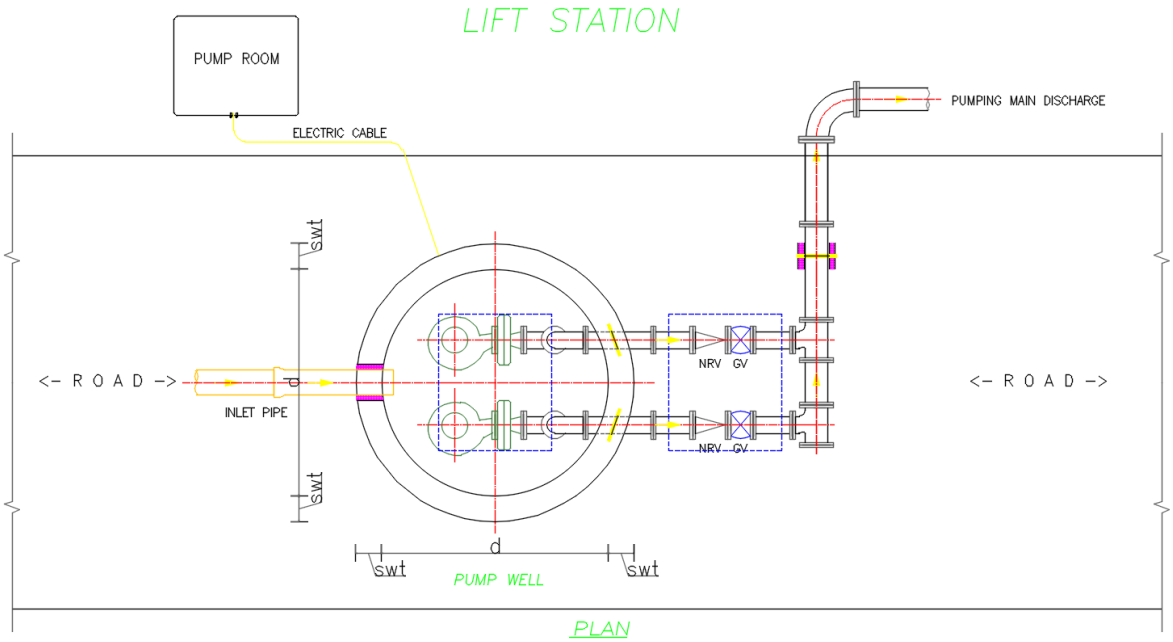
- The city has been highly vulnerable to extreme weather and erratic rainfall, including periodic droughts and floods.
- Finished Floor Level (FFL) in all SPS has been fixed above the Maximum Flood Level (MFL) occurred during 2015.

1.TYPICAL PUMPING STATION LAYOUT



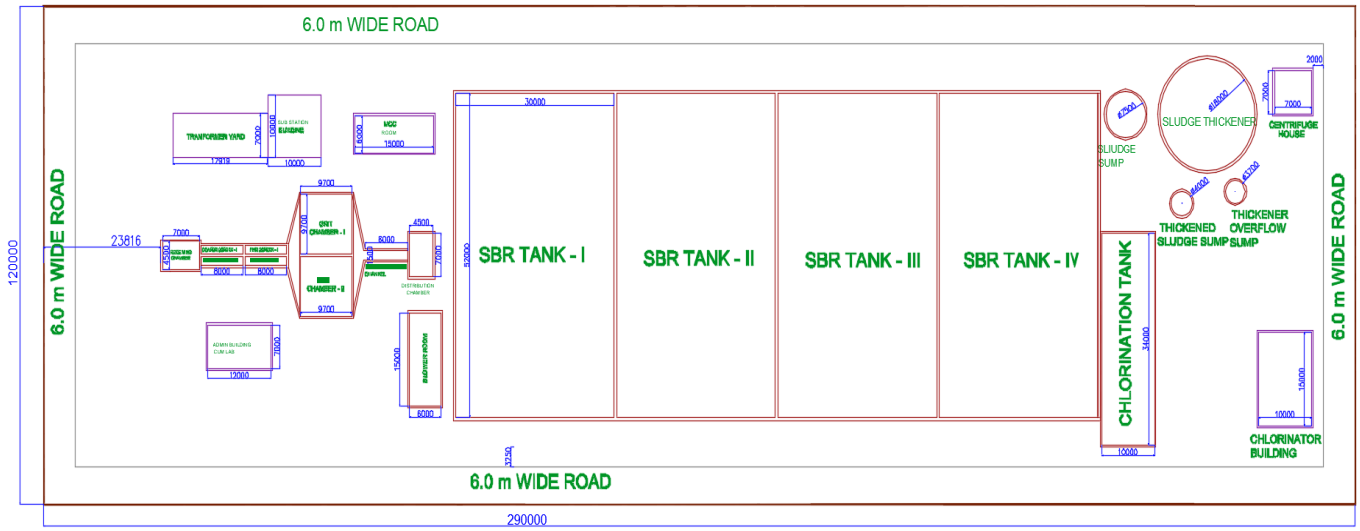
LAYOUT-PLAN

2.TYPICAL LIFT STATION LAYOUT

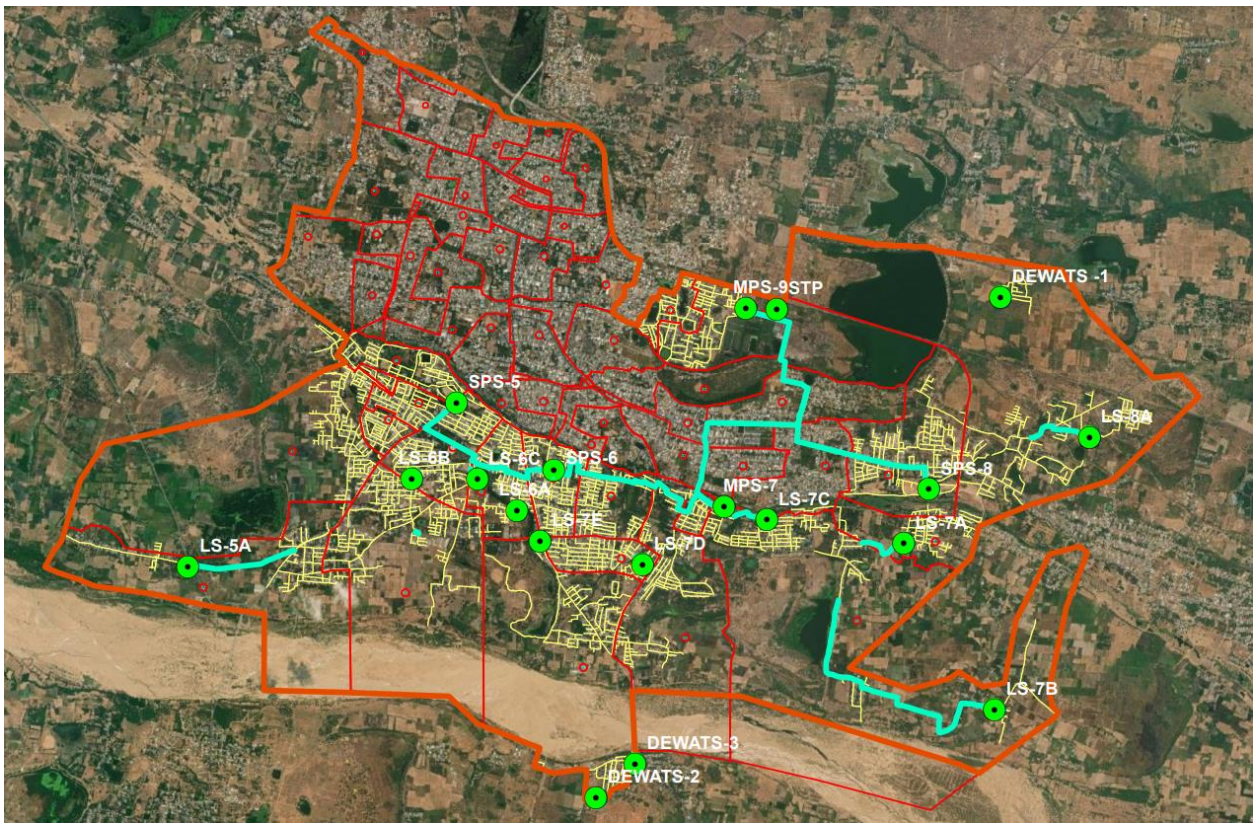


PLAN

3.SEWAGE TREATMENT PLANT LAYOUT



4.KCMC-UGSS LIFT STATION & PUMPING STATION LOCATIONS



3. LEGAL AND REGULATORY FRAMEWORK

In this section, the prevailing key National, State level laws, rules, policies, Acts, notifications pertaining to environmental, climate change and social aspects have been reviewed for their applicability to the proposed Under Ground Sewerage Scheme for Kancheepuram City Municipal Corporation and provided in the following table.

Table 3.1 National and State Regulations on Environmental, Climate Change and Social

Sl.No.	Acts/ Rules/ Regulations	Description	Relevance to sub-project
1.	Environment (Protection) Act, 1986	Popularly known as EP Act, it is an umbrella legislation that supplements existing environmental regulations. This law essentially links pollution and natural resource issues.	Applicable.
2.	EIA Notification, dt 2006 (S.O.1533(E), dt.14/09/2006) and subsequent amendments	The notification specifies that prior environmental clearance is required for the projects listed in the schedule of the notification before any construction work, or preparation of land by the project management except for securing the land, is started on the project or activity. The Schedule of the notification lists eight broad categories of projects that require prior environmental clearance.	Not Applicable.
3.	Wildlife Protection Act, 1972	This Act seeks to protect wildlife, by creating protected areas and controlling trade in wildlife products. Project activities that cross over into protected area regimes then requisite permission must be obtained.	Not Applicable.
4.	Forest (Conservation) Act, 1980	Forest (Conservation) Act, 1980 was enacted to halt rapid deforestation and governments cannot de-reserve forest land or direct that it be used for non-forest purposes.	Not Applicable. The project does not attract the provisions.
5.	Coastal Regulation Zone (CRZ) Notification, 2019	This notification under Environment (Protection) Act, 1986 supplements the law on site clearance by declarinxg certain zones as CRZ and regulates activities in these zones. Projects attracting this notification shall obtain CRZ clearance for implementation from the authority as required.	Not applicable.
6.	Water (Prevention And Control of Pollution) Act, 1974 and Tamil Nadu Water (Prevention	These laws seek to control pollution of water and enhance the quality of water. Under this law, it is mandatory to obtain consent for discharge of effluents and pay consent fees to Tamil Nadu State Pollution	Applicable. Activities involving emission of pollutants like establishing batch

Sl.No.	Acts/ Rules/ Regulations	Description	Relevance to sub-project
	And Control of Pollution) Rules, 1974	Control Board (TNPCB) for any municipal projects causing water pollution.	mixing plants and the proposed STP require consent from TNPCB.
7.	The Water (Prevention And Control of Pollution) Cess Act, 1977	This Act provides for levy and collection of access by local authorities on water consumed by persons or industries to augment resources for Pollution Control Boards.	Provisions are applicable.
8.	Air (Prevention and Control of Pollution) Act 1981 and Tamil Nadu Air (Prevention of Control of Pollution) Rules 1983	These laws address the prevention and control of air pollution. Under section 21 of this Act, it is mandatory to obtain consent from the Pollution Control Board to establish or operate any industrial operation.	Applicable. Activities involving emission of pollutants like establishing batch mixing plants and the proposed STP require consent from TNPCB.
9.	The Noise Pollution (Regulation and Control) Rules, 2000	The ambient air quality standards in respect of noise for different areas/zones namely industrial, commercial, residential or silence areas/zones are specified in the Schedule of these rules. An area comprising not less than 100 metres around hospitals, educational institutions and courts may be declared as silence area/zone as per these rules.	Provisions are applicable. The noise levels (during construction and during operation of pumping stations) shall not exceed the ambient air quality standards in respect of noise as specified in the Schedule.
10.	Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 (MSIHC Rules, 1989)	These rules aim at providing control for the generation, storage and Import of hazardous chemicals. According to these rules, the user of hazardous chemicals has to follow procedures as stipulated in the rules to prevent and control hazards from such chemicals and to ensure safety and permission has to be obtained from the authority concerned for such activity. The list of chemicals and threshold limits of handling falling under the purview of these rules is provided in the schedule to the rules.	Applicable. Use of chemicals like Chlorine gas in the project (for O&M of STP) attracts the provisions of the rules.
11.	Hazardous and Other Wastes Management Rules, 2016	This law addresses handling of hazardous and other wastes that fall under specified schedules and necessitates authorisation for such facilities from the State Pollution Control Board. Projects attracting these rules will have to follow the guidelines for handling and disposal of hazardous wastes. Measures include storage on a paved surface in a designated area with adequate secondary containment, with adequate	Provisions are applicable. During the construction and during operation, wastes and used oils will be generated which shall be stored and disposed as per the requirements of the rules.

Sl.No.	Acts/ Rules/ Regulations	Description	Relevance to sub-project
		labelling and before it is disposed of to TNPCB approved vendors.	
12.	Bio Medical Waste Management Rules, 2016	This notification by MoEF&CC lays down the method of collection of hospital waste, its transportation and disposal based on scientific methods.	Not applicable.
13.	Solid waste Management Rules 2016	This notification by the Ministry of Environment and Forest lays down the methods of handling Municipal Solid Waste and its scientific disposal. Establishing a facility for disposal requires authorisation from the State Pollution Control Board.	Provisions are applicable. Solid wastes from the construction/ labour camps are to be handled in compliance with the provisions of the rules.
14.	Fly Ash Notification, 2021	This notification necessitates use of fly ash for various construction activities like road laying, road and flyover embankments, shoreline protection structures in coastal districts, building construction projects etc within 300 kms from the lignite or coal based thermal power plants.	Not Applicable.
15.	E-Waste (Management and Handling) Rules, 2016	The rules prescribe procedures for manufacture, collection, dismantling, recycling, and disposal of electronic wastes and require authorisation of the State Pollution Control Board for the same.	Not applicable.
16.	Plastic waste (Management & handling) Rules 2016	This rules provides for collection, segregation, processing, treatment and disposal of the plastic waste in an environmentally sound manner, restriction on thickness of plastic sheet or like, prohibition on identified use, extended producer responsibility, marking and labelling requirement, registration of manufacturer, producer, importer, brand owner and plastic waste processor, reducing the plastic waste generation.	Not applicable.
17.	Construction and Demolition Waste Management Rules, 2016	The rules are an initiative to effectively tackle the issues of pollution and waste management from construction and demolition.	Not applicable.
18.	Explosives Rules, 2008	Explosive regulations serve as a guide for safety precautions during controlled blasting operations.	Applicable. NOC for Controlled Blasting for excavation of hard rock.

Sl.No.	Acts/ Rules/ Regulations	Description	Relevance to sub-project
19.	The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996	An Act to regulate the employment and conditions of service of building and other construction workers and to provide for their safety, health and welfare measure and for other matter connected therewith or incidental thereto.	Applicable. Contractor shall obtain necessary licence prior to start of works and comply with the provisions of the act during construction.
20.	Wetlands (Conservation and Management) Rules, 2017	The rules list the wetlands that need to be protected like those covered under Ramsar Convention, those in UNESCO heritage sites, those which are ecologically sensitive etc.	Not Applicable. There are no such wetlands within the project area.
21.	Public Liability Insurance Act, 1991	This act provides for providing immediate relief to the persons affected by accident occurring while handling any hazardous substance and for matters connected therewith.	Provisions are applicable.
22.	The National Green Tribunal Act, 2010	This act provides for establishment of National Green Tribunal for effective and expeditious disposal of cases relating to environmental protection and conservation of forests and other natural resources including enforcement of any legal right to environment and giving relief and compensation for damages to persons and property and for matters connected therewith or incidental. The National Green Tribunal established under this act is a specialized body equipped with the necessary expertise to handle environmental disputes involving multi-disciplinary issues. The Tribunal shall not be bound by the procedure laid down under the Code of Civil Procedure, 1908, but shall be guided by principles of natural justice.	Provisions are applicable.
23.	Central Electricity Authority (Measures Relating To Safety And Electric Supply) Regulations, 2010	An Act to consolidate the laws relating to generation, transmission, distribution, trading and use of electricity and generally for taking measures conducive to development of electricity industry, promoting competition therein, protecting interest of consumers and supply of electricity to all areas.	Applicable. Measures to be followed for use of electricity during construction and also during O&M.
24.	Gas Cylinders Rules, 2016	This rules provides guidelines for filling, possession, import or transportation of gas cylinders.	Applicable. For STP operation, if the number of Chlorine cylinders exceed Five, approval is to be

Sl.No.	Acts/ Rules/ Regulations	Description	Relevance to sub-project
			obtained from the Chief Controller of Explosives.
25.	Prohibition of Employment as Manual Scavengers 'and their Rehabilitation Act 2013	This act prohibits construction of insanitary latrines and employment or engaging of manual scavengers for the purpose of manual scavenging. No person, local authority or any agency shall, from such date as notified by the State Government (which shall not be later than one year from the date of commencement of this Act), engage or employ, either directly or indirectly, any person for hazardous cleaning of a sewer or a septic tank.	Applicable.
26.	National Action Plan on Climate Change	India is faced with the challenge of sustaining its rapid economic growth while dealing with the global threat of climate change.	Provisions are applicable for relevant projects.
27.	Energy Conservation Act, 2001	Aims to reduce specific energy consumption in different sectors and sets up a specialized Bureau of Energy Efficiency to institutionalize energy efficiency measures, monitoring, and measurement at plant and macro-levels.	Provisions are applicable for relevant projects.
28.	Energy Conservation Building Code (ECBC)	The Energy Conservation Act 2001 that was passed by the Indian Parliament empowered the Central Government to prescribe an Energy Conservation Building Code (ECBC). This code applies to new commercial buildings with a connected load of 100 kW & more or contract demand of 120 kVA or more; Introduces passive design features such as daylight requirements and shading provisions; Introduces provisions of installing Renewable Energy Systems; Sets minimum energy efficiency standards for design and construction; Encourages energy efficient design or retrofit of buildings .	Not Applicable.

Sl.No.	Acts/ Rules/ Regulations	Description	Relevance to sub-project
29.	The Ancient Monument and Archaeological Sites and Remains (Amendment and Validation) Act 2010	The Rules designate areas within a radius of 100 m and 200 m from the "protected property/ monument/ area" as "prohibited area" and "regulated area" respectively. Hence, no permission for construction of any public projects or any other nature shall be granted in the prohibited areas of the protected monument and protected area In respect of regulated areas, the competent authority may grant permission for construction, reconstruction, repair and renovation based on recommendation of the National Monument Authority duly taking note of heritage bye-laws, which shall be prepared in respect of each protected monument and protected areas.	Not relevant. However, in case of chance finds, provisions are applicable and measures identified will be implemented.
30.	The Right to Fair Compensation and transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (LARR)	The Act provides for enhanced compensation and assistance measures and adopts a more consultative and participatory approach in dealing with the Project Affected Persons. This act came into effect on 1 January 2014 and the Land Acquisition Act, 1894 stands repealed. The Act lays down procedures for estimating fair compensation of the affected families (and not just the titleholders) due to land acquisition, rehabilitation and resettlement. The Act was notified by the GoTN on 21 September 2017 (G.O. Ms. No. 298, Revenue & Disaster Management (LA-I (1), 20th September 2017).	Provisions of this Act are relevant to this project.
31.	The Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006	It grants legal recognition to the rights of traditional forest dwelling communities.	Not Applicable.
32.	The Child Labour (Prohibition and Regulation) Amendment Act, 2016. The Child Labour (Prohibition and Regulation)	No child below 14 years of age will be employed or permitted to work in any of the occupations set forth in the Act's Part A of the Schedule or in any workshop wherein any of the processes set forth in Part B of the Schedule. Child can help his family or family	Applicable.

Sl.No.	Acts/ Rules/ Regulations	Description	Relevance to sub-project
	Act,1986	enterprise, which is other than any hazardous occupations or processes set forth in the Schedule, after his school hours or during vacations.	
33.	The Occupational Safety, Health And Working Conditions Code, 2020	This code consolidates and amends the laws regulating the Occupational safety and health and working conditions of the persons employed in an establishment. The Act replaces 13 old central labour laws like The Factories Act, 1948, The Building and other Construction Workers Act, 1996, The Mines Act, 1952, The Inter-State Migrant Workmen Act, 1979, etc	Applicable. Stipulations of the code are to be complied with during construction.
34.	Code on Wages, 2019	The Code on Wages seeks to regulate wages & bonus payments in all employments. The code subsumes four existing acts namely, The Equal Remuneration Act, 1976, The Minimum Wages Act, 1948, The Payment of Bonus Act, 1965, The Payment of Wages Act, 1936.	Applicable. Stipulations of the code are to be complied with during construction.
35.	Workmen Compensation Act, 1923.	The Act provides for compensation by the employer to their workmen in case of injury by accident arising out of and during employment.	Applicable.
	State Regulations		
36.	The Tamil Nadu Preservation of Private Forest Act, 1949	Guidelines for extraction of trees from non-forest area stipulates that permission for tree cutting shall be taken from State Forest department	Not Applicable.
37.	The Tamil Nadu Hill Areas (Preservation of Trees) Act, 1955	This Act regulates the cutting of trees and cultivation of land in hill areas of Tamil Nadu, (Coonoor, Kodaikanal, Kotagiri, Ootacamund, Yercaud). Any tree cutting in these areas requires permission from the Committee under this Act.	Not Applicable.
38.	The Street Vendors (Protection of Livelihood and Regulation of Street Vending) Act, 2014 and Rules 2015 notified by GOTN.	The Street Vendors Act came into force on March 5, 2014, and seeks to protect the livelihoods of street vendors while regulating street vending. The Act recognizes street vendors of different types including mobile (moving) vendors, stationary (vending from a particular place), natural markets (spaces where buyers and sellers traditionally congregate), vendors with temporary built-up structures, hawkers, peddlers and squatters. It provides for regulation of street vendors, defines the rights and duties of street vendors and requires	Applicable if the project components are involved in the designated vending zones.

Sl.No.	Acts/ Rules/ Regulations	Description	Relevance to sub-project
		definition of designated vending zones, issue of certificates of vending and identity cards to street vendors, and proposes vending fees and maintenance charges. Under the Act, each state government is required to define the public purpose for which a street vendor may be evicted and the manner of relocation, manner of giving notice, and provides for a dispute resolution mechanism. As per the Act, planning and regulation of street vending is to be undertaken at town level by the Town Vending Committee. The Act also provides for social audit of the activities of the Town Vending Committee. This act specifically aims to protect the rights of urban street vendors and to regulate street vending activities. It provides for Survey of street vendors and protection from eviction or relocation; issuance of certificate for vending; provides for rights and obligations of street vendors; development of street vending plans; organizing of capacity building programmes to enable the street vendors to exercise the rights contemplated under this Act; undertake research, education and training programmes to advance knowledge and understanding of the role of the informal sector in the economy, in general and the street vendors, in particular and to raise awareness.	
39.	State Green Committee/District Green Committee	To consider the cutting of trees in public places and public offices. Ref G.O.(Ms).no.38 dated 02.07.2021 of the Environmental Climate Change and Forest (FR.13)Department, Government of Tamil Nadu	Applicable. If tree cutting is encountered, permission to be obtained.
40.	The Tamil Nadu Fire Service Act, 1985	An Act to provide for the establishment and maintenance of Fire Service in the State of Tamil Nadu	Not applicable
41.	Occupational, Safety, Health and Working Conditions (Tamil Nadu) Rules 2022.	This draft rules notified on 11.04.2022	Applicable. Stipulations of the code are to be complied with during construction.

Sl.No.	Acts/ Rules/ Regulations	Description	Relevance to sub-project
42.	Code on Wages (Tamil Nadu) Rules, 2022	This draft rules notified on 11.04.2022	Applicable. Stipulations of the code are to be complied with during construction.
	Climate Change		
43.	National Action Plan On Climate Change (30.06.2008) TNSAPCC, 31.03.2015	India is faced with the challenge of sustaining its rapid economic growth while dealing with the global threat of climate change. India, in 2008, has set up National Action plan on climate change (NAPCC) which outlined policies aimed at sustainable growth and dealing with climate change concerns effectively. NAPCC outlines eight national missions to address various adaptation and mitigation measures pertaining to Solar Energy, Enhanced Energy Efficiency, Sustainable Habitat, Water, Sustaining Himalayan Ecosystem, Green India, Sustaining Agriculture, Strategic Knowledge on Climate Change.	Provisions are applicable.
44.	Energy Conservation Act, 2001	Aims to reduce specific energy consumption in different sectors, and sets up a specialized Bureau of Energy Efficiency to institutionalize energy efficiency measures, monitoring, and measurement at plant and macro-levels.	Provisions applicable.
45.	Energy Conservation Building Code	The Energy Conservation Act 2001 that was passed by the Indian Parliament, empowered the Central Government to prescribe an Energy Conservation Building Code (ECBC). ECBC was launched in 2007 on a voluntary basis by the Bureau of Energy Efficiency (BEE and was revised in 2017. ECBC sets minimum energy efficiency standards for design and construction encouraging energy efficient design or retrofit of buildings without constraining the building function, comfort, health, or the productivity of the occupants and appropriate regard for economic considerations. Mandatory Scope Covers commercial Buildings having their Connected Load of 100kW and above or contract demand	Not Applicable.

Sl.No.	Acts/ Rules/ Regulations	Description	Relevance to sub-project
		120kVA and above and is ECBC is recommended for all new buildings and additions to existing buildings with the total load exceeding 200KW or 120kVA.	

3.1 Clearances / Permissions

3.1.1 Clearance to be obtained by KCMC (PIU)

Sl No	Proposed activity	Statutory authority	Applicable legislation	Status
1	Construction and operation of STP	TNPCB	Water (Prevention and Control of Pollution) Act, 1974	To be applied.
2	Tree Cutting	Department of Forest, Tamil Nadu and Greater Chennai Corporation & State Green Committee	Tamil Nadu Timber Transit Rules, 1968. G.O.(Ms).no.38 dated 02.07.2021 of the Environmental Climate Change and Forest (FR.13) Department, Government of Tamil Nadu	No tree cutting is involved in the project. This project is limited to only jungle clearance in the SPS/MPS/STP sites. However, in case of any tree cutting encountered during implementation, necessary permission will be obtained and compensatory plantation at 10 times will be carried out.
2	Highway crossings for laying of pipes.	NH, NHAI, SH	National Highways Rules 1957	To be applied
3	Electricity Connections and tariff.	TNEB/TANGEDCO	Tamil Nadu Electricity Supply Code (as amended up to 31-12-2009)	To be applied
4	Traffic diversion for Construction of collection	Deputy Commissioner of Police - Traffic Kancheepuram	MoRTH 112 SP 55 of IRC codes	To be applied

	system, Machine holes, pumping mains etc.,			
5	Delineation of land for construction for UGSS	District collector	Tamil Nadu Town and Country Planning Act, 1971 (Tamil Nadu Act 35 of 1972),	Not applicable as all the sites are owned by ULB.
6	Disposal of treated effluent into canal at 3.5 km from STP leading to Vegavathi River	Public Works Department		To be applied

3.1.2 Clearance to be obtained by the Contractor

Sl.no.	Construction Activity	Statutory Authority	Statute under which clearance is required	Responsibility	Supervision
1	Labour Licence and all other statutory work permits including Contract Labour& Interstate Migrant Worker License (if any)	Tamil Nadu Labour Department. Directorate of Industrial Safety and Health (DISH - https://dish.tn.gov.in/)	- The Contract Labour (Regulations & Abolition) Act, 1970 - The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996	Contractor	KCMC/PMC

2	Workmen compensation Insurance / Accident Insurance, EPF and ESIC (as applicable)	Tamil Nadu Labour Department	Tamil Nadu Labour welfare Fund Act	Contractor	KCMC/PMC
3	Crushers/Quarries and Batching plants/Ready Mix Concrete Plants	Tamil Nadu Pollution Control Board (TNPCB)	Consent to establish And consent to operate under Air Act, 1981	Contractor	KCMC/PMC
4	Discharges from construction activities	Tamil Nadu Pollution Control Board (TNPCB)	Consent to establish and consent to operate under Water Act, 1974	Contractor	KCMC/PMC
5	Sand mining, quarries and borrow areas	Department of Geology and mining, Government of Tamil Nadu	Contractor to obtain material from the existing Government licensed mines/quarries, Contractor will require prior approval of PIU for obtaining material from a particular source PIU to review and approve only existing licensed mines	Contractor	KCMC/PMC
6	Ground water extraction	WRD	Tamil Nadu Groundwater Development and Management Act 2000	Contractor	KCMC/PMC
7	Temporary traffic diversion measures	Traffic Police Chennai	MoRTH 112 SP 55 of IRC codes	Contractor	KCMC/PMC
8	Controlled Blasting	District Collector	The Explosives Act 1884	Contractor	KCMP/PMC
9	Use of Chlorine	Chief Controller of	The Gas	Contractor	KCMP/PMC

	Gas Cylinders at STP (storage & use >5nos)	Explosives, PESO	Cylinders Rules, 2016		

Applicable National Standards

A. National Ambient Air Quality Standards (NAAQS)

Parameter	Location[a]	National Ambient Air Quality Standards[b]
Particulate Matter PM_{10} ($\mu g/m^3$)	Industrial Residential, Rural and Other Areas	60 (Annual) 100 (24-hr)
	Sensitive Area	60 (Annual) 100 (24-hr)
Particulate Matter PM_{25} ($\mu g/m^3$)	Industrial Residential, Rural and Other Areas	40 (Annual) 60 (24-hr)
	Sensitive Area	40 (Annual) 60 (24-hr)
Sulfur Dioxide SO_2 ($\mu g/m^3$)	Industrial Residential, Rural and Other Areas	50 (Annual) 80 (24-hr)
	Sensitive Area	20 (Annual) 80 (24-hr)
Nitrogen Dioxide NO_2 ($\mu g/m^3$)	Industrial Residential, Rural and Other Areas	40 (Annual) 80 (24-hr)
	Sensitive Area	30 (Annual) 80 (24-hr)
Carbon Monoxide CO ($\mu g/m^3$)	Industrial Residential, Rural and Other Areas	2,000 (8-hr) 4,000 (1-hr)
	Sensitive Area	2,000 (8-hr) 4,000 (1-hr)
Ozone (O_3) ($\mu g/m^3$)	Industrial Residential, Rural and Other Areas	100 (8-hr) 180 (1-hr)
	Sensitive Area	100 (8-hr) 180 (1-hr)
Lead (Pb) ($\mu g/m^3$)	Industrial, Residential, Rural and Other Areas	0.5 (Annual) 1.0 (24-hr)
	Sensitive Area	0.5 (Annual) 1.0 (24-hr)
Ammonia (NH_3) ($\mu g/m^3$)	Industrial Residential, Rural and Other Areas	100 (Annual) 400 (24-hr)
	Sensitive Area	100 (Annual) 400 (24-hr)
Benzene (C_6H_6) ($\mu g/m^3$)	Industrial Residential, Rural and Other Areas	5 (Annual)
	Sensitive Area	5 (Annual)
Benzo(o) pyrene (BaP) (ng/m^3)	Industrial Residential, Rural and Other Areas	1 (Annual)
	Sensitive Area	1 (Annual)
Arsenic (As) (ng/m^3)	Industrial Residential, Rural and Other Areas	6 (Annual)
	Sensitive Area	6 (Annual)
Nickel (Ni) (ng/m^3)	Industrial Residential, Rural and Other Areas	20 (Annual)
	Sensitive Area	20 (Annual)

Source: Central Pollution Control Board

B. AMBIENT NOISE STANDARDS

Ambient Noise level standards have been notified by the MoEF vide Gazette Notification dated 26th December 1989 and also in the Schedule III of the Environmental (Protection) Rules 1986. It is based on the 'A' weighted equivalent noise level (Leq) and presented below.

Table 3.3 National Ambient Noise Standards

Category of Zones	Leq in dB(A)	
	Day *	**Night +**
Industrial	75	70
Commercial	65	55
Residential	55	45
Silence Zone **	50	40
* Day Time is from 6.00 AM and 9.00 PM. **+** Note –2 :Night Time is reckoned between 9.00 PM and 6.00 AM ** Silence Zone is defined as an area up to 100m around premises of Hospitals, Educational Institutions and Courts. Use of vehicle horn, loudspeaker and bursting of crackers is banned in these zones. ***Note:*** *Mixed categories of areas be declared as one of the four above mentioned categories by the competent Authority and the corresponding standards shall apply*		

Source: Central Pollution Control Board

C. Effluent Disposal Standards of Sewage Treatment Plans Applicable to All Modes of Disposal

S. No.	Parameter	Standard	
		Location	**Concentration not to exceed**
1	pH.	Anywhere in the country	6.5 - 9.0
2	Bio-Chemical Oxygen Demand (BOD)	Metro Cities*, all State Capitals except in the State of Arunachal Pradesh, Assam, Manipur, Meghalaya Mizoram, Nagaland, Tripura Sikkim, Himachal Pradesh, Uttarakhand, Jammu and Kashmir, and Union territory of Andaman and Nicobar Islands, Dadar and Nagar Haveli Daman and Diu and Lakshadweep	20
		Areas/regions other than mentioned above	30
3	Total Suspended Solids (TSS)	Metro Cities*, all State Capitals except in the State of Arunachal Pradesh, Assam, Manipur, Meghalaya Mizoram, Nagaland, Tripura Sikkim, Himachal Pradesh,	<50

		Uttarakhand, Jammu and Kashmir, and Union territory of Andaman and Nicobar Islands, Dadar and Nagar Haveli Daman and Diu and Lakshadweep	
		Areas/regions other than mentioned above	<100
4	Fecal Coliform (FC) (Most Probable Number per 100 milliliter, MPN/100ml	Anywhere in the country	<1000

*Metro Cities are Mumbai, Delhi, Kolkata, Chennai, Bengaluru, Hyderabad, Ahmedabad and Pune.

Note :
(i) All values in mg/l except for pH and Fecal Coliform.
(ii) These standards shall be applicable for discharge into water bodies as well as for land disposal/applications.
(iii) The standards for Fecal Coliform shall not apply in respect of use of treated effluent for industrial purposes.
(iv) These Standards shall apply to all STPs to be commissioned on or after the 1st June, 2019 and the old/existing STPs shall achieve these standards within a period of five years from date of publication of this notification in the Official Gazette.
(v) In case of discharge of treated effluent into sea, it shall be through proper marine outfall and the existing shore discharge shall be converted to marine outfalls, and in cases where the marine outfall provides a minimum initial dilution of 150 times at the point of discharge and a minimum dilution of 1500 times at a point 100 meters away from discharge point, then, the existing norms shall apply as specified in the general discharge standards.
(vi) Reuse/Recycling of treated effluent shall be encouraged and in cases where part of the treated effluent is reused and recycled involving possibility of human contact, standards as specified above shall apply.
(vii) Central Pollution Control Board/State Pollution Control Boards/Pollution Control Committees may issue more stringent norms taking account to local condition under section 5 of the Environment (Protection) Act, 1986".

D. Standards for Sludge Reuse as Manure

S**tandards for Composting:** As there are no specific standards notified for sludge reuse, the compost quality standards notified under the Solid Waste Management Rules, 2016 (Schedule II A, Standards for Composting) have been adopted here. According to the standards "In order to ensure safe application of compost, the following specifications for compost quality shall be met, namely:-

Parameters	Units	Organic Compost (FCO 2009)	Phosphate Rich Organic Manure (FCO 2013)
Arsenic	mg/kg	10	10
Cadmium	mg/kg	5	5
Chromium		50	50
Copper		300	300
Lead		100	100
Mercury		0.15	0.15
Nickel		50	50
Zinc		1000	1000
C/N ratio		<20	<20:1
PH		6.5 – 7.5	(1:5 solution) maximum 6.7
Moisture, percent by weight, maximum		15.0 – 25.0	25.0
Bulk density (g/cm3)		<1	Less than 1.6
Total Organic Carbon, per cent by weight, minimum		12	7.9
Total Nitrogen (as N), per cent by weight, minimum	percent by weight	0.8	0.4
Total Phosphate (as P205) percent by weight, minimum	percent by weight	0.4	10.4
Total Potassium (as K20), percent by weight, minimum	percent by weight	0.4	-
Colour			
Odour		Absence of foul Odor	
Particle size		minimum 90% material should pass through 4.0 mm is sieve	minimum 90% material should pass through 4.0 mm is sieve
Conductivity, not more Than	dsm-1	4	**8.2**

* compost (final product) exceeding the above stated concentration limits shall not be used for food crops. however, it may be utilized for purposes other than growing food crops.

4. ENVIRONMENTAL AND SOCIAL BASELINE

This chapter presents the baseline data required to understand the environmental, ecological attributes and socio-economic characteristics of the study area. The baseline includes climate, meteorology, topography, geology, hydrology, drainage, rainfall, land usage, water, air, noise, soil, flora, fauna and social profile of local population.

The social baseline survey includes social screening of the sites, screening of alignments for social impacts.

4.1 Methodology

The environmental and social baseline information has been collected from the primary and secondary sources and E&S screening of all the project sites and alignments.

The desk review of the available documentation and reports of this project is carried out including DPR. Also, the additional data will be collected from relevant websites, online as well as offline. Data thus collected from the secondary sources- published and unpublished literature, government documents, reports, etc are reviewed.

The secondary information collected from different sources include the Ministry of Environment, Forest and Climate Change (MOEF&CC), Census of India 2011, District Census Handbook, Geological Survey of India, Indian Meteorological Department, State Pollution Control Board (SPCB), Water Resources Department, PWD, tourism and other relevant departments of the state and Central governments. The data sources are indicated in the following Table.

Table 4.1 Sources of E&S data

S.No.	Attribute	Parameter	Source of Data
1	Land use /cover	Land use patterns	Satellite Imagery
2	Geology	Rock formation and mineral profile	Geological Survey of India and project site study
3	Air, water, noise, soil	As per relevant standards	Primary Survey in project area and from relevant department's websites.
4	Meteorology	Temperature, cloud, wind, etc.	IMD Chennai office and other studies.
5	Ecology	Existing terrestrial flora and fauna	Various sources.
6	Socio-economic aspects	Socio-economic characteristics	Census of India, 2011; District Hand Book, Primary survey in project area/ alignment.
7	E&S Screening	All the sub project utility sites and pipeline alignments, sewer networks, disposal line and point.	Carried out the during the month April 2023

4.2 Features

The features such as climate, topography, geology, drainage, vegetative cover of Tamil Nadu state, Kancheepuram District is described in following sections.

A. Tamil Nadu

4.2.1 Climate

The winter season in the project area commences early in December and continues till middle of March. The cold weather is pleasant. Under the Köppen climate classification the greater part of Tamil Nadu falls under Tropical Savanna climate and a smaller portion of the state falls under Humid subtropical climate; the climate of the state ranges from dry sub-humid to semi-arid. The summer season in Tamil Nadu is between the month of March to May and is characterized by intense heat and scant rainfall across the state.

Tamil Nadu is heavily dependent on monsoon rains, and thereby is prone to droughts when the monsoons fail. The state has distinct periods of rainfall, which are the advancing monsoon period, South-west monsoon (from June to September) with strong southwest winds, the North-east monsoon (from October to December), with dominant northeast winds, and the Dry season(from January to May). The normal annual rainfall of the state is about 945 mm (37.2 in) of which 48% is through the North East monsoon, and 32% through the South West monsoon.

4.2.2 Topography

The western, southern and the north-western parts are hilly and rich in vegetation. Tamil Nadu is the only state in India which has both the Western Ghat and the Eastern Ghat mountain ranges which meet at the Nilgiri hills. The Western Ghats dominate the entire western border with Kerala, effectively blocking much of the rain bearing clouds of the South West Monsoon from entering the state. The eastern parts are fertile coastal plains. The northern parts are a mix of hills and plains. The central and the south-central regions are arid plains.

Tamil Nadu has a coastline of about 1076 km which is the country's second longest coastline. Tamil Nadu falls mostly in a region of low seismic hazard with the exception of the western border areas that lie in a low to moderate hazard zone.The western, southern and the north-western parts are hilly and rich in vegetation.

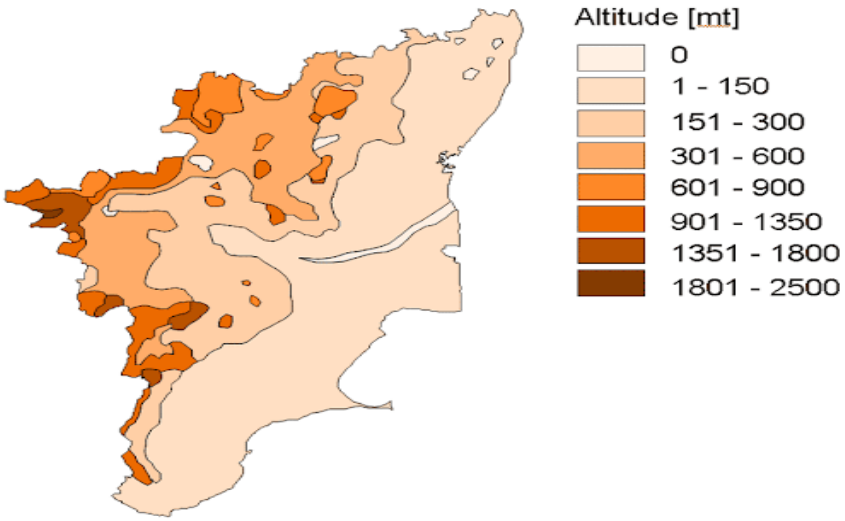


Figure 4.1 Topography map of Tamil Nadu state

4.2.3 Geology

Geological description of an area provides the information on the earth formation, the rocks of which it is made, the structure of those rocks and their occurrence in the area. Geologically, the Tamilnadu state comprises of Crystalline rocks of Archaean to late Proterozoic age occupying over 80% of the area of the state, while the rest is covered by the Phanerozoic sedimentary rocks mainly along the coastal belt and in a few inland river valleys. The hard rock terrain comprises predominantly of Charnockite and Khondalite groups and their migmatitic derivatives, supracrystal sequences of Sathyamangalam and Kolar groups and Peninsular Gneissic Complex (Bhavani Group), intruded by ultramafic-mafic complexes, basic dykes, granites and syenites. The sedimentary rocks of the coastal belt include fluviatile, fluvio-marine and marine sequences, such as Gondwana supergroup (Carboniferous to Permian and Upper Jurassic to Lower Cretaceous), marine sediments of Cauvery basin (Lower Cretaceous to Paleogene), Cuddalore/ Panambarai Formation (Mio-Pliocene) and sediments of Quaternary and Recent age. Geologically, the study area comes under Charnockite gneiss and Pyroxene granulites and also coastal sediments and alluvium.

4.2.4 Hydrology

Nearly 73% of the total area of the state is occupied by a variety of hard and fissured crystalline rocks like charnockite, gneisses and granites. The depth of open wells varies from 6 to 30 mbgl, while the depth of borewells generally varies from 30-100 m. The sedimentary formations consist of sand stones, limestones and shales whereas Quaternary sediments in the State are represented by older alluvium and recent alluvium and coastal sands. In the Cauvery delta, the artesian pressure ranges between 4.5 m to 17 mbgl with free flow upto 270 m3/hr. The yield of wells in the alluvium varies from 27 to 212 m3/hr. The yield of wells in the fissured formation varies from 7 to 35 m3/hr.

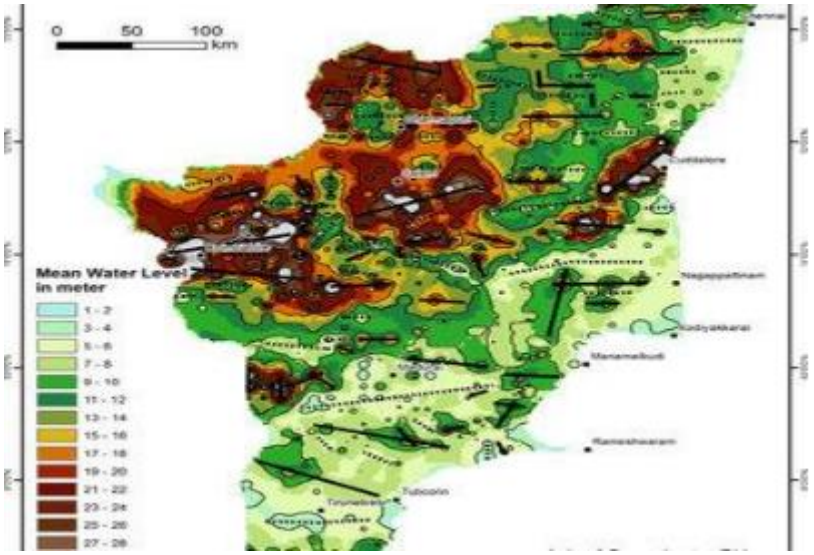


Figure 4.2 Hydrological map

4.2.5 Forest

Tamil Nadu is located in the southernmost state of the Indian peninsula and is spread over 130,058sq.km, which constitutes 3.96 % of the area of the country. It lies between latitude 8°05' and 13 ° 34' North latitudes and 76 ° 14' and 80 ° 21' East longitudes. The Tamil Nadu State of Forest gives a detailed view of the health of the forest cover of the State based on the Forest Survey of India (FSI) and India State of Forest Report (ISFR) 2015 assessment. The State has a spectrum of nine major forest types ranging from wet evergreen forest to moist deciduous, dry deciduous, sholas, grasslands and scrub forest. The Western Ghats, the longest hill range in the state is one of the 25 global hotspots of biodiversity and one of the three mega centers of endemism in India. The forest and tree cover of the State is about 30,952 sq. km which constitutes 23.80% of the total geographical area of the State.

B. Kancheepuram district

Kancheepuram district is located on the East Coast of Tamil Nadu and is adjacent to the Bay of Bengal in the east, bounded by Chennai and Thiruvallur district to its north, Vellore in the west, and Villupuram district in the south.

4.3.1 Climate

Kancheepuram district generally experiences hot and humid climatic conditions (tropical climate). During the summer season, the maximum temperature is 37.6 degrees and the minimum is 20.1 degree Celsius. During the winters, the maximum and minimum temperature is 28. 7 and 19.8 degree Celsius respectively. The average high and average low temperatures throughout the year are 37.5 and 20.4 respectively. Relative humidity is between 58% and 84% prevail throughout the year. The humidity reaches its peak during the morning and is lowest in the evening. The relative humidity is higher between November and January and is lowest throughout June.

Table 4.2 Temperature details Kancheepuram district (1991 – 2021)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg. Temperature °C (°F)	23.6 (74.5)	25 (77.1)	27.5 (81.5)	30 (86)	31.8 (89.3)	30.9 (87.6)	30.1 (86.2)	29.3 (84.8)	28.7 (83.6)	27 (80.5)	25.1 (77.1)	23.8 (74.9)
Min. Temperature °C (°F)	19 (66.1)	19.5 (67.1)	21.9 (71.5)	25.4 (77.7)	27.4 (81.3)	27.1 (80.8)	26.5 (79.7)	25.8 (78.4)	25.2 (77.3)	23.8 (74.8)	21.9 (71.4)	20.2 (68.4)
Max. Temperature °C (°F)	29 (84.2)	31.5 (88.8)	34.4 (93.9)	36.4 (97.6)	38 (100.4)	36 (96.8)	35 (95)	34 (93.2)	33.3 (92)	31.2 (88.2)	29.1 (84.4)	28.1 (82.6)

Source: Climate data.org

4.3.2 Rainfall

The district receives the rain under the influence of both south east and northeast monsoons. Most of the precipitation occurs in the form of cyclonic storms caused due to the depressions in Bay of Bengal chiefly during the northeast monsoon period. The southwest monsoon rainfall is highly erratic and summer rains are negligible.

The normal annual rainfall over the district varies from 1105 mm to 1214 mm. It is the minimum in the western and northwestern parts of the district around Uttiramerur (1105 mm) and it is the maximum around Kovalam (1214.2mm).

The average rain fall in Kancheepuram is 1159.4mm.

Table 4.3. Rainfall in Kancheepuram Corporation

Actual Rainfall in mm								Normal Rainfall (2022) in mm
2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	
2256.6	990.5	1191.7	833.0	1051.17	1258.4	1698.1	1404.6	1159.4

4.3.3 Topography

Kancheepuram is located about 75 km from Chennai. It has an average elevation of 81 m. The topography is almost plain, with no major geological formation. There are no notable mineral

resources available in and around the town. Types of soil found in Kancheepuram are red loam, lateritic soil, black soil, sandy coastal alluvium and red sandy soil. Clay, with some loam, clay, and sand, are suitable for use in construction.

4.3.4 Relative humidity

Kancheepuram district experiences high relative humidity, which ranges between 58% and 84% prevail throughout the year. Relative humidity is maximum in the morning and minimum in the evening. Higher rates of relative humidity are observed between November and January i.e., 83% to 84%. In the months of June, the humidity is lower i.e., around 58%. Average relative humidity in the morning and evening 74% and 64%.

The minimum and maximum temperature are 20°C & 37°C. The daytime heat is oppressive, and the temperature is as high as 43°C.

4.3.5 Cloud cover

Generally light clouds are observed in winter mornings. During pre-monsoon and the post- monsoon evenings the skies are either clear or lightly clouded. But in post-monsoon mornings as well as monsoon morning heavy clouds are commonly observed. And, the skies are light to moderately clouded in the evening time throughout the year.

4.3.6 Wind speed and direction

The available data indicate the trend of wind speed direction during pre-monsoon, monsoon, post monsoon and winter season in a year, wind rose is given at Figure 4.7

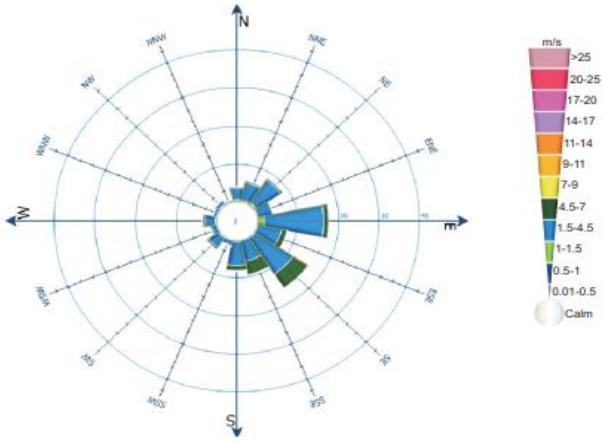


Figure 4.3 Windrose diagram

4.3.7 Hydrogeology

The district is underlain by both sedimentary and fissured formations. The important aquifer system in the district is constituted by 1) unconsolidated and semi consolidated formations and 2) weathered, fissured and fractured crystalline rocks.

In Kancheepuram Corporation area, the topography of the terrain is plain. The geological formation is Alluvium followed by granitic Gniess and charnokite. The trend of the formation strike direction

is North East – South west and dipping towards south east. The Alluvium thickness ranging from 9mto 15m and followed weathered formation varying from 5m to 6m below the Alluvium. The winter and summer water levels are ranging from 2m to 3m and 18m to 24 m respectively.

In PALAR RIVER – ORIKKAI TO SEVILIMEDU AREA the topography of the Terrain is plain. The geological formation is Alluvium followed by granitic Gniess and Charnockite. The trend of the formation strike direction is North East – South west and dipping towards south east. The Alluvium thickness ranging from 5mto 10m and followed weathered formation varying from 2m to 3m below the Alluvium. The winter and summer water levels are ranging from Bed level to 0.50m and 1.50m to 2m respectively.

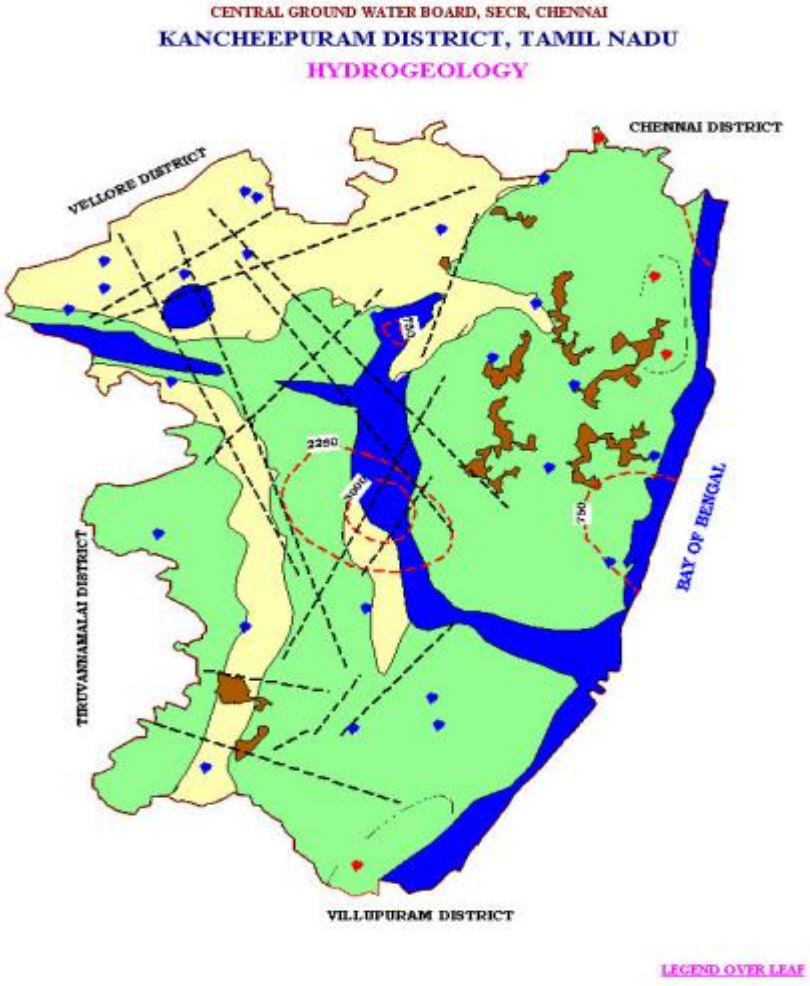


Figure 4.2 Hydrogeological map

4.3.8 Groundwater level

Tamil Nadu State Ground and Surface Water Resources Data Centre, WRD, Government of Tamil Nadu jointly with Central Ground Water Board (CGWB) determine the status of ground water level for each tehsil every year and publish the findings once in four years after monitoring the important wells.

The estimation of ground water resources for the district has shown that two blocks are over exploited and two blocks are under "Critical" category. The shallow alluvial aquifer along Palar and Cheyyar rivers serve as an important source of drinking water between Kancheepuram to Ayyapakkam and Chingleput to Tambaram. The dug wells in hard rock terrain tapping the entire weathered residuum are capable of yielding 30-100 m3 /day requiring the installation of 3 - 5 HP pumps for extraction of groundwater. Ground water potential of Kancheepuram, the project area, falls under "Safe" category.

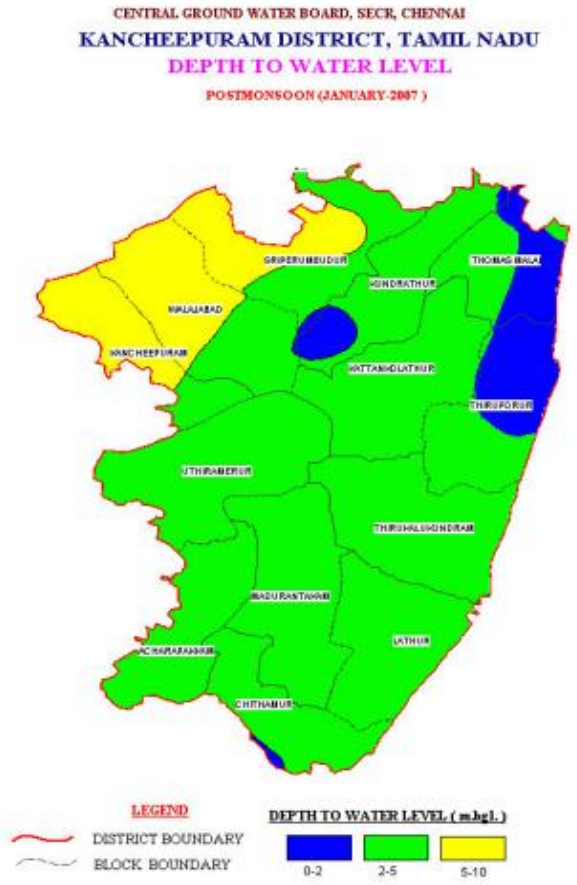


Figure 4.4 Groundwater level of Kancheepuram district

Drainage

Drainage details out the river systems and the pattern formed in the form of watersheds such as streams, rivers, and lakes in the region. Also, it describes the direction of flow and the route it takes from its entry into any region till the exit into the adjacent region. The drainage pattern in Kancheepuram District is developed by the river Palar and Cheyyar and its tributaries. The drainage

pattern in general is sub-dendritic and radial. All the rivers are seasonal and carry substantial flows during the monsoon period. River Palar, a major river that works as a drain for the district originates from Western Ghats in Karnataka state, and discharges in Bay of Bengal near Pudupattinam. The Cheyyar, a tributary of Palar river originates from the Jawadhu hills of Tiruvannamalai district. It has a north easterly flow in Kancheepuram district and confluences with the Palar near Pazhayaseevaram. Other seasonal rivers like Korattalaiar and Tandiar drain from the district partly on the northern and southern parts respectively.

4.3.9 Soil type

Soils have been classified into 1) clayey soil, 2) red sandy or red loamy soil 3) Red sandy brown clayey soil and 4) Alluvial soil. Of the above soils brown clayey soil is the most predominant, covering more than 71 percent of the area of Kancheepuram district. Alluvial soils are found on the banks of Palar, Cheyyar and other rivers. The river alluvium is transported and is seen in the coastal area of this district. Sandy coastal alluvial (arenacious soil) occurs along the seacoast as a narrow belt.

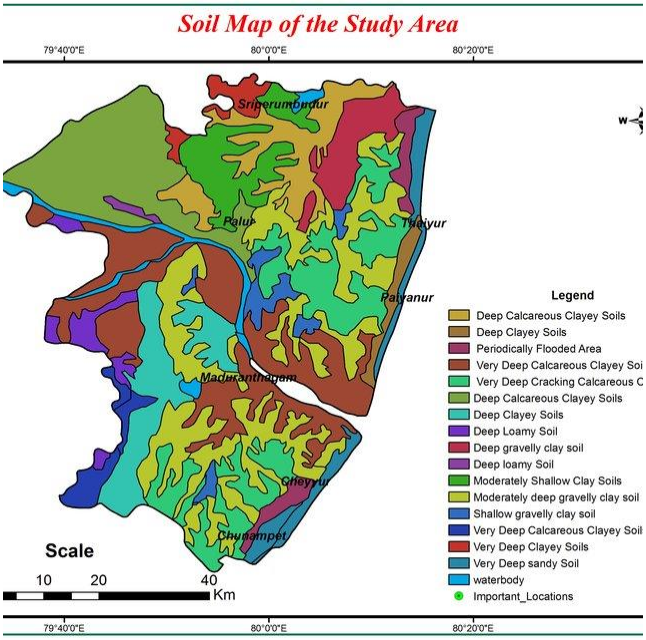


Figure 4.5 Soil map of Kancheepuram district

Biodiversity

Following are the important flora and fauna in the district.

Characteristic species

- *Manilkara hexandra*
- *Mimusops elengi*
- *Albizia amara*
- *Memecylon umbellatum*
- *Diospyros ferrea* syn *maba buxifolia*

Top Canopy

- *Mimusops elengi*
- *Diospyros ebenum* (occasional)

- *Strychnos nux vomia* (occasional)
- *Strychnos potatorum* (occasional)
- *Diospyros chloroxylon* occasional)
- *Drypetes sepiarea* (rare)
- *Syzygium cumini*
- *Canthirum decoccum* (frequent)
- *Ziziphus glaberrima* (frequent)
- *Acacia leucophloea* (frequent)
- *Catunaregam spinosa* (frequent)
- *Buchanania lanzan* (occasional)
- *Sapinda emarginatus* (occasional)
- *Albizia amara*
- *Albizia lebbek*
- *Tamarindus indica*
- *Azadirachta indica*
- *Borassus flabellifer*

Under wood

- *Carissa carandas* (abundant)
- *Flacourtia indica* (locally abundant)
- *Diospyros ferrea* (frequent)
- *Grewia* sp. (abundant)
- *Gymnosporia* sp. (frequent)
- *Ixora arborea* (frequent)
- *Tarenna ascatica* (frequent)
- *Memecylon umbellatum*
- *Garcinia spicata*

Shrubs

- *Strobilanthus*
- *Dodonaea viscosa* (abundant)
- *Glycosmis pentaphylla*
- *Ochna squarrosa*
- *Gmelina asiatica*

Herbs

- *Hemidesmus indicus*

Tropical dry evergreen scrubs

- *Diospyros ferrea*
- *Ziziphus glaberrima*
- *Calliea cinerea*
- *Catunaregam spinosa*
- *Carissa spinarum*
- *Albiziz amara*
- *Buchanania lanzan*
- *Dodonaea viscosa*

Thorn forests

- Karunkali - *Acacia chundra*

- Usil - *Albizia amara*
- Neem - *Azaridachita indica*
- Sarakonnai - *Cassia fistula*
- Namai - *Anogeissus latifolia*
- Karai - *Randia dumentorum*
- Vagai - *Albizia odaratissma*
- Kala - *Carisa carandas*
- Etti - *Strychnos nuxvomica*
- Virali - *Dodonaea viscosa*
- A varam - *Cassia auriculata*
- *Canthum dicoccum*
- *Aristida setaca*
- *Heteropogon contortus.*

Fauna

- Jackal - *Canis aureus*
- Jungle cat - *Felis chaus*
- Palm squirrels - *Funambulus pennanti* and *F.palmarum*
- Hare - *Lepus nigricollis nigricollis*
- Common mongoose - *Harpestes edwardsi*
- Shrew - *Suncus sp.*
- Pangolim - *Manis crassicaudata*.
- Pariyakite - *Milvus migrans govinda*
- Brahminy kite - *Haliastuf indus*
- Patridge - *Francolinus pondicerianus*
- Koel - *Eudynamys scolopacea.*
- Spotted owlet - *Athene brahma*
- Common rat snake - *Ptyas mucosus*
- Cobra - *Naja naja*
- Green whip snake - *Ahaetulla nasutus.*

History and Culture

Kanchipuram is one among the ancient cities of South India. Kancheepuram is a place of great importance all over the world due to its large number of temples and world famous silk industry. Kanchipuram is hailed as the cultural capital of Tamilnadu and is held in great reverence. This land of temples is famous pilgrim spot and has lots of famous temples including Sakkiswarar Temple, Vaikunta Perumal Temple, Kailasanatha Temple, Ekambareswarar Temple, Kamakshi Amman Temple. One of the four seats of Sri Adi Shankaracharya the Kanchi Kamakoti Peetham is situated here. Kanchi is also famous for its finest silk fabrics and saris with zari work.

Kanchipuram has been ruled by the Pallavas, the Medieval Cholas, the Later Cholas, the Later Pandyas, the Vijayanagara Empire, the Carnatic kingdom, and the British, who called the city "Conjeeveram".

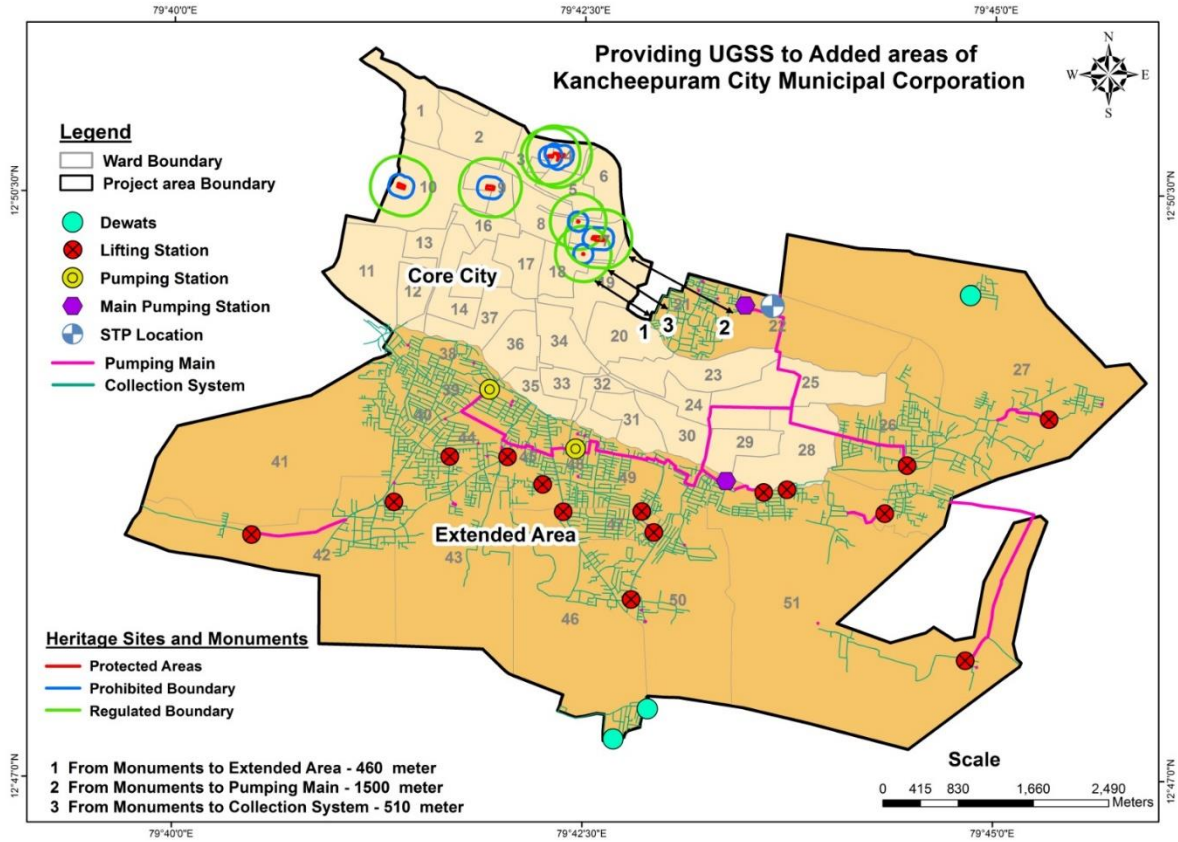
There are about 31 monuments & sites in Kancheepuram district out of which seven monuments are present within the Kanchipuram limits. The city's historical monuments include the Kailasanathar Temple, Vaikunta Perumal Temple, Piravathanesvara temple, Iravathanesvara temple, Jvarahesvara temple, Mathangesvara

temple, and Muktesvara temple. All these monuments are located in the core area of Kancheepuram Corporation whereas the project is proposed in the added areas.

None of the project sites identified for locating the proposed STP, pumping stations, lift stations and pipeline alignments are located within the 300m regulated boundary of the monuments and hence no impact is anticipated from the construction activities. However there are several temples and other religious structures in the project area and hence adequate precautions are to be taken not to cause any disturbance during construction. Further during construction if any chance finds encountered, then necessary management measures would be implemented.

There are archeological excavations being carried out by ASI in some locations in Kanchipuram District which are not relevant to project area. But there are secondary information on archeological excavations near River Vegavathi in Kanchipuram. The status of such locations and relevance to the project especially the proposed disposal point in River Vegavathi are to be examined by the KCMC in consultation with the ASI and requirements shall be identified and permits if applicable shall be obtained prior to start of work near those locations. Chance find procedures already in place as applicable shall be complied with, not to disturb such locations during construction.

Fig 13: Nearest Archaeological Survey of India Protected Monument



Socio-economic profile of Kancheepuram District

4.7.1 Project Area

Kancheepuram Erstwhile Municipality and Added areas (wards 1 to 51 of Kancheepuram City Municipal Corporation) spreads in a total area of 36.14 sq.m with population of 2,34,353 as per 2011 census. The decadal populations of Kancheepuram are given below:

Table: 4.4 Decadal population of Kancheepuram district

Location/year	1971	1981	1991	2001	2011
Kancheepuram- Core City	110657	130926	144955	153140	164384
Orikkai			3138	4607	12638
Nathapettai			9923	10111	19883
Thenambakkam			4415	9357	13994
Sevlimedu			13433	16125	23454

4.7.2 Connectivity

Kancheepuram is well connected to other major cities of the country via regular flights. The nearest airport is 52 kms away, Chennai (National & International Airports) Airports.

Kancheepuram Railway Station serves as the principal railway station of the city of Kancheepuram. The station is a part of the Chennai railway division of the Southern Railway zone, Walajabad block, St.Thomas Mount block and Chengalpattu taluk (covers Thirukaukundram block and Thiruporur block) and are well connected with Chennai and South districts of Tamil Nadu.

4.7.3 Economy

Kancheepuram is a major contributor to the state economy, accounting for over 5% of the state GDP. The share of the district has steadily grown over time towards 6%. The per capita income is high and both urban and rural incomes are comfortably above state levels. Agriculture is the predominant occupation of most of the work force. At the same time, proximity to Chennai has seen the emergence of heavy industrialization, with many large automobile, electronic and other manufacturers setting up shop here. Kancheepuram is historically significant to Tamil Nadu and is a major Tourist Hub, while IT services have also opened offices in the capital city of the same name.

Kancheepuram is a traditional centre of silk weaving and handloom industries for producing Kanchipuram Sarees. In 2005, "Kanchipuram Silk Sarees" received the Geographical Indication tag, the first product in India to carry this label. The silk trade in Kanchipuram began when King Raja Raja Chola I (985–1014) invited weavers from Saurashtra, Gujarat to migrate to Kanchi. The craft increased with the mass migration of weavers from Andhra Pradesh in the 15th century during the Vijayanagara rule. Kancheepuram is fondly called as the silk city and the silk industry here is a major contributor to the economy.

4.7.4 Social structure

Scheduled Castes and Scheduled Tribes accounted for 23.71% and 1.03% of the population respectively.

4.7.5 Literacy Level

The district has recorded the highest literacy rate of 84.5% as compared with the State literacy rate of 80.1%.

4.7.6 Occupational pattern

The district had a total of 1,006,245 households. There were a total of 1,673,814 workers, comprising 74,761 cultivators, 162,494 main agricultural labourers, 41,149 in household industries, 1,088,974 other workers, 306,436 marginal workers, 14,582 marginal cultivators, 110,020 marginal agricultural labourers, 13,583 marginal workers in household industries and 168,251 other marginal workers. The total number of Taluks are 13.

4.4 Baseline Monitoring

Primary survey for baseline was carried out in the project area as part of the environmental and social impact assessment during the month of April '23 and details of the assessment are provided below.

Table 4.4. Environmental Baseline Monitoring - Sampling Locations

Sampling Location	Latitude	Longitude	Environmental Monitoring with respect to Ambient air quality, ambient noise levels, soil quality surface and groundwater
Near Collectorate ground	12.822506	79.69801	Air, Noise, Groundwater
Thirukalimedu	12.826983	79.721707	Air, Noise, Groundwater, Surface water, surface water(project site)
Shri Vallabacharys baithak, Orikkai	12.812141	79.718783	Air, Noise, Groundwater, Soil
Arasu nagar	12.803137	79.710504	Air, Noise, Groundwater
Nathapettai lake	12.836082	79.73737	Air, Noise, Groundwater, surface water, soil
Vasantham nagar	12.792979	79.715623	Air, Noise, Groundwater
Perasiriyar nagar	12.809781	79.70859	Air, Noise, Groundwater
Thenambakkam	12.805059	79.734204	Air, Noise, Groundwater
Near Dharmalingeshwar temple tank	12.825543	79.695947	Air, Noise, Groundwater
Olimohammedpettai	12.856897	79.692095	Air, Noise, Groundwater

Criteria for selection of sampling locations:

The sampling locations have been identified to represent the project area, located near the pipeline alignment & project sites and availability of surface / ground water. For ground water locations with borewells currently being used by locals have been identified. Most of the sampling locations were predominantly residential.

The results of the location wise parameters is discussed below.

Photos of Sampling Locations

A. .1 Ambient Air Quality Monitoring

The prime objective of the baseline air quality study was to assess the existing ambient air quality of the project area as per MoEF&CC guidelines. The procedure adopted for the study is illustrated below

3.1.1 Parameters for Sampling & Sampling Frequency

The baseline status of the ambient air quality has been assessed through a scientifically designed ambient air quality monitoring network. The design of monitoring network in the Air quality surveillance programme has been based on the following considerations

- Meteorological parameters on synoptic scale
- Topography of the study area
- Representatives of regional background air quality for obtaining baseline status
- Representatives of likely impact areas.

Ambient Air Quality Monitoring (AAQM) stations were set up at 10 locations with due consideration to the above mentioned points. AAQM locations were selected in downwind, cross wind and upwind direction of the proposed project sites and alignment.

At each sampling station monitoring was carried out for a frequency of 24 hrs during study period. The common air pollutants namely Particulate Matter (PM_{10}, $PM_{2.5}$), Sulfur dioxide (SO_2), Oxides of Nitrogen (NO_x) and Carbon Monoxide (CO) were sampled on 8/24 hourly and results were averaged to 24 hours to meet the requirements of the MoEF&CC and compared with the NAAQM standard stipulated by the CPCB.

The existing concentration levels of air pollutants of concern, as mentioned above, are presented in Table 4.5. The observed values were compared with the standards as prescribed by Central Pollution Control Board (CPCB) for Industrial, Residential and Rural zone.

Table 4.5 Ambient Air quality monitoring – Monitoring Data

Parameters	AAQ1	AAQ2	AAQ3	AAQ4	AAQ5	AAQ6	AAQ7	AAQ8	AAQ9	AAQ10	Unit	CPCB Standards
Particulate Matter (Size Less than 10 gm) or PM_{10}	57.4	62.5	65.8	54.2	68.1	52.7	59.1	63.4	56.6	65.1	µg/m^3	100
Particulate Matter (Size Less than 2.5 gm) or PM_{25}	28.1	30.7	32.2	21.9	30.6	23.2	27.4	30.9	25.1	33.7	µg/m^3	60
Sulphur dioxide (SO_2)	6.3	5.7	6.8	5.7	6.3	5.2	5.2	6.3	6.8	5.7	µg/m^3	80
Nitrogen Dioxide (NO_2)	19.8	20.5	24.7	18.3	26.2	15.1	20.6	22.4	19.1	23.9	µg/m^3	80

Source: Primary Survey, 2023.

Note:

1. AAQ1-Collectorate Ground Thaiyar Kullam. AAQ2-Thirukalimedu AAQ3-Shri Vallabachara Baithak Orikkai. AAQ4-Arasu Nagar. AAQ5-Vasantham Nagar. AAQ6-Nathapettai Lake. AAQ7-Perasiriyar Nagar AAQ8- Brahmanar Street ThenambakkamAAQ9- Dharmalingaeshwar Temple Tank AAQ10-Olimohammedpettai
2. In all the above locations parameters like Ammonia (NH3), Ozone (O_3), Ozone (O_3), Benzene (C6F16), Benzo (a) Pyrene (particulate phase only), Lead (Pb), Arsenic (As) and Nickel (Ni) were found to be below Detectable limits.

a) Particulate Matter <2.5µm and <10µm

Particulate Matter <2.5µm were observed to be in high concentration at AAQ10 (Olimohammedpettai) & Particulate Matter <10µm were observed to be in high concentration at AAQ5 (Vasantham Nagar), both the locations are highly populated when compared to other monitoring locations. The 24-hourly average values of Particulate Matter <2.5µm & Particulate Matter <10µm were compared with the National Ambient Air Quality Standards and found that all sampling stations recorded values within the applicable limits of residential and rural area limits for all locations in study area.

b) Sulfur Dioxide

The 24 hourly average values of SO_2 were compared with the National Ambient Air quality standards and it was found that the recorded values, of all the monitored locations, were much lower than the applicable limit of 80µg/m^3 for residential and rural areas.

c) Oxides of Nitrogen

The 24 hourly average values of NO_x were compared with the national ambient air quality standards and it was found that all the sampling stations recorded values much lower than the applicable limit of 80 µg/m^3 for residential and rural areas.

d) Carbon Monoxide

The 8 hourly average values of CO were compared with the national ambient air quality standards and it was found that all the sampling stations recorded values much lower than the applicable limit of 4 mg/m3 for residential and rural areas.

Other monitoring parameters such as heavy metals, benzene and ammonia were found to be below detection limit.

4.4.2 Noise Quality

Baseline noise levels have been monitored in the study area, using portable Noise Level Meter. Keeping in view the land use pattern, random locations for noise level monitoring were identified for the assessment. The land use pattern incudes residential areas covering settlements, schools, bus stands, hospital, community properties, commercial areas, etc., the day levels of noise have been monitored.

The sampling locations for noise were identified close to the proposed component sites. The noise sampling locations and results are presented in **Table 4.6.**

Table 4.6 Noise Monitoring - Monitoring Data

S.No	Location of Sampling	Day time results dB(A) Leq
1	Collectorate Ground Thaiyar Kullam.	61.5
2	Thirukalimedu.	58.8
3	Shri Vallabachara Baithak Orikkai.	63.6
4	Uthiramerur Road Arasu Nagar.	62.3
5	Ayyampettai Vasantham Nagar.	64.2

6	Kamakshi Nagar Nathapettai Lake.	61.9
7	Perasiriyar Nagar	62.4
8	Brahmanar Street Thenambakkam	64.3
9	Dharmalingaeshwar Temple Tank	63.5
10	Olimohammedpettai	62.2
CPCB Standards for Residential Area (Maximum)		**55**

The noise levels observed in some of the rural areas are primarily owing to vehicular traffic and other anthropogenic activities. The day equivalents during the study period are ranging between 58.8 dB (A) to 64.3 dB (A). From the results, the noise levels in all the locations the Day equivalents were exceeding the Ambient Noise standards for residential area. At one location 8 - Brahmana Street Thenambakkam is in the border line. Necessary mitigation measure with noise control measures during project implementation is included in the ESMP.

4.4.3 Soil Quality

The study on soil quality establishes the baseline characteristics of the soil in the study area surrounding the project site. The study has been addressed with the following objectives.

- To determine the baseline characteristics
- To determine the soil characteristics of proposed project site.
- To determine the impact of industrialization/urbanization on soil characteristics
- To determine the impacts on soils from agricultural productivity point of view.

Criteria Adopted for Selection of Sampling Locations

For studying the soil types and soil characteristics, sampling locations were selected near to the project sites to assess the existing soil conditions representing various land use conditions and geological features. The homogenized soil samples collected at different locations were packed in a polyethylene plastic bag and sealed. The sealed samples were sent to laboratory for analysis. The important physical, chemical parameter concentrations were determined from all samples. The soil sampling results are given in **Table 4.6.**

Table 4.6 Soil monitoring data

S. No	Test Parameters	Results	
		Shri Vallabacharya Baithak — Orikkai **(S1)**	Near Nathapettai Lake **(S2)**
1.	pH @ 25°C	7.90	8.46
2.	Density	1.5 g/cc	1.2 g/cc
3.	Moisture Content	4.2 %	10.3%
4.	Conductivity @ 25°C	216 micromhos/cm	340 micromhos/cm
Texture			
5.	Clay	46.3%	65.7 %
6.	Sand	53.1 %	33.2%
7.	Silt	0.6 %	1.1 %
8.	Water Holding Capacity	40.9 %	47.4 %

S. No	Test Parameters	Results	
		Shri Vallabacharya Baithak — Orikkai **(S1)**	Near Nathapettai Lake **(S2)**
9.	Phosphorus as P	371 mg/kg	BDL (DL 1.0 mg/kg)
10.	Sodium as Na	779 mg/kg	1498 mg/kg
11.	Potassium as K	1112 mg/kg	1031 mg/kg
12.	Calcium as Ca	5002 mg/kg	3333 mg/kg
13.	Magnesium as Mg	3853 mg/kg	2521 mg/kg
14.	Iron as Fe	23529 mg/kg	13801 mg/kg
15.	Zinc as Zn	58.2 mg/kg	23 mg/kg
16.	Manganese as Mn	265 mg/kg	26.3 mg/kg
17.	Nickel as Ni	12.4 mg/kg	12.7 mg/kg
18.	Chromium as Cr	27.4 mg/kg	17.0 mg/kg
19.	Copper as Cu	26.5 mg/kg	19.7 mg/kg
20.	Cadmium as Cd	BDL (DL: 1.0 mg/kg)	BDL (DL : 1.0 mg/kg)
21.	Aluminium as Al	9772 mg/kg	9192 mg/kg
22.	Organic Carbon	0.2 %	0.1 %
23.	Organic Matter	0.3%	0.2 %
24.	Total Nitrogen as N	166 mg/kg	352 mg/kg

- The pH values in the study area are varying from 7.90 to 8.46 indicating that the soils are falling in normal to saline class.
- Based on the electrical conductivity, the soils are classified into 4 groups (Normal, Critical for germination, Critical for growth of the sensitive crops, Injurious to most crops). The electrical conductivity in the study area is varying from 216 to 340 μs indicating that soils falling under normal category.
- The organic carbon influences the soil in respect to color, physical properties, supply of available nutrients and absorptive capacity. The main source of soil organic carbon is plant tissue while animals are the subsidiary source. Though organic carbon is a small part of mineral soils, it plays a vital role in the productivity and conditioning of soils. It serves as source of food for soil bacteria and fungi which are responsible for converting complex organic materials into simple substances readily used by the plants. In association with clay and calcium, it helps to form the aggregates of soil particles to produce the crumb structure. The organic carbon in the study area is varying from 0.1 to 0.2% which is in low range.
- The other important parameters for characterization of soil for irrigation are N,P,K. Nitrogen, Phosphorus and Potassium are known as primary nutrients, Calcium, Magnesium and Sulphur as secondary nutrients. The primary and secondary nutrient elements are known as major elements. This classification is based on their relative abundance and not on their relative importance.
- Available Nitrogen encourages the vegetative development of plants by imparting a healthy green colour to the leaves. It also controls, to some extent, the efficient utilization of phosphorus and potassium. Its deficiency retards growth and root

development, turns the foliage yellowish or pale green, hastens maturity, causes the shriveling of grains and lowers crop yield. Excess nitrogen produces leathery and sometimes crinkled and dark green leaves with succulent growth. It also delays the maturation of plants, impairs the quality of crops like barley, potato, tobacco, sugarcane and fruits and increases susceptibility to diseases and causes "lodging" of cereal crops by inducing an undue lengthening of the stem internodes. The available Nitrogen as N in the study area is varying from 166 to 352 kg/ha which indicates that samples are falling in Low range.

- Available Phosphorus influences the vigor of plants and improves the quality of crops. It encourages the formation of new cells, promotes root growth (particularly the development of fibrous roots) and hastens leaf development, formation of grains, and the maturation of crops. It also increases resistance to disease and strengthens the stems of cereal plants, thus reducing their tendency to lodge. If phosphorus is deficient in the soil, plants fail to make a quick start, do not develop a satisfactory root-system, remain stunted and sometimes develop a tendency to show a reddish or purplish discoloration of the stem and foliage. In the study area available Phosphorus is varying from 371 mg/ha.
- Available Potassium enhances the ability of the plants to resist diseases, insect attacks, and cold and other adverse conditions. It plays an essential part in the formation of starch and in the production and translocation of sugars, and is thus of special value to carbohydrate rich crops, e.g. sugarcane, potato and sugar beet. The increased production of starch and sugar in legumes fertilized with potash benefits the symbiotic bacteria and enhances the fixation of nitrogen. Vegetables and legumes are particularly heavy consumers of potassium. Deficiency of potassium produces the characteristic ringing of alfalfa leaves, reddish brown discoloration of cotton leaves, curbing of leaf margins of potato, and intraveinal chlorosis and flaring of maize leaves. The available potassium in the study area is varying between 1031 to 1112 mg/kg which indicates that the samples are falling in Low range and two samples in medium range.

4.4.4 Groundwater Quality

The ground water samples were drawn from the hand pumps and open wells being used by the local people. The water samples collected from the above locations were analyzed for important major and minor ions and the analytical results of the groundwater samples were compared with IS: 10500 - 2012 drinking water standards and the results are shown in Tables 4.7.

Table 4.7 Groundwater Monitoring – Monitoring data

Sl. No	Test Parameters	Sample baseline locations and Results										Requirement/limit As per IS:10500/2012	
		GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8	GW9	GW10	Desirable	Permissible
1.	Colour	5 Hazen	5 Hazen	5 Hazen	5 Hazen	5 Hazen	5 Hazen	5 Hazen	5 Hazen	10 Hazen	5 Hazen	5	15
2.	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	-	-
3.	Turbidity (NTU)	Less than 0.5 NTU	1.1 NTU	1.4 NTU	6.8 NTU	Less than 0.5 NTU	1.78 NTU	Less than 0.5 NTU	2.40 NTU	2.94 NTU	1.4 NTU	1	5
4.	pH at 25°C	7.89	7.52	7.96	7.68	7.73	8.34	8.44	8.52	8.34	8.42	6.5 – 8.5	No relaxation
5.	Temperature	29°C	29°C	28°C	28°C	29°C	27°C	27°C	27°C	27°C	27°C	-	-
6.	Conductivity @ 25°C	1799 pmhos/cm	3490 pmhos/cm	1483 pmhos/cm	1915 pmhos/cm	936 pmhos/cm	2260 pmhos/cm	1940 pmhos/cm	1700 pmhos/cm	1868 pmhos/cm	1802 pmhos/cm	*2250	-
7.	Total Dissolved Solids	1136 mg/l	2163 mg/l	852 mg/1	1082 mg/l	582 mg/1	1460 mg/l	1180 mg/l	1168 mg/l	1188 mg/l	1470 mg/l	500	2000
8.	Total Suspended Solids	BDL (DL :1.0 mg/l)	3 mg/l	4 mg/1	12 mg/1	BDL (DL :1.0 mg/l)	4 mg/l	BDL (DL :1.0 mg/l)	14 mg/l	8 mg/1	14 mg/l	-	-
9.	Total Solids	1136 mg/l	2166 mg/l	856 mg/1	1094 mg/l	582 mg/l	1464 mg/l	1180 mg/l	1182 mg/l	1196 mg/l	1484 mg/l	-	-
10.	Total Alkalinity as CaCO3	547 mg/l	813 mg/l	435 mg/l	346 mg/1	330 mg/1	298 mg/l	435 mg/l	458 mg/l	344 mg/l	378 mg/l	200	600
11.	Acidity as CaCO3	BDL (DL :1.0 mg/l)	BDL (DL :1.0 mg/l)	BDL (DL :1.0 mg/l)	BDL (DL :1.0 mg/l)	BDL (DL :1.0 mg/1)	BDL (DL :1.0 mg/l)	BDL (DL :1.0 ring/1)	BDL (DL :1.0 mg/l)	BDL (DL :1.0 mg/l)	BDL (DL 1.0 mg/l)	-	-
12.	Total Hardness as CaCO3	130 mg/l	288 mg/1	342 mg/1	260 mg/1	258 mg/1	340 mg/l	300 mg/l	364 mg/l	490 mg/1	500 mg/l	200	600
13.	Calcium as Ca	26 mg/l	50 mg/l	71 mg/l	66 mg/l	54 mg/l	112 mg/l	51 mg/l	82 mg/l	131 mg/1	108 mg/l	75	200

14.	Magnesium as Mg	16 mg/l	40 mg/l	40 mg/l	23 mg/l	30 mg/l	15 mg/l	42 mg/l	39 mg/l	40 mg/l	56 mg/l	30	100
15.	Chloride as Cl	198 mg/l	591 mg/l	180 mg/l	325 mg/l	84 mg/1	513 mg/l	317 mg/l	225 mg/l	278 mg/l	333 mg/l	250	1000
16.	Fluoride as F	1.08 mg/l	1.59 mg/l	0.48 mg/l	0.16 mg/l	0.40 mg/l	0.571 mg/l	1.61 mg/l	0.83 mg/l	0.92 mg/1	0.83 mg/l	1.0	1.5
17.	Nitrate as NO3	BDL (DL :1.0 mg/l)	BDL (DL :1.0 mg/l)	BDL (DL :1.0 mg/l)	BDL (DL :1.0 mg/l)	BDL (DL :1.0 mg/l)	2.50 mg/l	1.20 mg/l	15.25 mg/l	28 mg/l	5.56 mg/l	8.2	45
18.	Total Nitrogen	BDL (DL :1.0 mg/l)	BDL (DL :1.0 mg/l)	BDL (DL :1.0 mg/l)	BDL (DL :1.0 mg/l)	BDL (DL :1.0 mg/l)	7.7 mg/l	6.73 mg/l	23.73 mg/l	34.31 mg/1	11.22 mg/l	-	-
19.	Sulphate as SO4	56 mg/1	126 mg/l	47 mg/1	69 mg/l	12 mg/1	46 mg/l	44 mg/l	70 mg/l	80 mg/1	70 mg/l	200	400
20.	Total Phosphate as P	BDL (DL :0.01 mg/1)	BDL (DL :0.01 mg/l)	BDL (DL:0.01 mg/l)	BDL (DL:0.01 mg/l)	BDL (DL:0.01 mg/1)	BDL (DL:0.01 mg/l)	BDL (DL:0.01 mg/l)	BDL (DL:0.01 mg/l)	0.331 mg/l	BDL (DL:0.01 mg/1)	-	-
21.	Lead as Pb	BDL (DL:0.01 mg/1)	BDL (DL:0.01 mg/l)	BDL (DL:0.01 mg/l)	BDL (DL:0.01 mg/l)	BDL (DL:0.01 mg/l)	BDL (DL:0.01 mg/l)	BDL (DL:0.01 mg/l)	BDL (DL:0.01 mg/l)	BDL (DL:0.01 mg/l)	BDL (DL:0.01 mg/l)	-	-
22.	Total Chromium as Cr	0.025 mg/l	0.022 mg/l	0.024 mg/1	0.028 mg/1	0.021 mg/l	0.061 mg/l	0.042 mg/1	0.0347 mg/l	0.061 mg/1	0.064 mg/l	0.05	No relaxation
23.	Iron as Fe	0.384 mg/l	0.408 mg/l	0.679 mg/1	0.337 mg/l	0.331 mg/l	0.901 mg/1	0.740 mg/1	0.742 mg/l	0.787 mg/l	0.986 mg/l	0.3	No relaxation
24.	Manganese as Mn	0.015 mg/1	0.027 mg/l	0.010 mg/l	0.013 mg/1	0.035 mg/l	0.022 mg/1	0.017 mg/l	0.211 mg/l	0.046 mg/l	0.064 mg/l	-	-
25.	Zinc as Zn	0.089 mg/1	0.026 mg/l	0.038 mg/l	0.429 mg/l	0.038 mg/l	0.056 mg/l	0.045 mg/l	0.055 mg/1	0.186 mg/l	0.123 mg/1	-	-
26.	Aluminum as Al	0.206 mg/1	0.494 mg/1	0.160 mg/l	0.147 mg/l	0.540 mg/l	0.397 mg/1	0.426 mg/l	0.366 mg/l	0.306 mg/1	0.328 mg/l	-	-
27.	Mercury as Hg	BDL (DL:0.0005 mg/l)	BDL (DL:0.0005 mg/l)	BDL (DL:0.0005 mg/1)	BDL (DL:0.0005 mg/l)	BDL (DL:0.0005 mg/l)	BDL (DL:0.0005 mg/l)	BDL (DL:0.0005 mg/1)	BDL (DL:0.0005 mg/1)	BDL (DL:0.0005 mg/1)	BDL (DL:0.0005 mg/1)	-	-
28.	Total Arsenic as As	BDL (DL:0.01 mg/l)	BDL (DL:0.01 mg/l)	BDL (DL:0.01 mg/1)	BDL (DL:0.01 mg/l)	BDL (DL:0.01 mg/l)	BDL (DL:0.01 mg/l)	BDL (DL:0.01 mg/l)	BDL (DL:0.01 mg/l)	BDL (DL:0.01 mg/l)	BDL (DL:0.01 mg/1)	-	-
Discipline: Biological													

29.	*Escherichia coli*	Absent/100 m1	Absent/100 m1	Absent/100 m1	Absent/100 m1	Absent/100 m1	Absent/100 m1	Absent/100 m1	Absent/100 m1	Absent/100 m1	Absent/100 m1	-	-
30.	Total Coliform	Present/100 m1	Present/100 m1	Present/100 m1	Present/100 m1	Present/100 m1	Present/100 m1	Present/100 m1	Present/100 m1	Present/100 m1	Present/100 m1	*50 MPN/100 ml	--

Source: Monitoring details, 2023.

Note: GW1-Near Collectorate Ground GW2-Thirukalimedu. GW3-Shri Vallabacharya Baithak - Orikkai GW4-Arasu Nagar Orikkai GW5-Vasantham Nagar GW6-Near Nathapettai Lake. GW7-Perasiriyar Nagar GW8-Thenambakkam. GW9-Near Dharmalingeshwar Temple Tank GW10- Olimohammedpettai

**Indicates the CPCB designated best use water quality criteria*

- The pH limit fixed for drinking water samples as per IS: 10500-2012 Standards is 6.5 to 8.5 beyond this range the water will affect the mucus membrane and or water supply system. During the study period, the pH was varying for ground waters from 7.52 to 8.5, indicating that they are in acceptable limits.

- The desirable limit for total dissolved solids as per IS: 10500 are 500 mg/l whereas the permissible limits in absence of alternate source are 2000 mg/l, beyond this palatability decreases and may cause gastro intestinal irritation. In ground water samples collected from the study area, the total dissolved solids are varying from 582 to 2163 mg/l. Except for one location (Thirukaimedu) the TDS of all other samples were above the permissible limits,

- The desirable limit for chloride is 250mg/l as per IS: 10500 whereas the permissible limit of the same is 1000 mg/l beyond this limit taste, corrosion and palatability are affected. The Chloride levels in the groundwater samples collected in the study area were ranging from 60mg/l to a maximum of 250 mg/l. Chloride levels of all samples were below the desirable limits.

- The desirable limit as per IS:10500 for hardness is 200 mg/l whereas the permissible limit for the same is 600 mg/l. Beyond this limit encrustation in water supply structure and adverse effects on domestic use will be observed. In the ground water samples collected from the study area, the hardness is varying from 130 to 500 mg/l. In GW1 – Near Collectorate Ground total hardness was below the desirable limits whereas the remaining locations, the hardness was above the desirable limits and below the permissible limits.

- Fluoride is the other important parameter, which has the desirable limit of 1 mg/l and permissible limit of 1.5 mg/l. However, the optimum content of fluoride in the drinking water is 0.6 to 1.5 mg/l. If the fluoride content is less than 0.6 mg/l it causes dental carries, above 1.5 mg/l it causes staining of tooth

enamel, higher concentration in range of 3 - 10 mg/l causes fluorosis. In the ground water samples of study area, the fluoride value were in the range of 0.16 to 1.61 mg/l.

- Heavy metal chromium values were high with compared standards in GW5-Vasantham Nagar, GW8-Thenambakkam and GW9-Near Dharmalingeshwar Temple Tank. Lead, Mercury and arsenic was found to be below detection level in all monitoring location.

- Overall all the samples collected from the study area were found to be fit for human consumption; however the hardness, dissolved solids and most of groundwater samples seem to be above acceptable limit but well within the permissible limits.

4.4.5 Surface Water Quality

Surface water samples were collected from different sources within the study area for depicting the baseline status of the study area. The water samples were analysed for important major and minor ions and the analytical results of the surface water results were compared with IS 2296 – 1982 standards and the results are shown in Table 4.8.

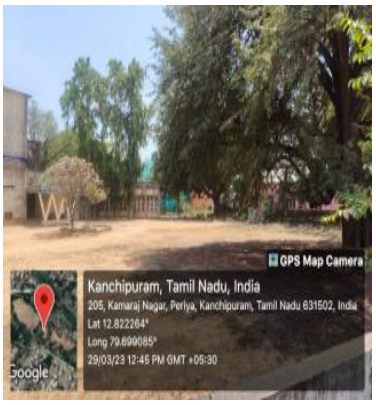
Table 4.8 Surface water Monitoring – Monitoring data

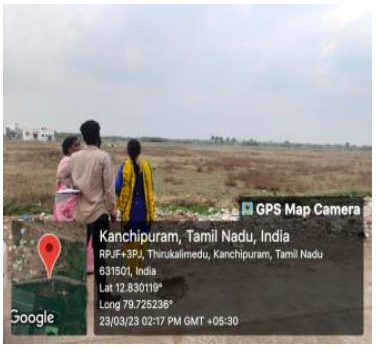
Sl. No	Test Parameters	Results	
		SW1: Thirukalimedu	SW2 : Nathapettai Lake
1.	Colour	55 Hazen	30 Hazen
2.	Odour	Agreeable	Agreeable
3.	Turbidity (NTU)	64 NTU	19.8 NTU
4.	pH at 25°C	7.15	8.75
5.	Temperature	28°C	27°C
6.	Conductivity @ 25°C	1487 pmhos/cm	1218 pmhos/cm
7.	Total Dissolved Solids	789 mg/l	790 mg/l
8.	Total Suspended Solids	155 mg/l	24 mg/1
9.	Total Solids	944 mg/l	814 mg/1
10.	Total Alkalinity as $CaCO_3$	309 mg/l	229 mg/l
11.	Acidity as $CaCO_3$	BDL (DL :1.0 mg/l)	BDL (DL :1.0 mg/l)
12.	Total Hardness as $CaCO_3$	178 mg/l	166 mg/l
13.	Calcium as Ca	43 mg/l	24 mg/l
14.	Magnesium as Mg	17 mg/l	26 mg/l
15.	Chloride as Cl	245 mg/l	207 mg/l
16.	Fluoride as F	1.47 mg/l	0.98 mg/1
17.	Nitrate as NO_3	BDL (DL :1.0 mg/l)	4.09 mg/l
18.	Total Nitrogen	2.56 mg/l	9.30 mg/l
19.	Sulphate as SO_4	24 mg/l	29 mg/l
20.	Total Phosphate as P	1.051 mg/l	0.448 mg/l
21.	Dissolved Oxygen	4.4 mg/l	6.50 mg/l
22.	BOD @ 27°C for 3 days	28 mg/l	9 mg/l
23.	COD	140 mg/1	55 mg/l
24.	Lead as Pb	BDL (DL:0.01 mg/l)	BDL (DL:0.01 mg/l)
25.	Total Chromium as Cr	0.023 mg/l	0.051 mg/l
26.	Iron as Fe	0.609 mg/l	1.020 mg/l

Sl. No	Test Parameters	Results	
		SW1: Thirukalimedu	SW2 : Nathapettai Lake
25.	Manganese as Mn	0.189 mg/l	0.049 mg/1
27.	Zinc as Zn	0.055 mg/l	0.035 mg/l
28.	Aluminum as Al	0.220 mg/1	0.740 mg/l
29.	Mercury as Hg	BDL (DL:0.0005 mg/l)	BDL (DL:0.0005 mg/1)
30.	Total Arsenic as As	BDL (DL:0.01 mg/l)	BDL (DL:0.01 mg/1)
31.	*Escherichia coli*	Absent/100m1	Absent/100m1
32.	Total Coliform	Present/100m1	Present/100m1

Surface water pH, chloride, fluoride and hardness, DO and BOD are meeting the Class 'A' norms. hence, overall the Surface water is Class 'A' as per IS: 2296 - 1982.

4.6 Site specific environmental features

Sl.No	Infrastructure details	Location and Environmental Feature	Site photograph
1	Pumping Station	**SPS-5A (near collectorate ground):** The proposed area is a vacant site and located in the main area of Kancheepuram. The site has access road. There are no residences nearby. The earmarked site is vacant and no tree cutting is proposed. Compound wall is proposed all around the site for safety. Mechanical Odour control device and planting trees in available space within the site are proposed.	

2	Pumping Station	**SPS -5 (near temple city 5th cross street):** The selected site is vacant, site is to be cleared of bushes. Residences are located at about 30m from the site. The site has access to road. Compound wall is proposed all around the site for safety. Mechanical Odour control device and planting trees in available space within the site are proposed.	
3	Main Pumping Station	**MPS-6 (near Vishnu nagar):** The selected site is vacant, located away from residences by around 20m. Compound wall is proposed all around the site for safety. Mechanical Odour control device and planting trees in available space within the site are proposed.	
4	Main Pumping Station	**MSP-8 (near Nathapettai WSP):** The selected area is located near the existing STP. The site is vacant and the nearest residence is at >50m. Compound wall is proposed all around the site for safety. Mechanical Odour control device and planting trees in available space within the site are proposed.	
5	Sub Pumping Station	SPS (Near Pachaiyappas College)	
6	Sewage Treatment Plant	The new STP is proposed to be constructed near the existing STP belonging to KCMC. The earmarked site is vacant and no tree cutting is involved.	

		The STP is proposed in DBOT mode and contractor will design the STP to comply with the standards for treated sewage disposal. The treated effluent will be disposed into vegavathi river.	
6	Disposal of treated sewage	Pumping main will be laid for 3.5Km from STP to the disposal point in River Vegavathi.	

Social Baseline

1. Screening process adopted to identify the social impact

a. Reconnaissance of the sub-project areas and their surroundings;
b. Discussion with the residents in the locality;
c. Identification of the major sub-project activities, and
d. Preliminary assessment of the impacts of these activities on the ecological, physico-chemical, and socio-economic environment of the sub-project surrounding areas

2. Scope of Land Acquisition and Resettlement

Table 4.8 : Details of Pump Stations & Pumping Mains

S.NO	LOCATION	ZONE	LATITUDE	LONGITUDE	SURVEY NO	AREA NAME	LAND EXTENT AVAILABLE (Sq.m)	LAND EXTENT REQUIRED	CLASSIFICATION	REMARKS
1	GOVERNMENT LAND	LS-5A	12.80781	79.674436	889	SEVILIMEDU (VIPEDU)	1231.72	100	GOVERNMENT POROMBOKE	
2	LAKSHMI VAIKUNTHAVALLI NAGAR	LS-6A	12.813192	79.702701	289	SEVILIMEDU & ORIKKAI	200	100	PARK	
3	ADHIYAMAN NAGAR	LS-6B	12.815366	79.693467	176	SEVILIMEDU NEAR PSK NAGAR	800	100	PARK	
4	EMPERUMAN KOVIL STREET	LS-6C	12.814775	79.700744	256/2	GE NAGAR	6063	100	Belongs to ULB	
5	VISHNU NAGAR	LS-7C	12.811517	79.728638	18	THENAMBAKKAM	1200	100	PARK	
6	ANNA KUDIYIRUPU	LS-7A	12.807684	79.715486	109	ORIKKAI	777	100	CHILDREN PLAYGROUND	
7	AMBEDKAR STATUE	LS-7B	12.809415	79.706654	298	ORIKKAI	28028	100	GOVERNMENT POROMBOKE	
8	ELLAPPAN NAGAR	SPS-5	12.821325	79.699511	8	SEVILIMEDU OPPOSITETO COLLECTOR OFFICE	1638	900	PARK	
9	TEMPLE STREET 5TH CROSS STREET	SPS-6	12.812783	79.704201		TEACHERS NAGAR		900	Belongs to ULB	
10	NETHAJI NAGAR	MPS-7	12.812924	79.722823	55	NETHAJI NAGAR	34398.9	1600	Belongs to ULB	
11	JJ NAGAR BCK SIDE (COLLEGE GROUND)	SPS-8	12.815261	79.740014	41	PERIYAR NAGAR	830	900	PLAYGROUND	
12	NATHAPETTAI	MPS-9	12.828771	79.72276	484	NATHAPETTAI	850000	900	Belongs to ULB	
13	NATHAPETTAI	STP	12.829958	79.726652	484	NATHAPETTAI	850000	30000	Belongs to ULB	

Sewerage scheme may pose adverse environmental impacts during the construction period as well as during day to day operation. The likelihood of such impacts and the mitigatory steps that should be incorporated in the project proposals are discussed below. The likely adverse impacts during construction are the same as for any major civil engineering project with the added disadvantage that in the case of sewerage projects, the construction activities will interface with the public very closely. Therefore the various regulations mentioned in the legal and regulatory framework to be followed during the construction, implementation and maintenance phase of the project.

Sewage Treatment Plant (STP) - The sewage Treatment Plant shall be designed to a quantity of 36 MLD including the sewage generation projected for the core city as well as the added areas for the Ultimate year 2055.The Ultimate projection of sewage generation is 42 MLD and intermediate is 36 MLD. Hence considering the size of the units required the STP shall be designed for 36 MLD. Since there is a proposal ongoing for desilting of the existing waste stabilization ponds, taking the existing WSP into consideration, a 36 MLD STP has been proposed.

Eight acres of vacant land is selected for construction of the STP near the near Nathapettai Waste Stabilisation Plant. dumping yard located near the existing STP. There is no adverse social impact identified in the construction of STP.

2. Main and Sub Pumping Stations:

In the site selected for SPS 5, Ellapan Nagar, there is a functional Cooperative Bank Office located near Collectorate Ground.
In SPS 6 located near Temple city in 5th Cross street, both the sides of land are vacant and there is no requirement for land acquisition.
Nethaji Nagar (MPS 7) is a vacant land located inside a residential area however the space around the proposed site is vacant. The bund of Vegavathi River is located in one of the sides of this proposed land.

The SPS 8 is a ground belongs to Pachayappan College- a government aided college. There is an existing pump room and it is not functional. All sides of this proposed land are vacant. To check the land records as it is a government-aided college and land acquisition is required.
The MPS 9 is also a vacant land located near the proposed STP and no land acquisition is required.

3. Lift Stations and LMH:
There are around 7 Lift Stations and 17 Lift Machine holes in the proposed UGSS in the added areas of KCMC. The Proposal of UGSS to the added areas of Kancheepuram city Municipal consists of 7 Lift Stations and 3 DEWATS systems.

4. DEWATS system are proposed to avoid crossing railway lines, Palar River, Canal and Military roads.

Table 4.9: Lift Stations

S.No	Zone No.	Lift Station	Probable Impacts
1	Zone 5	LS-5A Government Land	The land proposed for LS 5A is located in Government Land. It is a vacant land. There is no issues in this land.
2	Zone 6	LS-6A Lakshmi Vaikunta Nagar	The land proposed for LS 6A is a vacant government poramboke land (surrounded by vacant land on three sides and residential area on one side).

3		LS- 6B Adhiyaman Nagar	The proposed LS 6B is located in Adhiyaman Nagar. This is a park located inside a residential area. The park is maintained well and is used by the residents in the area. This site is earmarked as ULB as a park.
4		LS-6C Emperummal Kovil	The proposed land for LS 6C is located in Emperummal Kovil Street. This is a vacant land with vacant lands surrounding in two sides, residential area in one side and canal crossing in the other. The land details for this site is not available.
5	Zone 7	LS-7C Vishnu Nagar	Vishnu Nagar is a vacant site located inside a residential area earmarked as Park by the ULB.
6		LS-7A Anna Kudiyiruppu	The proposed LS 7A is located in Anna Quarters. It is a large vacant land with an existing Over Head Tank in one side and the temple in the other side. Behind the identified site is a functional toilet constructed by the ULB for women. A Focus Group Discussion was conducted in this site to understand the residents opinion for constructing a new LS in the proposed site. Consultation with the residents of the area is to be undertaken before finalising. This land belongs to the ULB
7		LS-7B Ambedkhar Statue	The proposed LS 7B is located near the Ambedkar Statue. This is a roadside LS located near a main road with residential areas on two sides and one side is vacant. This is a Government Poramboke Land.

Summary:

List of sites where consultation with the residents to be taken up prior to finalisation of lands as these lands/adjacent lands are being used by the residents for various purposes.

- LS 7A located in Anna Quarters.

5. House Service Connections - House service connections are provided in the project report. House service connections will be laid below 0.60m from the boundary of compound wall of dwelling up to the receiving manhole with 100mm uPVC and will be joined with the machine hole with proper sealing of concrete.

During sewer laying work, there is danger of accidents because of temporary removal of excavated earth, hence caution boards to be put up adequately. When roads are narrow, the project estimate shall provide for temporary removal of excavated earth from the road site and its conveyance back for refilling to avoid hindrance to pedestrians. Noise pollution and dust pollution shall be controlled. Indiscriminate dumping of

surplus excavated earth and construction debris as will hinder traffic and obstruct waterways shall be avoided as also damage to existing underground utilities. Delay in road restoration and failure of the restored road surface which may cause accidents shall be specially guarded against.

4. Findings of the focus group discussion:

In Anna Quarters (beneficiaries of both UGSS and WSS), this land was provided by a society. All the 202 families are traditional weavers. Initially the people of this area have opposed setting up of waste segregation unit and LS in the proposed site. People claim that setting up of LS will result in infestation of flies that will affect their livelihoods (as the silk threads will become dirty). They also proposed LS only to collect the sewer of the 202 families of that localities. The residents also pointed out that there is an immediate requirement of storm water drains rise of ground water level and seepage from the floors inside the houses, which affects their livelihood as they are located very closer to the river. Their livelihoods are carried out inside their houses as they are traditional weavers.

It was informed to the participants that the LS/PS locations have been finalised based on the technical requirements for collection & transfer of sewage and adequate O&M precautions have been included to immediately lift/pump the collected sewage without stagnation including secondary power supply, regular clearing of screenings/grit from the site, etc and hence the issue of flies is not envisaged in the LS sites.

Impact of Climate Change on beneficiaries:

Residents have pointed out that they are constantly facing water shortage during summer despite the fact that the OHT is located near their area of residence. They only have running water supply for one hour every day.

The unpredictable change in climate, especially before and after the monsoons affect their livelihoods as traditional weavers find it difficult to weave during the rains because of ground water level rising and seeping inside their houses during rainy season. Therefore their livelihoods are affected. To mitigate this they are proposing construction of storm water drains.

During floods, the water supply pipes from the OHT to the settlement gets broken and the ULB does not provide immediate solution to ensure regular water supply, it takes about 5 to 7 days to rectify the issue after people submit petition to the authorities. Flood mitigation work has to be strengthened by constructing storm water drains in the area.

During summer, they get water supply from tankers by the ULB. Some of them.

Discussion with targeted beneficiaries of Household Water Supply in Bangara Esappan Street reveals that they receive running water supply from Thirupaarkadal only on alternative days for 45 minutes. The quality of water is poor and often found to be in yellowish colour. They are also proposing for Palar water.

Discussing on the impact of climate change the participants of the focus group discussion pointed out that they used to avail ground water in 30 feet before 2 decades but now they have to set up bore wells even upto 150 feet and the water is extremely salty.

Because of the unpredicted and excessive rainfalls, they feel that the ground level water has increased and they have also set up rainwater harvesting in all their houses. They do not face drought in the last 7 years when they used to get running water only once in 3 days now they are receiving on alternate days. They are dependent on packaged water for drinking as the ground water as well as the water supplied are both of poor quality. They have not faced flooding issues because of that they are able to benefit from the excessive water supply that they get because of excessive rainfall because of climate change.

They have got UGSSS 50 years back, there are several issues including clogging, over flowing etc because of increase in the number of families/houses and deteriorating quality of the old pipelines. This area is not proposed under the current project. They have appealed for addressing the sewerage issue that they face.

However they do not have any provision for draining of excessive water during heavy rains. It has to drain on

its own and they are also proposing for storm water drains in their area.

5. POTENTIAL ENVIRONMENTAL IMPACT AND MITIGATION MEASURES

This section identifies and assesses the potential changes in the environment and social aspects that could be expected from the proposed project. The impacts have been predicted for the proposed activities assuming that the impact due to the existing activities has already been covered under baseline environmental monitoring and will continue to remain the same till the operation of the project. The proposed project activities would create impact on the environment in two distinct phases i.e., construction and operation phases. Impacts are identified, predicted and evaluated based on the analysis of the information collected from following:

- Project information (as discussed in Chapter-2) and
- Baseline information and site visits of the study area (as discussed in Chapter-4)

This section also describes mitigation measures, which have been suggested for the adverse impacts likely to be caused due to activities of both construction and operation phases of the project. The identification of likely impacts during construction and operational phases of the proposed project has been done based on likely activities having their impact on one or another environmental parameters. The details of the activities and their impacts have been worked out in the following sections.

5.1 Identification of likely impacts

Every activity and operation has either adverse or beneficial impacts on the environment. The environmental and social impact identification has been done based on proposed project activities. Potential environmental and social impacts of the proposed infrastructure components are presented in this section. Mitigation measures to minimize / mitigate negative impacts, if any, are recommended along with the agency responsible for implementation. Monitoring actions to be conducted during the implementation phase is also recommended to reduce the impact.

Screening of potential environmental and social impacts are categorized into four categories Considering subproject phases: location impacts and design impacts (pre-construction phase), construction phase impacts and operations and maintenance phase impacts.

(i) Location impacts include impacts associated with site selection and include loss of on-site biophysical array and encroachment either directly or indirectly on adjacent environments. It also includes impacts on people who will lose their livelihood or any other structures by the development of that site.

(ii) Design impacts include impacts arising from Investment Program design, including technology used, scale of operation/throughput, waste production, discharge specifications, pollution sources and ancillary services.

(iii) Construction impacts include impacts caused by site clearing, earthworks, machinery, vehicles, workers, occupational health and safety. Construction site impacts include erosion, dust, noise, traffic congestion and waste production.

(iv) O&M impacts include impacts arising from the operation and maintenance activities of the infrastructure facility. These include routine management of operational waste streams, and occupational health and safety issues.

This section of the ESIA reviews possible project-related impacts, in order to identify Issues requiring further attention and screen out issues of no relevance. The Environmental and Social Screening formats are provided in the Annexures.

In the case of this project most of the individual elements involve simple construction and operation, so impacts will be mainly localized and not greatly significant negative impacts associated with sewage facilities such as odour are already considered in the design and siting, most of the predicted impacts are associated with the construction process, and are produced because that process is invasive, involving excavation and earth movements; and being mostly located in an urban area, will not cause direct impact on biodiversity values. No controlled blasting is proposed for this project. The project will be in properties held by the local government and access to the project location is through public rights-of-way and existing roads hence, land acquisition and encroachment on private property will not occur.

5.1.1 Design & Location impacts

Design of the Proposed Components. Technical design of the (i) sewage treatment plants; (ii) sewage pumping and lifting stations; and (iii) sewer network including manholes and house connections, follows the relevant national planning and design guidelines, focusing on providing a robust system which is easy to operate, sustainable, efficient and economically viable.

1. Design of Sewage Treatment Plant. A 30 MLD STP is proposed to be constructed at the identified site to treat the sewage generated from the added areas of the subproject town, Kancheepuram City Municipal Corporation. Since the treatment and disposal system is proposed under DBOT contract, the STP will be designed by the DBOT contractor. The STP process will be designed to meet the stipulated disposal standards for STP.

One of the critical aspects in STP operation is, change in raw sewage characteristics at inlet of STP may affect the process and output quality. The system is designed for municipal wastewater, which does not include industrial effluent. Characteristics of industrial effluent widely vary depending on the type of industry, and therefore disposal of effluent into sewers may greatly vary the inlet quality at STP, and will upset process and affect the efficiency. Although legally the disposal of effluent meeting certain standards is allowed into municipal sewers the monitoring of the same is not-practical. Although there are no significant presence of industries with problematic water discharges in the subproject area of Kancheepuram, following measures are suggested to safeguard sewerage system efficiency:

(i) No industrial wastewater shall be allowed to dispose into municipal sewers
(ii) No domestic wastewater from industrial/ textile units shall be allowed into municipal sewers
(iii) Ensure that there is no illegal discharge through manholes or inspection chambers

(iv) Conduct public awareness programs; in coordination with TNPCB
(v) Conduct regular wastewater quality monitoring (at inlet and at outlet of STP) to ensure that the treated effluent quality complies with the standards

The site for STP selected is located near dumping yard near the existing Nathapettai WSP. An area of eight acres is allocated for the proposed STP. From the existing STP the treated effluent will be disposed in River Vegavathi. The sewage treatment being an aerobic process and conducted in a compacted system with automated operation, odor nuisance will be very minimal. Limited bad odors may be generated from wet well, primary treatment units and sludge treatment. Besides operating the plant as per the standard operating procedures, which will further minimize the odor potential, the following measures are also included in the site planning and design:

- Providing a green buffer zone of 15-20 m wide all around the STP with trees in multi-rows and land scaping. This will act as a visual screen around the facility and will improve the aesthetic appearance.
- Dewatering units shall be located in enclosed building vented to odour control unit, and health and safety precaution shall be put in place H2S build up.
- Locate sludge drying beds maintaining maximum distance from the residential area.

Sewage sludge generally consists of organic matter, pathogens, metals and micro pollutants. The concentration of parameters such as metals can be influenced by input to the sewers system from industry. Since no industrial wastewater is allowed into sewers, it is unlikely that sludge contains heavy metals. The sludge from reactors will be collected in sludge sump and conveyed to centrifuge for dewatering. Dewatering units will be in enclosed building vented to odour control unit, and health and safety precaution shall be put in place H2S build up. The sludge in the form of a wet cake will be further air-dried in the sludge drying beds. The treatment and drying processes kill enteric bacteria and pathogens, and because of its high content of nitrates, phosphates and other plant nutrients the sludge is an excellent organic fertilizer for application to the land. Adequate drying is however necessary to ensure maximum kill of enteric bacteria. To achieve adequate drying minimum drying period (15 days) shall be ensured. The drying period, which will be varying depending on the season will be determined during operation and be followed. A sludge management plan will be developed by the STP facility designer. Sludge shall be periodically tested for presence of heavy metals. Proper sludge handling methods should be employed. Personal Protection Equipment should be provided to the workers.

2. Properly dried sludge can be used as soil conditioner. Periodic testing of dried sludge will be conducted to ensure that it does not contain heavy metals that make it unsuitable for food crops. Tests will be conducted to confirm the concentrations below the following standards. As there are no specific standards notified for sludge reuse, the compost quality standards notified under the Solid Waste Management Rules, 2016 have been adopted.

Sewer system – collection and conveyance

The sewerage system is designed as a separate system of sewage collection (i.e. caters only to wastewater). Existing surface road side drains in the project area cater to collection and conveyance of runoff during rains. The underground gravity sewers will carry sewage from households to the nearest lifting or pumping station, from where the sewage is pumped to the STP. To maximize the

benefits as intended, City Corporation will ensure that all existing septic tanks are phased out by bypassing the inlet and connecting the toilet discharge from each house directly to sewerage system.

3. Accumulation of silt in sewers in areas of low over time, overflows, blockages, power outages, harmful working conditions for the workers cleaning sewers etc. are some of the issues that are taken into consideration during the sewer system design. Measures such as the following are included in sewer system design to ensure that the system provides the benefits as intended:

(i) Limit the sewer depth where possible
(ii) Sewers shall be laid away from water supply lines and drains (at least 1 m), if not possible, sewer lines shall be laid below the water lines;
(iii) In all cases, the sewer line should be laid deeper than the water pipeline (the difference between top of the sewer and bottom of water pipeline should be at least 300 mm)
(iv) In unavoidable cases, where sewers are to be laid close to storm water drains, appropriate pipe material(that has no or least infiltration risk) shall be selected (stoneware pipes shall be avoided)
(v) For shallower sewers and especially in narrow roads, use small inspection chambers in lieu of manholes;
(vi) Design manhole covers to withstand anticipated loads and ensure that the covers can be readily replaced if broken to minimize silt/garbage entry
(vii) Ensure sufficient hydraulic capacity to accommodate peak flows and adequate slope in gravity mains to prevent buildup of solids and hydrogen sulfide generation

1.1.1 Sewage Pumping Stations and Lift Stations

It is proposed to construct 15 lift stations and 4 Pumping stations and these will receive sewage from the catchment area via the sewer network and pump to higher level Machine holes or pumping stations or to STP as per the design. Lift stations become necessary to restrict the depth of sewer. Lift stations will not have any super structure and entire component will be below the road surface, only a Kiosk for operation of pumps will be erected at the road side. In view of the above, it will not obstruct the locals. Further, the diameter of the lift stations is limited to 2.50 and placed mostly on wider roads and government lands.

Sewage lift Station will also perform same function as sewage pumping stations but cater to much larger area or sewage flow, and will also have several components, and occupy comparatively larger area. At these pumping or lifting stations, the operation involves accumulation of incoming sewage in the suction well and then pumping out as the sewage level reaches the designed pumping depth. The water level in the well rises up before the pumping cycle starts and as the pumping is performed the water level goes down registering its lowest depth at the end of pumping of cycle. This cycle of rising and lowering will continue throughout the day and night. However, the duration between successive pumping cycles will significantly vary depending on the sewage generation. During

morning and evening peak hours, sewage will accumulate quickly, and pumping frequency will be high. The sewage retention time in the suction well therefore varies throughout the day, with very high retention periods during the nights and mid-days.

1.1.2 Odour from Pumping Stations

In the suction wells, the sewage emits gases, which accumulated in the air above water surface. The gas may include odorous compounds like hydrogen sulfides (H2S), amines, fatty acids, aldehydes, ketones and other volatile organic compounds (VOCs). As the water level rises before the pumping cycle, it physically displaces the air, along with the odorous gas compounds. H_2S is the most dominant odor causing compound and therefore can cause nuisance to nearby area. When sewage becomes stagnant, H_2S is generated in the anaerobic conditions. The quantum of H_2S generation depend on quantity of accumulated sewage and sewage retention time that create anaerobic conditions. Both increase in quantity of sewage accumulation and retention time will increase the H_2S generation. Since most of the pumping stations are located in residential areas, it is propose to have tall compound wall with creepers, climbers, fragrance flower plants and green belt around the unit as an environmental safeguard. In addition, odour control mechanism are proposed in all the pumping stations, depending on size of the well and quantum of sewage, system is designed and proposed in BOQ, also maximum of 10m distance between sensitive receptors like residence, schools, hospitals etc., from the unit is kept as guiding factor.

Layout planning related measures

(i) Siting of wells within the identified site at an internal location as far as possible from adjoining residential buildings;

(ii) Develop green buffer zone around the facilities with a combination of tall and densely growing trees in multi rows as per the land availability to control odor and also act as visual shield, and improve aesthetical appearance;

(iii) Provision of high compound wall.

Design related measures to prevent and control odor from pumping/lifting station operations

(i) Proposed wells to be closed using RCC slabs. Design of RCC slab to consider both superimposed loads (human equipment loads) and severe corrosion risk from sewer gas from within wells.

(ii) RCC Slab to be designed and fixed in a modular manner such that access to pumps / appurtenances and other equipment can be provided for maintenance/replacement/renewal purposes;

(iii) Since human intervention is involved and safety shall be primary and critical consideration, additional protection by way of a metalled grating / grill work shall be provided over the sections (or full cross section if required) where workers will stand / work for inspection and repair/O&M purposes;

(iv) Provision of passive gas ventilation arrangement by providing a take-off vent from top of well by positioning vent in such a way that cover slab

fitment/movement/drawl if required for maintenance purposes is not compromised.

(v) Height of vent to be provided appropriately and a minimum 2 m above the lintel level (top level) of window(s)/passageways/doors in the nearby adjoining buildings.

(vi) Provision of odor control / mitigation system as per site conditions / requirements. Suitable granular activated carbon filter with bird-screen fitted at the vent outlet to control odor. Size of GAC (including material size) should be selected based on the vent diameter and expelled air flow rate expected;

(vii) Submersible sewage pumps of suitable rating, minimum submergence requirements, open impeller with cutting-tearing arrangement and high strength-corrosion resistant heavy duty construction shall be proposed;

(viii) In locations / cases where sewage flow in the present to intermediate design stage is envisaged to be low, position of the submersible pumps and design of the collection well floor by providing necessary side benching / sloped flooring to allow for higher submergence during low flow shall be made to ensure regular pump operation and avoid sewage stagnation beyond the permissible limit;

(ix) Diesel Generators shall be provided for all pump stations and in cases of lift stations with space for control room. In cases of lift manholes (road-side or road-center type structures with only provision of kerb-side kiosk), an electrical cut-out provision shall be made for connecting an Emergency Mobile / Skid Mounted Diesel Generator for pumping out during long period of electricity supply interruption;

(x) Develop standard operating procedures/operational manual for operation and maintenance of lifting and pump stations; this shall include measures for emerge situations;

(xi) Provide training to the staff in SOPs and emergency procedures;

(xii) Periodic monitoring of H2S levels at sewage pumping and lifting stations using handheld H2S meters.[3]

1.1.3 Noise from pumping operations

Operation of pumps and motors and diesel generators is a major source of noise. As the pumping and lifting stations are located in the residential areas, with few located very close to the houses, noise generated from lifting/pump stations can have continuous negative impacts on the surrounding population. Although STP is located outside the city, noise control measures are necessary. High inside noise levels can affect the health of operators and staff at the facilities, and therefore, noise levels needs to be maintained within and outside the plant at acceptable levels. .

(i) Procure good quality latest technology high pressure pumps that guarantee controlled noise at a level of around 80dB(A) at a distance of 1 m[4]

[3] There are no any standards notified by Government of India or Government of Tamil Nadu. However, Central Pollution Control Board (CPCB) has stipulated Guidelines on Odor Pollution and its Control. These guidelines deal only with the basics of odor pollution, its sources and measurement, technologies for its control etc. but do not specify any threshold limits for odor-causing pollutants. Therefore, as part of mitigation, provision for odor control measures has been made in the sewage pumping stations for all UGSS subprojects. However, in case of STPs, the odor-causing processing units will be located far off to the extent possible within the premises so as to mitigate the odor nuisance. Further, the technology for treating sewage plays a vital role since release of gases like H2S cannot be avoided in the process involving anaerobic decomposition whereas release of H2S will almost be nil in case of aerobic treatment. PIU and design engineers have not specified any odor standards adopted elsewhere in the preliminary design as not to limit the technology that can be considered by the bidders in the treatment of domestic sewage. Sufficient mitigation measures have been taken for all sewage pumping stations and will be taken for all STPs when finalizing/revising the IEEs based on the detailed engineering design.

[4] Indian Standards require to maintain the noise level of 70 dBA or less during night time. However, in case of STPs/WTPs/Water

(ii) Use appropriate building materials and construction techniques for pump houses which can absorb sound rather than reflect noise
(iii) Use acoustic enclosures – manufacturer specified, for all pumps, motors
(iv) Procure only CPCB approved generators to meet air emission and noise level requirements
(v) Provide sound mufflers for ventilators in the plant rooms; and sound proof doors
(vi) Provide ear plugs designated for noise reduction to workers

1.1.4 Energy Efficiency

Project area is mostly plain and gently sloping ground, it is therefore not technically feasible or economical to design a completely gravity system to collect sewage from individual houses and transfer the same the STP. It necessitated provision of lifting and pumping stations, which are optimized to the extent possible to minimize the overall pumping. In the current design, sewage will be collected from the houses via sewer network and conveyed by gravity to the lifting station. Lifting stations are designed just to lift the sewage to higher level and deliver it to a nearby sewer Machine holes on the higher elevation, from there it can flow again by gravity, rather than pumping directly to a pumping station. This optimized the energy consumption.

To optimize the power consumption, the hydraulic design shall follow optimal approach and the following also considered in design and selection of pumping systems. According to Manual for the Development of Municipal Energy Efficiency Projects in India (jointly developed by Bureau of Energy Efficiency (BEE) and International Finance Corporation in 2008), energy savings, at minimum, of 25% to 40% is possible with appropriate measures. The following measures have been considered and incorporated into the subproject designs wherever possible:

- Using low-noise and energy efficient pumping systems
- Efficient Pumping system operation
- Installation of Variable Frequency Drives (VFDs)

Tree cutting at selected project sites. As presented in the baseline profile of subproject sites, there are no notable tree cover in the project sites. Sewers are proposed within the roads, and therefore no tree cutting envisaged. Following measures need to be implemented to minimize and/or compensate for the loss of tree cover.

(i) Minimize removal of trees by adopting to site condition and with appropriate layout design of STP and pumping stations
(ii) Obtain prior permission for tree cutting
(iii) Plant and maintain 10 trees for each tree that is removed

1.1.5 Utilities

Supply Head works, where heavy duty pump sets are to be installed and the noise levels may even exceed 80 decibels at 1 m distance, noise level will be measured at the time of commissioning the units and necessary mitigation measures such as noise barriers will be installed if required.

Telephone lines, electric poles and wires, water lines, drains, if exists within the proposed project locations may require to be shifted. All the selected project sites are vacant and unused government lands, there are no notable existing utilities. Sewer lines are proposed within the road way, where there are no utilities. In the outer areas where there is adequate earthen shoulder along the road carriage way, sewer lines can be accommodated in the shoulder. In such cases, the work may require shifting of utilities on the shoulder. To mitigate the adverse impacts due to relocation of the utilities, the contractor, in collaboration with the KCMC will

- identify the locations and operators of these utilities to prevent unnecessary disruption of services during construction phase; and
- instruct construction contractors to prepare a contingency plan to include actions to be done in case of unintentional interruption of services

1.1.6 Site Selection of Construction Work Camps, Stockpile Areas, Storage Areas, and Disposal Areas

Priority is to locate these near the project location, but it shall be at least 100m away from residential areas, groundwater wells and surface water bodies. However, if it is deemed necessary to locate elsewhere, sites to be considered will not promote instability and result in destruction of property, vegetation, irrigation, and drinking water supply systems.

Residential areas will not be considered for setting up construction camps to protect the human environment (i.e., to curb accident risks, health risks due to air and water pollution, dust, noise etc. It is also intended to prevent any social conflicts, shortages of amenities, and crime). Extreme care will be taken to avoid disposals near forest areas, water bodies, or its nearby areas. The contractor will prepare Waste Management Plan prior to construction and submit to PIU/PMC.

1.1.7 Site Selection of Sources of Materials

Significant quantities of coarse aggregate and fine aggregate will be required for construction works. Contractor should procure these materials only from the licensed quarries with valid permits. Contractor should, to the maximum extent possible, procure material from existing quarries. It will be the main contractor's responsibility to verify the suitability and legal status of all material sources and to obtain the approval of Department of Geology and Mining and local revenue administration, as required. The record should be maintained and made available for verification by KCMC as and when required.

1.1.8 Social and Cultural Resources – Chance Finds

Any work involving ground disturbance can uncover and damage archaeological and historical remains. For this project, excavation will occur in project sites for foundations, laying pipelines, and for construction of underground structures at pumping/lifting stations and at STP. There are no archeologically or historically recognized sites or places close to project sites or within the project area. Therefore it is not likely that the project sites contains any archaeological or historical remains, and risk of uncovering them is very low. Nevertheless, City Corporation will follow chance find protocol to ensure that any chance finds are recognised and measures are taken to ensure they are protected and conserved:

(i) Construction contractors to follow these measures in conducting any excavation work
(ii) Create awareness among the workers, supervisors and engineers about the chance finds during excavation work
(iii) Stop work immediately to allow further investigation if any finds are suspected;
(iv) Inform State Archaeological Department if a find is suspected, and taking any action they require to ensure its removal or protection in situ..

5.2 Construction Impacts

Main civil works in the subproject include laying of sewer lines and construction of sewage treatment plant, sewage pumping and lifting stations at the identified sites. Sewage pumping and lifting stations works will be confined to sites, and construction will include general activities like site clearance, excavation for foundations, and creation of concrete structures will be one of the major construction activities for this project, as many of the subproject components will be fixed to concrete plinths and most will be housed in buildings with at least some concrete structural elements. Most such structures will be constructed from reinforced concrete (RC), where steel reinforcing rods and bars are placed and attached by hand to create an interior skeleton for the foundations, walls, columns, plinths, etc, and heavy-duty metal and timber/plywood formwork is bolted around the outside to build a mould into which pre-mixed concrete is poured.

Once the concrete has set, the formwork is removed, and the concrete surface is finished by masons by hand if necessary. Some buildings, such as the pump station, facilities, etc., may be constructed from brick work, in which case this work will be done using standard house-building techniques. Since these works are confined to the boundary of identified sites, there is no direct or significant interference of construction work with the surrounding land use. However, construction dust, noise, use of local roads for transportation of construction material, waste, labour camps etc., will have negative impacts, which needs to be avoided or mitigated properly.

Sewers will be laid along almost all the roads in the subproject area. Lateral sewers collect sewage from households provided with house service connections (proposed in this project) will be laid in all streets and roads, the larger sewers that collect sewage from tertiary sewers and convey to pumping stations will be laid mostly on wider main roads. For all the Highways and Major road crossings, trenchless technology will be adopted.

Open cut trenching method of sewer laying involves trench excavation in the road, placing sewers in the trench, jointing and testing, and refilling with the excavated soil. Pipelines proposed are of two types, DWC (Double wall corrugated) and CI (Cast iron) pipes, up to 4.5mt depth and diameter up to 600mm DWC is adopted and beyond 600mm dia, and depth more than 4.5mts irrespective of diameter CI pipes are considered.

Earth work excavation will be undertaken by machine (backhoe excavator) and include danger lighting and using sight rails and barricades. The work will also be supplemented manually where there is no proper working area (e.g. very narrow streets) for the backhouse excavators. As trenches are deep (up to 5.5 m), there is risk of collapse of trenches and/or damage to surrounding buildings,

safety risk to pedestrians and traffic. Necessary precautions such as bracing / shoring in the trench will be provided for The normal working hours will be 8 hours daily, the total duration of each stage depends on the soil condition and other local features. Excavated soil will be used for refilling the trench after placing the sewer and therefore residual soil after pipe laying and refilling is not significant and needs to be disposed safely.

Although sewer laying work involves quite simple techniques of civil work, the invasive nature of excavation in the urban area where there are a variety of human activities, will result in impacts to the environment and sensitive receptors such as residents, businesses, and the community in general. These anticipated impacts are temporary and for short duration, however, needs to be mitigated.

UGSS proposed under this area is well developed urban pockets of KCMC hence contract company needs to take all site safety, Environmental safe guard measures strictly also PPE (Personnel protective equipment) to all who are at site shall be provided.

Anticipated impacts during the construction phase are discussed below along with appropriate mitigation measures to avoid, minimize or mitigate those impacts to acceptable levels.

Sources of Materials

For the construction work, the required materials like coarse aggregate and fine aggregate will be obtained from the permitted / licensed quarries by the Department of Geology & Mining, Government of Tamil Nadu. Contractor should not create/use any new borrow pits / quarries. The contractor should also make a concerted effort to re-use as much excavated material from this project as possible.

The construction contractor will be required to:

(i) Obtain construction materials only from government-approved quarries with prior approval from Kancheepuram City Municipal Corporation;
(ii) Kancheepuram City Municipal Corporation to review, and ensure that proposed quarry sources have all necessary clearances/ permissions in place prior to approval;
(iii) Contractor to submit to Kancheepuram City Municipal Corporation on a monthly basis documentation on material obtained from each source (quarry/ borrow pit) and
(iv) Avoid creation of new borrow areas, quarries, etc., for the project; if unavoidable, contractor to obtain all clearances and permissions as required under law, including environmental clearance prior to approval by Kancheepuram City Municipal Corporation.

5.2.1 Impact on Air Quality

During the construction period, the impacts on air quality are mainly due to the material movement and the actual construction activities. Due to material movement air quality over the immediate influence area will be affected though, not in significant levels. There will be an increase in the dust levels. In order to reduce the dust emissions in the construction area due to material transport and

construction activities, provisions should be made for sprinkling of water on all the roads in the area of improvement. It should be ensured that

- construction debris is removed daily;
- construction requiring street closings should be performed during off-peak hours;
- Idling of delivery trucks or other equipment should not be permitted during periods of unloading or when they are not in active use;
- low emission construction vehicles should be used wherever possible; and
- As soon as construction is over the surplus earth should be utilised to fill up low-lying areas. In no case, loose earth should be allowed to pile up in the streets.

Anticipated impacts during the construction phase are discussed below along with appropriate mitigation measures to avoid, minimize or mitigate those impacts to acceptable levels.

Construction work, especially from earthwork activities, coupled with dry and windy working conditions, material and debris transport, and works along the public roads carrying significant traffic and has high potential to generate dust in an air.

Significant quantities of earthwork will be conducted in the subproject, spread all over the project area. Also, emissions from construction vehicles, equipment, and machinery used for excavation and construction will induce impacts on the air quality. Anticipated impacts include dust and increase in concentration of vehicle-related pollutants such as carbon monoxide, sulfur oxides, particulate matter, nitrous oxides, and hydrocarbons. Dust generation from construction work in individual and confined work sites lifting and pumping stations etc., will be mainly during the initial construction phase of earth work, as the site is confined, dust can be effectively controlled with common measures. Dust generation will be significant during sewer laying along the roads. Increase in dust/ particulate matter in ambient air is detrimental and may have adverse impacts on people and environment. To mitigate the impacts, construction contractors will be required to ensure followings for all construction works:

- Provide a dust screen (6 m high) around the construction sites of pumping and lifting stations, provide 2 m high barricades for the sewer works.
- Damp down the soil and any stockpiled material on site by water sprinkling. (water sprinkled 3-4 times a day - before the start of work, 1-2 times in between, and at the end of the day). when working in the roads there should permanently be one person responsible for directing when water sprinkling needs to take place to stop the dust moving
- Reduce the need to sprinkle water by stabilizing surface soils where loaders, support equipment and vehicles will operate by using water and maintain surface soils in a stabilized condition.
- Apply water prior to levelling or any other earth moving activity to keep the soil moist throughout the process.
- Cover the soil stocked at the sites with tarpaulins and surround by dust screens.
- Control access to work area, prevent unnecessary movement of vehicle, public trespassing into work areas; limiting soil disturbance will minimize dust generation
- Use tarpaulins to cover the loose material (soil, sand, aggregate etc.,) when transported by open trucks.

- Control dust generation while unloading the loose material (particularly aggregate, sand, soil) at the site by sprinkling water and unloading inside the barricaded area; minimize the drop height when moving the excavated soil
- Clean wheels and undercarriage of haul trucks prior to leaving construction site
- Ensure that all the construction equipment, machinery is fitted with pollution control devises, which are operating correctly, and have a valid pollution under control (PUC) certificate.
- No vehicles or plant to be left idling at site generators to be at placed maximum distance from properties.

For pipe laying works

- Inform the residents likely to be affected by the works in the locality about the upcoming pipe laying works well in advance so that necessary arrangements are planned by the residents with reduced inconvenience.
- For sections where the controlled blasting is proposed, the residents are provided with the schedule of blasting at least three days in advance and the residents are explained about the preventive, precautionary, mitigation and emergency response measures being taken to address their concerns.
- The project staff from the PIU, consultants and contractors would undertake a survey of structures (including videography and/or photography) lying within the area of influence of blasting from the impacts (preferably in the presence of the owners of the said structures) during pre- and post-blasting situations to assess and/or ascertain regarding the damages, if any, caused to the structures because of blasting activities.
- Barricade the construction area using hard barricades (of 2 m height) on both sides;
- Initiate site clearance and excavation work only after barricading of the site is done;
- Confine all the material, excavated soil, debris, equipment, machinery (excavators, cranes, etc.), to the barricaded area;
- Limit the stocking of excavated material at the site; remove the excess soil from the site immediately to the designated disposal area;
- Undertake the work section wise a 100 m section should be demarcated and barricaded; open up several such sections at a time, but care shall be taken to locate such sections in different zones;
- The section proposed for blasting shall be supervised by properly trained staff to ensure no movement of pedestrians, motorized or non-motorized vehicles, and residents takes place during blasting within the area of influence.
- For sections involving controlled blasting, ensure that dust curtains of adequate height are provided to the trenches to prevent emission of dust during drilling for charge holes and controlled blasting.
- Ensure that the excavated soil and debris along the section identified for blasting is sprinkled with adequate water prior to blasting to reduce dust emissions upon explosion of charge placed for breaking the hard rock;
- Ensure that adequate precautions are taken to avoid flying debris post blasting (such as covering the trench with sturdy metallic sheets having sufficient weights to absorb the blast waves);
- Conduct work sequentially - excavation, pipe laying, backfilling; testing section-wise (for a minimum length as possible) so that backfilling, stabilization of soil can be done;

- Remove the excavated soil of first section to the disposal site; as the work progresses sequentially, by the time second section is excavated, the first section will be ready for back filling, use the freshly excavated soil for backfilling, this will avoid stocking of material, and minimize the dust; and
- Backfilled trench at any completed section after removal of barricading will be the main source of dust pollution. The traffic, pedestrian movement and wind will generate dust from the backfilled section. Road restoration shall be undertaken immediately.

Excavation and refilling activities disturb the topsoil, and under the influence of wind, traffic, pedestrians, and other activities etc., produces dust. There is large potential to generate significant quantities of dust after refilling the trench, and prior to road relaying. It is a common practice not to restore the road immediately after refilling the trench so as to allow sufficient time for the refilled material to stabilize naturally. Given the dry and windy conditions, and heavy traffic and other activities along the roads, the refilled trenches with loose topsoil along the roads will generate maximum dust and create very unhealthy conditions. Moreover, as the barricades/ dust screens will be removed after the trench is refilled, there will be absolutely nothing to control the dust generation. Dust control activities like wetting of topsoil will not be effective given the site conditions. It is therefore necessary to restore/ relay the road surface immediately or take suitable steps to arrest the dust. Soil consolidation techniques shall be used so that roads can be restored immediately.

While obtaining permission for the proposed clear water transmission mainly from NH, SH & rural roads, the necessary restoration charges will be paid and accordingly the respective department will restore their roads.

Generation of Construction Wastes. Solid wastes generated from the construction activities are excess excavated earth (spoils), discarded construction materials, cement bags, wood, steel, oils, fuels and other similar items. Domestic solid wastes may also be generated from the workers' camp. Improper waste management could cause odor and vermin problems, pollution and flow obstruction of nearby watercourses and could negatively impact the landscape. Earthwork excavation in the road will be reused for leveling the roadside and earth excavation from other locations will be safely disposed of to corporation lands.

Mitigation measures

The following mitigation measures to minimize impacts from waste generation shall be implemented by the contractor:

(i) Prepare and implement a Construction Waste (Spoils) Management Plan (format is given in Appendix 4);
(ii) Avoid stockpiling any excess spoils at the site for a long time. Excess excavated soils should be disposed to corporation lands;
(iii) If disposal is required, the site shall be selected preferably from barren, infertile lands; sites should locate away from residential areas, forests, water bodies and any other sensitive land uses;
(iv) Domestic solid wastes should be properly segregated in biodegradable and non-biodegradable for collection and disposal to designated solid waste disposal site; create a compost pit at workers camp sites for disposal of biodegradable waste; non-

biodegradable / recyclable material shall be collected separately and sold in the local recycling material market;

(v) Prohibit burning of construction and/or domestic waste;

(vi) Ensure that wastes are not haphazardly thrown in and around the study area; provide proper collection bins, and create awareness to use the dustbins; recycle waste material where possible; and

Conduct site clearance and restoration to original condition after the completion of construction work; PIU to ensure that site is properly restored prior to issuing of construction completion certificate.

5.2.2 Impact on surface water

Runoff from the excavated areas and material and waste soil stocks likely to contain silt, and this silt runoff will deteriorate the water bodies due to silting. Large-scale silting is likely to lead to flooding. This impact will however be considered only during the rainy season. These potential impacts are temporary and are of short-term duration only and to ensure these are mitigated, construction contractor will be required to:

(i) Avoid stockpiling of earth fill especially during the monsoon season unless covered by tarpaulins or plastic sheets;

(ii) Prioritize re-use of excess spoils and materials in the construction works. If spoils will be disposed, consult with Kancheepuram City Municipal Corporation on designated disposal areas;

(iii) Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies;

(iv) Place storage areas for fuels and lubricants away from any drainage leading to water bodies; and

(v) Dispose any wastes generated by construction activities in designated sites; and

(vi) Conduct surface quality inspection according to the ESMP.

Aquatic Environmental Impacts:

Based on the review of secondary information, there are no movement/ migration of fish species/ fish breeding ground or endangered fish species/ aquatic animals found in the River Palar and Vegavathi as there is no ecological flow in the proposed PCB location. Hence the proposed construction of pipe carrying bridges is not envisaged to have any impact on the fish species/ fish breeding pattern. However, care shall be taken to avoid deposition/ disposal of construction waste / accidental spillage of construction material into the river and also construction works shall be restricted during the monsoon seasons.

1.1.9 Noise and Vibration Levels

The sites for pumping and lifting station sites are located predominantly urban and suburban areas, STP is located outside the city, in Nathapettai near the existing WSP. Sewer lines are spread over entire project area. Except STP, all these sites are located close to habitation areas, where there are houses, schools and hospitals, religious places and businesses. The sensitive receptors are the general population in these areas. Increase in noise level may be caused by excavation, particularly

breaking of cement concrete or bitumen roads for laying of sewers, operation of construction equipment, and the transportation of equipment, materials, and people. Vibration generated from construction activity, for instance from the use of pneumatic drills, will have impact on nearby buildings. This impact is negative short-term, and reversible by mitigation measures. The construction contractor will be required to:

(i) Plan activities in consultation with PIU so that activities with the greatest potential to generate noise are conducted during periods of the day which will result in least disturbance, especially near schools and other sensitive receptors
(ii) Minimize noise from construction equipment by using vehicle silencers, fitting jackhammers with noise-reducing mufflers, and use portable street barriers to minimise sound impact to surrounding sensitive receptor; and
(iii) Maintain maximum sound levels not exceeding 70 decibels (dBA) when measured at a distance of 10 m or more from the vehicle/s.
(iv) Identify any buildings at risk from vibration damage and avoiding any use of pneumatic drills or heavy vehicles in the vicinity; if any building at risk, structural survey be completed prior to work, to provide baseline in case any issues from vibration, and if building is structurally unsound that measures taken to avoid any further damage. Horns should not be used unless it is necessary to warn other road users or animals of the vehicle's approach;
(v) Consult local communities in advance of the work to identify and address key issues, and avoid working at sensitive times, such as religious and cultural festivals.

1.1.10 Accessibility and Traffic Disruptions

Excavation along and across the roads for laying of sewers, hauling of construction materials and operation of equipment on-site will cause traffic problems. Sewers are proposed along all the main roads and streets. All of the roads connects the city from east to west and north to south carrying huge traffic. These roads also centers of commercial activities. There are internal important roads within the project area connecting different parts of city. As the sewer lines are proposed to be laid within the road carriage way, it will disrupt the traffic in one-traffic lane. In the narrower roads, sewers will be laid in the center of the road, and therefore during the work traffic movement will be mostly disrupted. Works related to all the remaining components (lifting and pumping stations) will be confined to the selected sites, therefore there is no direct interference of these works with the traffic and accessibility.

The impacts due to vehicular movement and construction machinery can be minimized by using the designated routes for movement of heavy vehicles and machinery to avoid the soil compaction in areas other than the site. The transportation of construction material will be generally supplied in night when the traffic is minimum. Indicative traffic management plan given below will be updated prior to the diversion of traffic where required for the construction activities.

Hauling of construction material, equipment, construction waste, etc., to and from the work site may increase the road traffic on local roads. This will further inconvenience the local community and road users. Potential impact is negative but short term and reversible by mitigation measures.

1.1.10.1 For Excavation

- Prepare a sewer work implementation plan and undertake the work accordingly, ensure that for each road where the work is being undertaken there is an alternative road for the traffic diversion, take up the work in sequential way so that public inconvenience is minimal, Plan the sewer work in coordination with the traffic police, provide temporary diversions, where necessary with clear signage and effectively communicate with general public.
- Avoiding conducting work in all roads in a colony at one go, it will render all roads unusable due to excavations at the same time, creating large scale inconvenience. Undertake the work section wise: a section should be demarcated and barricaded; open up several such sections at a time, but care shall be taken to locate such sections in different zones. Confine work areas in the road carriageway to the minimum possible extent, all the activities, including material and waste/surplus soil stocking should be confined to this area. Proper barricading should be provided, avoid material/surplus soil stocking in congested areas take action to immediately removed from site/ or brought to the as and when required.
- Limit the width of trench excavation as much as possible by adopting best construction practices, adopt vertical cutting approach with proper shoring and bracing, this is especially to be practiced in narrow roads and deeper sewers, if they deep trenches are excavated with slopes, the roads may render completely unusable during the construction period. Leave spaces for access between mounds of soil to maintain access to the houses / properties, access to any house or property shall not be blocked completely, alternative arrangements, at least to maintain pedestrian access at all times to be provided.
- Provide pedestrian access in all the locations; provide wooden/metal planks with safety rails over the open trenches at each house to maintain the access. Inform the affected local population in advance about the work schedule a week before, and a day before start of work. Plan and execute the work in such a way that the period of disturbance/ loss of access is minimum. Keep the site free from all unnecessary obstructions.
- Necessary care to be taken during excavation to protect all the property connections (water, gas, electrical, telecom, septic tanks etc.) to avoid inconvenience to the local residents and disruption to works.
- Notify public by prior information notices, providing sign boards informing nature and duration of construction works and contact numbers for concerns/complaints. Provide information to the public through media newspapers and local cable television (TV) services. At work site, public information/caution boards shall be provided including contact for public complaints.

1.1.10.2 Hauling (material, waste/debris and equipment) activities

- Plan transportation routes so that heavy vehicles do not use narrow local roads, except in the immediate vicinity of delivery sites.
- Schedule transport and hauling activities during non-peak hours (peak hours 7 to 10 AM and 4 to 7 PM).
- Locate entry and exit points in areas where there is low potential for traffic congestion.
- Drive vehicles in a considerate manner.
- Notify affected public by public information notices, providing sign boards informing nature and duration of construction works and contact numbers for concerns/complaints.

1.1.10.3 Control dust generation

- Immediately consolidate the backfilled soil and restore the road surface, this will also avoid any business loss due to dust and access inconvenience of construction work.
- Employee best construction practices, speed up construction work with better equipment, increase workforce, etc., in the areas with predominantly commercial, and with sensitive features like hospitals, and schools.
- Consult businesses and institutions regarding operating hours and factoring this in work schedules.
- Provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints.

1.1.10.4 Socio-Economics

Sites for all projects components are carefully selected in government owned vacant lands and therefore there is no requirement for land acquisition or any resettlement. Blocking of access to the business / livelihood activities, especially during pipeline laying along the roads, may impact the income of households. However, given the alignment of pipeline within the road carriage way, and also the measures suggested for ensuring accessibility during sewer works, notable but temporary impact is envisaged. Some shops and other premises along the roads may lose business income if the access will be impeded by excavation of trenches, the presence of heavy vehicles and machinery, etc. Access disruption to hospitals, socio cultural places etc., will inconvenience public. Implementation of the following best construction measures will avoid the disturbance reduce the inconvenience and disturbance to the public..

- Inform all businesses and residents about the nature and duration of any work well in advance so that they can make necessary preparations.
- Do not block any access completely. Leave spaces for access between barricades/mounds of excavated soil and other stored materials and machinery, and providing footbridges so that people can crossover open trenches.
- Barricade the construction area and regulate movement of people and vehicles in the vicinity, and maintain the surroundings safely with proper direction boards, lighting and security personnel – people should feel safe to move around Occupational Health and Safety

Workers need to be mindful of the occupational hazards which can arise from working in confined areas such as trenches, working at heights, near the heavy equipment operating areas etc. Potential impacts are negative and long-term but reversible by mitigation measures. The construction contractor will be required to provide all at site with personnel protective equipment such as boots, Spectacles, Hand gloves Helmets and to follow all national, state and local labour laws. Develop and implement site-specific occupational health and safety (OHS) Plan, informed by OHS risk assessment seeking to avoid, minimize and mitigate risk, which shall include measures such as:

- safe and documented construction procedures to be followed for all site activities.
- Ensuring all workers are provided with and use personal protective equipment.
- OHS Training for all site personnel.
- Exclude public from the work sites.
- Documentation of work-related accidents.

- Follow International Standards such as the World Bank Group's Environmental, Health and Safety Guidelines.
- Ensure that qualified first-aid is provided at all times. Equipped first-aid stations shall be easily accessible throughout the sites;
- Secure all installations from unauthorized intrusion and accident risks.
- Provide H&S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injuring to fellow workers.
- Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazard areas unescorted.
- Ensure the visibility of workers through their use of high visibility vests and other PPE when working in or walking through heavy equipment operating areas.
- Ensure moving equipment is outfitted with audible back-up alarms.
- Mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate.
- Disallow worker exposure to noise level greater than 85 dBA for duration of more than 8 hours per day without hearing protection. The use of hearing protection shall be enforced actively.
- Provide supplies of potable drinking water.
- Provide clean eating areas where workers are not exposed to hazardous or noxious substances.

1.1.10.5 Community Health and Safety

- Sewers works and deep excavations along the roads and narrow streets, and hauling of equipment and vehicles have potential to create safety risks to the community. Deep excavations without any proper protection may endanger the close by buildings. Hazards posed to the public, specifically in high-pedestrian areas may include traffic accidents and vehicle collision with pedestrians. Potential impact is negative but short-term and reversible by mitigation measures. The construction contractor needs to ensure following during execution.
- Confine work areas, prevent public access to all areas where construction works are on-going through the use of barricading and security personnel.
- Attach warning signs, blinkers to the barricading to caution the public about the hazards associated with the works, and presence of deep excavation.
- Minimize the duration of time when the sewer trench is left open through careful planning; plan the work properly from excavation to refilling and road relaying.
- Control dust pollution – implement dust control measures as suggested under air quality section.
- Ensure appropriate and safe passage for pedestrians along the work sites.
- Provide road signs and flag persons to warn of on-going trenching activities.
- Restrict construction vehicle movements to defined access roads and demarcated working areas (unless in the event of an emergency).
- Enforce strict speed limit (10 - 20 kmph) for plying on unpaved roads, construction tracks.

- Provide temporary traffic control (e.g. flagmen) and signs where necessary to improve safety and smooth traffic flow.
- Where traffic is diverted around crossings, traffic control or careful selection of the exit from the working areas will be provided with the aim of ensuring that vehicles join the road in a safe manner.
- At sensitive locations particularly where there are schools and markets close to the road, awareness of safety issues will be raised through neighborhood awareness meetings
- All drivers and equipment operators will undergo safety training.
- Maintain regularly the construction equipment and vehicles; use manufacturer-approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure.

1.1.10.6 Construction Camps

Contractor may require setting up construction camps – for temporary storage of construction material Pipes, cement, steel, fixtures, fuel, lubricants etc.,) and stocking of surplus soil, and may also include separate living areas for migrant workers. The contractor will however be encouraged to engage local workers as much as possible. Operation of work camps can cause temporary air, noise and water pollution, and may become a source of conflicts, and unhealthy environment if not operated properly. Potential impacts are negative but short-term and reversible by mitigation measures. The construction contractor will be required to ensure :

- Consult PIU before locating project offices, sheds, and construction plants.
- Select a camp site away from residential areas (at least 100m buffer shall be maintained) or locate the camp site within the existing facilities of City Corporation.
- Avoid tree cutting for setting up camp facilities.
- Provide a proper fencing/compound wall for camp sites. Camp site shall not be located near (100 m) water bodies, flood plains, flood prone/low lying areas, or any ecologically, socially, archeologically sensitive areas
- Separate the workers living areas and material storage areas clearly with a fencing and separate entry and exit.
- Ensure conditions of livability at work camps are maintained at the highest standards possible at all times, living quarters and construction camps shall be provided with standard materials (as far as possible to use portable ready to fit-in reusable cabins with proper ventilation), thatched huts, and facilities constructed with materials like GI sheets, tarpaulins, etc., shall not be used as accommodation for workers.
- Camp shall be provided with proper drainage, there shall not be any water accumulation.
- Provide drinking water, water for other uses, and sanitation facilities for employees, drinking water should be regularly tested to confirm that drinking water standards are met.
- Prohibit employees from cutting of trees for firewood, contractor should provide cooking fuel (cooking gas) fire wood not allowed.
- Train employees in the storage and handling of materials which can potentially cause soil contamination
- Wastewater from the camps shall be disposed properly either into sewer system, if sewer system is not available, provide on-site sanitation with septic tank and soak pit arrangements (100 m away from surface water body or groundwater well).
- Recover used oil and lubricants and reuse or remove from the site.

- Manage solid waste according to the following preference hierarchy reuse, recycling and disposal to designated areas, provide a compost pit for bio degradable waste, and non-biodegradable / recyclable waste shall be collected and sold in local market.
- Remove all wreckage, rubbish, or temporary structures which are no longer required.
- At the completion of work, camp area shall be cleaned and restored to pre-project conditions, and submit report to PIU, PIU to review and approve camp clearance and closure of work site.

1.2 Operation and Maintenance Impacts

Operation and Maintenance of the sewerage system will be carried out by Kanchipuram City Corporation. Operation will involve collection and conveyance of wastewater from houses to nearest lifting/pumping stations; operation of lifting/pumping stations to pump accumulated sewage main pumping stations; operation of main pumping stations to pump accumulated sewage to STP; treatment of sewage at STP to meet the disposal standards; and final disposal of treated wastewater from STP. STP is proposed under DBOT modality, and the contractor will prepare detailed designs for STP including the outfall sewer and disposal arrangements.

4. During its operation phase, STP will treat 30million liters of wastewater every day. As discussed in the preconstruction stage impacts, various measures, following measures are suggested for detailed design to avoid, mitigate any impacts on the environment due to operation of STP.

(i) Process design to meet the stringent standards for disposal into river
(ii) Conduct a detailed baseline water quality assessment of receiving water body; monitor water quality periodically during operation phase as per the Environmental Monitoring Plan
(iii) Develop a sludge management plan : Sludge management to collect, treat and dispose the accumulated sludge safely; sludge will be treated in a mechanical centrifuge which will thicken the sludge by separating the liquid, thicken sludge will be further dried, and dried sludge will be used as a soil conditioner in fields; Sludge will be tested periodically for heavy metal concentration.
(iv) Designing the entire system to maintain optimal flow and terminal pressure, and optimising the overall energy usage in sewer system, including STP
(v) Using low-noise and energy efficient pumping systems
(vi) Installing the noise-producing pumps and motors etc., in enclosed buildings with noise reducing walls, and also maintaining adequate buffer to the nearby inhabited areas
(vii) Provision of appropriate personal protection equipment to the workers and staff

5. **Treatment and Disposal**. Sewage treatment facility would be designed to meet the present disposal standards notified by CPCB for disposal of treated wastewater from STPs into river. The treated sewage effluent would be disposed into Vegavathi River at 3.5Km from STP. With the implementation of subproject, disposal of untreated wastewater from added areas (subproject areas) will be prevented, and only treated wastewater will be disposed into river. This will in fact improve the water quality, and therefore no adverse impacts envisaged. A detailed baseline will be established during the detailed design phase since the implementation modality of this subproject

is design-build. This is part of scope of work of DB contractor. Any change / lowering of treatment efficiency during operation may lead to poor quality of wastewater and may further pollute surface waterbody. It is therefore critical that STP treats the sewage as designed. Operation and maintenance of STP and change in incoming sewage quality will have impact on the treatment efficiency.

6. During the detailed design phase::

(i) Conduct a detailed baseline water quality assessment of receiving water body
(ii) Monitor water quality periodically during operation phase as per the Environmental Monitoring Plan

7. **STP operation**. It must be ensured that the facility is operated with standard operating procedures and only by trained staff. Ensuring uninterrupted power supply with back-up facility is a must. Standard operating procedures and operation manual shall be prepared by the contractor. Besides routine operation, this will cover all necessary items such as preventive maintenance, periodic maintenance and emergency maintenance, replacement of pumps, motors, and other electro-mechanical parts as per the design life to optimize energy use and system efficiency etc., Manual shall also include safety awareness and mock drills for worker safety.

8. **Quality of Raw Sewage**. As discussed previously, one of the critical aspects in STP operation is, change in raw sewage characteristics at inlet of STP may affect the process and output quality. The system is designed for municipal wastewater, which does not include industrial effluent. Characteristics of industrial effluent widely vary depending on the type of industry, and therefore disposal of effluent into sewers may greatly vary the inlet quality at STP, and will upset process and affect the efficiency. There are no significant presence of industries with problematic water discharges in the subproject area, however, it is important that no wastewater from industries is allowed into the sewer network with strict monitoring and enforcement.

9. **Sewage sludge**. Sewage sludge contains harmful substances such as bacteria and pathogens, and nutrients like nitrogen, phosphates. Improper handling and disposal of the sludge will have adverse impacts on health and environment. STP will have proper facilities for handling, treatment and disposal of sludge safely with implementation of sludge management plan. Therefore no adverse impacts envisaged. The treatment and drying processes kill enteric bacteria and pathogens, and because of its high content of nitrates, phosphates and other plant nutrients the sludge is an excellent organic fertilizer for application to the land. The reuse of sludge should be preceded by rigorous bacteriological tests to confirm that the treatment methods render all dried sludge and effluent free from enteric bacteria and pathogens, so that it is safe to humans, animals and crops. Sludge shall also need to be periodically tested for presence of heavy metals, to check if it meets the compost standards specified the Solid Waste Management and Handling Rules, 2016.

10. Following measures are to be implemented during the operation phase:

(i) Ensure proper knowledge transfer, hands-on training to municipal staff engaged in STP operation has been provided by contractor prior to handover of facility;
(ii) Ensure continuous uninterrupted power supply;
(iii) Operate and maintain the facility following standard operating procedures of operational manual;
(iv) Undertake preventive and periodic maintenance activities as required;
(v) Maintain the mechanical / electrical parts as per the maintenance plan to avoid any hazards;
(vi) Conduct periodic training to workers;
(vii) Ensure that all safety apparatus at STP including personal protection equipment are in good condition all times; and are at easily accessible and identifiable place; periodically check the equipment, and conduct mock drills to deal with emergency situations;
(viii) Implement sludge management plan at the STP;
(ix) No wastewater from industrial premises (including domestic wastewater) shall be allowed to dispose into municipal sewers;
(x) Monitor regularly and ensure that there is no illegal discharge through manholes or inspection chambers; conduct public awareness programs; in coordination with TNPCB;
(viii) Conduct regular wastewater quality monitoring (at inlet and at outlet of STP) to ensure that the treated effluent quality complies with design standards;
(ix) Conduct periodic testing of dried sludge/compost to check presence of heavy metals and confirming to the applicable standards to use as compost.

11. **Odor and Noise from Sewage lifting and pumping stations**. Various measures are included in the design of these facilities giving utmost importance to odor and noise. Therefore it is anticipated there will not be any significant generation of odor or noise that will impact the surrounding households. Following measures are to be implemented during the operation:

(i) Strictly follow standard operating procedures / operational manual for operation and maintenance of lifting and pump stations;
(ii) Ensure that operating staff is properly trained, and have clear understanding of odor issues vis-à-vis its related with operational practices;
(iii) Ensure that pumping cycles are properly followed; and there is no buildup of sewage beyond design volume in the wells;
(iv) Conduct periodic H2S monitoring at pumping and lifting stations using handheld H2S meters.

12. **Sewer network.** During the system design life (15/30 years for mechanical/civil components) it shall not require major repairs or refurbishments and should operate with little maintenance beyond routine actions required to keep the equipment in working order. The stability and integrity of the system will be monitored periodically to detect any problems and allow remedial action if required. Any repairs will be small-scale involving manual, temporary, and short-term works involving regular checking and recording of performance for signs of deterioration, servicing and replacement of parts.

13. There are also certain environmental risks from the operation of the sewer system, most notably from leaking sewer pipes as untreated fecal material can damage human health and contaminate both soil and groundwater. It will be imperative therefore that the operating agency establishes a procedure to routinely check the operation and integrity of the sewers, and to implement rapid and effective repairs where necessary. There is an occupation health risk to workers engaged in sewer maintenance activities. Following measures should be followed:

(i) Establish regular maintenance program, including:
   a. Regular cleaning of grit chambers and sewer lines to remove grease, grit, and other debris that may lead to sewer backups. Cleaning should be conducted more frequently for problem areas;
   b. Inspection of the condition of sanitary sewer structures and identifying areas that need repair or maintenance. Items to note may include cracked/deteriorating pipes; leaking joints or seals at manhole; frequent line blockages; lines that generally flow at or near capacity; and suspected infiltration or exfiltration; and
   c. Monitoring of sewer flow to identify potential inflows and outflows;
   d. Conduct repairs on priority based on the nature and severity of the problem. Immediate clearing of blockage or repair is warranted where an overflow is currently occurring or for urgent problems that may cause an imminent overflow (e.g. pump station failures, sewer line ruptures, or sewer line blockages).

(ii) Maintain records; review previous sewer maintenance records to help identify "hot spots" or areas with frequent maintenance problems and locations of potential system failure, and conduct preventative maintenance, rehabilitation, or replacement of lines as needed;

(iii) When a spill, leak, and/or overflow occurs, keep sewage from entering the storm drain system by covering or blocking storm drain inlets or by containing and diverting the sewage away from open channels and other storm drain facilities (using sandbags, inflatable dams, etc.). Remove the sewage using vacuum equipment or use other measures to divert it back to the sanitary sewer system.

(iv) Prohibit/prevent disposal of wastewater/effluent from industrial units in the sewers; ensure regular checking to ensure no illegal entry of industrial wastewater into sewers;

(v) Develop an Emergency Response System for the sewerage system leaks, burst and overflows, etc.;

(vi) Provide necessary health and safety training to the staff in sewer cleaning and maintenance;

(vii) Provide all necessary personnel protection equipment;

(viii) Do not conduct manual cleaning of sewers; for personnel engaged sewer maintenance work, there is a risk due to oxygen deficiency and harmful gaseous emissions (hydrogen sulphide, methane, etc.); provide for adequate equipment (including oxygen masks) for emergency use.

1.3 Social Impact Assessment

1.3.1 Project components and social impacts

The impact assessment and Components wise social impacts are explained in detail in the following Table.

Table 5.1: Project Components and Social Impacts Matrix

Area	Collection System (M)	MH (Nos)	Pumping Main(M)	Lift Stations (Nos)	Pumping Stations (Nos)	STP
Kanchipuram City	180.442	7437	14.101 km	7 Lift Stations	5	Proposed Near WSP site @ Nathapettail
Description	The collection system comprises of laying of sewer line with machine holes for every 30m. The line will be laid in the middle of the road by cutting open the black to portions.	The MHs are having provision for house service connections. Each MH will be able to connect five houses on either side	Pumping main with varying size (dia) (250mm to 750mm) is proposed. The pumping mains will be laid in the berm of the road within the carriage width of the ROW.	1.Lakshmi Vaikunthavalli Nagar 2.Adhiyaman Nagar 3.Emperuman Kovil Street. 4.Anna Kudiyiruppu 5.Ambedkar Statue 6.Vishnu nagar 7.Near Bangalore by-pass road	SPS @ Near Temple City 5th Cross Street SPS @ Near Collectorate ground MPS @ Near Vishnu Nagar SPS@ Near Pachaippas College MPS@ Near Nathapettai WSP	The STP will be constructed in the Municipal Owned Land. The treated effluent proposed to be disposed into Vegavathi River through pumping main.
Social Impacts	The sewer line will be laid in the roads under the control	The MHs will be constructed in the middle	The land use of the project area is mostly	The above sites are free from encumbrances and permanent or	The above sites are free from encumbrances and permanent or	The STP site is vacant land and owned by the ULB and free from encumbrances.

	of Greater Chennai Corporation. There are 12 potential temporary economic impact	of the road. Hence there is no permanent or temporary resettlement impacts.	residential. Hence laying of pumping main is devoid of permanent and temporary resettlement impacts.	temporary resettlement impacts are not envisaged	temporary resettlement impacts are not envisage d	The disposal pumping main alignment is taken through roads and no permanent/temporary impacts envisaged in the alignments till the disposal point.

1.3.2 Social Screening Survey

The social baseline survey was carried out on 21-10-2022, in order to screen for social impacts in project sites and alignments.

6. ANALYSIS OF ALTERNATIVES

6.1 Proposed Zoning for the uncovered areas

6.1.1 General Principle

The zoning of the project area is based on the following general principle:

- Topography of the project area
- Possibility of restricting the sewer depth to max 6m (invert level).
- Availability of vacant site for locating the pumping stations

6.2 Proposed Zoning

Kancheepuram Corporation area is characterized by an undulating terrain with the elevation ranging between 72 m and 90 m above MSL. River Vegavathi flowing through the centre of the corporation from west to east divides the corporation into northern part and southern part. The terrain gently slopes from northern and southern boundary of the corporation towards the south i.e towards the Palar River. Following two alternatives are available for zoning:

- Deeper sewer with less number of pumping stations.
- Shallow sewer with more number of pumping stations.

After detailed analysis considering the Topography, water table and the ground profile of Kancheepuram (mostly sandy) it is proposed to restrict the depth of sewers to 6.0m. This may result in more number of pumping stations than going for deeper sewers but will result in optimum solution and has the following advantages:

(i) Savings in the cost of collection system
(ii) Easy and Quick completion
(iii) Easy O&M (Cleaning, repairs etc)
(iv) In case of failure of a pumping station only a smaller area will get affected

Main disadvantage is that the establishment charges for the pumping operations will increase, as the cost increase due to additional staff required for manning more number of pumping stations.
Following are the drainage zones identified based on initial review of the terrain. This will be further refined based on the availability of land for location pumping stations, restricting the depth of excavation to less than 6.0 m etc. (Zone 1 to 4 are existing).

6.3 Sewage Treatment Plant

6.3.1 General

In general the selection of suitable least cost treatment process for the domestic sewage depends on raw sewage characteristics, capacity of plant, availability of land (extent and shape), the desired treated sewage characteristics, which in turn depends on the intended use/ mode of disposal, capital cost, O&M requirements and other local factors.

6.3.2 Raw sewage characteristics

Characteristics of the raw sewage at the inlet of the sewage treatment plant were collected from the existing sewage treatment plant and presented. Typical value ranges for major pollution parameters are presented in Table below:

Table 6.1 Characteristics of Raw Sewage

Sl. No	Parameter	Unit	Range
1	Biochemical Oxygen Demand (BOD) – 20°C	Mg/l	150 -250
2	Chemical Oxygen Demand (COD)	Mg/l	500 -600
3	Total Suspended Solids (TSS)	Mg/l	50 - 200
4	pH	Mg/l	7 to 8

The discharge standards prescribed by Tamilnadu Pollution Control Board (TNPCB) for disposal of treated sewage into inland water course are given in Table 6.2 below

Table 6.2 TNPCB standard for disposal of treated sewage into inland surface water

Sl. No	Parameter	Unit	Range
1	Biochemical Oxygen Demand (BOD) – 20°C	Mg/l	10
2	Chemical Oxygen Demand (COD)	Mg/l	50
3	Total Suspended Solids (TSS)	Mg/l	20
4	pH	Mg/l	1.0

6.3.3 Treatment Plant options

6.3.3.1 Existing Sewage Treatment Plant

The existing WSP is located at Nathapettai. The installation capacity is 14 MLD. This 14 MLD capacity will be just sufficient to treat the sewage generated from the area covered by the existing sewerage system. It is not possible to treat additional flow from the adjacent areas.

6.3.3.2 Proposed Sewage Treatment Plant

The following options are possible:

- Decentralized sewage treatment plant
- Centralized sewage treatment plant

The total extent of project area is 24.42Sq.Km. The quantity of sewage generated from the project area is expected to be about 13.93 MLD and 17.15 MLD for the year 2040 and 2055 respectively. Considering the project area, the sewage generation from the project area, considering the economics of conveying the sewage to the sewage treatment plant and as suggested it is proposed to have centralized treatment plant.

6.3.4 Treatment Options

6.3.4.1 Selection of treatment process

The selection of treatment process (or combination of processes) depends on:

- Capacity of STP
- Inlet sewage characteristics
- Required treated sewage characteristic
- Intended use of treated sewage (gardening, industrial use etc) or mode of disposal (ie for on land or inland surface waters or sea)
- Location of STP
- Land availability (extent and shape)
- Cost economics
- Simplicity (minimum equipments)
- Ease of construction and operation
- Availability of skilled manpower for operation
- Proven technology worldwide
- Ability to take shock load
- Aesthetically acceptable

6.3.4.2 Comparison of processes

Treatment processes most widely used in sewage treatment in Tamil Nadu are given below:

i) Conventional Activated sludge Process (ASP)
ii) Extended Aeration Process (EAP)

iii) Sequential Batch Reactor (SBR)
iv) Moving Bed Bio Reactor (MBBR)
v) Membrane Bio Reactor (MBR)

Table 6.3 Comparision of Treatment Processes - Performance

Sl. No	Item Description	Activated Sludge Process (ASP)	Extended aeration process	Sequential Batch Reactor (SBR)	Moving Bed Bio Reactor (MBBR)	Membrane Bio Reactor (MBR)
1	BOD Removal %	85 -95	90-95	90-95	85 -95	95 -98
2	Total Suspended Solids Removal %	85 -90	85 -90	90 - 96	85 – 95	98 – 99
3	Level of Supervision	Highly Skilled	Semi Skilled	Highly Skilled	Highly Skilled	Highly Skilled
4	Comparison -O&M Cost (EA Process taken as 1)	1.10	1	1.05	1.05	1.10
5	Comparison - Total capital cost – Excluding land cost (EA Process taken as 1)	1.25	1	1.50	1.10	1.80
6	Land Requirement (acres)	2.4	2.4	2.4	2.4	2.4

6.3.5 Alternatives

Alternative 1

- Float the bid with only one specified process with five year of Operation & Maintenance and with specified norms for power and chemical consumption.

Alternative 2

- Float the BID as DBOT tender with five years of Operation & Maintenance, leaving the option of selecting the process to the Bidder from the approved technologies.

Selection of bidder will be based on least life cycle cost for 5 years (capital cost and guaranteed power, chemical & O&M cost for 5 years)While Alternative 1 has been generally practiced, recent tenders floated / decided by the Municipalities in Tamil Nadu have opted for Alternative 2.

Decision on treatment process will be decided at appropriate time based on the land availability, mode of disposal etc.

6.4 Selection of Sewage Treatment Technology:

In order to arrive at the best feasible sewage treatment option for expansion of existing STP‟s and identified new STP for various design horizons, further screening of waste water at certain catchments/ drains where industrial effluent being discharged needs to be investigated. Further to this, economic evaluation of few selected treatment options has been done keeping in view of the experiences available in NRCD projects. Generally, basic considerations taken into account for selecting most viable treatment option depends upon following factors:

1. Treatment efficiencies.
2. Capital costs (Civil, Mechanical, Electrical costs).
3. Energy requirements
4. Land area requirements.
5. Operational and Maintenance costs.

Other considerations include, utility of treated effluent and by-products from STP like sludge and biogas. On the basis of description of various alternatives as discussed above, their advantages and disadvantages, capital costs, operation and maintenance cost collected from various sources have been computed. The data/information given in this table is used as a bench mark for calculating the anticipated costs of the proposed STP sand selection of appropriate technology.

Table 6.4 Life Cycle Cost for different technology– Per MLD

Sl.No	Assessment parameter	Rs					
		ASP	**WSP**	**UASB+ FPU**	**UASB+ EAS**	**MBBR**	**SBR**
1.	**Capital Cost**	**110**	**55**	**95**	**105**	**120**	**120**
	Civil Works Cost	70.00	50.00	75.00	65.00	70.00	70.00
	E &M Works Cost	40.00	5.00	20.00	40.00	50.00	50.00
	Capital Cost	110.00	55.00	95.00	105.00	120.00	120.00

2	**Operation & Maintenance Costs**						
	Energy Costs						
	Annual Power Cost	3.40	0.17	0.68	1.25	1.95	2.05
	Annual Repairs Cost						
	Civil Works Maintenance	0.70	0.50	0.75	0.65	0.70	0.70
	E &M Works Maintenance	1.20	0.15	0.60	1.20	1.50	1.50
	Total Annual Repair Costs	1.90	0.65	1.35	1.85	2.20	2.20
3	**Annual Non Recurring Costs (Chemicals etc.)**	0.50	0.30	0.60	0.25	0.27	0.27
4	**Annual Man power O &M**						
	Total Annual Man power costs	1.60	1.50	1.50	1.60	1.00	1.00
5	**Total Annual O & M costs,**	7.40	2.62	4.13	4.95	5.42	5.52
6	**Resource recovery by sale of Sludge.**	0.70	0.17	0.75	0.75	0.65	0.67
	Effluent	0.27	0.27	0.27	0.27	0.27	0.27
	Total Annual Resource Recovery	0.97	0.44	1.02	1.02	0.92	0.94
7	**Life Cycle Cost Evaluation**						
	Avg. Land Cost Assumed (Per Ha)	300	300	300	300	300	300
	Land required in hect.	0.15	0.60	0.30	0.12	0.05	0.04
	Cost of Land	45.00	180.00	90.00	36.00	15.00	12.00

	Unit Capital Cost including Land	155.00	235.00	185.00	141.00	135.00	132.00
	Capitalized cost for 30 years @ 10% interest rate	5764.65	5138.06	4708.17	4330.62	4497.19	4482.91

ASP -Activated Sludge Plant
WSP -Waste Stabilization Pond
FPU - Final Pollution Unit
EAS - Extended Aeration System
MBBR/FAB -Moving Bed Bio Reactor
SBR - Sequential Batch Reactor
UASB -Up Flow Anaerobic Sludge Blanket

SBR technology is found to be little costlier as compared to UASB+EAS but being the latest and innovative technology and considering the better performance and effluent quality and as well as considering the area required for STP, SBR technology has been adopted.

Disposal Options

As per the design it is proposed to let the treated disposal in the Nathapettai lake. But considering the Environmental, Climate Change, Social factors this was changed into River. Presently it is revised to let the treated effluent in the Vegavathi River by laying disposal pumping main for a length of about 3.5km. This decision is actually avoided the impact to the stagnant water body i.e. lake in spite of maintaining the treated effluent standards as per the TNPCB consent conditions.

7. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

The ESMP is developed to mitigate the adverse E&S risks and impacts of sub-project providing underground sewerage system to the added areas of Kancheepuram City Municipal Corporation. It explains the mitigation measures, responsibility, implementation phase, monitoring method, monitoring indicators and frequency during pre-construction, construction, operation and decommissioning phases. The Contractor supervised by the PIU is mainly responsible for the implementation of plans during the project life cycle. The project specific ESMP is provided in Table- 7.1.

Table 7.1 Environmental and Social Management Plan

S. No.	Aspect	Mitigation measures	Responsibility	Implementation phase	Monitoring method	Monitoring indicator	Frequency
Pre-construction phase							
1.1	Engineering design and alternative analysis	• All National State regulations and guidances applicable shall be followed • Ensure that the investigation and analysis of alternative engineering design and technologies, and the route location of the proposed pipeline network cause minimum environmental and social risk and impact during the project cycle; • Ensure the activities like trenching, excavation, pipes joint welding result into minimum or no loss to ecosystem; • Alternatives in terms, low maintenance requirements, minimum length of pipeline route along the existing roads may cause minimum E&S impact. • For reducing energy consumption, evaluate use of low-noise and energy efficient pumping systems, efficient Pumping system operation, and Installation of Variable Frequency Drives (VFDs), and other energy efficient appertunances as feasible. • Construction of compound wall around project sites / pumping stations, chain-link mesh above with climbers and creepers (with sweet scented flowers) are proposed to act as screen. • Tree cover, shrubs having dense foliage and sweet-scented flowers (preferably in different layers starting from shrubs in the inner layer) depending upon space availability) along the compound wall is proposed. The greenbelt thus developed shall be well maintained by the Contractor during the	PIU/PMC, Contractor	Design/Pre-construction	Review the performance of design and technology and route decided for the project; and Consult the experts and learn from the experiences gained from such projects elsewhere	Minimum E&S risk and impact; Minimum or no impact on local ecology, waterbodies and forest; Minimum impact on land and local communities; and cost effective and O&M efficient.	Periodically

S. No.	Aspect	Mitigation measures	Responsibility	Implementation phase	Monitoring method	Monitoring indicator	Frequency
		contract period					
1.2	Design of STP	• Design process to meet the TNPCB disposal standards/or better standards for disposal into the River / latest standards prescribed as applicable. • Ensuring continuous uninterrupted power supply, including a back-up facility (such as generator) that would not be affected by floods / other disasters • Incorporate safety system and spill containment in design for chemical/ chlorine handling like separate storage rooms, Installation of alarm and safety systems, including automatic shutoff valves, that are automatically activated in case of leak, Installation of containment and scrubber systems to capture and neutralize during leakage, Use of corrosion-resistant piping, valves, & equipments, etc. • Prepare waste and sludge management plan to ensure safe collection, adequate treatment prior to reuse / disposal and get it approved by the PIU. The sludge management plan shall comply with the consent conditions/ latest regulatory requirements, and shall do no harm to the environment and communities. • Provision for online monitoring of crucial wastewater quality parameters at the inlet and outlet of the plant • Design shall consider climate risks on construction and operations of the networks and other facilities	Contractor, PIU/PMC	Design/Pre-construction	Review of design	Design complying with requirements	One-Time
1.3	Discharge of treated wastewater	• Conduct detailed water quality assessment of receiving water body at two locations, one in the upstream and other in the downstream of discharge point. Adopt mitigation measures if downstream water usages are seen affected by such disposal	Contractor, PIU/PMC	Design/Pre-construction	Review of results	Variation in the parameters	Periodical

S. No.	Aspect	Mitigation measures	Responsibility	Implementation phase	Monitoring method	Monitoring indicator	Frequency
1.4	Odor nuisance	• Site layout design of STP within allocated land, maintaining adequate buffer to the closest housing area or any other sensitive receptor. The layout shall be in line with regulations if any in this regard. • Providing a green buffer zone of 15-20 m wide all around the STP with flowering (sweet scented) trees and shrubs in multi-rows and landscaping. This will act as a visual screen around the facility and will improve the aesthetic appearance. Treated wastewater shall be used for landscaping.	Contractor, PIU/PMC	Design/Pre-construction	Design review	Design complying with requirements	One-time
1.5	Sewerline	• Limit the sewer depth where possible • Sewers shall be laid away from water supply lines and drains (at least 1 m), if not possible, sewer lines shall be laid below the water lines. In all cases possibility of mixing of sewage with water shall be fully avoided; • In all cases, the sewer line should be laid deeper than the water pipeline (the difference between top of the sewer and bottom of water pipeline should be at least 300 mm) • In unavoidable cases, where sewers are to be laid close to storm water drains, appropriate pipe material(that has no or least infiltration risk) shall be selected (stoneware pipes shall be avoided) • For shallower sewers and especially in narrow roads, use small inspection chambers in lieu of manholes; • Design manhole covers to withstand anticipated loads and ensure that the covers can be readily replaced if broken to minimize silt/garbage entry & would not cause any H&S impacts on road users • Ensure sufficient hydraulic capacity to accommodate peak flows and adequate slope in gravity mains to prevent buildup of solids and hydrogen sulfide generation	Contractor, PIU/PMC	Design/Pre-construction	Review of plan	Plan meeting the regulatory requirements	One-time

S. No.	Aspect	Mitigation measures	Responsibility	Implementation phase	Monitoring method	Monitoring indicator	Frequency
1.6	Climate risks in STP and sewerage network	Design shall consider climate risks on construction and operations of the networks and other facilities	Contractor, PIU/PMC	Design/Pre-construction	Review of plan	Plan meeting the regulatory requirements	One-time
1.7	Odour from Pumping Stations	<u>Layout planning related measures</u> • Siting of wells within the identified site at an internal location as far as possible from adjoining residential buildings; • Develop green buffer zone around the facilities with a combination of tall and densely growing trees, shrubs and herbs, in multi rows and creepers/climbers on compound walls or vertical gardens with sweet scented flowers as per the land availability to control odor and also act as visual shield, and improve aesthetical appearance; • Provision of high compound wall. <u>Design related measures to prevent and control odor from pumping/lifting station operations</u> • Proposed wells to be closed using RCC slabs. Design of RCC slab to consider both superimposed loads (human and equipment loads) and severe corrosion risk from sewer gas from within wells. • RCC Slab to be designed and fixed in a modular manner such that access to pumps / appurtenances and other equipment can be provided for maintenance /replacement /renewal purposes; • Since human intervention is involved and safety shall be primary and critical consideration, additional protection by way of a metalled grating / grill work shall be provided over the sections (or full cross section if required) where workers will stand / work for inspection and repair/O&M purposes; • Provision of passive gas ventilation arrangement by providing a take-off vent from top of well by	Contractor, PIU/PMC	Design/Pre-construction	Review of plan	Plan meeting the regulatory requirements	One-time

S. No.	Aspect	Mitigation measures	Responsibility	Implement ation phase	Monitoring method	Monitoring indicator	Freque ncy
		positioning vent in such a way that cover slab fitment/movement/drawal if required for maintenance purposes is not compromised. • Height of vent to be provided appropriately and a minimum 2 m above the lintel level (top level) of window(s)/passageways/doors in the nearby adjoining buildings. • Provision of odor control/mitigation system as per site conditions / requirements. Suitable granular activated carbon filter with bird-screen fitted at the vent outlet to control odor. Size of GAC (including material size) should be selected based on the vent diameter and expelled air flow rate expected; • In locations / cases where sewage flow in the present to intermediate design stage is envisaged to be low, position of the submersible pumps and design of the collection well floor by providing necessary side benching / sloped flooring to allow for higher submergence during low flow shall be made to ensure regular pump operation and avoid sewage stagnation beyond the permissible limit; • Diesel Generators shall be provided for all pump stations and in cases of lift stations with space for control room. In cases of lift manholes (road-side or road-center type structures with only provision of kerb-side kiosk), an electrical cut-out provision shall be made for connecting an Emergency Mobile / Skid Mounted Diesel Generator for pumping out during long period of electricity supply interruption; • Develop standard operating procedures/operational manual for operation and maintenance of lifting and pump stations; this shall include measures for emergency situations;					

S. No.	Aspect	Mitigation measures	Responsibility	Implementation phase	Monitoring method	Monitoring indicator	Frequency
1.8	Visual impacts	• Ensure that the design of the water pipeline causes no visual impact to the landscape, local scenery and sustain the aesthetic importance in project area; • Ensure construction of pipeline without obstruction to natural topography and flow of water into water bodies; • Maintain limit on the outdoor security lighting for unobtrusive sight to people; and • Make use of local material and appropriate construction techniques.	PIU/PMC, Contractor	Design and construction phase	Review detailed layout plan; and site inspection	Visual measures are addressed in layout plan; and No visual impact due to construction of structures at pumping house in project.	Monthly
1.9	Noise from Pumping operations	• Procure good quality latest technology high pressure pumps that guarantee controlled noise at a level of around 80dB(A) at a distance of 1 m • Use appropriate building materials and construction techniques for pump houses which can absorb sound rather than reflect noise • Use acoustic enclosures – manufacturer specified, for all pumps, motors • Procure only CPCB approved generators to meet air emission and noise level requirements • Provide sound mufflers for ventilators in the plant rooms; and sound proof doors • Provide ear plugs designated for noise reduction to workers • Plan green belts around all SPS, LS, STPs etc.	Contractor, PIU/PMC	Design/Pre-construction	Design review	Compliance with requirements	One-time
1.10	Energy efficiency in project	• Choice of pumps: Installation of VFDs at all pumping stations. • All equipment and apperturances to be certified and of good energy star ratings.	Contractor, PIU/PMC	Pre-construction phase	Review design and specifications		Onetime
1.11	Utility relocation	• Identify the common utilities to be affected such as telephone cables, electric cables, electric poles, water pipelines, public water taps, etc; and	PIU/PMC, Contractor/ Authority of	Pre-construction phase	Review detailed layout plan and site inspection	Utilities shifted in	Onetime

S. No.	Aspect	Mitigation measures	Responsibility	Implementation phase	Monitoring method	Monitoring indicator	Frequency
		• Seek prior approval and inform the concerned agencies for utilities shifting before construction starts.	concerned utilities			time where necessary	
1.12	Permits and approvals	• Obtain all permits and approvals required during pre-construction, construction, operation and decommissioning phases and follow permit conditions. • These shall be made available from the TNPCB, PWD, and other line departments like National/State highways, Traffic, Police, Telecom, Electricity, etc and regulators of the State and Central governments as applicable. • Obtain prior permission for tree cutting. • Ensure that all necessary approvals for construction to be obtained by contractor like labour licence / labour insurance are obtained before start of construction.	PIU/PMC, Contractor Contractor	Before construction commences	Keep record of all permit, approvals and authorizations	Permits and approvals are available	One to two times
1.13	Source of Materials	• Obtain construction materials only from government approved quarries with prior approval of PIU. • PIU to review, and ensure that proposed quarry sources have all necessary clearances/ permissions in place prior to approval. • Contractor to submit to PIU on a monthly basis documentation on material obtained from each sources (quarry/ borrow pit) • No new borrow areas, quarries etc., shall be developed for the project; if unavoidable, contractor to obtain all clearances and permissions as required under law, including environmental clearance prior to approval by Kancheepuram City Municipal Corporation and/or any authorities as required.	PIU/PMC, Contractor	Pre-Construction and Construction Phase	Records, approvals	Approvals available	Periodically
1.14	Material storage and	• Storing the pipeline fittings and associated materials;	Contractor/ PIU/ PMC	Pre-construction	Site inspection	Location and its	Semi-annually

S. No.	Aspect	Mitigation measures	Responsibility	Implement ation phase	Monitoring method	Monitoring indicator	Freque ncy
	portable office cabin	• Establish a suitable place for site camp at the start of the civil works, which will allow for site offices in portable cabin.				access; and Basic facilities and civic amenities.	
1.15	Labour accommoda tion and facilities	• Identify the suitable building in terms of location, sufficient area, access, security, basic amenities, etc. If labour camp is established, design and location shall be finalised in consultation with the Engineer and in line with regulations, prior to start of establishing the camp. • Follow all relevant provisions of the Contract Labour (Regulation and Abolition) Act, 1970, IFC guidelines, the Building and other Construction Workers (Regulation of Employment and Conditions of Service) Act,1996, ILO convention 62-Safety provisions (Building) Convention and applicable laws for rented labour accommodation; • The location, layout and basic facility provision for labour accommodation shall be reviewed by the Engineer/PIU/PMC and suggestions to be communicated to the contractor prior to the construction; • Maintain necessary living accommodation and ancillary facilities in functional, safe and hygienic conditions; accommodation & other facilities shall be appropriate for male and female workers also ensuring required privacy. • Provide drinking water, water for other uses, and sanitation facilities for employees, drinking water should be regularly tested to confirm that drinking water standards are met. • Provide adequate number of toilets, bathing area, kitchen, safe fuel/ LPG for cooking and uncontaminated water for drinking, cooking and	Contractor	During Pre-construction	Visual inspection; Consultations with labour, and local communities nearby; Site inspection; Facilities made available; Type of illness and its causes; and Discussions about the level of health awareness and safety precautions taken by the workers while working on the work site.	All the facilities available as per law and standards; Assess the satisfaction level of labourers; Cordial relation between labour and local communitie s; Easy access of first-aid box with required medicine and accessories at each working site, labour accommoda	Everyda y

S. No.	Aspect	Mitigation measures	Responsibility	Implement ation phase	Monitoring method	Monitoring indicator	Freque ncy
		washing; • Prohibit employees from cutting of trees for firewood; fire wood not allowed; • Labour accommodation and temporary rest areas near work sites shall provide protection from heat, rain, flooding, insects, snakes and mosquitoes. It should have adequate provisions for water, toilets, emergency such as fire safety, first aid, security, etc; • Adequate health care and periodic health check ups is to be provided for the workforce; • Ensure adequate water supply in all toilets and urinals; Provide separate toilets/ bathrooms for women laborers and shall be screened from those for men (marked in vernacular language). • Provide first aid medical kit at labour accommodation, temporary labour shed and working site; train the labour for usage of items in injury, emergency, coordinate with nearest government and private medical centers for the medical services, display the contact number of medical doctor(s) and keep a vehicle for emergency travel all the time; Labourers shall be trained on emergency medical response • Separate the workers living areas and material storage areas clearly with appropriate fencing and separate entry and exit. • Camp shall be provided with proper drainage, there shall not be any water accumulation. • As per provisions of WHO and MOHFW guidelines of Covid-19, sanitizer, soap, mask, etc. should be made available in sufficient quantity and its use by the workers mandatorily and maintain social distancing all the time; • SWM shall follow segregated storage, collection, Transport, Treatment and Disposal in lie with SWM				tion, labour and office to workers all the time; and Arrangeme nt made with the Doctors at the nearest government health and medical center/ private clinic.	

S. No.	Aspect	Mitigation measures	Responsibility	Implement ation phase	Monitoring method	Monitoring indicator	Freque ncy
		Rules, 2016. The contractor shall provide garbage bins (separate for wet and dry wastes) in the camps and ensure that these are regularly emptied and disposed off in ULB SWM facilities in co-ordination with the PMC/PIU. NO wastes shall be thrown around / dumped. If required bin composting may be well maintained in the camp & recyclables taken to nearby MCF/MRF • Ensure medical tests and treatment of Covid-19 positive cases and other infectious diseases immediately; and • Maintain the required data and documents at site and regularly submit the compliance report to the PIU. • Remove all wreckage, rubbish, or temporary structures which are no longer required. • At the completion of work, camp area shall be cleaned and restored to pre-project conditions, and submit report to PIU, PIU to review and approve camp clearance and closure of work site.					
1.16	Public disclosure	• Ensure timely and fully project information dissemination through distribution of prior notice, pamphlet in local language, oral communication, meetings, websites, etc.	PIU/PMC, Contractor	Pre-construction phase	Consultation with potential temporary economic impacts and other stakeholders	Methods used for public disclosure; and Project awareness.	Onetime
1.17	Grievances redressal system	• Establish the efficient grievance redressal mechanism and accordingly constitute the grievance redressal committee (GRC) as outlined in the ESIA project level with representatives of all the stakeholders as members, including women and vulnerable groups of local communities; • Ensure the wider publicity of procedure, functioning and availability of GRC since the	PIU /PMC, Contractor	Project life cycle	Review the proceeding and minutes of meetings; and Consultations with the members of GRC.	GRC established; GRC meetings held; Number of cases	Monthly or as required

S. No.	Aspect	Mitigation measures	Responsibility	Implement ation phase	Monitoring method	Monitoring indicator	Frequency
		inception of the project; • All the grievances received shall be acknowledged and proper recording and tracking should be carried out; • GRC will adjudicate the complaints in 6-8 weeks depending upon the severity of case; • Convenor will be the coordinator for organizing GRC meetings as required, writing the proceedings, minutes of meeting, informing the aggrieved party about the decision of GRC, etc;				received and resolved; Decision taken within a timeframe; and Court case filed or withdrawn.	
1.18	Sensitive Areas	The sensitive areas like Schools, hospitals, religious places and others to be provided with suitable noise barriers and safety measures, prior to the start of work in order to minimize the dust and noise impacts due to vehicle movement during construction and their effectiveness to be checked.	PIU/PMC, Contractor	Pre-construction phase	Site inspection	Location and its access; and Basic facilities and civic amenities.	Periodically
• **Construction and operation phases:** All National State regulations and guidances applicable shall be followed Irrespective of the contents of this ESMP							
2.1	Labour mobilization	• Obtain site management and labour plan approval from the Convenor; and • Accordingly, mobilize the labour on worksite for the laying of sewer line, machine hole, chambers and construction of pumping stations, lift stations and control rooms if any. • Contractor shall prepare a Labour Management Plan which shall be reviewed by the Engineer in-charge of PIU and approved.	Contractor, PMC/PIU	Construction phase	Review site management and labour plan; and Site inspection	Number and date of labour mobilization; and Date of starting works.	Periodically
2.2	Appointment and Mobilizatio	• The contractor will appoint qualified and experienced Environment, Health & Safety Officer (ESHO), who will be mobilized prior to start of	Contractor	Pre-Construction Phase	Review reports and records	Compliance at site to all ESHS	One time

S. No.	Aspect	Mitigation measures	Responsibility	Implementation phase	Monitoring method	Monitoring indicator	Frequency
	n of Environment , Health & Safety Officer	works. • Appointment and availability of EHSO through-out the project cycle to ensure ESMP implementation. • EHSO will dedicatedly work and ensure implementation of Environmental Management Plan including Occupational, Health and Safety measures during the project implementation.		Project Cycle		requirements	
2.3	Submission of updated environmental & social management plan (ESMP)/ ESMP implementation and reporting	Contractor shall prepare contract -specific and site specific ESMP as below • Submission of updated ESMP to the PIU/PMC prior to start of construction. • For sites near parks, schools etc, location wise Occupational Health & Safety, Community Health & Safety plans shall be prepared by the contractor as part of the updated ESMP • Site specific Hazards may be identified prior to start of works shall be done and be included in the updated ESMP • Contractor shall prepare SEP, LMP, Waste Management Plan including Sludge Management Plan as required. • The Updated ESMP shall also cover the proposed trainings, green belt for all facilities, work permit for all hazardous works including excavations and work underwater and others; including lighting, type of PPEs & hazard assessment, work in confined spaces, work on heights, trench/ excavated area management, lighting, restoration of roads after laying pipes, flag men, and lighting for large equipment's, works under / near water. • All workers staff to be trained; OHS during emergencies, heat waves. • Timely submission of monthly monitoring reports including documentary evidence on ESMP implementation such as photographs.	Contactor	Project cycle	Review of reports and records	Compliance at the site	One-time / As and when need arises

S. No.	Aspect	Mitigation measures	Responsibility	Implementation phase	Monitoring method	Monitoring indicator	Frequency
2.4.	Site clearance Tree cutting	• Identify the number of trees that will be affected with girth size and species type. Avoid tree cutting and loss of vegetation, shrubs, grasses, etc. to the maximum extent possible; • Trees where necessary shall be removed from the construction site before commencement of construction with prior permission from the concern department and other authority as applicable; • Compensatory plantation for every tree cut by way of re-plantation at ten times the trees cut; • Growth and survival of trees planted shall be ensured and monitoring should be conducted at least for 3 years. Survival rate of plants shall be reported to the PIU/PMC on monthly basis; • Contractor shall develop plantation program for the site; • Greenbelt will be developed around the site.	Contractor, PIU/PMC	Construction phase	Review site management and labour plan; and Site Inspection.	No tree cutting Minimum vegetation loss; Number and species of trees cut and replanted; and Survival of number and species of trees planted.	Monthly
2.5.	Site preparation	• Disturbance to land surface contours to be kept to minimum; • Maintain the natural drainage pattern existing onsite; • Adequate drains and slopes to be laid across the proposed project site prior to start of excavation work to ensure adequate cross drainage; and • Ensure that the earmarked operational area for laying of pipeline and pumping house is barricaded with hard barricades to prevent any fall; specific access (entry and exit) points. • Barricading of the earmarked sites, besides the safety, will limit the disturbances or construction impacts to the adjacent areas within the premises. • Necessary precautions such as bracing / shoring in the trench will be provided for trenches of more than 1.2 m deep or as required based on site	Contractor, PIU/PMC	Beginning of construction	Site inspection	Natural drainage maintained; and Minimum excavation for drainage and levelling	One time and periodically

S. No.	Aspect	Mitigation measures	Responsibility	Implementation phase	Monitoring method	Monitoring indicator	Frequency
		conditions.					
2.6	Site Camp	• Locate the suitable place for site camp at the start of civil works for the labours constructing sewer line/ pumping station at a place approved by the PIU; • Provide water and/or other facilities at the site camp; • Establish a suitable site office in portable cabin at the start of the civil works in the land provided at pumping station; and • Designate the area beyond the boundary of the site as No-Go areas for all personnel on site. • No vehicles, machinery, materials and people shall be permitted in the No-Go area at any time without the permission. • Register on entrants shall be maintained by the security personnel	Contractor, PIU/PMC	Prior to start of construction	Review approved site camp and site office layout; and Site inspection	Approved site plan layout; and Area outside the site camp and site office designated as No-go area.	Once
2.7	Barricading working site	• Ensure that the construction site should be barricaded at all time with adequate marking, flags, reflectors etc. to isolate it from other operating areas; and • Barricade the sewer pipeline route and identified construction sites prior to construction activities.	Contractor	Prior to start of construction	Site inspection	Proper barricading in place; and Accident or casualty reported	Onetime
2.8	Stakeholder consultations	• Undertake detailed mapping and analysis of key stakeholders. Based on the stakeholder analysis, stakeholder engagement plan is prepared that will be updated as required; • Ensure that stakeholder including impacted persons are consulted and made aware about the project's purpose, risks/ impacts, mitigation measures and time- frame; and • Maintain the records and documentation of the procedure followed and the output of stakeholder engagement.	Contractor/ PIU/PMC	Construction phase	Consultations with local communities, beneficiaries, potential temporary economic impacts and other stakeholders	Awareness level of stakeholders, particularly the local communities, beneficiaries of the proposed water	Regularly

S. No.	Aspect	Mitigation measures	Responsibility	Implement ation phase	Monitoring method	Monitoring indicator	Freque ncy
						supply; and Perception of local communities, POTENTIAL TEMPORARY ECONOMIC IMPACTSs about the project and its impact and mitigation measures.	
2.9	Traffic managemen t	• Route for use by construction traffic within site to be planned with proper signage, flagman, barriers and safety to minimize encountering of workers with vehicles as per National Road Safety Policy 2010. • Route for movement of heavy machinery shall be designated to avoid the soil compaction in other areas; • All vehicles deployed at site shall be certified for pollution under control (PUC), undertake regular maintenance of vehicles; • Transportation of construction material shall be generally scheduled in during non-peak hours; • Locate entry and exit points in areas where there is low potential for traffic congestion. • Holding area shall be provided within the site for vehicles waiting to deliver loads at site to avoid queuing outside the site; • Ensure that the vehicles follow speed norms of the traffic department; and	Contractor, PIU/PMC	Constructio n phases	Review traffic management plan; and Site inspection	Implementa tion of traffic manageme nt plan adequately; Number of complaints received; and Incidence of accidents	

S. No.	Aspect	Mitigation measures	Responsibility	Implementation phase	Monitoring method	Monitoring indicator	Frequency
		• Investigate and respond to complaints about traffic.					
2.10	Accessibility to adjacent landuses	• Leave spaces for access between mounds of soil or material or wok areas to maintain access to the houses / properties. Access to any house or property shall not be blocked completely; safe alternative arrangements, at least to maintain pedestrian access at all times to be provided Provide pedestrian access in all the locations; provide wooden/metal planks with safety rails over the open trenches at each house to maintain the safe access. • Inform the affected local population about the work schedule a week before, and a day before to start of work • Plan and execute the work in such a way that the period of disturbance/ loss of access is minimum. • Keep the site free from all unnecessary obstructions; • Notify affected public-by-public information notices, providing signboards informing nature and duration of construction works and contact numbers for concerns/complaints. • At work site, public information/caution boards shall be provided including contact for public complaints	Contractor, PIU/PMC	Construction phases	Site Inspection	Number of grievances received	Periodically
2.11	Construction material and machinery	• Modern machineries such as JCBs, poclain, roadroller, etc. shall be used to increase work efficiency and minimize the construction period; • During the operation of all such heavy vehicles, equipments and machinery at ay point, adequate safeguards shall be taken to ensure safety of workers and communities; including providing trained flag men with whistles, flags/barricades, lighting etc as appropriate. Drivers shall have vald licence for such operations and shall not be under intoxication	Contractor, PIU/PMC	Construction phase	Review the material procurement detail; and Site inspection	Noise level and working of heavy machineries in order; and Construction material and its transportatio	

S. No.	Aspect	Mitigation measures	Responsibility	Implementation phase	Monitoring method	Monitoring indicator	Frequency
		• Ensure that material transported is properly covered with Tarpaulin, and sprinkled with water to reduce dust emissions and other appropriate measures. • Schedule material deliveries after daylight hours; • Identify and repair minor leaks and prevent machineries/equipment failures.				n follow the norms.	
2.12	Construction material storage Construction works (concrete, Cement, etc.)	• Ready mix concrete (RMC) will be outsourced and contractor shall identify designated covered area for storage of construction material such as pipeline fittings, etc. with proper marking and measures to avoid dust emissions; • Construction material stored in open shall be covered in order to avoid wind-blown dust emissions; • Ensure and maintain record of proper stacking, loading and unloading of material and provide sufficient space for the movement of heavy vehicles inside the yard; • Ensure handling the construction material safely by the labour; • Use ready-mix concrete outsourced for the works on pumping station and lift station site and construction of machine holes and chambers to the maximum extent possible • If required, ensure that cement is mixed on mortar boards or appropriate surfaces and not directly on the ground.	Contractor, PIU/PMC	Construction phase	Site inspection; and Review the material record maintained.	Clean and organized storage site; and Incidence of injury in loading, unloading and handling the material. Visible concrete on site; and Contamination of water and soil.	Periodically
2.13	Top soil protection	• Topsoil removed prior to commencement of construction activities shall be stored (stockpile no higher than 2 meter) safely and separately without slippage or flow, and reused for backfilling and landscape development within the project area; • Keep topsoil stockpiles in an area protected from the wind and water;	Contractor, PIU/PMC	Construction phase	Site inspection; and Assessment of disturbed (project components construction area)	Incidence of erosion; Storage and uses of top soil; and	Regularly

S. No.	Aspect	Mitigation measures	Responsibility	Implementation phase	Monitoring method	Monitoring indicator	Frequency
		• Land disturbance shall be restricted to the footprint of the project components and remaining area will be kept undisturbed to the extent possible; • Ensure suitable control of run-off during the construction phase to prevent erosion of topsoil on adjacent land and undeveloped portions of the site; and • All excavations should be closed safely at the earliest before the start of rainy season.			and undisturbed area.	Topsoil erosion on adjacent land.	
2.14	Noise from vehicles and machineries	• Servicing of all vehicles, machinery, power generating equipment shall be done regularly as per the manufacturer's guidelines and during routine servicing operations, the effectiveness of exhaust silencers will be checked and if found defective will be replaced; • All machines to be used shall conform to the relevant Indian Standards (IS), will be free from patent defect, kept in good working order, properly maintained and inspected regularly; • Acoustic enclosure measures will be provided during operation to reduce noise level of DG set; • Minimize noise from construction equipment by using vehicle silencers, fitting jackhammers with noise-reducing mufflers, and use portable street barriers to minimise sound impact to surrounding sensitive receptor; • Construction activities shall be carried out in a planned manner restricting high noise generating construction activities only during daytime; • Consult local communities in advance of the work to identify and address key issues, and avoid working at sensitive times, such as religious and cultural festivals. • Contractor will maintain the proper record for all the construction vehicles which shall have the valid	Contractor, PIU/PMC	Construction phases	Review of monitoring records Random Noise measurements	Level of noise generated; and Number of registered complaints	Regularly

S. No.	Aspect	Mitigation measures	Responsibility	Implementation phase	Monitoring method	Monitoring indicator	Frequency
		fitness certificate, NOC, insurance, etc. • Maintain maximum sound levels not exceeding 70 decibels (dBA) when measured at a distance of 10 m or more from the vehicle/s. • Regular monitoring of noise shall be conducted at site during the operations of machines and equipment; and • Technicians/mechanics/workers working on noise generating machineries will use PPEs such as ear plug, muffler, etc.					
2.15	Dust emissions	• Immediately consolidate the backfilled soil and restore the road surface, this will also avoid any business loss due to dust and access inconvenience of construction work. • Employ best construction practices, speed up construction work with better equipment, increase workforce, etc., in the areas with predominantly commercial, and with sensitive landuses like hospitals, and schools. • Consult businesses and institutions regarding operating hours and factoring this in work schedules. • Provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints. • Avoid clearing of vegetation until absolutely necessary; • Trucks carrying construction material shall be adequately covered with tarpaulin sheet to avoid the dust pollution and the material spillage; • DG set shall have permits & adequate stack height as per TNPCB requirement; • Dust levels will be controlled, through spraying of water from water tankers fitted with pressurized fine spray;	Contractor	Construction phase	Site inspection; Incidence of dust plumes; and Review of dust emission control measures.	Emission from construction site; Incidence of dust plumes observed; Dust mitigation measures followed; and Number of complaints received.	Regularly

S. No.	Aspect	Mitigation measures	Responsibility	Implementation phase	Monitoring method	Monitoring indicator	Frequency
		• Maintain all generators, vehicles, vessels and other equipment in good working order to minimise exhaust fumes; and • Locate soil stockpiles in sheltered areas where they are not exposed to the erosive effects of wind.					
2.16	Air quality	• Provide a dust screen (6 m high) around the construction sites of pumping and lifting stations, provide 2 m high barricades for the sewer works. • Damp down the soil and any stockpiled material on site by water sprinkling. (water sprinkled 3-4 times a day - before the start of work, 1-2 times in between, and at the end of the day). when working in the roads there should permanently be one person responsible for directing when water sprinkling needs to take place to stop the dust moving • Water sprinkling, cover dumping and stockpiles of lose material with plastic sheets or nets, particularly in windy conditions should be used to reduce airborne dust at construction sites; and • Control dust generation while unloading the loose material (particularly aggregate, sand, soil) at the site by sprinkling water and unloading inside the barricaded area; minimize the drop height when moving the excavated soil • Clean wheels and undercarriage of haul trucks prior to leaving construction site • Ensure that all the construction equipment, machinery is fitted with pollution control devises, which are operating correctly, and have a valid pollution under control (PUC) certificate. • No vehicles or plant to be left idling at site; generators to be at placed maximum distance from properties • Maintain all vehicles, DG sets/generators and	Contractor	Construction phases	Site inspection; Incidence of air pollution; and Review of fuel emission control measures.	Fuel emission from vehicles; Air pollution mitigation measures followed; and Number of complaints received.	Regularly

S. No.	Aspect	Mitigation measures	Responsibility	Implementation phase	Monitoring method	Monitoring indicator	Frequency
		other equipment in good working condition to minimise GHG emission, exhaust fumes, etc.; • Avoid excavation, handling and transport of materials which may generate dust under high wind conditions or when a visible dust plume is present; • Prevent burning, fire, use of wood for cooking in the project sites to avoid air contamination.					
2.17	Measures of handling existing Asbestos Cement pipes	Contractor shall ensure that the existing asbestos cement pipes are not disturbed during construction. In case any need arises during construction, • Asbestos management plan shall be prepared by the contractor in line with the Hazardous wastes management rules, 2016 and got approved from PIU. • Labourers shall be made fully aware of the risks involved and be provided training to handle hazardous wastes.	Contractor, PIU/PMC	Construction phases	Site inspection; Review of measures and records	Incidence of damage to AC pipes	Regularly
2.18	Underground water	• Contractor shall ensure that all vehicle/machinery and equipment operation, maintenance and refueling will be carried out in such a manner that spillage of fuels and lubricants will not contaminate the ground water. • Workforce will be trained about environmental pollution aspect and activities should stop immediately and resume only when problem is resolved; and • Faulty equipment, vehicles and other source of possible oil and lubricant contamination should be repaired on priority and must be kept in good condition all the time.	Contractor	Construction &operation phases	Site inspection; and Review of spillage control measures.	Fuel or lubricant spillage; and Underground water pollution mitigation measures followed.	Regularly
2.19	Protection of lakes/ waterbodies/	• Contractor shall ensure that all vehicle/machinery and equipment operation, maintenance and refueling will be carried out in such a manner that spillage of fuels and lubricants will not contaminate	Contractor	Construction phases	Site inspection; and Review of spillage control measures.	Fuel or lubricant spillage; and	Regularly

S. No.	Aspect	Mitigation measures	Responsibility	Implementation phase	Monitoring method	Monitoring indicator	Frequency
	Surface water quality	the waterbodies and construction of pipe carrying bridges across the rivers/ waterbodies; • Storage of fuel and lubricants shall be away from waterbodies. • Store fuel, construction chemicals etc., on an impervious floor, also avoid spillage by careful handling; provide spill collection sets for effective spill management, training shall be provided to workers on this • Avoid stockpiling of earth fill especially during the monsoon season unless covered by tarpaulins or plastic sheets; • Waterbodies need to be cordoned off by using protective barriers such as green cloth and subsequently plantation; and • Install temporary silt traps, oil traps, or sedimentation basins along the water leading to the water bodies; • Dispose any wastes generated by construction activities in designated sites; • Construction works shall be restricted during the monsoon seasons. • Conduct surface quality inspection as per the Environmental Monitoring Plan • In case of waterlogging, water will be pumped out during the construction of pipelines.				Changes in water quality water pollution mitigation measures followed.	
2.20	Measures for pipe carrying bridges	Following measures shall be ensured to prevent any impact on the surface water quality during construction of pipe carrying bridges. • The pipe carrying bridges shall be constructed during non-monsoon period.	Contractor	Construction phase	Site inspection; and Review of measures.	Changes in water quality Water pollution mitigation measures followed.	Regularly

S. No.	Aspect	Mitigation measures	Responsibility	Implement ation phase	Monitoring method	Monitoring indicator	Freque ncy
		● Adequate care shall be taken to avoid deposition/ disposal of construction waste / accidental spillage of construction material into the river. ● While laying the foundation for piers, coffer dam shall be constructed for each pier foundation in order to provide water free regime for speedy construction of piers for pipe carrying bridge. ● Supporting piers for pipe carrying bridge shall be designed not to obstruct the flow. ● Foundation of pillars shall not be above the bed level. ● Personal protective equipments shall be ensured to the labourers and supervising officials. ● Labourers shall be provided with periodical training on emergency preparedness. ● On completion of pier construction, coffer dam shall be removed and river bed shall be restored to its original condition. Permission shall be obtained from PWD for construction of PCBs and conditions stipulated therein shall be complied with during construction.					
2.21	Protection of archaeologi cal and heritage	Any work involving ground disturbance can uncover and damage archaeological and historical remains. For this project, excavation will occur in project sites for foundations, laying pipelines, and for construction of MPS. There are seven protected monuments within core area of the project town. The proposed project located in added areas does not have any of the project sites or alignment falling within the regulated boundary of the monuments. However, There are several temples and	Contractor, PIU /PMC	Constructio n phases	Site inspection; and Actions taken by the workers, PIU and ASI.	Discovery of archaeologic al/ paleontologi cal material; Level of awareness among workers;	When occurren ce of chance finding

S. No.	Aspect	Mitigation measures	Responsibility	Implement ation phase	Monitoring method	Monitoring indicator	Freque ncy
		other religious sites in the project area and hence adequate precautions are to be taken during construction not to disturb them. Further, in case chance finds are recognized during excavation, all necessary measures are to be taken to ensure they are protected and conserved. Construction contractors follow these measures in conducting any excavation work. • Conduct training to impart knowledge and create awareness among the workers, supervisors and engineers about the significance of archaeological, paleontological and geological aspects and the applicable AMASR 2010 and Indian Treasure Trove Act, 1878 and chance found during excavation work. • The fossils, coins, articles of value of antiquity, human skeletal and other remains or things might be exposed during construction activities. In such situation, stop the work, do not remove and damage any article • Stop work immediately to allow further investigation if any finds are suspected and take any action they require to ensure its removal or protection in situ. • Inform the concerned authority (Archaeological Survey of India) immediately to take-action per referred Act and recommence the work after receiving written permission; and Also, prevent any type of impact on the cultural heritage, monument, etc. • Appropriate chance Find Procedures shall be also applied in agreement with concerned authorities to chance found flora & fauna				and Protection and reporting of identified material when discovered.	
2.22	Safety of workforce	• Every new job, site work shall start with Hazard Assessment by the ESHO and the Engineer/PIU/PMC • Special care shall be taken for all laying,	Contractor, PIU/PMC	Constructio n phases	Site inspection; and Observation of workers with PPE and safety	Quantity and timely supply of PPEs;	Everyda y

S. No.	Aspect	Mitigation measures	Responsibility	Implementation phase	Monitoring method	Monitoring indicator	Frequency
		maintenance works on sewers in line with applicable regulations and guidelines on Manual Scavenging as applicable to Project components. The SOPs that would developed by the Project fully in line with the existing regulations and guidance shall be followed by the Contractors • Adequate precautions shall be taken to prevent the accidents from the work or machineries. All machines shall confirm to the relevant Indian Standards Code and shall be regularly inspected for its working condition; • Provide H&S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injuring to fellow workers. • Where loose soil is met with, shoring and strutting shall be provided to avoid collapse of soil. • Provide job specific safety induction training, including environmental awareness and ensure daily toolbox talk to workers at the working area; • Ensure availability and mandatory use of PPEs at the site; • Use of protective footwear and protective goggles by the workers involved in mixing of materials like cement, concrete etc. at sites; • Use of earplugs by the workers exposed to loud noise, and those engaged in crushing, compaction, concrete mixing operations; • Ensure sufficient quantity of all PPEs, necessary safety appliances such as safety goggles, helmets, boots, safety belts, ear plugs, mask, etc. to workers and staffs; • Disallow worker exposure to noise level greater than 85 dBA for duration of more than 8 hours per			measures while working on work site.	Awareness level about the use of PPEs; and Incidence of injury, accident, infirmity.	

S. No.	Aspect	Mitigation measures	Responsibility	Implementation phase	Monitoring method	Monitoring indicator	Frequency
		day without hearing protection. The use of hearing protection shall be enforced actively. • For workers working at elevated levels (@6 feet/1.8m), ensure adequate fall protection system like guardrails, equipments including safety harness, safety nets etc and safe working platform are provided. • Adequate measures and care to be taken while approaching any open water bodies for construction of bridges or any other works. Ensure railing around such sites are intact and in good condition; and adequate PPEs and control measures shall be ensured in addition to floats & harnesses • The contractor will comply with all the precautions as required for ensuring the safety of the workmen as per the International Labor Organization (ILO) and applicable laws of India and Tamil Nadu state as applicable.					
2.23	Work-zone safety Management	• All work spaces shall have adequate lighting at all times of day and night, watch and ward as required, and hard barricading with reflectors. • All opened trenches shall be closed once work is over at the place, temporarily (but safely) or permanently and awareness boards that such an opening & work site exist shall be provided at least 200m on all sides of such trench. • Temporary barricades shall be provided to delineate construction zone as well material stacking areas. The construction site and the labour facility shall be appropriately barricaded to prevent entry and accidental tress-passing of workers, staff and others into the construction sites. • Ensure adequate fall protection system like guardrails, safety nets etc and safe working platform are provided.	Contractor, PIU/PMC	Construction phase	Site inspection Incident Reporting	Availability of safety measures Absence of safety Incidents	Everyday As and when occurs

S. No.	Aspect	Mitigation measures	Responsibility	Implement ation phase	Monitoring method	Monitoring indicator	Freque ncy
		• All operational areas shall be access controlled. Watch and ward facilities at all times shall be provided by the contractor. • Adequate signages shall be provided indicating the work and type of precautions required which are easily understood by workers, visitors, and the general public as appropriate. • Mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Al signoards shall be well lit at all times • Proper retro reflective warning signage will be installed on the access road next to the construction site about movement of construction machinery and vehicles. • In excavations for longitudinal surface road drains, culverts etc., a high visibility warning and retro reflective signage shall be displayed in vermicular language and English. • Entry of unauthorized persons should be prevented. • Excavations will be adequately barricaded and well lit – with signages/info boards. • There shall be adequate lighting arrangement at night and adequate barricading to prevent mishaps after construction activity ceases for the day. • Provide temporary traffic control (e.g. flagmen) and signs where necessary to improve safety and smooth traffic flow. • Minimize the duration of time when the sewer trench is left open through careful planning; plan the work properly from excavation to refilling and road relaying. • At sensitive locations particularly where there are					

S. No.	Aspect	Mitigation measures	Responsibility	Implement ation phase	Monitoring method	Monitoring indicator	Freque ncy
		schools and markets close to the road, awareness of safety issues will be raised through neighborhood awareness meetings • All drivers and equipment operators will undergo safety training. • Maintain regularly the construction equipment and vehicles; use manufacturer-approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure. • A readily available first aid unit with necessary supplies, first aid kit. drinking water, resting shed, sanitation etc shall be made available in every work zone. • Documentation of work-related accidents, proper maintenance of record and reporting.					
2.24	Removal of rock during excavation Controlled Blasting	• During excavation for works, wherever removal of rock is identified, alternatives like drilling and chiselling, controlled blasting etc will be examined and the suitable technology shall be finalised depending upon the site conditions. Following measures for ensuring safety shall be ensured during controlled blasting. • Carryout controlled blasting with all safeguard in consultation with PIU and other relevant authorities so that blasting activities with the least potential to generate impacts are conducted during periods of the day which will result in least disturbance; especially near schools and other sensitive receptors. • Permission shall be obtained from The District Collector for controlled blasting for excavation. Conditions stipulated in the permission issued by the District Collector shall be complied with during implementation. • The contractor shall submit a blasting plan in	Contractor, PIU/PMC	Constructio n phase			

S. No.	Aspect	Mitigation measures	Responsibility	Implement ation phase	Monitoring method	Monitoring indicator	Freque ncy
		advance to PIU; and implement in accordance to the plan. • An emergency response system shall be developed at the site level to address the situations emerging due to accidents or any other unfortunate incidents pertaining to human and structure safety. Training related to controlled blasting activity will be included in the overall safeguards training programme meant for PIU and Contractor. • For the diversion of traffic in the blasting area, the contractor shall prepare a traffic management plan and obtain permission from KCMC and traffic police. • Blasting shall be done through a licensed Explosive Contractor only • For controlled blasting, explosives including blasting caps shall be transported to the blasting site only through exclusive vehicle in safe manner in accordance with the requirements of the blasting license. After blasting is over, the balance explosives shall be returned to the licensed storage. • Cost for implementation of mitigation measures and liability are the responsibility of contractor. • Proper prior notice will be issued to the Residents before Commencing project activity works Schedule • Proper information will be Given to Police Officials • Workers (Flagman) shall be stationed on both end of roads to warn people before firing any blasts and not to permit the traffic. • When blasting, ample warning shall be given to all persons within the vicinity prior to blasting. Warning signs shall be erected a minimum of 24 hours prior to the blast time. The warning signs will state the time and date of each blast.					

S. No.	Aspect	Mitigation measures	Responsibility	Implement ation phase	Monitoring method	Monitoring indicator	Freque ncy
		• Contractor shall ensure necessary precautions / protection (like excavated earth, sand-filled bags, etc) to reduce noise levels, etc., Sites shall be provided with necessary shields all around. • Minimum Explosive will be used for Control Blasting for Residential areas • After a blast has been fired, the Blast Control Specialist shall make a careful inspection to determine that all charges have exploded before employees are allowed to return to the operation. • The contractor shall be responsible for any and all damage to property or injury to persons resulting from blasting or accidental or premature explosions that may occur in connection with his use of explosives. • Ensure to conduct a pre-blasting survey through videography and photography of residential properties and other structures falling along the sewerage alignment to ascertain the d prevailing conditions of the structures likely to be impacted by the controlled blasting and take adequate measures to minimize such impacts.					
2.25.	Exposure to electrical equipment Electrical Safety	• The Contractor shall take all required precautions to prevent danger from electrical equipment at all work areas and pumping room, etc. and ensure that: • No material will be so stacked or placed as to cause danger or inconvenience to any person or the public; • All necessary fencing and lights will be provided in construction area; • Deactivation and proper grounding of live power equipment and distribution lines to be ensured before initiating work; • All energized electrical devices to be marked with	Contractor, PIU/PMC	Constructio n phase	Site inspection; Observation of power supply system; and Electricity safety precaution taken by workers while working on work site.	Incidence of current shock, injury, electrocution	Daily

S. No.	Aspect	Mitigation measures	Responsibility	Implement ation phase	Monitoring method	Monitoring indicator	Freque ncy
		warning signs. Use the symbol of danger as warning of high electricity voltage or current flow on cable boxes or where required to avoid any incidence of current shock or electrocution; and • Provision of specialized electrical safety training to those workers working with or around exposed components of electric circuits. • Appropriate PPEs shall be used					
2.26.	Fire Safety	• Ensure that no fires are permitted on or adjacent to site; • Ensure that no smoking is permitted on the working site; • Ensure that sufficient and certified firefighting equipment are placed and maintained on the site; • Equip all fuel stores and waste storage areas with fire extinguishers; • Ensure that all workforce and staff on site are aware of the location of firefighting equipment on the site; and • Conduct training program on use of extinguishers, sand, etc for fire-fighting and ensure that they are trained in its operations.	Contractor	Project life cycle	Inspect Attendance register for fire fighting training conducted; and Observation of fire extinguishers and certificate at the sites.	Number of Fire incidents; Certified extinguisher s in appropriate locations; and Workers knowledge to operate the fire extinguisher	When required
2.27	Emergency response to manage floods, cyclone and other disaster conditions	• Contractor shall ensure efficient communication system in place which will be required during occurrence of any natural hazard; • Evacuation plan shall be in place for the site; • Evacuation plan or route is displayed clearly through signs or picture at prominent places within the sites; • Ensure effective coordination within the workforce and concerned departments and display contact number of concerned persons at prominent places; and	Contractor, PIU/PMC	Project life cycle	Inspect attendance register for training program; and Inspect fire extinguishers and certificate	DMP in place; Communica tion system inexistence; Display of evacuation route; Capacity of workers to	When required

S. No.	Aspect	Mitigation measures	Responsibility	Implementation phase	Monitoring method	Monitoring indicator	Frequency
		• Conduct training program and mock drills to workers to deal with the disaster situations due to occurrence of floods, cyclones and tsunami. • All safeguards for floods, heat wave shall be taken in line with the Guidelines of Disaster Management Authorities / other departments • Materials, fuels, chemicals etc shall be stored appropriately to avid impacts of disasters and SOPs for managing emergencues shall be followed as required • All workers shall be trained on ERP				manage; and Disaster and emergency situations	
2.28	Waste and Sludge management	• The contractor shall prepare a waste and sludge management plan which shall include Construction & Demolition (C&D) wastes, hazardous wastes, ewastes, plastic wastes etc during construction and sludge handling from STP, hazardous wastes (including existing asbestots), oil, e-wastes, chemical wastes, batteries if any from O&M of both STP and network, as required for the project activities. Effective mechanisms to dry and treat sludge shall be adopted in line with regulations and the program requirements / supported studies and be ensured that the Contractor's Sludge management will be in a manner not to cause any harm to health or environment. • The WMP shall cover liquid and solid waste management at the STP and ancillary facilities, in all the worksites, material yards, labour camps etc., • The waste management plan shall be prepared by the contractor and be reviewed and approved by the PIU prior to start of construction. • The plan shall be in compliance with the requirements of the respective C&D wastes/ E-waste/Hazardous wastes management rules. • The STP contractor to include measures for	Contractor, PIU/PMC	Project Cycle	Site Inspection; Review of waste management plan; disposal registers	No complaints in wastes handling, Compliance to regulatory requirements	Periodical

S. No.	Aspect	Mitigation measures	Responsibility	Implementation phase	Monitoring method	Monitoring indicator	Frequency
		managing waste various stages including for the O&M stage.					
2.29	Demolition of existing structures from project sites (if required)	• Prior to carrying out any building demolition, detailed building appraisal by means of surveys and appropriate assessments shall be carried out. • Hoarding and covered walkway is to be provided for protection of the public during the demolition of buildings since hoarding isolates the demolition site from the public, thus preventing unauthorized access and trespassing. • Metal scaffolds shall be used for top down demolition. Both bamboo scaffolds and metal scaffolds are considered acceptable provided that they are erected according to the Construction Sites (Safety) Regulations and the codes of practices on scaffolding safety. • Concrete breaking, handling of debris and hauling process are main sources of dust from building demolition. Dust mitigation measures complying with the Air Pollution Control (Construction Dust) Regulations shall be adopted to minimize dust emissions. • Silent type power mechanical equipment shall be used to reduce noise impact as much as practicable or possibilities of engaging man power with light dismantling tools with PPE are studied and engaged. • Debris waste and other materials shall not be thrown, tipped or shot down from a height where they are liable to cause injury to any person on or near the site. • Disposal of debris has to be controlled and to be reused in filling of low ground depending on the quality and if permitted from local authority. C&D wastes shall be sent to C&D recycling facility in the vicinity. Wasted reinforcement will be handled as	Contractor, PIU/PMC	Construction phases	Site Inspection; Review of waste management plan; disposal registers	Air quality, noise level;	When required

S. No.	Aspect	Mitigation measures	Responsibility	Implement ation phase	Monitoring method	Monitoring indicator	Freque ncy
		per the departmental procedure.					
Social aspect							
2.30	Compensati on and Assistances to potential temporary economic impacts	• Provide compensation and assistance to potential temporary economic impacts; • Employ people of local communities for project works with a priority to potential temporary economic impacts based on their skills; • Employ the potential temporary economic impacts, particularly willing women on priority in project related unskilled, semi-skilled and skilled works as applicable;	Contractor, PIU/PMC	Constructio n Phase	Verify the disbursement of compensation and assistance; and Conduct consultations with local communities	Potential temporary economic impacts were compensate d at replacement cost against the income loss	One time
2.31	Loss of access	• The contractor shall ensure that access to connecting roads; market, residence and other places should not be blocked. In case, it is unavoidable, then alternate route should be provided to people. • The community should be made aware about the diversion plan along with expected deadline for the completion of work. • Limit the width of trench excavation as much as possible by adopting best construction practices, adopt vertical cutting approach with proper shoring and bracing, • Leave spaces for access between mounds of soil to maintain access to the houses / properties, access to any house or property shall not be blocked completely, alternative arrangements, at least to maintain pedestrian access at all times to be provided. • Provide pedestrian access in all the locations; provide wooden/metal planks with safety rails over the open trenches at each house to maintain the access.	Contractor	Constructio n	Visual inspection	Crossing/ access closed	Regularl y

S. No.	Aspect	Mitigation measures	Responsibility	Implement ation phase	Monitoring method	Monitoring indicator	Freque ncy
		• Necessary care to be taken during excavation to protect all the property connections (water, gas, electrical, telecom, septic tanks etc.) to avoid inconvenience to the local residents and disruption to works. • The contractor is required to provide notice to the shop owners of the need to shift kiosk/wares displayed on ROW as soon as the work plan is ready with minimum 7 working days. • Provide information to the public through media newspapers and local cable television (TV) services. At work site, public information/caution boards shall be provided including contact for public complaints. • After completion of the work, the access should be restored as per original condition. • No works can be commenced unless 100% shifted in sections ready for implementation.					
3.Decommissioning phase							
3.1	Site clearance and rehabilitatio n/ Post-constructio n clean-up	• Remove all construction equipment, vehicles, surplus materials, site office facilities, temporary fencing, structures and other items from the project site including pumping stations and lifting stations; • Clean up and remove any spills and contaminated soil in the appropriate manner; • Do not bury discarded materials on site or on any other land , water body, forest or sensitive areas. These shall be disposed in ULB approved / agreed facilities • The area that previously housed the construction camp is to be checked for tools, sharps, materials, batteries, spills of substances such as oil, paint, etc. and these shall be cleaned up. • Level the disturbed area and restore to a condition resembling its natural profile; and	Contractor	After completion of construction phase and operation phase	Site inspection; and Review of record of activities upon completion of construction phase and commissioning phase	Restoration of construction sites in original condition; and Sites are fully rehabilitated prior to commissionin g of project	Weekly

S. No.	Aspect	Mitigation measures	Responsibility	Implementation phase	Monitoring method	Monitoring indicator	Frequency
		• Ensure site is fully clean and tidy before the exit and prior to its handover to the officer of PIU and other authorized persons. • Prepare and submit site closure report.					
4. Operation and Maintenance phase							
4.1	Operation and maintenance of STP Failure of treatment, Blocks, overflows, system malfunction Occupational health and safety Sludge handling and disposal	• Operate and maintain the facility following standard operating procedures of operational manual; • Ensure proper knowledge transfer, hands-on training to municipal staff engaged in STP operation has been provided by contractor prior to handover of facility; • Ensure continuous uninterrupted power supply; • Undertake preventive and periodic maintenance activities as required; • Maintain the mechanical / electrical parts as per the maintenance plan to avoid any hazards; • Ensure that all safety apparatus at STP including personal protection equipment are in good condition all times; and are at easily accessible and identifiable place; periodically check & replace the equipment as required, and conduct mock drills to deal with emergency situations; • Ensure compliance to safety requirements for Chlorine handling • Conduct periodic training to workers on H&S requirements; • Implement the approved sludge management plan to ensure safe collection, adequate drying and treatment prior to reuse / disposal and comply with the consent conditions/ latest regulatory requirements as in Environmental Guidance Section of the Program Operations Manual for TNCRUDP. • Conduct periodic testing of sludge to check its	Contractor/ KCMC	Operation and Maintenance phase	Site inspection	Nil grievances/ incidents	Regularly

S. No.	Aspect	Mitigation measures	Responsibility	Implement ation phase	Monitoring method	Monitoring indicator	Freque ncy
		quality according to set standards for reuse (for ex: as manure/soil conditioner); but with no harm to the environment or health • Sludge Management and works on sewage / sewers shall be safe in line with existing National Regulations on Manual Scavenging & Sludge Management and the program requirements/ supported studies . Provide training on safe handling of sludge, along with proper apparatus and personnel protection equipment (PPEs) to workers • No wastewater from industrial premises (including household industries, and domestic wastewater) shall be allowed to dispose into municipal sewers; • Monitor regularly and ensure that there is no illegal discharge through manholes or inspection chambers; conduct public awareness programs; in coordination with TNPCB; • Conduct regular wastewater quality monitoring (at inlet and at outlet of STP) to ensure that the treated effluent quality complies with the regulatory standards; • Renewal of Consent to Operate for STP's to be obtained from TNPCB and comply with the consent conditions and report to PCB & PIU. • Conduct periodic testing of dried sludge/compost to check presence of heavy metals and confirming to the applicable standards to use as compost (FCO Order & SWM Rules, 2016). IF hazardous matter is found as per Hazardous Waste Management Rules 2016, it shall be send to TSDF for disposal as in National Regulations • The STP shall have sufficient buffer zone in form of greenbelt to reduce the odor and noise impacts and be maintained well. Periodically monitor the survival status and maintain records.					

S. No.	Aspect	Mitigation measures	Responsibility	Implementation phase	Monitoring method	Monitoring indicator	Frequency
4.2	Operation and maintenance of collection system Worker & Community health and safety	• No industrial wastewater shall be allowed to dispose into municipal sewers (including from household industries etc) • Ensure that there is no illegal discharge through manholes or inspection chambers • Conduct public awareness programs; in coordination with TNPCB • Establish regular maintenance program, including: • Regular cleaning of grit chambers and lines to remove grease, grit, and other debris that may lead to water backups. Cleaning should be conducted more frequently for problem areas. Cleaning activities shall be safe, preferably using machines and existing Regulations & Hon'ble High Court / other on safe sewer cleaning/Manual Scavenging shall be followed & hazard assessment & precautions shall be taken as approved by Engineer & ESHO before initiating the work. Workers shall be properly trained on H&S • Periodic de-siltation of sewers to be done with equipment/vehicle through machine holes. No desilted material shall be stacked near sewers or any where in the open. It shall be disposed in agreed facilities as per Waste and Sludge Management Plan. • Screening material disposal in lift/ pumping stations shall be as per rules, and no double handling to be allowed: no waste shall be disposed on ground or scooped up by workers. • All incidents shall be reported to the Engineer & PIU/PMU immediately, Immediate Assistance and hospitalisation shall be provided to the injured workers. Root Cause Analysis of the incident shall be undertaken and Corrective Action Plan shall be prepared and implemented	KCMC	Operation and Maintenance phase	Site inspection	Nil grievances/ incidents	Regularly

S. No.	Aspect	Mitigation measures	Responsibility	Implement ation phase	Monitoring method	Monitoring indicator	Freque ncy
		• Inspection of the condition of sanitary sewer structures and identifying areas that need repair or maintenance. Items to note may include cracked/deteriorating pipes; leaking joints or seals at manhole; frequent line blockages; lines that generally flow at or near capacity; and suspected infiltration or exfiltration; and • Monitoring of sewer flow to identify potential inflows and outflows; • Develop an Emergency Response System for the water system leaks, burst and overflows, etc. • Ensure that operating staff is properly trained, and have clear understanding of odor issues vis-à-vis its related with operational practices; • During cleaning/maintenance operation, the sewer line shall be adequately vented to ensure that no toxic or hazardous gases are present in the line. • Maintain records; review previous sewer maintenance records to help identify "hot spots" or areas with frequent maintenance problems and locations of potential system failure, and conduct preventative maintenance, rehabilitation, or replacement of lines as needed; • Strictly follow standard operating procedures / operational manual for operation and maintenance of lifting and pump stations; • Ensure that pumping cycles are properly followed; and there is no buildup of sewage beyond design volume in the wells; • Provide training to the staff in SOPs and emergency procedures; Provide necessary health and safety training to the staff in sewer cleaning and maintenance; • Conduct periodic H2S monitoring at pumping and lifting stations using handheld H2S meters.					

S. No.	Aspect	Mitigation measures	Responsibility	Implement ation phase	Monitoring method	Monitoring indicator	Freque ncy
		• Standard operating Procedures (SoP) for working with electric instruments and facilities shall be defined and implemented. • Ensure Electrical DB must be kept inside closed shed to prevent from water/ dust with a gate outside. Keep CO2 fire extinguisher outside shed for electrical fire fighting. • Proper health and hygiene management plan shall be prepared for laborers engaged in O&M activities periodic health checkup, and sanitization. This should also include safety measure to be undertaken while working in these areas. Workers shall be well trained on safe and hygienic operations. Manual scavenging shall be avoided fully as per existing Act & suitable machines to be employed. SOPs that would be developed as part of the Program shall be followed. Appropriate PPEs, equipment's to work in sewers/machine holes, guidance of safety experts, and authorities to be ensured before any maintenance work on sewers • PPE' s (Safety shoes, Safety helmet, Full body harness, Safety jacket, Gloves and others as appropriate to the type of work) must be provided to the workers while working at site. • Power tools which is not under proper condition should be replaced or prepared. • Worker should use face shield or goggles while welding and cutting work. • Contact details of nearest fire brigade and hospital shall be provided on site • Regular housekeeping shall be conducted. Records shall be maintained for the same. • Storage area for raw material and waste shall be defined and appropriate signages shall be informed.					

S. No.	Aspect	Mitigation measures	Responsibility	Implementation phase	Monitoring method	Monitoring indicator	Frequency
		• Working area shall be periodically sanitized and kept clean and hygienic • Safety Engineer should be available at site to give daily pep talks and submit the report daily • Training/ awareness programs at all the stages of the project shall be conducted. Special training shall be provided to those engaged in sludge handling. No sludge shall be handled directly (touched) by workers. Periodic health checkups and medical support shall be ensured • Mock drills shall be conducted frequently to the workers. • Records of training/ awareness programs/ mock drills shall be maintained					
4.3	Monitoring of performance	• Conduct regular wastewater quality monitoring (at inlet and at outlet of STP) to ensure that the treated effluent quality complies with the standards. • Periodic monitoring of H2S levels at sewage pumping and lifting stations using handheld H2S meters.	KCMC	Operation and Maintenance phase	Review of records	Compliance to standards Nil grievances for odour	Regularly
4.4	Workers exposure to toxic gases in sewers and hazardous material during sewer maintenance work	• Periodic de-siltation of sewers to be done with equipment/vehicle through machine holes. • All regulations guidance to be followed • During cleaning/ maintenance operation, the sewer line will be adequately vented to ensure that no toxic or hazardous gases are present in the line. • Ensure availability of PPE for maintenance workers. • Follow safety and Emergency preparedness plan.	KCMC	Operation and Maintenance phase	Site inspection	Nil grievances/ incidents	Regularly

Note: Additional measures for ensuring safety at site is provided in the Annexure 10 and ensuring adoption & compliance will be the contractor's responsibility and should be reflected in the C-ESMP.

7.2 Monitoring and Evaluation

The E&S experts of the PMC will review the updated ESMP and sub-plans submitted by the contractor and will ensure that such plans are in line with the applicable laws and regulations. The experts will supervise the implementation of plans and will report on the E&S safeguard status and performance under the project. The internal monitoring reports will at minimum include, but may not be limited to the following:

- Reporting period and context;
- Summary of project status;
- Regulatory compliance;
- Institutional set up and manpower management status;
- Environmental, social, health and safety of workers and local communities;
- Implementation status of ESMP, SEP, WMP;
- Monitoring of waste disposal and management;
- Monitoring of environmental attributes (air, water, noise) and social mitigation measures (e.g. compensation to potential temporary economic impacts at replacement value);
- Complaints and grievances redressal; and
- Stakeholder engagement and community development activities.
- Labour Management

Contractors EHS person shall ensure ESMP implementation on all work days. Contractor shall report weekly to PIU on ESMP. PMC & PIU Engineers also shall visit the sites & supervise ESMP implementation. PMC shall prepare the internal monitoring report and submit it to the PIU every month, and PIU to submit a monthly report to TNUIFSL. Details of schedule of activities are given in Table 8.2 and indicative budget for construction phase is reflected in Table 8.3.

Table 7.2 Schedule of activities

S.No.	Schedule of activities	Responsibility	Time line
1	Obtain required permits and licenses	PIU/Contractor	Prior to Pre-construction
2	Designate the Convenor	PIU	Pre- construction
3	Constitute the GRC& disclose in all the project work sites and zonal offices.	PIU	Pre- construction
4	Mobilization of EHS officer	Contractor	Prior to construction
5	Mobilization of one environment expert	PMC	During construction
6	Mobilization of one social expert	PMC	During construction
7	Submission of management plans viz., i. updated ESMP (incl STP design & measures) ii. Plan iii. Sludge Management Plan	Contractor	Prior to construction

8.3 Environment Monitoring Plan

To monitor the extent of environmental impact of the proposed project, the contractor has to periodically monitor the ambient environmental quality along the proposed project area. The monitoring requirement for the different environmental components is presented in table below:

Table 1: Construction Stage Environmental Monitoring Plan

Monitoring field	Monitoring location	Monitoring parameters	Frequency	Responsibility	Cost and Source of Funds
Ambient air quality	8 locations (STP site, 50 m downwind direction near sewer and pumping station work sites)	PM10, PM2.5 NO2, SO2, CO	Once before start of construction Quarterly (yearly 3-times) during construction (3year construction period)	Construction Contractor	Cost for implementation of monitoring measures responsibility of contractor (80 samples x 5000 per sample = 4,00,000)
Ambient noise	8 locations (STP, locations near sewer and pumping station work sites)	Day time and night time noise levels	Once before start of construction Quarterly (yearly 4-times) during construction (3year construction period)	Construction Contractor	Cost for implementation of monitoring measures responsibility of contractor (104 samples x 1500 per sample = 1,56,000)
Water quality	4 locations (Waterbodies near work sites, PS/LS/STP sites, upstream and downstream of disposal point in receiving waterbody, Borewells)	As per CPCB guidelines for Water quality monitoring (Surface and Ground water)	Once before start of construction Half yearly during construction (3year construction period)	Construction Contractor	Cost for implementation of monitoring measures responsibility of contractor (28 samples x 4000 per sample = 1,12,000)

Table 2: Operation Stage Environmental Monitoring Plan

Monitoring field	Monitoring location	Monitoring parameters	Frequency	Responsibility	Cost and Source of Funds
Monitoring of treated	Inlet and outlet of STP	Parameters as specified	Monthly Once	KCMC	O&M Costs

Monitoring field	Monitoring location	Monitoring parameters	Frequency	Responsibility	Cost and Source of Funds
wastewater quality from STP		by TNPCB in the consent/ disposal standards notified for STPs.			
Odor monitoring at STP	2 points (downwind direction) with at STP boundary and at boundary with RAF quarters)	Hydrogen sulphide (H2S)	Half yearly (yearly twice) and as and when based on public complaints (throughout the operation phase)	KCMC	O&M Costs
Ambient noise	2 locations (downwind direction) with at STP boundary and nearby receiver	Day time and night time noise levels	Monthly once during operation	KCMC	O&M Costs
Water quality at disposal point	2 locations - disposal point, (downstream and upstream)	pH, Cl, F, NO3, TC, FC, Hardness, Turbidity BOD, COD, DO, Total Alkalinity, heavy metals and pesticides	Yearly twice during operation (pre and post monsoon)	KCMC	O&M Costs (water quality will be tested at the internal laboratory part of STP)
Odor monitoring	4 points (downwind direction) at	Hydrogen sulphide (H2S)	Periodical (throughout	KCMC	Handheld H2S meters to be procured as part of the

Monitoring field	Monitoring location	Monitoring parameters	Frequency	Responsibility	Cost and Source of Funds
at pumping stations	all pumping stations: near inlet/suction well; outside the pumping station and at nearest house		the operation phase)		project and operated by operating staff
Odor monitoring at lifting stations	2 points (downwind direction) at all lifting stations: near suction well and at nearest house	Hydrogen sulphide (H2S) in ambient air	Periodical (throughout the operation phase)	KCMC	Handheld H2S meters to be procured as part of the project and operated by operating staff
Sludge quality and suitability as manure	STP	Analysis for concentration of heavy metals and confirm that value are within the limits for use as compost	Start of operation and Yearly once	KCMC	O and M costs (testing to be done at an accredited external laboratory)

Note: Additional measures for ensuring safety at site is provided in the Annexure 10 and ensuring adoption & compliance will be the contractor's responsibility and should be reflected in the C-ESMP.

4 Cost Estimate for Environmental and Social Management Plan

The estimated ESMP implementation cost comprises EMP as well as Compensation for the social impacts. The indicative budget for ESMP is provided in the following table.

The ESMP costs are under two heads, one is already covered in the Detailed Project Report and cost provisions are made. Secondly, ESMP costs as per the outcome of ESIAR.

A- Estimate included in the DPR for UGSS

S.No	Description	Rate of BOQ's	Unit Cost	Quantity	Total cost in RS
1	Collection System and Pumping Main				
a	Hard Barricading and other safety measures	Collection system (Included in BOQ)		190373 - RM	
b	Hard Barricading and other safety measures	Pumping Main (Included in BOQ)		4230 - RM	
c	Restoration of cut open trenches collection,Pumping mains & HSC's	Collection system & Pumping main Estimates (Included in BOQ)		170702 -RM	
d	Carting and de carting excess Earth	Collection system & Pumping main Estimates,LMH,LS & PS (Included in BOQ)		22757 - CUM	
2	Pumping Stations				
a	Construction of high compound wall around the Pumping Station	(Included in BOQ)		940 - RM	
TOTAL					

C- Estimate as per ESIA study

S.No.	E&S monitoring parameters	Frequency	Responsibility	Amount (INR in lakhs)
1	Organize meetings with line departments.	Bi-annual	PIU	
2	Workshop on E&S safeguards and on-job training as identified.	Annually	PIU/PMC	
3	**Green** belt development &Gardening	In all pumping stations and one STP	PIU	
4	Odour Control Measures in PS & LS	Rs.75Lacs /unit * 5 PS sites Rs.5Lacs /unit * 5 LS sites	PIU	

5	Use of IEC material and use of media channel to create public awareness on waste management	Regularly	Contractor	
6	Consultations with stakeholders regularly	Regularly	PIU/PMC/ Contractor	
7	Meetings of GRC	As and when required.	PIU	
8	Environmental Monitoring	Quarterly	PMC/ Contractor	
9	Health camp, occupational health and prevention of Covid 19	Regularly	Contractor	
			Total	

8. STAKEHOLDER ENGAGEMENT AND GRIEVANCE REDRESSAL MECHANISM

Stakeholders engagement is an integral part of developing an understanding about the project and the associated risks and impacts as perceived by the public. It helps in planning and setting up priorities for project management. This section provides details of the stakeholder engagement during project preparation stage. SEP has been prepared and is provided in Annexure.

8.1 Public disclosure

Stake Holder Consultation was held at Kancheepuram Corporation on 30.11.2022, under the chairmanship of Hon'ble Mayor, Kancheepuram Corporation and the Respected Council members along with officials of Kancheepuram Corporation and the following suggestions were given during the presentation.

- It was suggested to reduce the Number of Lift Stations provided since there will be public objection and maintenance issues.
- It was suggested to provide precast machine holes to make the execution easier and faster.
- It was also suggested to add the conveyance charges in the Estimation for the precast machine holes.
- It was suggested to add and design the UGGS in Thiruvedhi pallam, MGR nagar and Vignesh Nagar of Ward 25 which comes under the core city according to the newly formed wards.
- Cost for utility shifting and reconstruction of culverts and suggested to be included in the estimation after conducting survey of the culverts.

Public disclosure is aimed at making information accessible to interested and affected persons. Communicating such information in a manner that is understandable to stakeholders is an important first step in the process of stakeholder engagement. All activities in the process from consultation and informed participation to negotiation and resolution of grievances will be more constructive if stakeholders have accurate and timely information about the project.

Information disclosure demonstrates the fact that transparency and accountability are being upheld in the planning and development of a proposed project and general public is aware of it. This would create awareness among the local people and instil the participation and public involvement in the project management.

8.2 Public consultation

Public consultation is a continuous process throughout the project planning, preparation, implementation, and monitoring stages. The sustainability of any infrastructure development project depends on the participatory planning in which public consultation plays a major role. Experiences indicate that environmental and social impacts, particularly the involuntary resettlement generally causes numerous problems for the affected population. Such problems may be reduced to a great extent if people are properly informed and consulted about the project, its impacts, mitigation measures and potential temporary economic impacts allowed to make meaningful choices or preferences. This helps to reduce the sense of insecurity and opposition of potential temporary economic impacts to the project which otherwise are likely to occur during project implementation. The overall objective of the consultation process and SEP is to minimize, mitigate or offset negative impact of the project and make people aware about the rationale and positive impacts of the impact.

The practical measures will be taken through consultative process to make the stakeholders as partners in project planning, implementation and monitoring stages. One way to help satisfy stakeholder concerns and promote transparency is to involve project affected stakeholders in monitoring the implementation of mitigation measures or other environmental and social impact related activities. The stakeholders will be informed about relevant policies, laws, types and severity of impacts, entitlements for compensation and mitigation measures through the proper communication channel, verbally or distribution of pamphlets in local language with required details. Once consultations have taken place, stakeholders will want to know which of their suggestions have been taken on board, what risk or impact mitigation measures will be put in place to address their concerns. Such information will be disseminated in time and regularly. The consultations shall be arranged with the beneficiaries, potential temporary economic impacts and other stakeholders to understand and solicit their views about risk and impact due to the project at the pre-construction stage.

Stakeholder Engagement

Concept presentation was held at TNUIFSL on 01.12.2022 and the following suggestions were given during the presentation, the actions taken are also listed below,

Sl. No	Suggestions	Actions Taken
1.	It was suggested to prepare the Land Plan Schedule and FMB sketch marked with Components for proposed pumping stations.	FMB sketches for the areas allotted for the Pumping stations received and awaiting council resolution for the confirmed locations.
2.	DWC pipe to be considered for the depth below 3m and up to the diameter of 300 mm.	Incorporated
3.	uPVC pipe to be considered for the depth above 3m and up to the diameter of 300 mm.	Incorporated
4.	For the pipes above 300 mm diameter, CI pipes will be considered invariable to all depth.	Incorporated
5.	It was suggested to consider the maximum depth of 5m for sewer network after exploring the soil strata.	Incorporated
6.	Replacement and revamping of existing sewer network may be studied separately and to submit a separate report and also to check the feasibility for diverting a part flow from existing sewer network (Zone 1 to 4 – Core city) into the newly proposed sewer system.	It will be taken as a separate study and will be incorporated.
7.	It was recommended to avoid Valve pits in Pumping station outlets below ground level to avoid inundation of water and to provide the same above Ground Level.	Incorporated

Presentation to World Bank officials at Kancheepuram Corporation

Concept presentation was held at Kancheepuram Corporation on 06.12.2022 for representatives and officials from the World Bank and the following suggestions were given during the presentation.

Sl. No	Suggestions	Actions taken
1.	It was suggested to check the possibilities to cross the canals by gravity sewers to avoid Lift Stations.	Field study like maximum flow in the canal, scour depth, etc have been carried over for the canals and it has been ascertained that the sewer line cannot be crossed by gravity and hence Lift stations have been retained.
2.	It was suggested to explore the feasibility of reusing the effluents from STP to achieve zero waste of effluents.	
3.	Instead of Brick masonry machine holes, it was recommended to provide RCC precast machine holes by providing precast rings.	Incorporated
4.	The implementation schedule for execution of the project has to be prepared.	Will be carried over in Final DPR.

Stakeholder Engagement during implementation

Stakeholder Engagement during implementation is proposed as a continuous process for smooth implementation of the project and the strategy prepared for the same is provided in Annexure.

8.3 Grievance Redress Mechanism

A common GRM will be in place to redress social, environmental or any other project related grievances. The GRM described below has been developed in consultation with stakeholders. Two tier GRM shall be constituted.

Grievance Redress Committee (GRC)

1. 1st level grievance redress: Comprises of
    - PIU Site Engineer
    - Safeguard Specialists from PMC
    - Contractors site engineer & EHS. To resolve issues on-site in consultation with each other.
2. 2nd Level grievance redress: The Project level GRC shall be constituted with three persons (preferably one of them as woman).

The Executive Engineer at project level, the Convenor for the project, will be designated as the Secretary, who will coordinate with all the members, convene meetings and perform other activities required to ensure the efficient grievance redressal system. Such meetings will be held as per requirements. The GRC would

assist in amicable settlement of issues/complaints raised by the aggrieved person/ Potential Temporary Economic Impacts without any interruption to the project implementation. As referred, the Executive Engineer of PIU, Team Leader and Safeguard Specialists of PMC, Project Manager and the EHS officer will also act as the community liaison officers (CLOs). They will inform the Potential Temporary Economic Impacts, workers and other stakeholders / public about the set-up of GRC, its constitution, functioning and procedure to address their project related E&S concerns and complaints. They will conduct consultations with the Potential Temporary Economic Impacts and other stakeholders regularly to keep them informed about the project progress and future activities, as required. The Project Manager supported by the EHS Officer stationed at the project site will be the first contact person for the Potential Temporary Economic Impacts and local residents, who will try to settle the concerns of people immediately. The Project Manager will report to the EE/PIU and PMC, who will help, and initiate actions required to resolve the complaints received orally or in writing. The cases not resolved within one or two weeks will be referred to the GRC for taking decision within the four weeks or stipulated time as deemed appropriate. The concerns of any aggrieved person or issues of Potential Temporary Economic Impacts regarding the compensation at replacement value, income restoration and other losses and adverse impact will be examined and decided in consultation with the GRC members.

The concerns and complaints of the labourers will be directly redressed by the Project Manager of the Contractor. The cases not being resolved by the Project Manager or the higher management of the contractor will be presented to the GRC to settle the same with a consultative approach.

The EE designated as the Secretary will report to the SE, who in turn will report to the Chief Engineer, KCMC about the status of complaints and performance of GRC regularly. The CE supported by the EE will be overall responsible for resolving the grievances of potential temporary economic impacts and any other stakeholders amicably within a timeframe.

The phone numbers of these personnel and addresses will be disclosed on the hoardings fixed at prominent public places and will be shared with the GRC members. Potential temporary economic impacts and other stakeholders usually communicate grievances orally and those submitted in writing will be logged in the register maintained at the CLO office. The grievances form in Tamil and English including the details of Complaint Receiving Officer (Convenor) will be made accessible at public places.

Recordkeeping. Records of all grievances received, including contact details of complainant, date the complaint was received, nature of grievance, agreed corrective actions and the date these were effected and final outcome will be kept by PIU and submitted to TNUIFSL. A Sample Grievance Registration Form has been given in the Annexure.

9. INSTITUTIONAL AND IMPLEMENTATION MECHANISM

9.1 Implementation of proposed project and institutional arrangement

The implementation arrangement for this project is provided below.

Project Management Unit (PMU)

A PMU in TNUIFSL jointly with the Directorate of Municipal Administration will be established. PMU will have dedicated Environmental and Social Safeguards specialists.

Project Implementation Unit (PIU)

The PIU will be established in the Kancheepuram City Municipal Corporation for implementation of this project. This will include designated officials as Environmental Officer & Social Safeguards Officers.
PIU will supervise activities of Environmental and social safeguards for ensuring adoption and compliance of ESMP and report to TNUIFSL.

Project Management Consultants (PMC)

A PMC will be appointed and will assist the PIU in the implementation of the project. The PMC will have dedicated Environmental, Social, Gender and ESHS specialists and will implement the ESMP. Preparation of periodical progress reports, flag critical issues to the PIU and PMU are the scope of the PMC.

Contractor

Contractor will appoint EHS personnel who along with the Project Manager will be responsible for implementation of the Environmental and Social management plan and submit the compliance report to PMC/PIU. PIU will supervise activities of Environmental and social safeguards for ensuring adoption and compliance and report to TNUIFSL.

ANNEXURE-1 ENVIRONMENTAL, CLIMATE CHANGE AND SOCIAL SCREENING

Date:_____ **Contact Person: The Commissioner**

Name of ULB : Kancheepuram City Municipal Corporation

Background and Objective: Suggest to add a few brief sentences on the objective of this Screening and how it will be used.

Project Details		
Sl.no	Components	Details
1	Project Objective and components	The objective of the project is to provide Underground sewer scheme UGSS to added areas in Kancheepuram district.
2	Details of Alignment / Components (main components including construction activities)	• Laying of sewer line for a length of 168.722 km • Construction of 5 Lift Stations (LS) • Construction of 17 Lift Machine Holes (LMH) • Construction of 5 Pumping Stations (PS) • Laying of Pumping mains for 12.12 kilometres • Construction of Pipe Carrying Bridges (PCBs) for pumping main canal crossings in 5 locations – (3 nos of 24m length crossing, 1 no of 56m length in Vegavathi River, 1 nos 32m length @ Manjal neer kalvai) • Providing 14768 House Service Connections (includes internal plumbing) • Proposed 8315 no of Machine Holes • Construction 30 MLD STP with proposed SBR technology[5] at Thirukalimedu near existing WSP Disposal of treated effluent into Vegavathi River by laying pumping main for a length of 3.5km. • The treated effluent will be conveyed through a pumping main for a length of 3.5 km and ultimately disposing into the Vegavathi river.

[5] Construction of STP is proposed under DBOT Contract basis.

3	Location of the Project Sites (all sites including alignment of networks, other structures like pumping stations; offices, locations where treated wastewater, sludge & C&D wastes will be disposed/reused directly, any other) Current Land use (Provide information for all sites involved in the project), any historic land use (related to heritage, or contamination) Site Survey No:/s (with ownership), Geographical coordinates of the site	The location is Kancheepuram City Municipal Corporation administrative area. All the project sites identified for locating PS and STP belong to KCMC. LS are proposed in the roads.

Proposed Resource Use

Resource Use				
Sl.no	Proposed Resources	Area/Quantity	Unit	Details
(i).	Land Area proposed to be used: Location wise (in sq km / sq m)			
(ii).	Estimated energy consumption for the project activities – Source wise			
(iii).	Estimated usage of water quantity for the project: Groundwater and Surface water?			

Baseline Environmental Conditions

Sl.no	Environmental Aspects	Yes	No	Details (mention distance to these features in meters/kilometres, and quantities in g/kg/T as applicable. Also mention if any project components is excluded / regulated based on location/activities as per National / State regulations& need permits/follow guidance)
1	Is the project site located on or adjacent to any of the following (Provide information for all sites and alignment of the project components/subcomponents, associated activities; mention distance to these features in meters/kilometres)			

i)	Critically Vulnerable Coastal Areas, Ecosensitive Areas		√	
ii)	Cultural Heritage site, Protected monuments		√	There are protected monuments like Kailasanathar Temple, Jvarahareshwara Temple, Sri Matangeswara Temple, Vaikunta Perumal Temple, etc are situated in the core area of Kancheepuram. The project is proposed in added areas which is devoid of any such protected monuments.
iii)	Natural Forests / Protected Areas Is the project in an eco-sensitive or adjoining an eco-sensitive area or its demarcated buffers? If Yes, provide details.		√	
iv)	Any other Wetlands/ Mangrove/ Estuarine Region?		√	
v)	Any Natural Habitat areas, areas with natural features such as the Coasts, Lakes/ other water bodies?		√	
vi)	Any other Sensitive Environmental Components?		√	
vii)	Any Residences, schools, hospitals, sensitive receptors?	√		The project area consists both residential and commercial entities.
viii)	Any culturally – socially important paths, areas/religious occupancies, sacred groves, burial grounds, tourist or pilgrim congregation areas, borders, etc?	√		There are temples and other religious structures present in the project area.
ix)	Any Drinking water source, upstream and downstream uses of rivers, etc which may be impacted by proposed discharge of treated sewage / sludge from water supply or sewage treatment plant?		√	
x)	Any Low-lying areas prone to flooding/areas of Tidal Influence used as part of the Project or near the project components?		√	
xi)	Details of Surface water quality at intake point or Disposal point of treated sewage			Disposal location has been changed when this report has

				been under preparation. This will be included in the contractor scope.
xii)	Any areas affected by other disasters?		√	
2	Groundwater: Is the site in Critical / Over Exploited condition?		√	
3	Is the area disaster-prone? If yes; list all disaster zone categories applicable		√	
4	Describe the soil and vegetation on site		√	All the sites are vacant and PS sites has bushes. There are no trees present in any of the project sites.
5	Is the site area and condition suitable for proposed development?	√		
6	Describe existing pollution/contamination or degradation in the site(s)		√	
7	Near Dams, Barrages		√	
8	Any other remark on baseline condition?		√	

Anticipated Environmental Impacts: Impacts on Land, Geology and Soils

Sl.no	Impacts	Yes/ May crea te	No	Details(mention distance to these features in meters/kilometres, and quantities in g/kg/T as applicable. Also mention if any project components is excluded / regulated based on location/activities as per National / State regulations & need permits/follow guidance)
8.	Will the proposed project cause the following on Land / Soil?			
i)	Impact on Surrounding Environmental Conditions including Occupation on Low lying lands/flood plains		√	
ii)	Substantial removal of Top Soil (mention area in sqm)		√	
iii)	Any degradation of land / eco-systems expected due to the project?		√	

iv)	Loss or impacts on Cultural/heritage properties/precincts, features		√	
v)	Does the project activity involve cutting and filling/ blasting etc?	√		During pipe laying, soil cutting and filling activities will be carried out. Blasting for hard rock removal is not identified. However if encountered during construction, measures identified in the ESMP will be followed.
vi)	Will the project cause physical changes in the project area (e.g., changes to the topography) due to earth filling, excavation, earthwork or any other activity?		√	No change in topography anticipated. During pipe laying, excavation, refilling of soil, road restoration will be carried out.
vii)	Will the project involve any quarrying/ mining etc?		√	
viii	Will the project / any of its component contaminate or pollute the Land? (for example sludge, disposal of untreated sewage/bypass)		√	
ix)	Pre-existing contamination on site/s		√	

Impacts on Water Environment

Sl.no	Impacts	Yes/ May Create	No	Details(mention distance to these features in meters/kilometres, and quantities in g/kg/T as applicable. Also mention if any project components is excluded / regulated based on location/activities as per National / State regulations & need permits/follow guidance)
9	Will the subproject or its components cause any of the following impact on Water sources (Quantity or Quality):			
i)	Will the activities proposed at the site(s) impact water quality (surface or underground) and water resource availability and use? Will this sub-project involve the dredging of water bodies, sea, canals, etc.		√	
ii)	Impacts on Water Resources		√	
iii)	Pollution of Water bodies/ground water nearby or downstream		√	

iv)	Will the project affect the River /cannel flow pattern, stream pattern or any other irrigation canal?		√	Temporarily during construction. And will be restored to the original condition after completion of the work.
v)	Will the project result in stagnation of water flow or pondage or weed growth due to increased pollution/siltation		√	

Impacts on Biodiversity and Host Communities

Sl.no	Environmental Impacts	Yes/ May Create	No	Details(mention distance to these features in meters/kilometres, and quantities in g/kg/T as applicable. Also mention if any project components is excluded / regulated based on location/activities as per National / State regulations & need permits/follow guidance)
10	Will the subproject or its components cause any of the following impacts on Biodiversity or the neighborhood			
i)	Will the project necessitates cutting of? Trees / Loss of Vegetation		√	No tree cuttings involved in the project.
ii)	Will the project result in Health & Safety Risks in the neighborhood including the release of toxic gases, accident risks		√	
iii)	Potential risk of habitat fragmentation due to the clearing activities? (e.g. Hindrance to the local biodiversity like disturbing the migratory path of animals/ birds etc.)		√	
iv)	Potential Noise and Light Pollution or disturbance to surrounding habitats/communities		√	
v)	Potential disruption to common property, accessibility, traffic disruptions, conflicts or disruption to the local community within the subproject area?	√		Temporary impacts on accessibility and traffic disruptions are envisaged which will be managed through measures identified in ESMP.

Impacts due to Storage and Wastes: Pollution and Hazards

Sl.no	Type	Yes	No	Details(mention distance to these features in meters/kilometres, and quantities in g/kg/T as applicable. Also mention if any project components is excluded / regulated based on location/activities as per National / State regulations & need permits/follow guidance)
11	Will the subproject or its components cause any impact due to storage of materials, wastes or pollution due to releases during various project activities			
i)	Will the project use or store dangerous substances (e.g., large quantities of hazardous chemicals/ materials like Chlorine, Diesel, Petroleum products; any other?	√		Diesel will be used by vehicles for excavation during construction phase and chlorine gas during operation phase. Necessary precautions for Chlorine gas storage are proposed in STP for O&M.
ii)	Will the project produce solid or liquid wastes; including construction/demolition wastes (including dredging, de-weeding wastes, muck/silt, dust, sludge, C&D wastes, hazardous wastes (such as asbestos from existing network), e-wastes (from equipment)); polluted liquids?	√		Waste generated from the project will be handled as per the WMP which will be prepared by the contractor. Treated effluent from STP will comply with the prescribed standards and TNPCBs consent conditions. Sludge from STP may be used for manure and balance be disposed in SWM site.
iii)	Will the project cause or increase air pollution or odour nuisance?	√		During construction increase in dust particles may generate due to excavation activities and demolition of old structures. Proper dust control measures to be provided e.g. water sprinkling. Odour control measures are proposed for pumping stations for O&M.
iv)	Will the project generate or increase noise levels which will impact surrounding biodiversity or communities?		√	
v)	Will the project generate or increase visual blight or light pollution?		√	
vi)	Will the project cause water pollution? (of waterbodies/ groundwater)?		√	

Sl.no	Type	Yes	No	Details(mention distance to these features in meters/kilometres, and quantities in g/kg/T as applicable. Also mention if any project components is excluded / regulated based on location/activities as per National / State regulations & need permits/follow guidance)
vii)	Will the project involve dangerous construction activities which may be a safety concern to workers/ host communities		√	
viii	Is there a potential for release of toxic gases or accident risks (e.g. potential fire outbreaks)		√	
12	Describe any other features of the project that could influence the ambient environment		√	

Baseline Climate Data		
13. Project Area Baseline Note: Please provide details for ULB and also site. Please provide quantitative information where relevant.		
i)	Agro climatic zone	North Easter Zone
ii)	No of Water Bodies in the ULB area	
iii)	Name of the River(s) in the ULB	River Palar
iv)	Proximity to River (kms)	Section of the project area is adjacent to the river.
v)	Proximity to Sea (kms)	About 60km (Bay of Bengal)
vi)	Proximity to hilly terrains (kms)	About 65km (Jawadu Hills)
vii)	High Flood Level of the River	
viii)	Flooding Events (Years) (Based on historic data of extreme flood events and future projections based on available analysis)	2015, 2021, 2022

ix)	Flooding hotspots in the ULB		There are low lying areas in KCMC like Bharathi Nagar, Varadarajapuram, Pachiappan slum, Orikkai which are vulnerable to flooding.		
x)	Available Water sources (Surface / ground)		Infiltration wells and Borewells from Palar & local sources.		
xii)	Groundwater Level and potential zone		5-10 m. bgl[6], Safe Zone		
xiii)	Normal Temperature &long term average; trends in changes in temperature		The temperature ranges between 20°C & 37°C.		
xiv)	Rainfall trends &long term average		The city receives an average of 1159.4mm of rainfall annually.		
xv)	Land Use				
xvi)	% of Green Cover in the ULB area				
xvii)	% of Water Bodies/Rivers				
xviii)	Seismic Zone		Zone III		
xix)	Coverage rain water harvesting structures (in %)				
	a) Residential				
	b) Commercial & Institutional				
	c) Government/ULB				
xx)	RWH in buildings – Mandating byelaws				
xxi)	Frequency of drought in study area. Does the area face water scarcity? Please provide details.		The city faced drought during 2016-17 due to shortfall in rains. (182 mm lesser than the annual average)		
xxii)	Frequency and intensity of cyclones in study area.		No		
14	Climate Change Impacts in project area				
(i)	Climate signal Please select the relevant signals	Climate hazard Please select the relevant hazards	Yes	No	Details

[6] District Ground water Brochure Kancheepuram District, 2007

	☐ Sea level rise ☐ Frequency of tropical storms ☐ Intensity of tropical storms ☐ Higher precipitation amounts ☐ Shifting seasons ☐ Higher temperatures ☐ Less precipitation ☐ Lower temperatures ☐ Others	☐ Salt water intrusion		√	
		☐ Flooding of the coast		√	
		☐ River flood	√		Flood in River Palar
		☐ Bank erosion (sea/river)		√	
		☐ Flash flood (heavy rain)		√	
		☐Landslides		√	
		☐ Forest/Bush fires		√	
		☐ Water shortage/drought	√		Drought in 2016-17 due to shortfall in rains
		☐ Effects of heat	√		Heat wave (temperature above 40°C) during the years 2016-2018
		☐ Effects of cold		√	
		☐ Effects of winds		√	
		☐ Effects of air quality		√	
		☐Effects of storm surge		√	
		☐Soil quality/land degradation		√	
		☐ Others		√	
ii)	Energy consumption for the project? Will the project result in GHG emission?		√		
iii)	Will the project affect any other water or other user? (downstream intake points of Water Supply projects, downstream water use by people, animals; irrigation)			√	
iv)	Is the project located in exploited ground water block?			√	The project area is in safe zone.
v)	Is the project area vulnerable to temperature fluctuations and drought?			√	
vi)	Is the site vulnerable to hazards such as Earthquakes, Landslides, Flooding, Storm surge, Severe wind damage, Fire, Explosion, Other (specify)		√		There are low-lying areas in the city which are vulnerable to flooding.
vii)	Will the project result in generation of wastes / by-product?		√		Construction waste. During operation, sludge would be generated from treatment of sewage.

viii)	Will the project impact the water resource availability (surface/ ground water) and use (effluent/sewage disposal, bypasses from STPs/PS, leachate, runoff, wastes deposition, erosion)		√	
ix)	Will the project cause flooding of adjoining low lying areas		√	
(x)	Will the project impact water quality or quantity in natural/constructed Lakes, or ponds		√	

Project Environmental Enhancement Measures

Sl.No	Enhancement Measures	Yes	No	Details
15	Has the subproject design considered environmental enhancement measures?			
i)	Energy conservation measures/ energy recovery options incorporated in subproject design? Quantify the reduction in CO_2emission from the sub-project.	√		
ii)	Has the project considered alternate /renewable energy?		√	
iii)	Has the project considered waste minimization (waste reuse/recycle options/circular economy)	√		
iv)	Rainwater harvesting, water recycling and other water resource enhancement measures proposed in the project?		√	
v)	Does the project include measures for prevention of wastage of water resource?		√	
vi)	What waterbody conservation/ drinking water source improvements/drought management options are being proposed?		√	
vii)	Design Considerations for protection of project components from extreme events - flood, drought, other natural disasters	√		
viii)	Greenbelt development proposed for the project?	√		Greenbelt will be developed in STP site along the boundary and in available space in the PS sites.
ix)	Is the sub-project including design elements to strengthen infrastructure resilience? If so what?	√		To provide underground sewerage system facility to the project area. This will

				prove the sanitation facility and improved life style at the project area.
x)	Has the project considered nature-based solutions and if so what?			
xi)	Is the sub-project combining infrastructure and nature-based solutions? If so how?			
xii)	What design considerations is the project including to mitigate heat island effect?		√	
xiii)	What design considerations is the project including to preserve and expand green cover?		√	

Land Use, Resettlement, and/or Land Acquisition

Sl.no	Components	Yes	No	Details
1	Does the project involve acquisition of private land?		√	
2	Alienation of any type of Government land including that owned by Urban Local Body?	√		
3	Clearance of encroachment from Government/ Local body Land?		√	
4	Clearance of squatters/hawkers from Government/ Local Body Land?		√	
5	Number of structures, both authorized and/or unauthorized to be acquired/ cleared/		√	
6	Number of households to be displaced?		√	
7	Village common properties to be alienated Pasture Land (acres) Acquisition / burial ground and others specify?		√	
8	Existing land uses on and around the project area (e.g., community facilities, agriculture, tourism, private property) will be affected?		√	
9	Will the project result in construction workers or other people moving into or having access to the area (for a long-time period and in large numbers compared to permanent residents)?		√	
10	Are financial compensation measures expected to be needed?	√		

Loss of Crops, Fruit Trees, Household Infrastructure and livelihood

Sl.no	Components	Yes	No	Details
11	Will the project result in the permanent or temporary loss of the following?			
11.1	Crops?		√	
11.2	Fruit trees? Specify with numbers		√	
11.3	Petty Shops		√	
11.4	Vegetable/Fish/Meat vending		√	
11.5	Cycle repair shop		√	
11.6	Garage		√	
11.7	Tea stalls		√	
11.8	Grazing		√	
11.9	Loss of access to forest produce		√	
11.10	Any others - specify		√	
Welfare, Employment, and Gender				
12	Is the project likely to provide local employment opportunities, including employment opportunities for women?	√		
13	Is the project being planned with sufficient attention to local poverty alleviation objectives?	√		
14	Is the project being designed with sufficient local participation (including the participation of women) in the planning, design, and implementation process?	√		
Historical, Archaeological, or Cultural Heritage Sites				
15	Historical heritage site(s) require excavation near the same?		√	
16	Archaeological heritage site(s) require excavation near the same?		√	
17	Cultural heritage site(s) require excavation near the same?		√	
18	Graves or sacred locations require excavations near the same?		√	

Tribal Population/Indigenous People				
19	Does this project involve acquisition / alienation of any land belonging to Tribal people?		√	
20	Will the project lead to displacement / other adverse impacts on tribal / indigenous peoples ?		√	
Beneficiaries				
Sl.no	Components	Yes	No	Details
21	Population proposed to be benefitted by the proposed project	Approx. no.:		116387
22	No. of Females proposed to be benefitted by the proposed project	Approx. no.:		57984
23	Vulnerable households /population to be benefitted[7]	Approx. no.:		
24	No. of Families to be benefitted	Approx. no.:		

Date: _____

Signature and name of the Borrower

Authorised Signatory

Note: This Screening sheet must be completed for each of the proposed subproject along with the DPR and ESIA Report.

Indicative Enclosures:

1. Provide maps with the geographical location of the project; Google maps with project sites and project alignment
2. An appropriately scaled map clearly showing the project area and project sites with land use, existing buildings, infrastructure, vegetation, adjacent land use, utility lines, access roads and any planned construction, and
3. Any other information to describe the project, locations and possible impact as required.
4. Provide relevant maps on flooding hotspots, LULC, etc

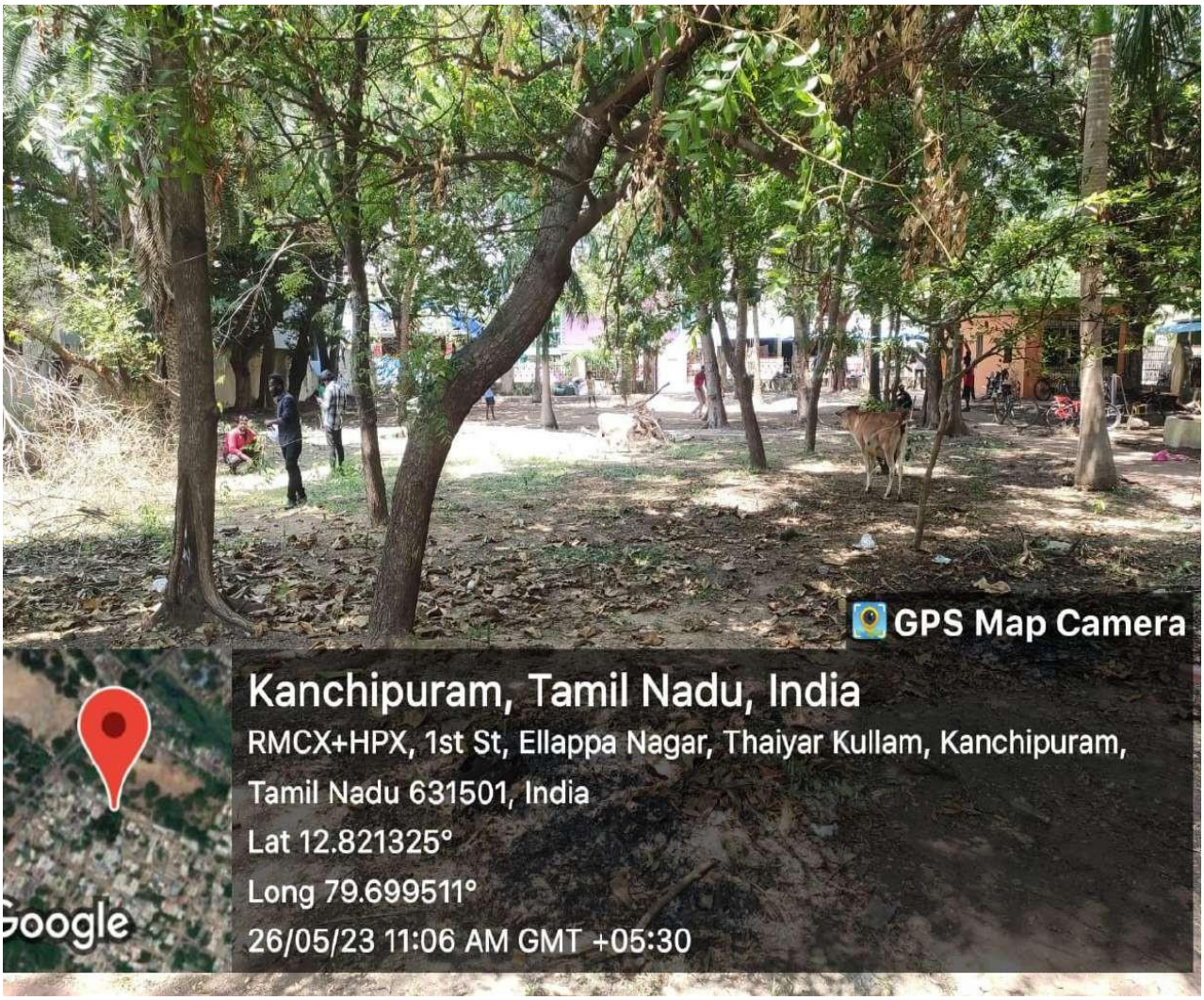
[7]Vulnerable PAPs are those living below poverty line, SC / ST families and women headed households, Widows, Physically Challenged persons; Elderly persons above the age of 60 years among the affected families.

5. Land details for the project sites with (i) extent available and required, (ii) location, (iii) survey numbers, (iv) FMB extract, (v) current land use, landuse classification (vi)land ownership, alienation/acquisition status, (vii) certificate giving availability of sites required for the project by the borrower, (viii) location photographs with Geo-co-ordinates of all project sites and alignment (start, end point).

ANNEXURE 2 LAND RECORDS

PROVIDING UGSS TO KCMC - PHASE 1 (LIFT STATION, PUMPING STATION AND STP-LAND CLASSIFICATION AND FMB DETAILS)									
S.NO	**LOCATION**	**ZONE**	**LATITUDE**	**LONGITUDE**	**SURVEY NO**	**AREA NAME**	**LAND EXTEND AVAILABLE (Sq.m)**	**LAND EXTEND REQUIRED (Sq.m)**	**CLASSIFICATION**
1	ELLAPPAN NAGAR	SPS-5	12.821325	79.699511	8	SEVILIMEDU OPPOSITE TO COLLECTOR OFFICE	1638	900	PARK
2	LAKSHMI VAIKUNTHAVALLI NAGAR	LS-6A	12.813192	79.702701	289	SEVILIMED U &ORIKKAI	200	100	PARK
3	ADHIYAMAN NAGAR	LS-6B	12.815366	79.693467	176	SEVILIMEDU NEAR PSK NAGAR	800	100	PARK
4	EMPERUMAN KOVIL STREET	LS-6C	12.815368	79.700679	256/2	GE NAGAR	6063	100	
5	ANNA KUDIYIRUPU	LS-7A	12.807684	79.715486	109	ORIKKAI	777	100	CHILDREN PLAY GROUND
6	AMBEDKAR STATUE	LS-7B	12.809415	79.706654	298	ORIKKAI	28028	100	GOVERNMENT POROMBOKE
7	NETHAJI NAGAR	MPS-7	12.812924	79.722823	55	NETHAJI NAGAR	34398.9	1600	
8	JJ NAGAR BCK SIDE (COLLEGE GROUND)	SPS-8	12.815261	79.740014	41	PERIYAR NAGAR	830	900	PLAY GROUND
9	NATHAPETTAI	MPS-9	12.828771	79.72276	484	NATHAPETTAI	850000	900	

1. ELLAPPAN NAGAR (SPS-5)



District : Kancheepuram

Taluk : Kancheepuram

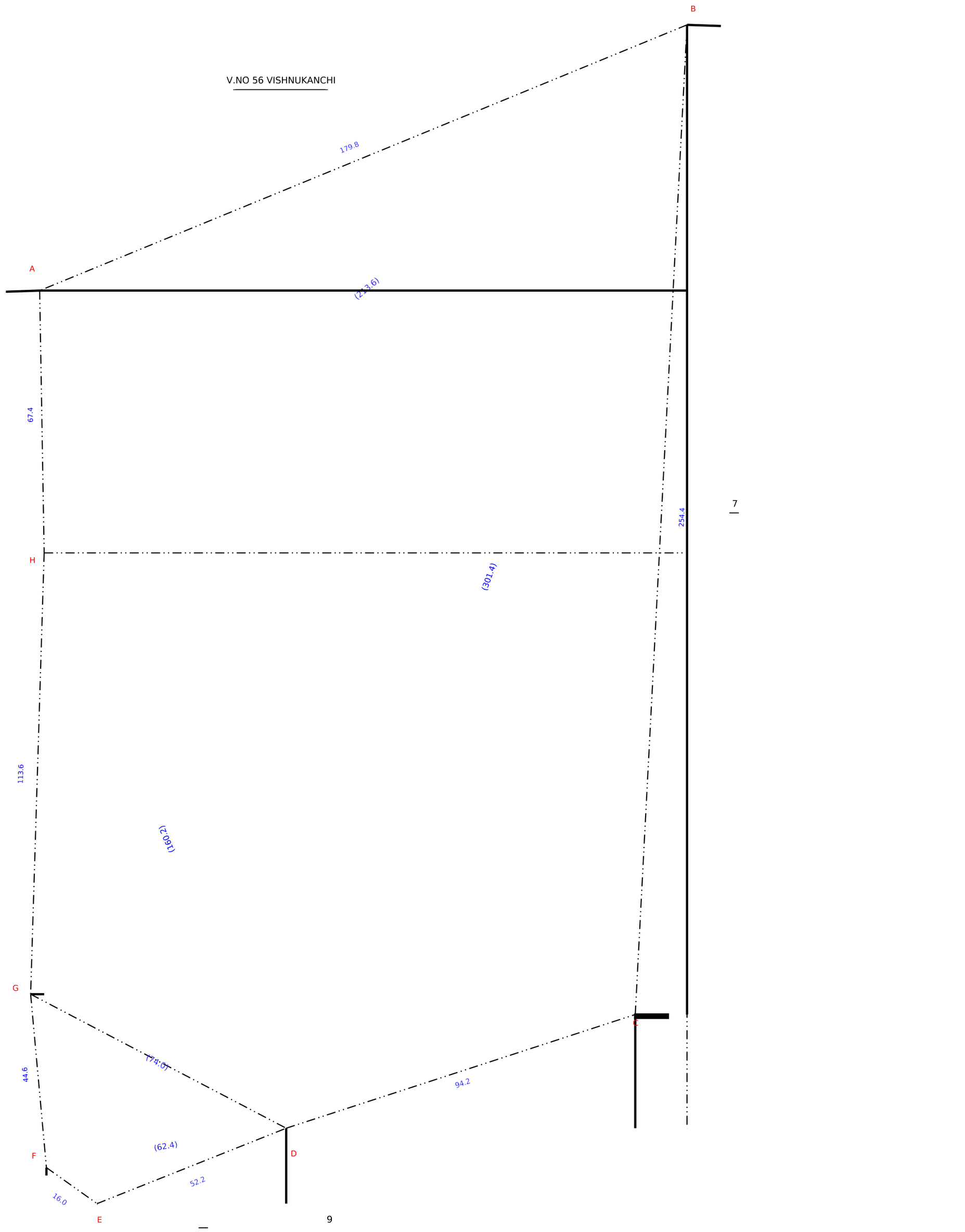
Village : Sevilimadu - A [54]

Survey No : 8

Area : Hect 03 Ares 90.00

Scale : 1 : 819

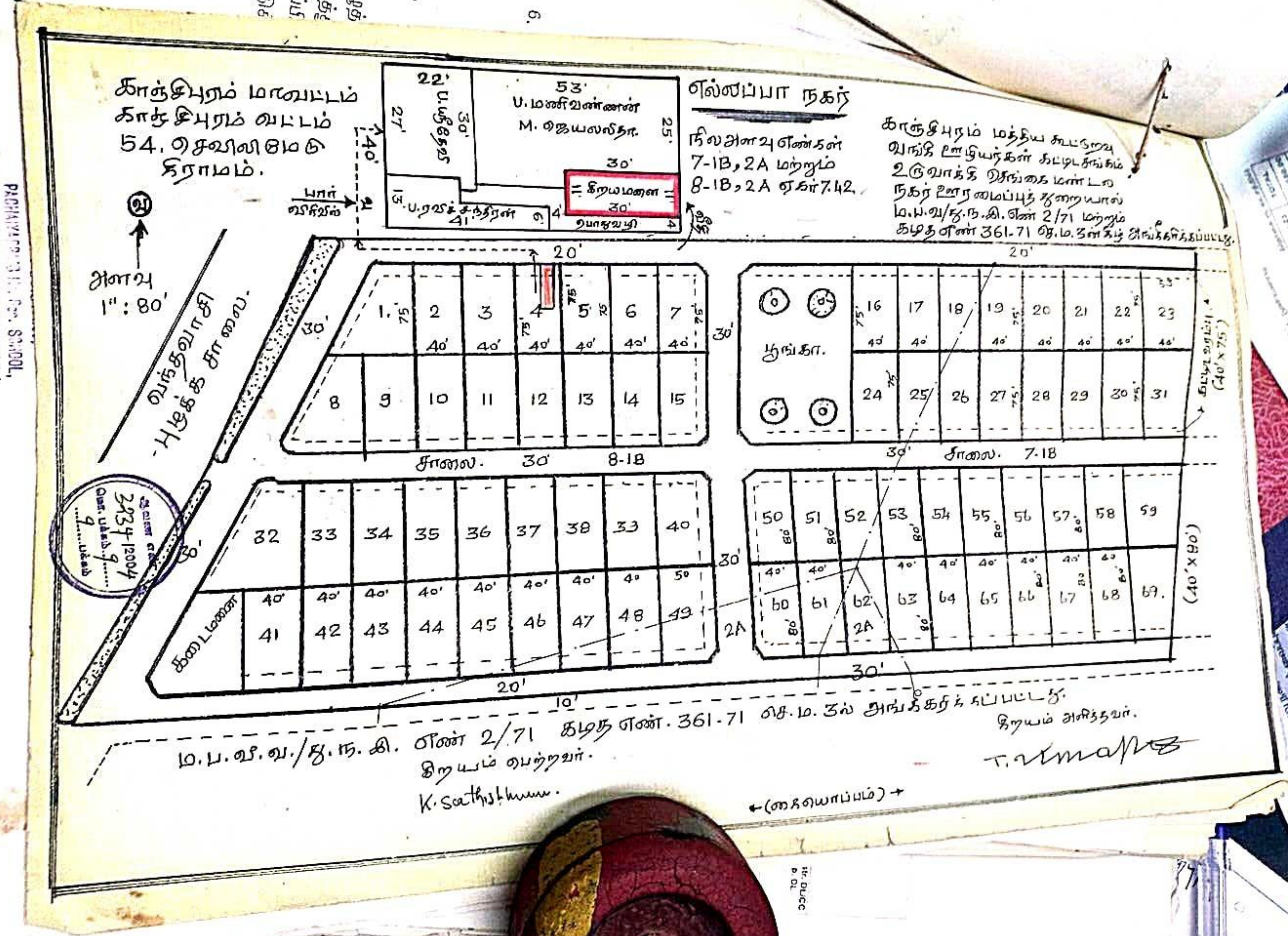
1. ELLAPPAN NAGAR (SPS-5)



Date of Issue: 09-06-2023 18:47:13

250 fv.1

Survey and Settlement Department, Government of TamilNadu


காஞ்சிபுரம் மாவட்டம்
காஞ்சிபுரம் வட்டம்
54. செவிலிமேடு கிராமம்.
அளவு 1": 80'
எல்லப்பா நகர்
நில அளவு எண்கள் 7-1B, 2A மற்றும் 8-1B, 2A ஏக்கர் 7.42.
ப. மணிவண்ணன்
M. ஜெயலலிதா.
கிரயமனை
பூங்கா.
சாலை. 30' 8-1B
சாலை. 7-1B
கடைமனை
(40' x 75')
(40' x 80')
ம.ப.வ.வ./கு.ந.கி. எண் 2/71 கடித எண். 361-71 தெ.ம.3ல் அங்கீகரிக்கப்பட்டது.
கிரயம் பெற்றவர்.
கிரயம் அளித்தவர்.
←(கையொப்பம்)→
3234/2004

2. LAKSHMI VAIKUNTHAVALLI NAGAR (LS-6A)

District : Kancheepuram

Taluk : Kancheepuram

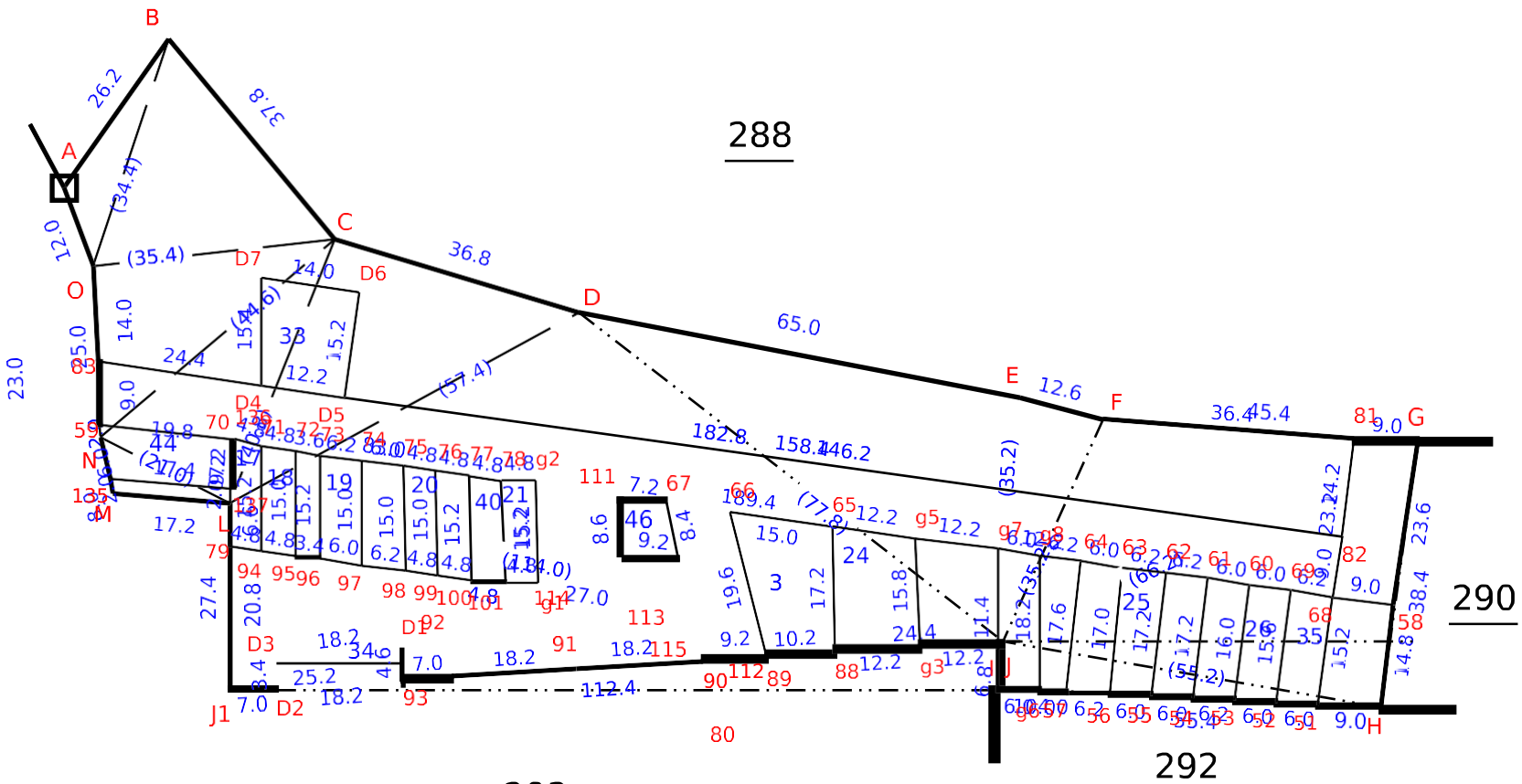
Village : Orrikai [52]

Survey No : 289

Area : Hect 00 Ares 16.78

Scale : 1 : 1000

2. LAKSHMI VAIKUNTHAVALLI NAGAR (LS-6A)



Date of Issue: 28-05-2023 14:44:49

Data Digitally Signed By
BHUVANESWARAN MOHANDASS
260 fv.6

Survey and Settlement Department, Government of TamilNadu

2. LAKSHMI VAIKUNTHAVALLI NAGAR (LS-6A)

அளவர் / உதவி வரைவாளர்

வரைவாளர் நிலை - 3

மேற்பார்வையாளர் / வரி -2

விற்கப்படாத மனைகளின் பரப்பு

மனை எண்கள்	ச.அடி	மனை எண்கள்	ச.அடி
1	1865	65	2000
2	1835	66	2000
3	1805	67	2000
4	1860	68	2000
5	1965	69	2000
6	2160	70	2000
7	2080	71	2298
8	2155	72	2000
9	2270	73	2000
10	2407	74	2000
11	2000	75	2000
12	2000	76	2000
13	2249	78	1177
14A	916	79	1518
15	1085	80	1001
16	1495	81	1949
17	2106	82	1212
18	2000	83	1200
19	2000	84	1200
20	2000	85	1200
21	2306	86	1200
22	2746	87	1200
23	2530	88	1200
24	2435	89	1200
25	2340	90	1337
26	2245	91	1000
27	2150	92	1000
28	2050	93	1000
29	1471	94	1000
30	2781	95	1000
31	2000	96	1000
32	2000	97	1262
33	2398	98	1150
34	2443	99	1000
35	1800	100	1000
36	2000	101	1000
37	2000	102	1000
38	2000	103	1000
39	2160	104	1000
40	2975	105	1069
41	3157	106	962
42	2665	107	1000
43	1826	108	1000
44	2058	109	1000
45	2000	110	1740
46	2000	111	1160
47	2000	112	1160
48	2000	113	1160
49	2000	114	1160
50	2000	115	1160
51	2000	116	1160
52	2000	117	1160
53	2000	118	1160
54	2000	119	1160
55	2000	120	1160
56	2000	121	1160
57	2000	122	1160
58	2000	123	1160
59	2000	128	700
60	2000	129	740
61	2000	130	780
62	2000	131	1022
63	2000	132	1069
64	2000		

விற்கப்படாத மனைகளின் பரப்பு

மனை எண்கள்	ச.அடி	மனை எண்கள்	ச.அடி
133	986	150	1000
134	1092	151	1000
135	1197	152	1000
136	1320	153	1000
137	1431	154	1000
124	1180	155	1000
125	1200	156	1000
126	1200	157	1000
127	1383	158	1000
128	700	159	1000
138	1575	160	1000
139	1000	161	1000
140	1000	162	1000
141	1000	163	1000
142	1630	164	1000
143	1000	165	1000
144	1000	166	1000
145	1000	167	1000
146	1000	168	1000
147	1000	169	1000
148	1000	மொத்தம்	259139
149	1000		

பூங்கா

மனை எண்கள்	ச.அடி
14	4280
77	2492
173	746
174	2591
175	1712
176	3902
177	2000
178	4492
179	675
180	1035
181	2012
மொத்தம்	25937

விற்பனை செய்த மனைகளின் பரப்பு

மனை எண்கள்	ச.அடி
170	2260
171	2775
172	4230
மொத்தம்	9265

அனுமதியற்ற மனைகள் மற்றும் மனைப்பிரிவுகள் வரன்முறைப்படுத்தும் திட்டம் - 2017

அரசாணை நிலை எண் : 78 வீட்டு வசதி மற்றும் நகர்புற வளர்ச்சிபுடி4(3)| துறை நாள் : 04.05.2017. (ம)அரசாணை நிலை எண் : 172 வீட்டு வசதி மற்றும் நகர்புற வளர்ச்சிபுடி4(3)| துறை நாள் : 13.10.2017.

	காஞ்சிபுரம் உள்ளூர் திட்டக்குழுமம்
	காஞ்சிபுரம் பெருநகராட்சி
மாவட்டம்	காஞ்சிபுரம்
வட்டம்	காஞ்சிபுரம்
உள்ளாட்சி	காஞ்சிபுரம் பெருநகராட்சி
கிராமம்	ஓரிக்கை
சர்வே எண்	289 & 293
கிராமம்	செவ்வலிமேடு
சர்வே எண்	47/2A, 2B, 5, & 48/1A,1B2
அளவு	1 ஏக்குலம் = 66 அடி.
கோப்பு எண்	190/2018 கா.உ.தி.கு

குறிப்பு:-
மனைப்பிரிவின் மொத்தப்பரப்பு 9.09 ஏக்கர் (அ) 395960.4 ச.அடி

மொத்த மனைகள் - 172 (1 - 13,14A, 15 - 76, 78 -172)
மனைப்பிரிவு எல்லை
உத்தேச சாலை
நிலையில் உள்ள சாலை
உள்ளாட்சிக்கு தானமாக ஒப்படைப்பு செய்ய வேண்டிய பகுதி:

திறந்தவெளி ஒதுக்கீடு இடம் (OPEN SPACE RESERVATION) 25937.00 ச.அடி (10.00%)

மனைப்பிரிவு ல் அமையும் உத்தேச சாலைகள் உள்ளாட்சிக்கு தானமாக ஒப்படைப்பு செய்யப்பட வேண்டும்.

1. விற்பனை செய்த மனைகளின் பரப்பு - 9265.00 ச.அடி
2. விற்கப்படாத மனைகளின் பரப்பு - 259139.00 ச.அடி

	கட்டட வரம்பு	முழுமை முறுக்கு
23' - 0" சாலைக்கு	5' - 0"	5' - 0" x 5' - 0"
30' - 0" சாலைக்கு	10' - 0"	5' - 0" x 5' - 0"

செலுத்தப்பட வேண்டிய கட்டணங்கள்:

1. பரிசீலனை கட்டணம் மனை ஒன்றுக்கு சூபாய் 500 வீதம் 169 மனைகளுக்கு மட்டும் பெறப்பட்டுவிட்டது. இதர மீதி 3 மனைகளுக்கு Member Secretary Kancheepuram Local Planning Authority என்ற பெயரில் வங்கி வரைவோலை (DD) பெறப்பட வேண்டும்.
2. வரன்முறைப்படுத்துதல் கட்டணம் ஒவ்வொரு மனைப்பரப்புக்கேற்ப 1 சதுர மீட்டருக்கு சூபாய் 60 வீதம் கீழ்காணும் அரசு கணக்கில் செலுத்தப்பட வேண்டும்.

Head Of Account:
0217 Urban Development 60 Other Urban Development Schemes 800 Other Receipts, At Receipts Under Regularisation Charges of Unapproved Layouts and Plots - DTCP
(DPC : 0217 - 60 - 800 - AT - 0007)

3. வளர்ச்சி கட்டணம் மனைகளின் மனைப்பரப்புக்கேற்ப ஒவ்வொரு மனைக்கும் 1 சதுர மீட்டருக்கு சூபாய் 250 வீதம் உள்ளாட்சி தனி கணக்கில் செலுத்தப்பட வேண்டும்.

நிபந்தனை:-

1. உறுப்பினர் செயலர் (பொ) அவர்களின் உத்தரவு கடிதம் ந.க.எண்: 190 /2018 கா.உ.தி.கு நாள் : 01.03.2018-ல் குறிப்பிடப்பட்ட நிபந்தனைகள் மற்றும் கட்டணங்கள் செலுத்திய பின்னரே இம்மனைப்பிரிவு ஒப்புதல் வழங்கப்பட்டதாகும்.

ம.வ/ கா.உ..தி.கு எண் - 54(R)/2018

உறுப்பினர் செயலர் (பொறுப்பு).
காஞ்சிபுரம் உள்ளூர் திட்டக்குழுமம்.
காஞ்சிபுரம்.

3. ADHIYAMAN NAGAR (LS-6B)

District : Kancheepuram

Taluk : Kancheepuram

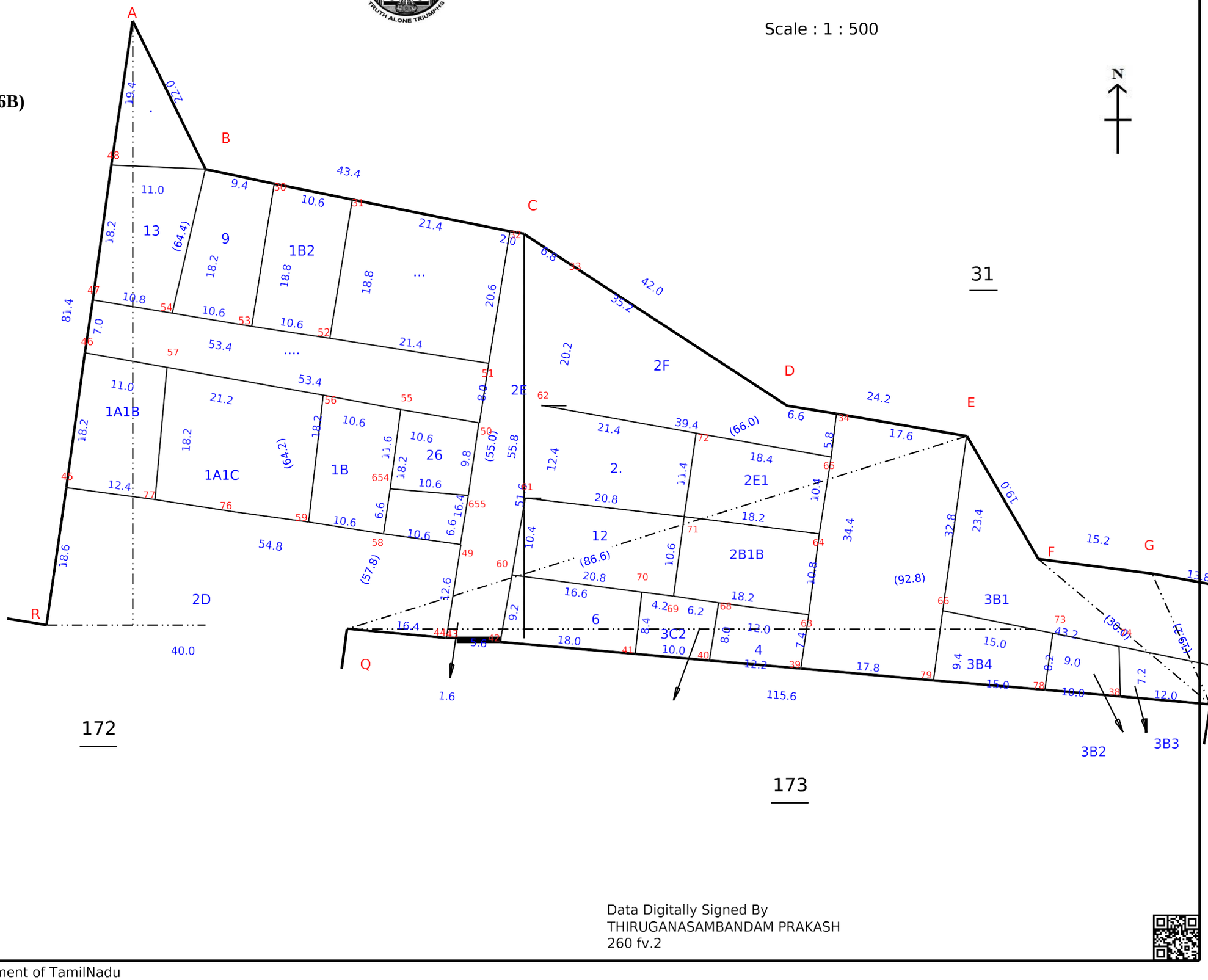
Village : Sevilimadu - A [54]

Survey No : 176

Area : Hect 00 Ares 82.50

Scale : 1 : 500

3. ADHIYAMAN NAGAR (LS-6B)



Data Digitally Signed By
THIRUGANASAMBANDAM PRAKASH
260 fv.2

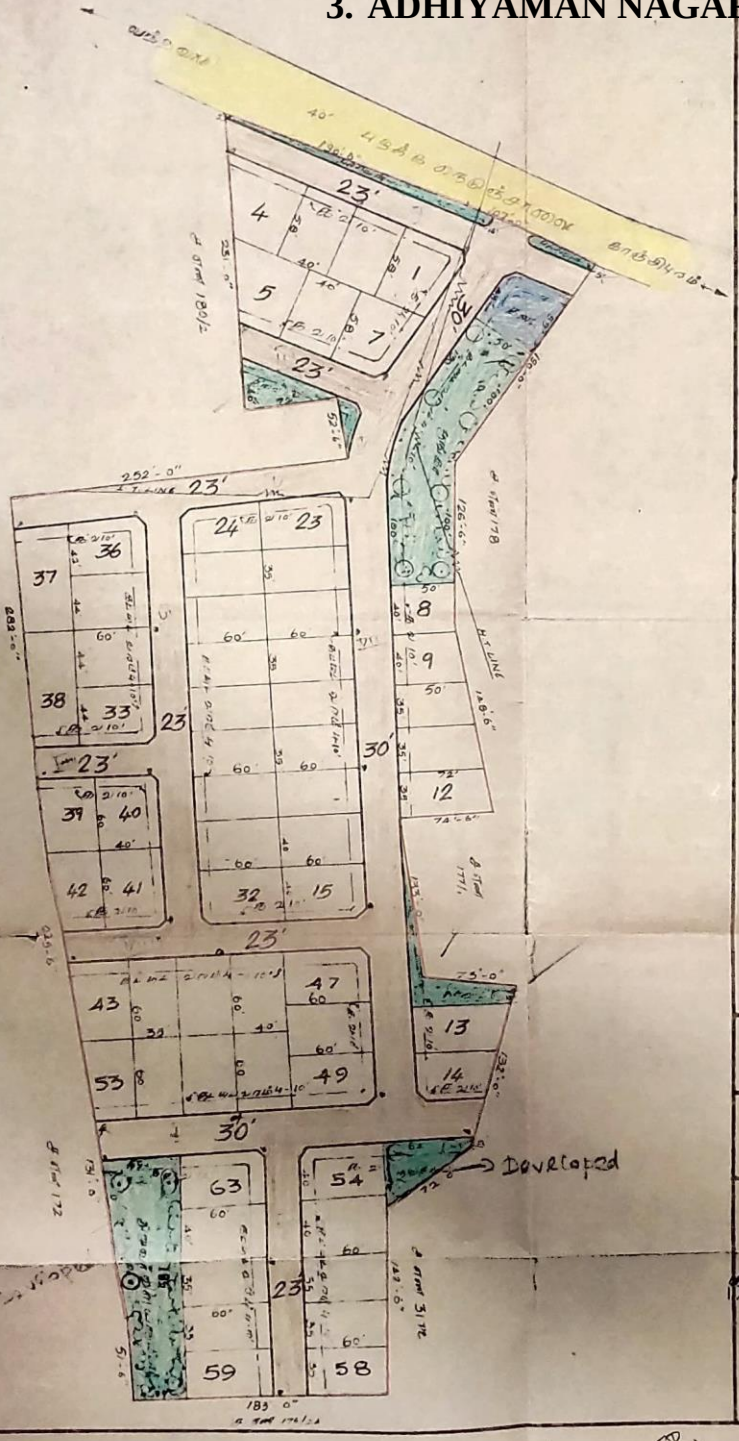
Date of Issue: 09-06-2023 18:29:50

Survey and Settlement Department, Government of TamilNadu

3. ADHIYAMAN NAGAR (LS-6B)

62

13 AUG 97



மனைப்பிரிவு வரைபடம்

மாவட்டம் : செங்கல்பட்டு

வட்டம் : காஞ்சிபுரம்

உள்ளாட்சி மன்றம் : செவிலிமேடு பேரூராட்சி (காஞ்சிபுரம் உ.தி.(மேம்)

கிராமம் : செவிலிமேடு.

நில அளவு எண் : 176/1, 177/2A, 179, 180/1(பு) 181/2

கோப்பு எண் : 2874/87. சை.தை.ம-3

மொத்த பரப்பு : 5.62 ஏக்கர் வார்டு-49

மொத்த மனைகள் : 63 மனைகள் F.ஸ்பேஸ் : 532 ச

பொது உபயோகம் :

தூங்கா : 12478 ச.அடி

புல்வெளி : 1770 ச.அடி

தீரவிடம் : 3528 ச.அடி

சிறுவர் விளையாடும் இடம் : 7150 ச.அடி

மொத்தம் : 24926 10.18%

கடைகள் உபயோகம் : 2650 ச.அடி 1.08%

புழுதிக சாலை :

உத்தேச சாலை :

மனைப் பிரிவு எல்லை :

நிபந்தனைகள்: 1.

2.

அளவு = 1" = 66'-0"

— 21

செதை/ந.உ.கி.எண்- 87-270

ம-ப-200

நகர்-ஊரமைப்பு துணை இயக்குநர்

செங்கை-தென்னார்காடு மண்டலம்,

செங்கல்பட்டு-2.

F

District : Kancheepuram

Taluk : Kancheepuram

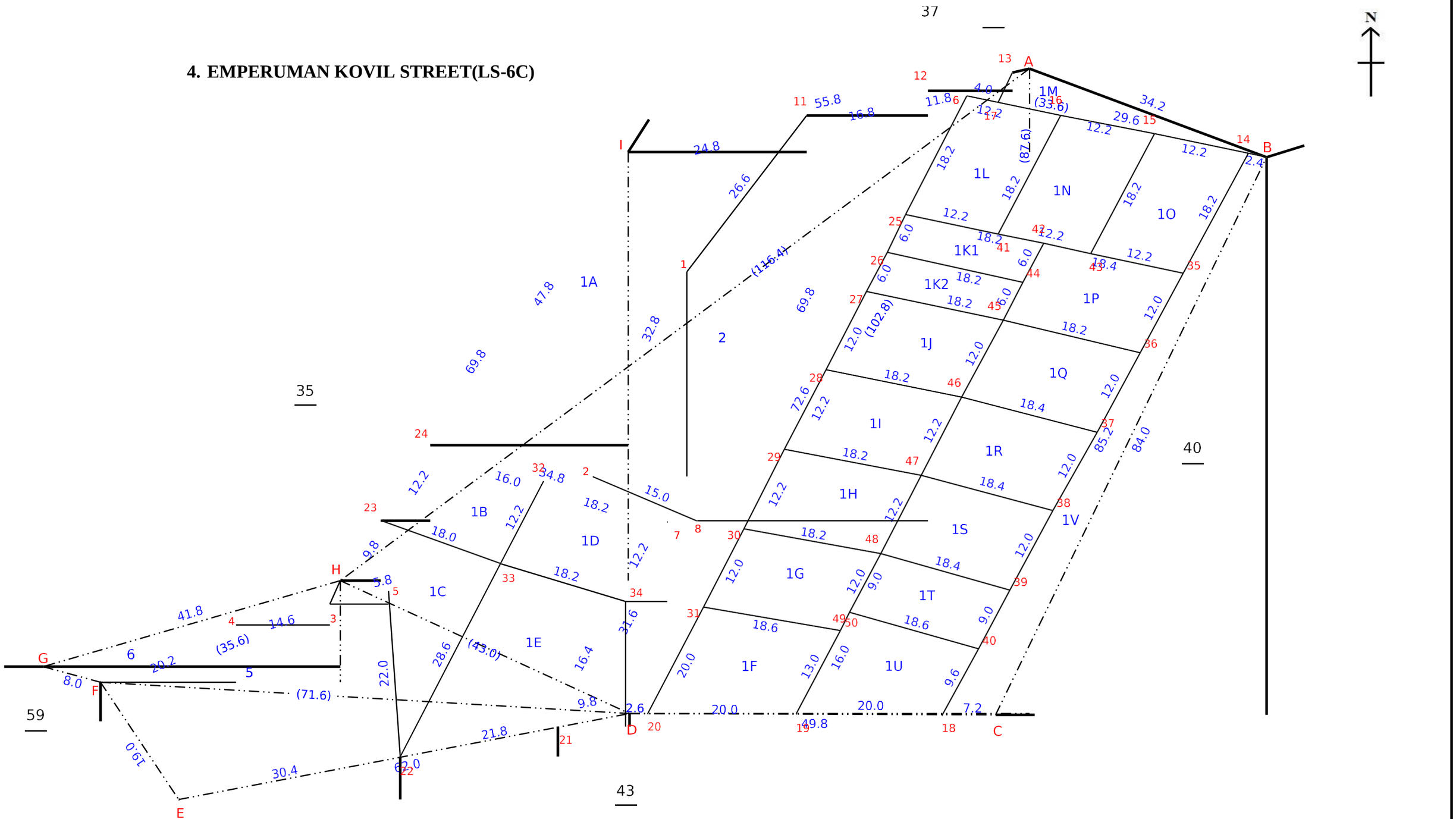
Village : Sevilimadu - A [54]

Survey No : 41

Area : Hect 00 Ares 86.50

Scale : 1 : 500

4. EMPERUMAN KOVIL STREET(LS-6C)

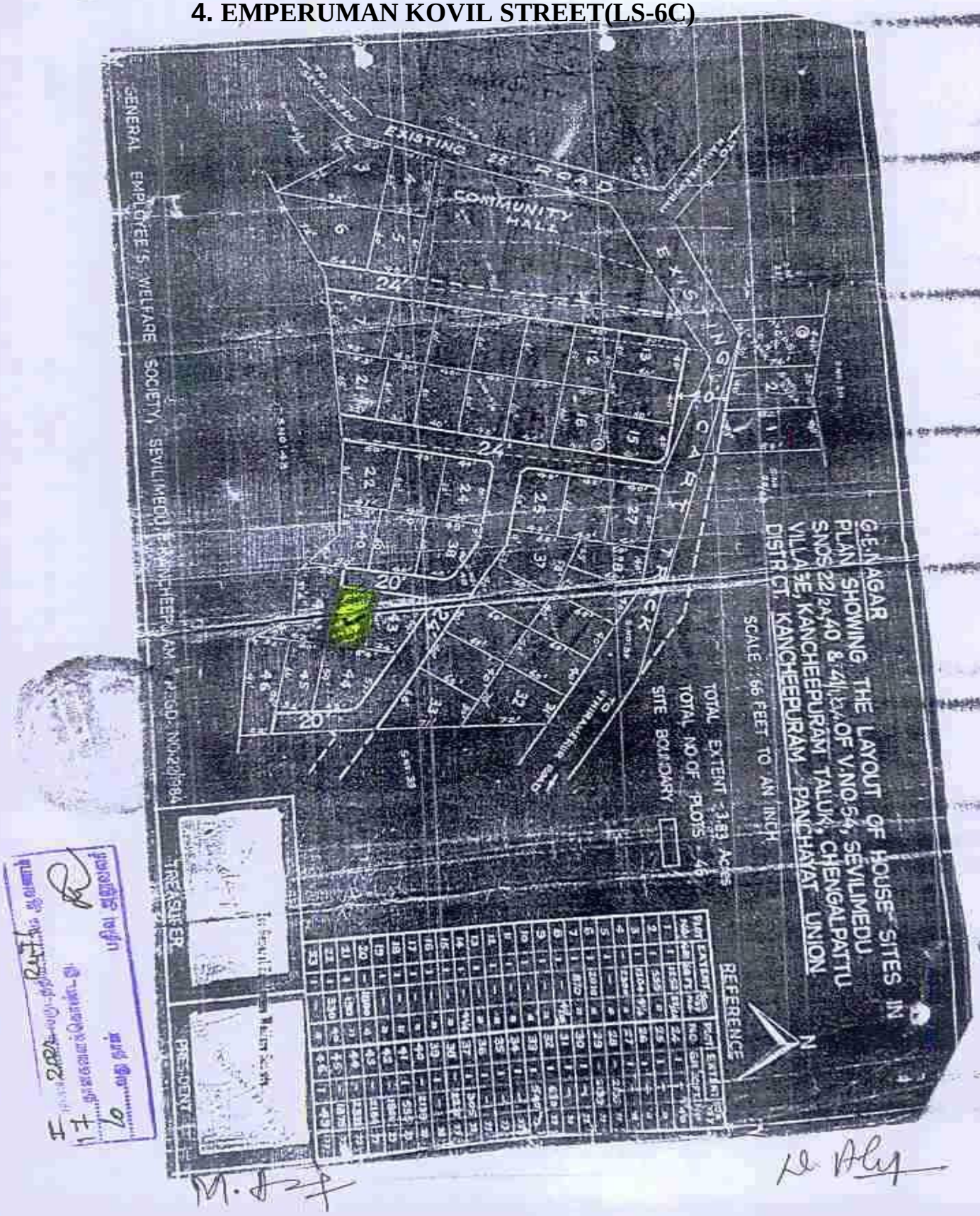


Date of Issue: 09-06-2023 18:01:58

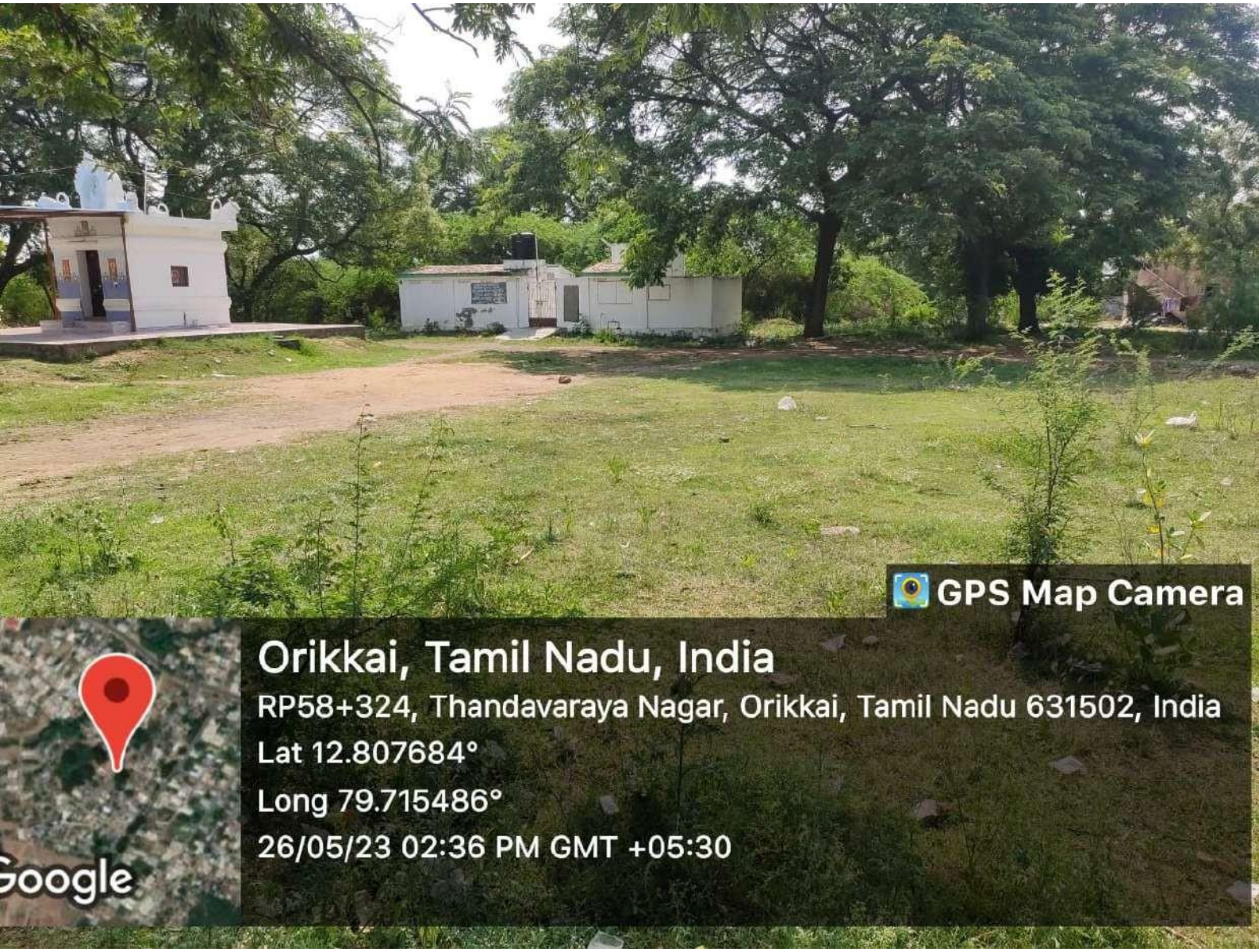
240 fv.1

Survey and Settlement Department, Government of TamilNadu

4. EMPERUMAN KOVIL STREET(LS-6C)



5. ANNA KUDIYIRUPU (LS-7D)



District : Kancheepuram

Taluk : Kancheepuram

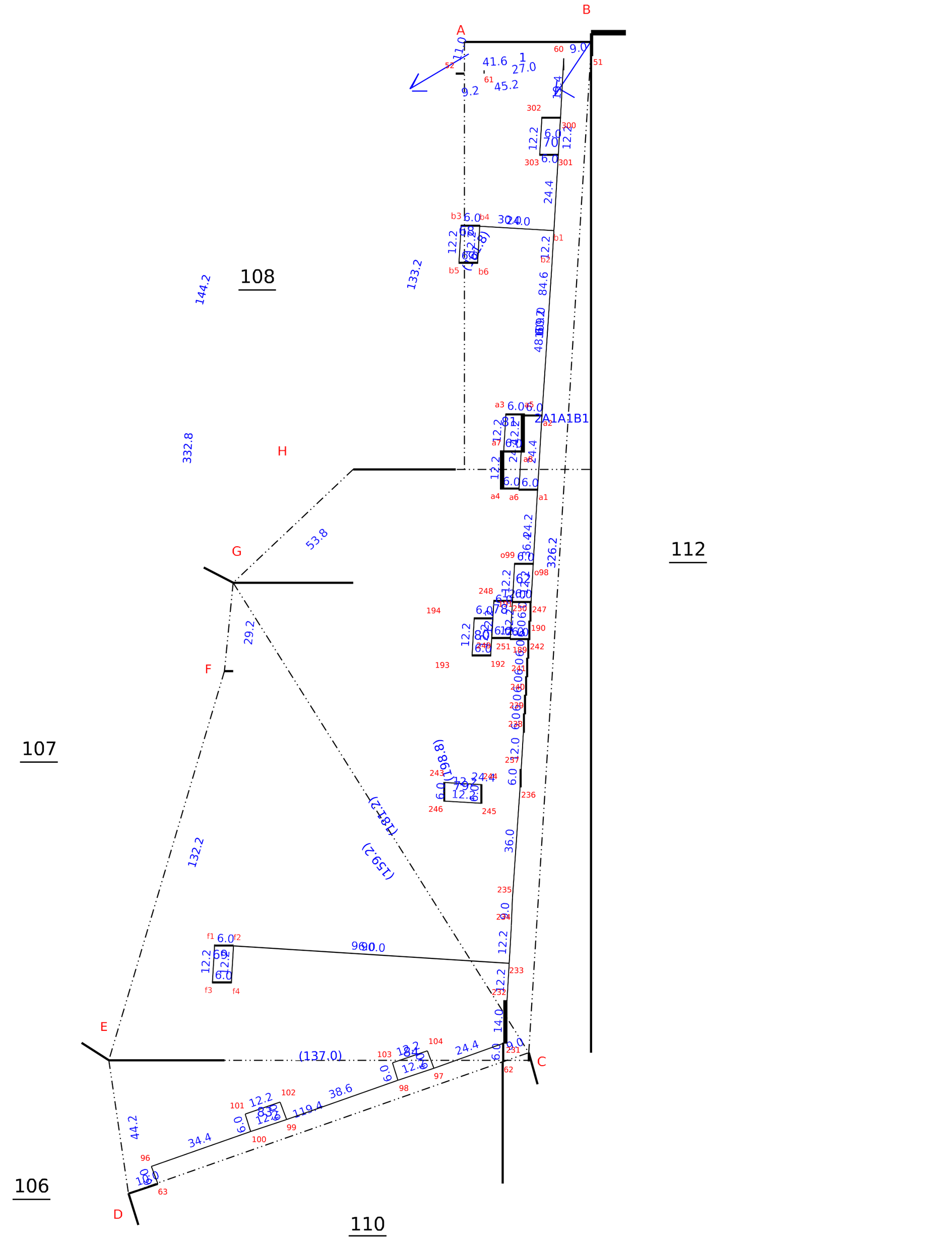
Village : Orrikai [52]

Survey No : 109

Area : Hect 02 Ares 68.47

Scale : 1 : 1008

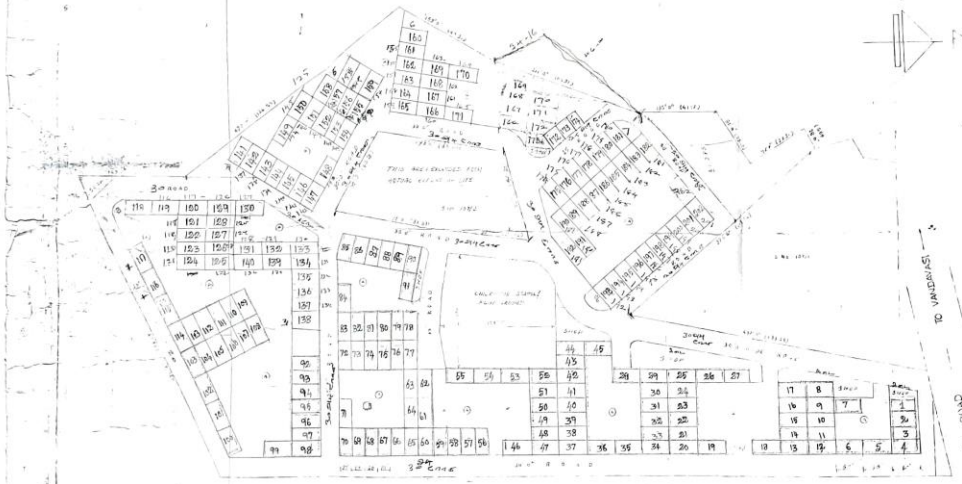
5. ANNA KUDIYIRUPU (LS-7D)



Date of Issue: 08-06-2023 20:51:21

Data Digitally Signed By
BHUVANESWARAN MOHANDASS
260 fv.9

5. ANNA KUDIYIRUPU (LS-7D



LAY OUT PLAN

ARIGNAR ANNA SILK WEAVERS
CO-OP SOCIETY LTD
KANCHIPURAM

LAY OUT PLAN SCALE 1" = 56'-0"

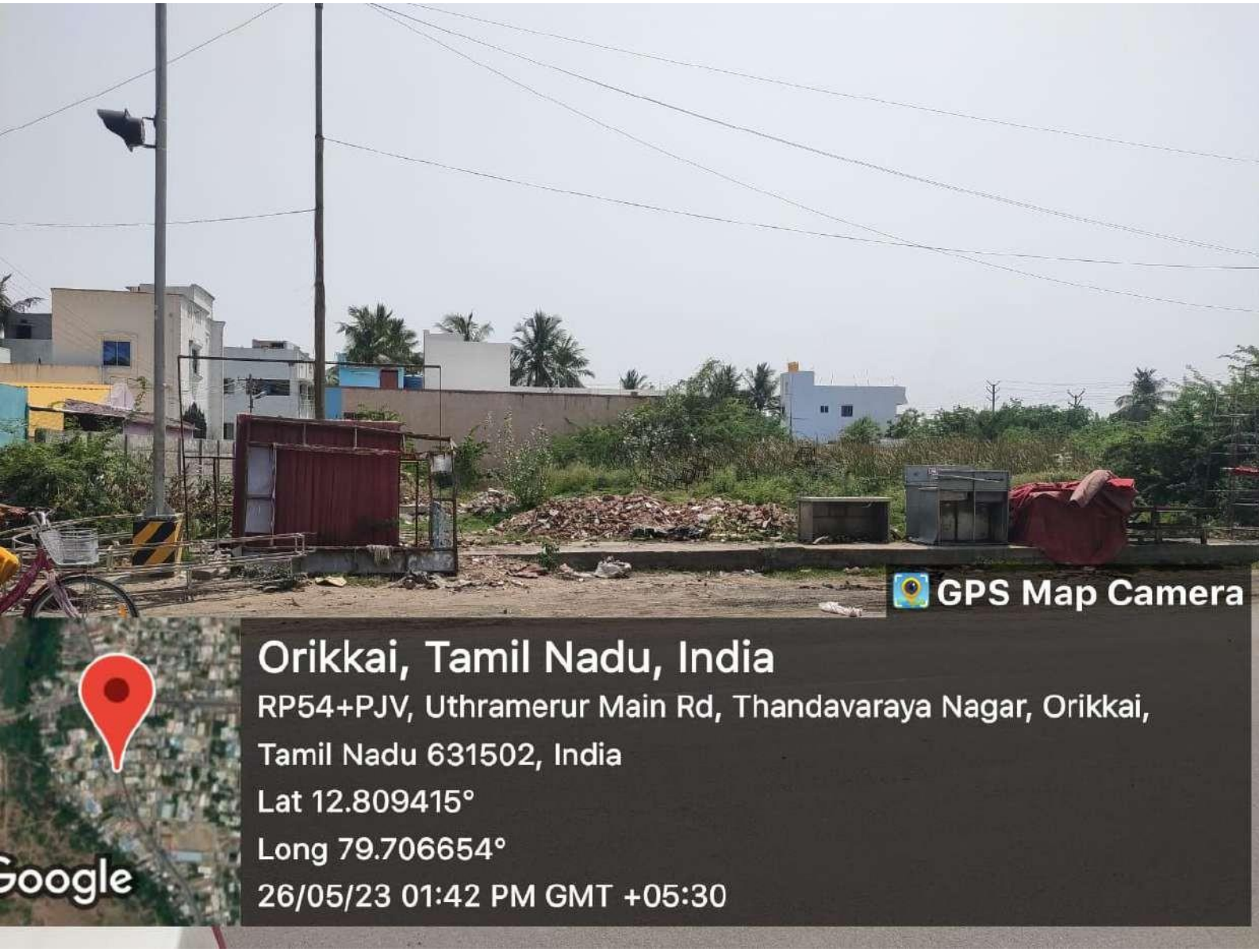
LOCAL BODY	KANCHIPURAM PANCHAYAT UNION
SURVEY NO	10, 18, 101/2 A3, 108/2B, 103/2
VILLAGE	ORIKKAI
TALUK	KANCHIPURAM
DISTRICT	CHINGLEPUT
TOTAL EXTENT	11.16 ACRES (4,86,163 SQ.FT.)
TOTAL PLOTS	202 PLOTS EACH PLOT (45'x26') i.e. 1203sq.ft.

LEGEND

RESIDENTIAL
OPEN COMMUNITY SPACE (A)
SHOPS
CHILDRENS PLAY GROUND
PARK
EXISTING ROAD
PROPOSED ROAD
LAY OUT BOUNDARY

TO ADOPT THE BOUNDARIES AS DETAILED BELOW

6. AMBEDKAR STATUE (LS-7E)



District : Kancheepuram

Taluk : Kancheepuram

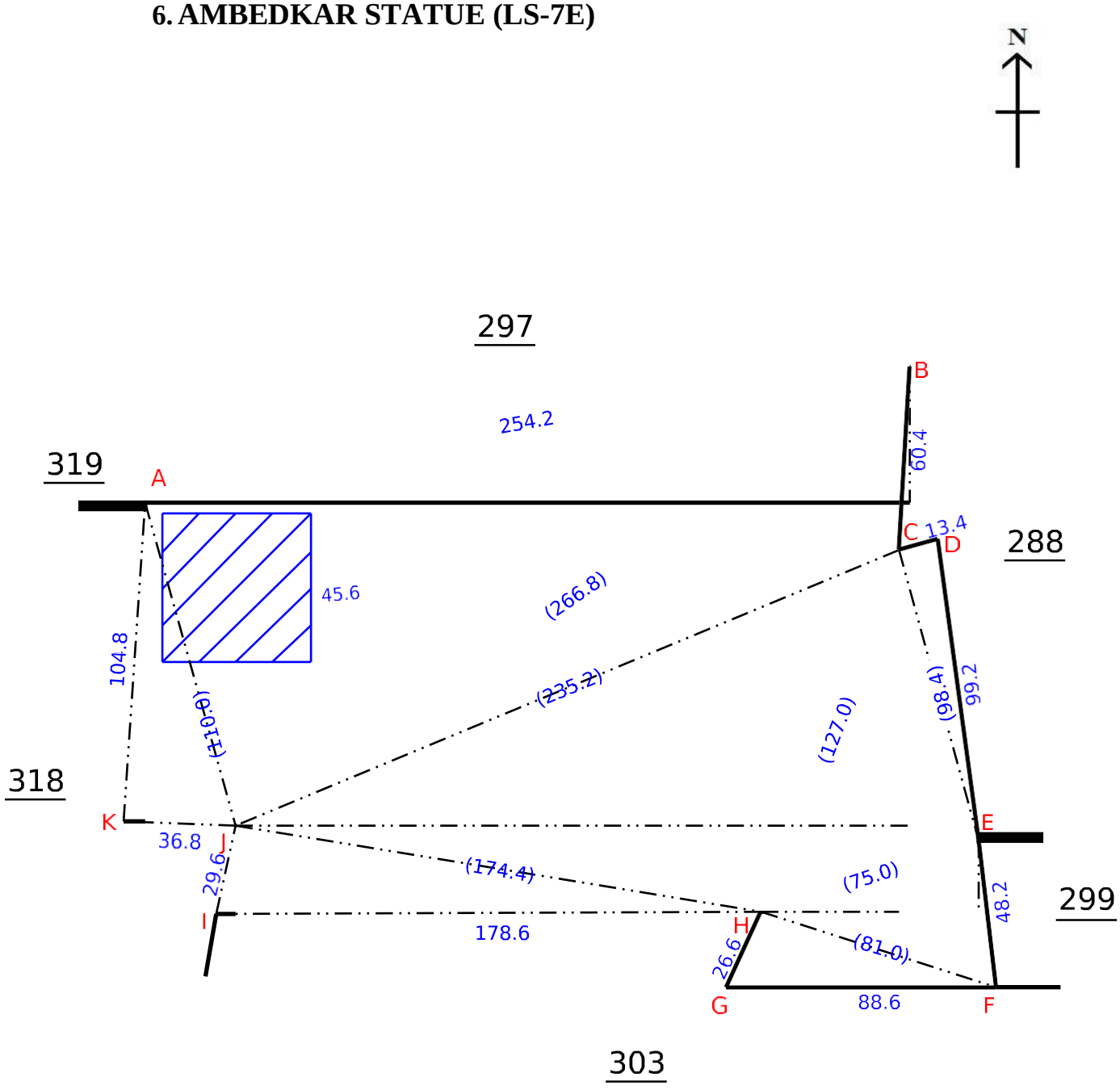
Village : Orrikai [52]

Survey No : 298

Area : Hect 04 Ares 26.50

Scale : 1 : 2000

6. AMBEDKAR STATUE (LS-7E)



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Survey and Settlement Department, Government of TamilNadu

7. NETHAJI NAGAR (MPS-7)

District : Kancheepuram

Taluk : Kancheepuram

Village : Vishnu Kanchi - A [56]

Survey No : 55

Area : Hect 00 Ares 9.15

Scale : 1 : 1072

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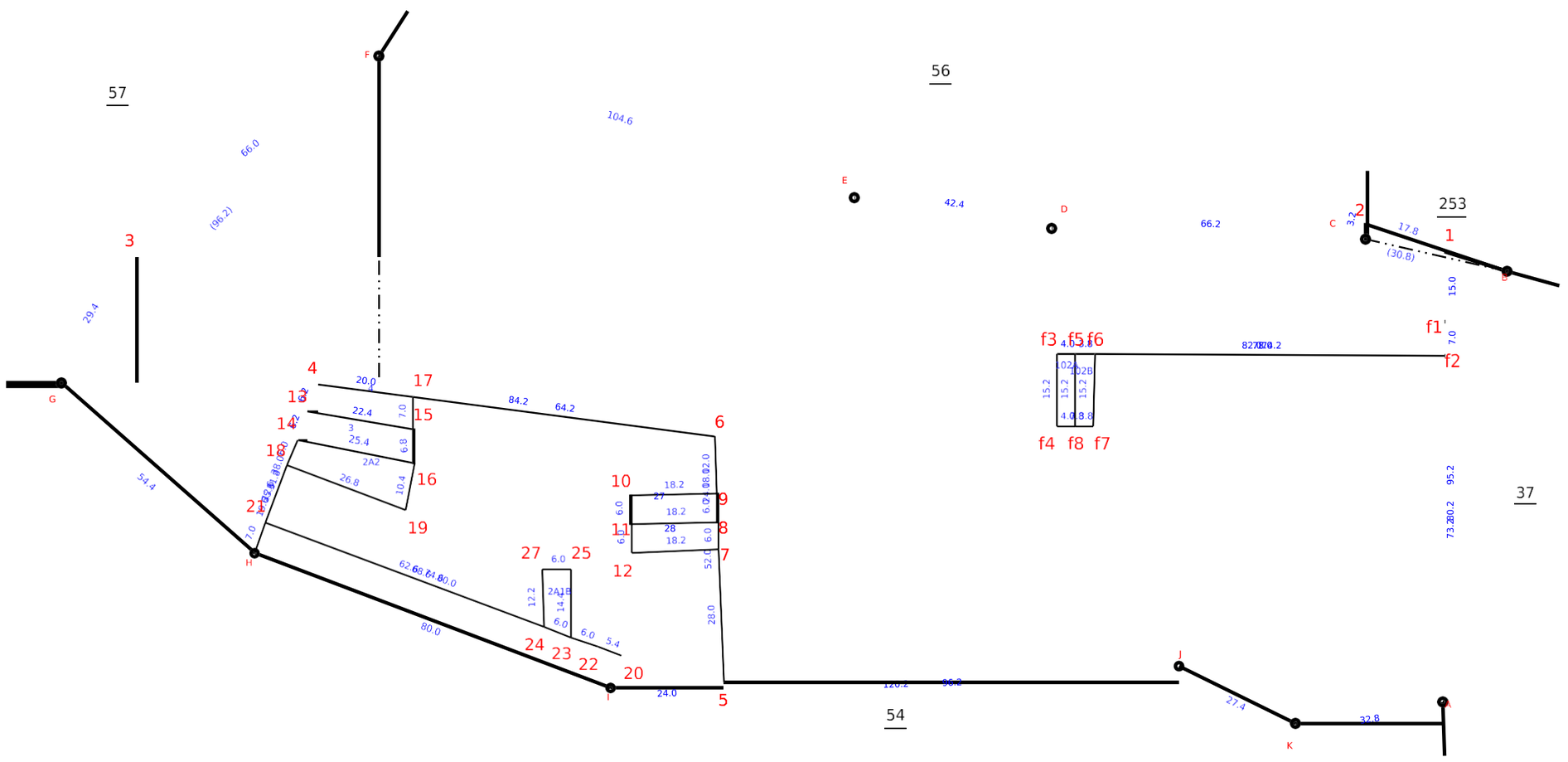
7. NETHAJI NAGAR (MPS-7)



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BHUVANESWARAN MOHANDASS
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Survey and Settlement Department, Government of TamilNadu

8. JJ NAGAR BCK SIDE (COLLEGE GROUND) (SPS-8)

காஞ்சிபுரம்.

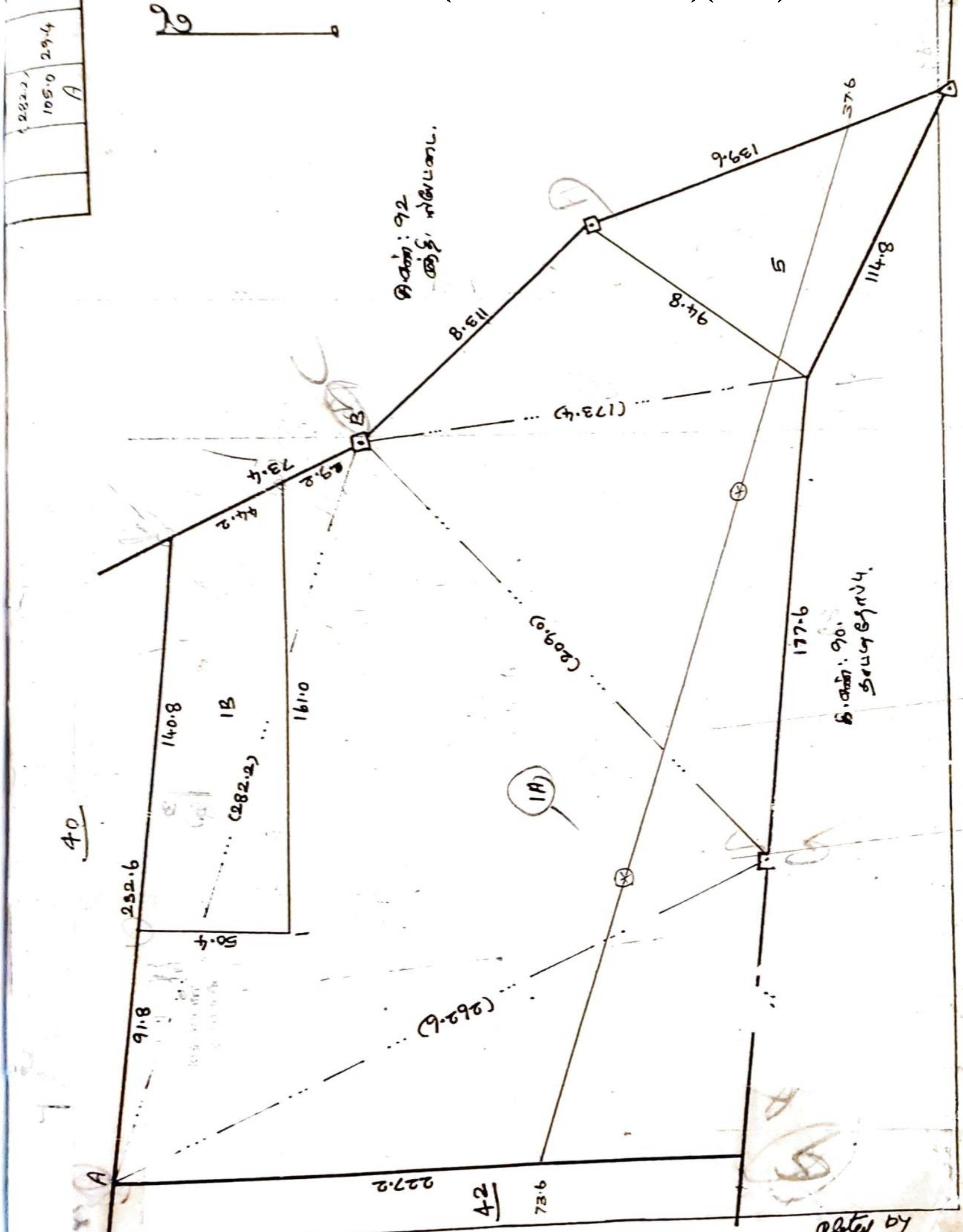
கிராமம் எண்: 71

பெயர்: கதிர்பேட்டை.

புல எண்: 41.

பரப்பு : ஹெக்டேர் 7 ஏர்: 11.0

8.JJ NAGAR BCK SIDE (COLLEGE GROUND) (SPS-8)



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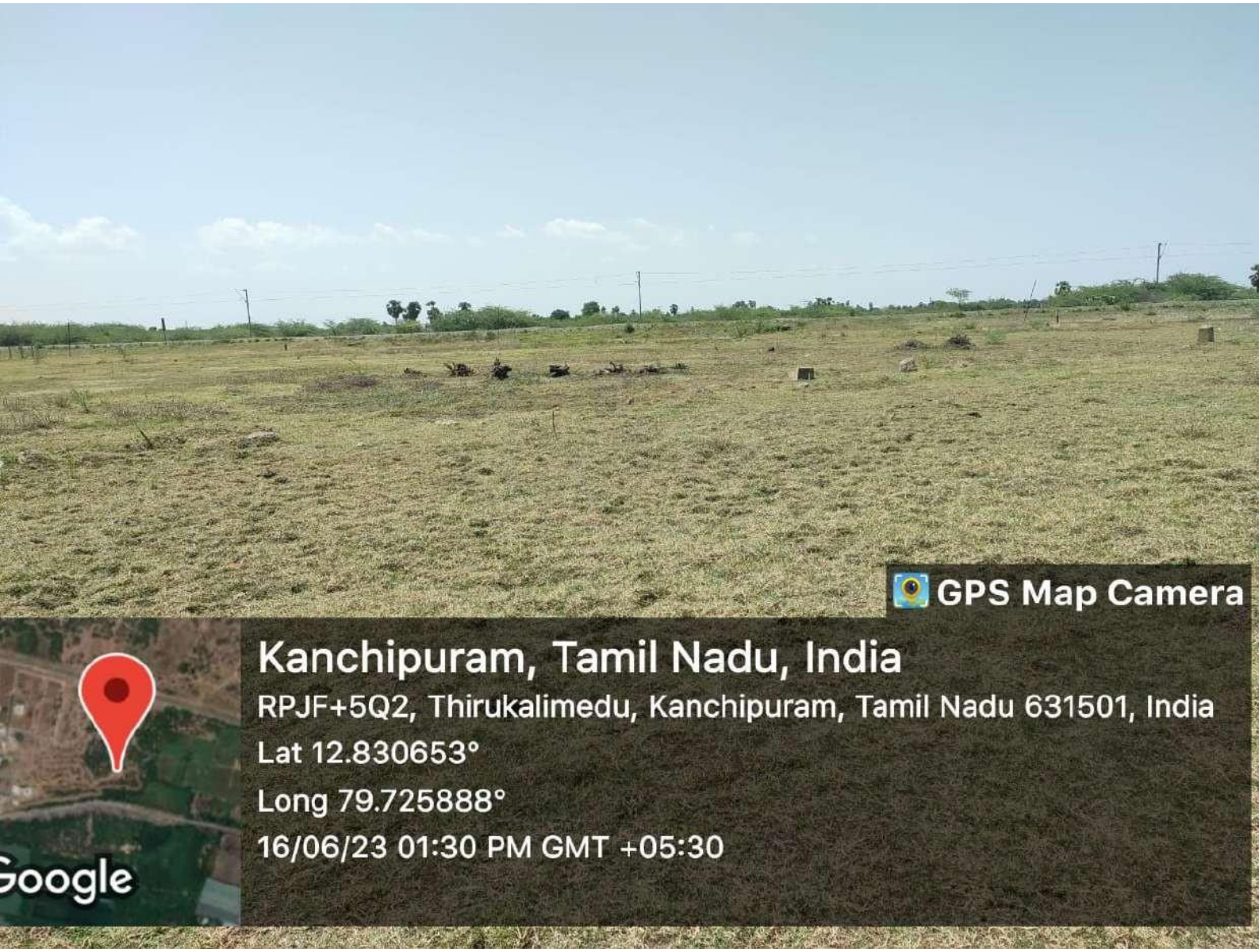
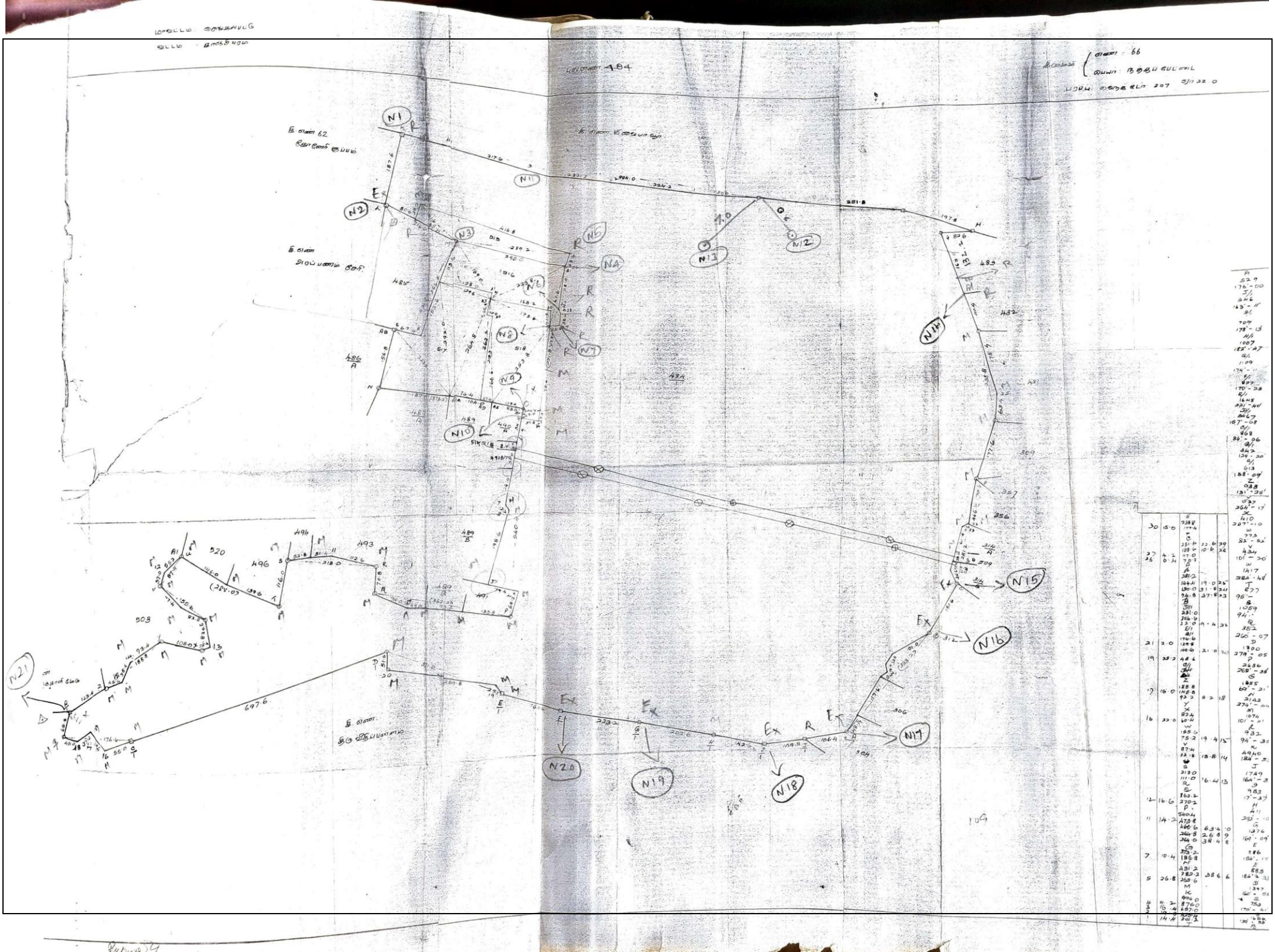
Plotted by N.Sambandam F.S 26.2.98.

9. NATHAPETTAI (MPS-9)





ANNEXURE 3 CLIMATE RESILIENCE REPORT

General

Kancheepuram City Municipal Corporation is implementing UGSS to the uncovered Areas. The brief project components are collection of Sewage, pumping and treating the sewage collected and disposal of the effluent into Vegavathi river. Also propose to cover the entire uncovered collection network for about 168.722 km and providing house service connections.

The climate screening in terms of three extreme events and mitigation measures are proposed. The three extreme events are Flood, drought and High winds. The sustainability of this scheme in terms extreme events were analysed.

Kancheepuram Climate Facts

Kancheepuram is falls under North Eastern Agro climatic zone, with varying soil types 1. Red Sandy Loam 2. Clay Loam 3. Saline coastal Alluvium.

Its falls under Seismic Zone III.

Kancheepuram generally experiences hot and humid climate throughout the year with heavy to moderate rainfall during the monsoon seasons. The normal monsoon pertains to around 1200 mm rainfall in Kancheepuram with the highest amount of rainfall in the month of October and November. Kancheepuram agriculture mainly depends on monsoon. The irrigation in Kancheepuram is mostly taken care by the tanks and wells.

During the summer season, the maximum temperature is 37.6 degrees and the minimum is 20.1 degree Celsius. During the winters, the maximum and minimum temperature is 28. 7 and 19.8 degree Celsius respectively. The average high and average low temperatures throughout the year are 37.5 and 20.4 respectively. Relative humidity varies between 58 percent and 84 percent throughout the year. Relative humidity is higher between November and January and is lowest throughout June. The humidity reaches its peak during the morning and is lowest in the evening that's why it is advisable to visit the temples in Kancheepuram during the evening.

Precipitation:

Percent Change in Annual Rainfall for Kancheepuram (district)

	2020s	2050s	2080s
Annual Rainfall	-1.0%	-5.0%	-1.0%

Source: ENVIS website accessed on 01.06.2023.

As per the ENVIS report, the annual precipitation for Kancheepuram district will be fall short by 1 %. However this will not affect the present sub project due to the following factors

1. During Increased floods, the Machine holes shall be kept closed. However, during heavy rains, the STP staff shall be alerted in order to initiate Bypass in the Treatment plant.
2. During low flows, Jet rodding shall be done to avoid desilting.

Table 3 Changes in Temperature in Kancheepuram

Parameter	2020s	2050s	2080s
Maximum Temperature	+0.9°C	+2.0°C	+3.0°C
Minimum Temperature	+1.1°C	+2.3°C	+3.4°C

The average change of maximum and minimum temperature for Kanchipuram are expected to increase by **3.0°C** and **3.4°C** respectively by the end of the century. However, this will not affect this sub-project as

1. During Increased floods, the Machine holes shall be kept closed. However, during heavy rains, the STP staff shall be alerted in order to initiate Bypass in the Treatment plant.
2. During low flows, Jet rodding shall be done to avoid desilting.

1.1 Climate Change Extreme Events - Kancheepuram

1.1.1 Climate Events and Hazard Level

The thinkhazard use to understand the extrement climate events for Kancheepuram District. Level of hazard provided in the following table.

Table 22 Extreme events and Hazard level, Chennai District

Sl. No	Events	Hazard level
1.	River flood	High
2.	Coastal flood	High
3.	Cyclone	High
4.	Water Scarcity	High
5.	Extreme Heat	High
6.	Wild Fire	High
7.	Tsunami	Medium
8.	Earthquake	Medium
9.	Urban flood	Low
10.	Land slide	Very Low

Source: thinkhazard.org/en/report/

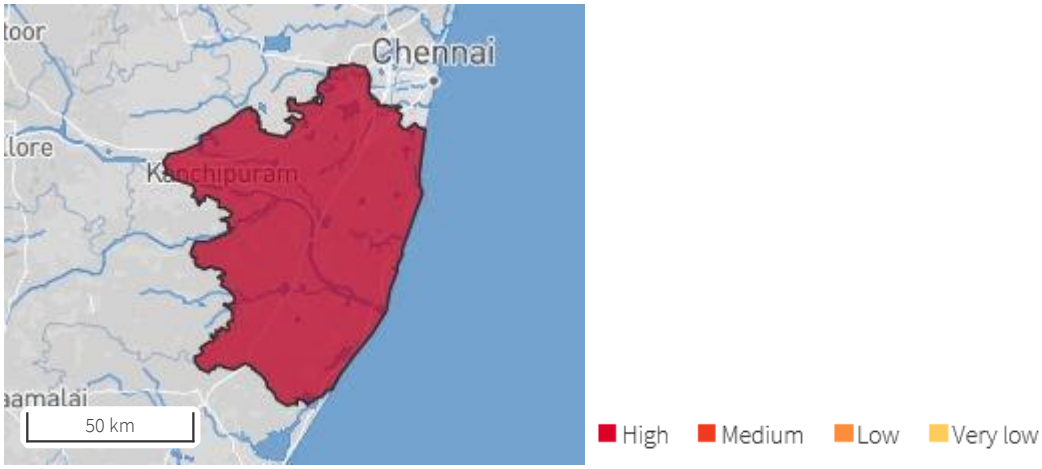
Out of 10 events, the hazard levels are high for 6 events, such us River Flood, Coastal flood, Cyclone, Water Scarcity, Extreme Heat, Wild Fire. The hazard level is medium for 2 events, such us Tsunami and earthquake. The hazard level is low and very low for urban flood and land slide events respectively.

1.1.2 Wildfire:

In Kancheepuram, the wildfire hazard is classified as high according to the information that is currently available to this tool. This means that there is greater than a 50% chance of encountering weather that could support a significant wildfire that is likely to result in both life and property loss in any given year. Based on this information, the impact of wildfire must be considered in all phases of the project, in particular during design and construction. Project planning decisions, project design, construction and emergency response planning methods should take into account the high level of wildfire hazard. Note that damage can not only occur due to direct flame and radiation exposure but may also include ember storm and low level surface fire. In extreme fire weather events, strong winds and wind born debris may weaken the integrity of infrastructure. It would be prudent to consider this effect in the design and construction phase of the project. Further detailed information specific to the location and planned project should be obtained to adequately understand the level of hazard.

Climate change impacts: Modeled projections of future climate identify a likely increase in the frequency of fire weather occurrence in this region, including an increase in temperature and greater variance in rainfall. In areas already affected by wildfire hazard, the fire season is likely to increase in duration, and include a greater number of days with weather that could support fire spread because of longer periods without rain during fire seasons. Climate projections indicate that there could also be an increase in the severity of fire. It would be prudent to design projects in this area to be robust to increases in the severity and frequency of wildfire hazard. Areas of very low or low wildfire hazard could see an increase in hazard, as climate projections indicate an expansion of the wildfire hazard zone.

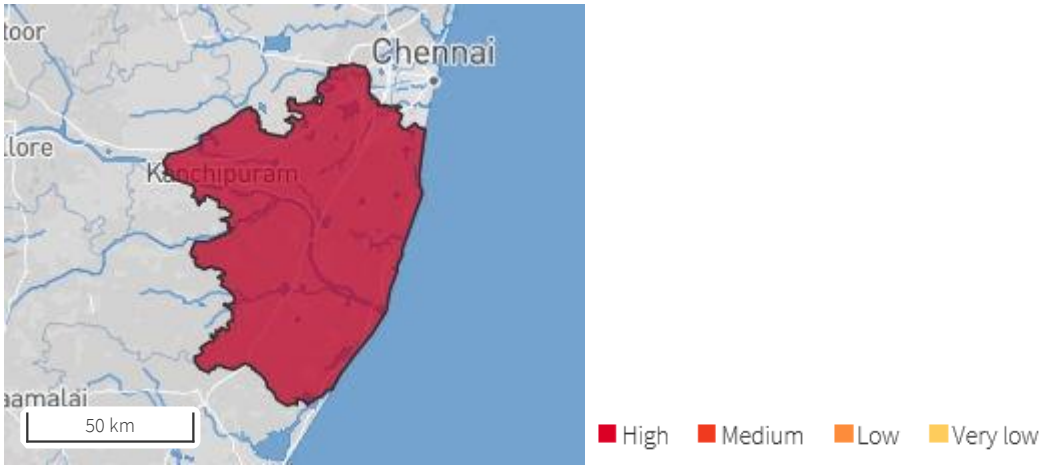
Consider local studies on the impacts of climate change on wildfire trends, before deciding whether to design projects to withstand fire of greater intensity than those previously experienced in this region.



1.1.3 River Flood:

In Kancheepuram, river flood hazard is classified as high based on modeled flood information currently available to this tool. This means that potentially damaging and life-threatening river floods are expected to occur at least once in the next 10 years. Project planning decisions, project design, and construction methods must take into account the level of river flood hazard. Surface flood hazard in urban and rural areas is not included in this hazard classification, and may also be possible in this location. Please see 'Urban Flood' for consideration of urban surface and river flooding. The following is a list of recommendations that could be followed in different phases of the project to help reduce the risk to your project. Please note that these recommendations are generic and not project-specific.

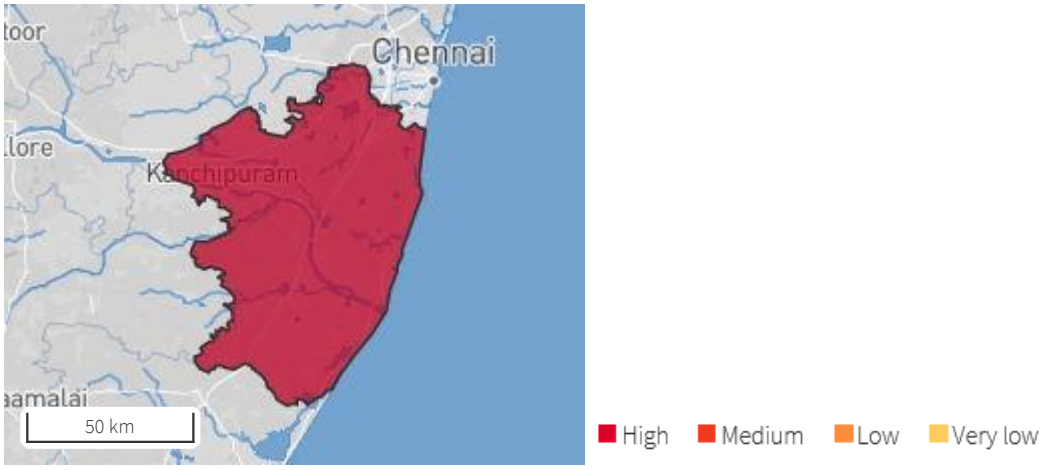
Climate change impacts: Model projections are inconsistent in their estimates of changes in rainfall. The present hazard level may increase in the future due to the effects of climate change. It would be prudent to design projects in this area to be robust to river flood hazard in the long-term.



1.1.4 Coastal Flood:

In Kancheepuram, coastal flood hazard is classified as high according to the information that is currently available. This means that potentially-damaging waves are expected to flood the coast at least once in the next 10 years. Based on this information, the impact of coastal flood must be considered in different phases of the project for any activities located near the coast. Project planning decisions, project design, and construction methods must take into account the level of coastal flood hazard. Further detailed information should be obtained to adequately account for the level of hazard.

Climate change impact: According to the IPCC (2013), there is high confidence that extremes in sea level will increase with mean sea level rise yet there is low confidence in region-specific projections in storm surges. Projects in low-lying coastal areas such as deltas, or in island states should be designed to be robust to projected increases in global sea level.

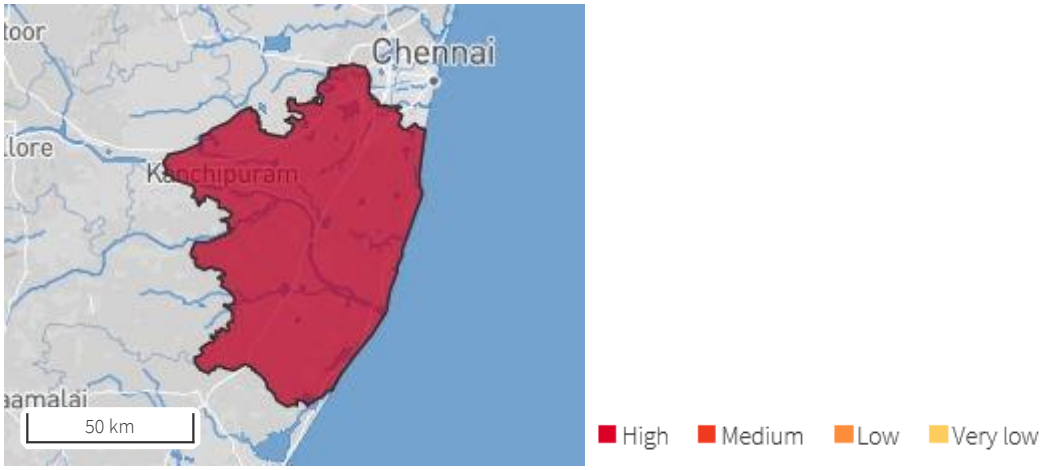


1.1.5 Water Scarcity:

In Kancheepuram, water scarcity is classified as high according to the information that is currently available to this tool. This means that droughts are expected to occur on average every 5 years. Based on this information, the impact of drought must be considered in all phases of the project, in particular its effect on personnel and stakeholders, and during the design of buildings and infrastructure. Project planning decisions, project design, and construction methods must take into account the level of water scarcity. Further detailed information should be obtained to adequately account for the level of hazard.

Climate change impact: Model projections are inconsistent in their estimates of change in drought hazard, which influences water scarcity. The present hazard level may increase in the

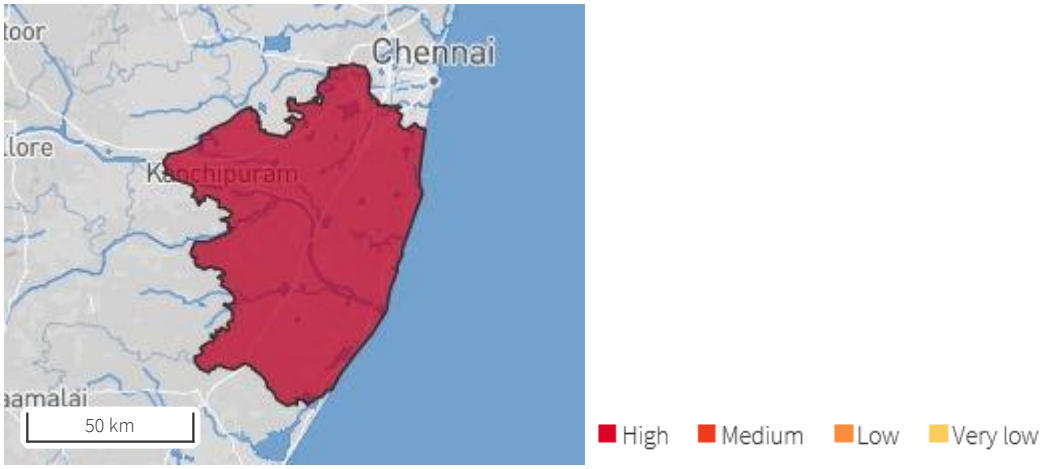
future due to the effects of climate change. It would be prudent to design projects in this area to be robust to increased drought hazard and water scarcity in the long-term.



1.1.6 Extreme Heat:

In Kancheepuram, extreme heat hazard is classified as high based on modeled heat information currently available to this tool. This means that prolonged exposure to extreme heat, resulting in heat stress, is expected to occur at least once in the next five years. Project planning decisions, project design, and construction methods must take into account the level of extreme hazard. The following is a list of recommendations that could be followed in different phases of the project to help reduce the risk to your project. Please note that these recommendations are generic and not project-specific.

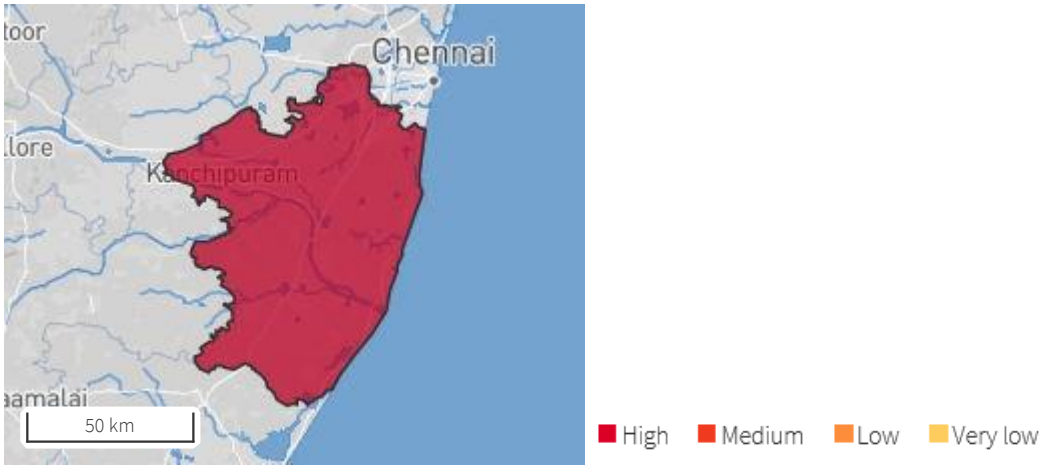
According to the most recent assessment report of the Intergovernmental panel on Climate Change (IPCC, 2013), continued emissions of greenhouse gases will cause further warming, and it is virtually certain that there will be more frequent hot temperature extremes over most land areas during the next fifty years. Warming will not be regionally uniform. In the Himalayas, the temperature increase in the next fifty years will be slightly higher than the worldwide average. In other parts of India, the temperature increase in the next fifty years will be slightly lower than the worldwide average, but still significant. It would be prudent to design projects in this area to be robust to global warming in the long-term.



1.1.7 Cyclone:

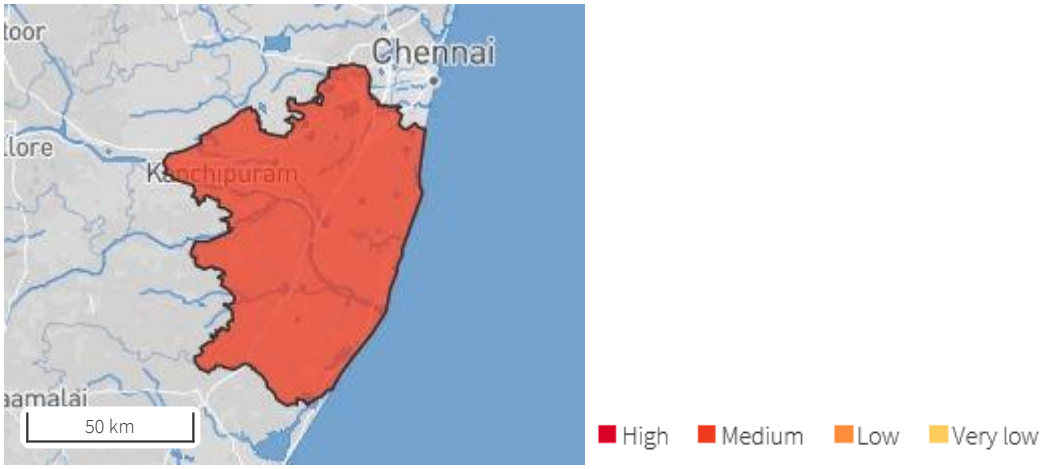
In Kancheepuram, cyclone (also known as hurricane or typhoon) hazard is classified as high according to the information that is currently available. This means that there is more than a 20% chance of potentially-damaging wind speeds in your project area in the next 10 years. Based on this information, the impact of cyclones must be considered in all phases of the project, in particular during design and construction. Project planning decisions, project design, and construction methods should take into account the level of cyclone hazard. Note that damages can not only occur due to wind but also cyclone induced heavy rainfall and subsequent flooding as well as coastal floods in coastal areas. Further detailed information should be obtained to adequately accounted for the level of hazard.

Climate change impact: Global average tropical cyclone wind speed and rainfall is likely to increase in the future, and the global average frequency of tropical cyclones is likely to decrease or remain unchanged. It is possible that the frequency of the most intense tropical cyclones will increase substantially in some ocean regions (IPCC, 2013). The present hazard level in areas currently affected by tropical cyclones may increase in the long-term. Projects located in such areas should be robust to future increases in cyclone hazard.



1.1.8 Earthquake:

In Kancheepuram, earthquake hazard is classified as medium according to the information that is currently available. This means that there is a 10% chance of potentially-damaging earthquake shaking in your project area in the next 50 years. Based on this information, the impact of earthquake should be considered in all phases of the project, in particular during design and construction. Project planning decisions, project design, and construction methods should take into account the level of earthquake hazard. Further detailed information should be obtained to adequately account for the level of hazard.



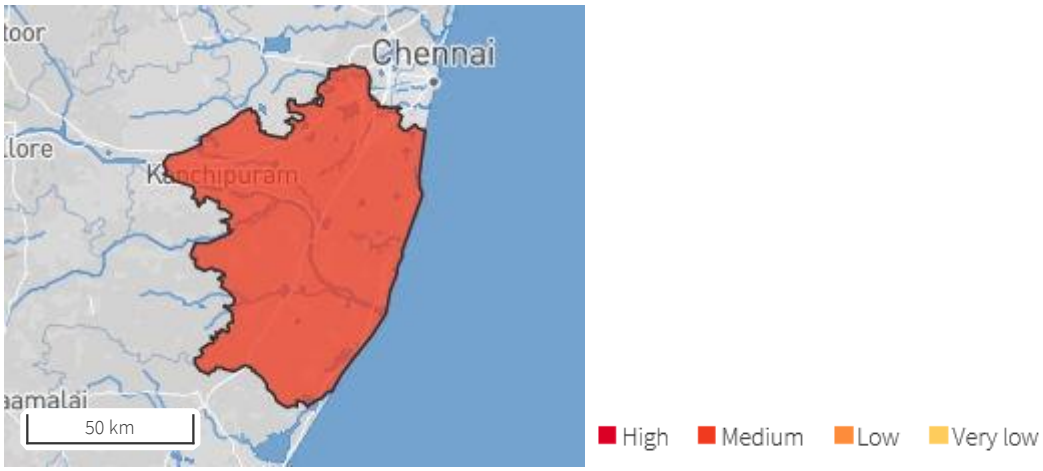
1.1.9 Tsunami:

In Kancheepuram, tsunami hazard is classified as medium according to the information that is currently available. This means that there is more than a 10% chance of a potentially-damaging tsunami occurring in the next 50 years. Based on this information, the impact of tsunami should be considered in different phases of the project for any activities located near the coast. Project planning decisions, project design, and construction methods should take into account the level

tsunami hazard.

Further detailed information should be obtained to adequately account for the level of hazard.

Climate change impact: The areas at risk of tsunami will increase as global mean sea level rises. According to the IPCC (2013), global mean sea level rise depends on a variety of factors, and estimates for 2100 range from ~20 cm to nearly 1 m. However, regional changes in sea level are difficult to predict. Projects in low-lying coastal areas such as deltas, or in island states should be designed to be robust to projected increases in global sea level.

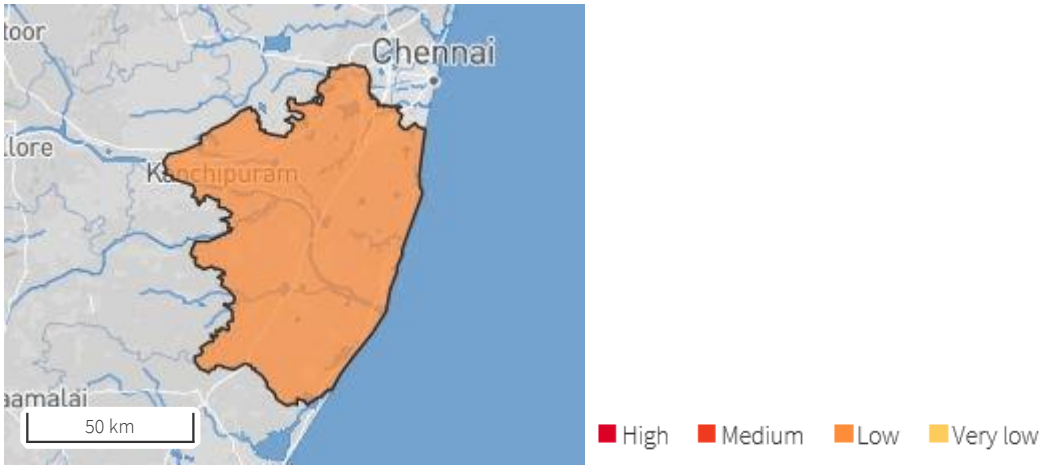


1.1.10 Urban Flood:

In Kancheepuram, urban flood hazard is classified as low based on modeled flood information currently available to this tool. This means that there is a chance of more than 1% that potentially damaging and life-threatening river floods occur in the coming 10 years (return period of c. 1 in 1000 years). Project planning decisions, project design, and construction methods should take into account the level of urban flood hazard. The following is a list of recommendations that could be followed in

different phases of the project to help reduce the risk to your project. Please note that these recommendations are generic and not project-specific.

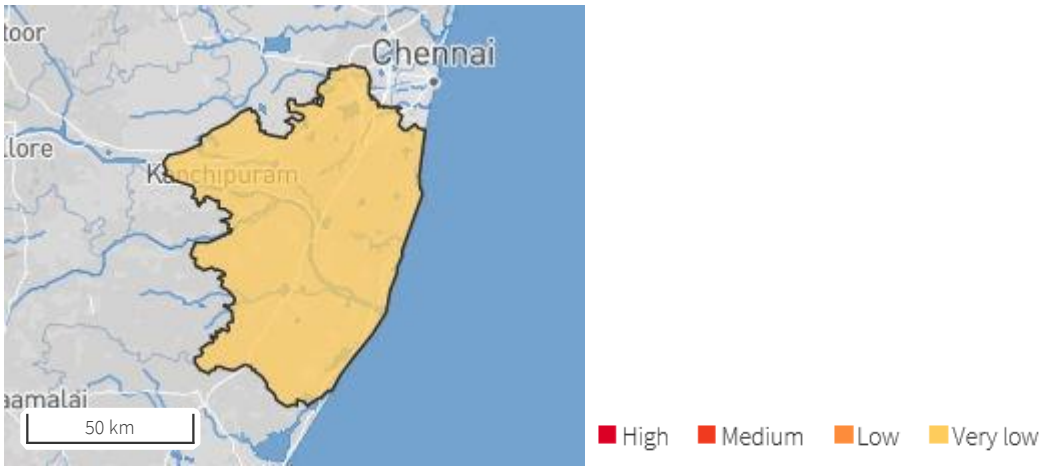
Climate change impacts: Model projections are inconsistent in their estimates of changes in rainfall. The present hazard level may increase in the future due to the effects of climate change. It would be prudent to design projects in this area to be robust to river flood hazard in the long-term.



1.1.11 Landslide:

In Kancheepuram, landslide susceptibility is classified as very low according to the information that is currently available. This means that this area has rainfall patterns, terrain slope, geology, soil, land cover and (potentially) earthquakes that make localized landslides a rare hazard phenomenon. Based on this information, planning decisions such as project siting, project design, and construction methods, may want to consider the potential for landslides. Further detailed information should be obtained to better understand the level of landslide susceptibility in your project area.

Climate change impact: Climate change is likely to alter slope and bedrock stability through changes in precipitation and/or temperature. It is difficult to determine future locations and timing of large rock avalanches, as these depend on local geological conditions and other non-climatic factors.



S.no	*Component*	*#*	*Expected Climate risk /damage*	*Recommended Design Measures*	*Sub Project Specific Climate Resilience*	*Recommended O&M Measures*
			A**: Types of Damages due to Flood in Wastewater Management Systems**			
1	Collection network	a.	Increased flows due to entry of rain water may cause overflow of sewers and result in sewer blockages and backup into residences		During Increased floods, the Machine holes shall be kept closed. However, during heavy rains, the STP staff shall be alerted in order to initiate Bypass in the Treatment plant.	Alert the STP staff on bypass and super chlorination measures within the compliance requirements and define a release event in the O&M contract
2	Lift stations	b.	Frequent power fluctuations may stop pumps leading to overflow of sewage	Provide Diesel generating sets at least for 50 % pumping capacity	Diesel Generators for 100% capacity have been provided in BOQ	
3	Sewage Treatment plants	c.	Flooding of STP	Provide protection wall if the STP is located in flood plain	Protection walls will be provided in the STP (DBOT).	
4	Outfalls	d.	Freefall Inlet disposing into water bodies may not be possible when in floods.	Provide pumping arrangement for disposal of treated water by pumping	Pumping arrangements will be provided for disposal of treated effluents during floods.	Operate effluent disposal pumps as required
			E: Types of Damages due to Drought in Wastewater Management Systems			
		-				
5	Collection network	a.	Sewers likely to be silted due to low flows		During low flows, Jet rodding shall be done to avoid desilting.	Arrange for flushing of sewers as required

S.no	*Component*	*#*	*Expected Climate risk /damage*	*Recommended Design Measures*	*Sub Project Specific Climate Resilience*	*Recommended O&M Measures*
6	Lift stations	b.	Frequent power fluctuations may interrupt pumping leading to overflows	Provide Diesel generating sets at least for 50 % pumping capacity	Diesel Generators for 100% capacity have been provided in BOQ	
7	Sewage Treatment plants	c.	Drought creates low flows and increased concentration of contaminants (more mg/l of BOD or SS), Higher concentration of contaminants may cause ineffective treatment and disinfection	Design the plant for higher than normal BOD (Extent to be decided)	The arrangements for dilution of sewage at the inlet chamber will be provided in STP (DBOT)	O&M staff sufficiently trained in handling high concentrate shock loads
8	Outfalls	d.	Lesser flows in receiving body makes receiving body loose its carrying capacity	Design to consider a holding basin for treated effluent	Since the receiving body is a River, the boundary / Bund is defined and it shall not lose its carrying capacity	Disposal of treated effluent to be regulated
9	Sewage Treatment plants (STP)	e.	Power failures in drought likely to be frequent	Provide Diesel generating sets at least for 50 % pumping capacity	Diesel Generators for 100% capacity have been provided in BOQ	
			F: Types of Damages due to Wind in Wastewater Management Systems			
		-				
10	Sewage treatment plant (STP) and lift stations	a.	High speed winds likely to cause power shutdown	Provide Diesel generating sets at least for 50 % pumping	Diesel Generators for 100% capacity have been provided in BOQ	

S.no	*Component*	*#*	*Expected Climate risk /damage*	*Recommended Design Measures*	*Sub Project Specific Climate Resilience*	*Recommended O&M Measures*
				capacity both in lift stations and STP		

Climate Resilient Check List – Soft – FGDs outcome

TNCRUDP - Check list for climate risk and Recommended mitigation for Water Supply and Sanitation Sub Projects

Interaction with community and society to assess their considerations about the resilience of the community and society				
1	**Expected Climate risk /damage explained to the stake holders**	**Likely effect explained to the stake holders**	**Recommended Mitigation measures, explained to the stake holders**	**Response of the community/ stakeholders to the Climate resilience**
	Focus group discussion was conducted in two locations of Anna Quarters and Bangara Esappan Street in the month of June 2023 on climate risks that people face and their suggestions for mitigation. The Social Expert facilitated the discussion at the habitat and documented the same. Verbal consent to record to conduct the focus group discussion was sought from the participants. The expected climate risk/damage, its impact, and recommended mitigation measures were explained to the participants of the focus group discussion. Most of the participants of the focus group discussion were women and the insights from women were recorded to ensure that gender-responsive mitigation measures can be incorporated in the project.			
2	Explain the project proposals with selected source and expected service levels			
	The Social Expert provided the relevant information in the vernacular language for the participants to respond to the various components of the project proposal.			
3	Climate Resilience to floods and drought.	Service delivery affected by water related shocks and stresses, such as floods, droughts.	ULB to disclose to the people about the designed service levels and the need for reduction in service levels. Both during floods and drought ULB will strive to maintain a reduced service level.	How much minimum quantity consumer expects

	One of the major issues people face is flooding and there is no availabilty of storm water drains to faciliate draining of water in the settlement.	*The settlement of Anna Quarters face flood situation where the stagnated water is contaminated with sewer water posing a risk to health of the residents. Water-borne diseases is a threat druing floods.*	*The ULB will ensure mitigate flooding and resultant issues in the settlements.*	*Residents want the ULB to provide long-term solution for flooding by construction of storm water drains and ensuring that there is pathway for storm water to drain from the settlements.*
4	Partially affected system	Reduction in hours of supply and frequency of supply	ULB will arrange essential supplies through tankers till system recovers.	Desired Frequency of tanker supply. (to the consumers)
	Draining of stagnated water	*During flooding the water connection is also disrupted leading to non availability of water for few days.*	*So far the ULB has been addressing the issue through tankers but communities are demanding for a sustainable solution*	*Though special arrangements are made by ULB based on the demands of the people, there needs to be a permanent solution for addressing this issue.*
5	When system is Completely affected	System components cannot serve the community	ULB in coordination with water resource department and multiple users, will arrange supply of water from borewells . Where Hand pumps are available consumers will be encouraged to use the same.	

	Livelihood	*Traditional weavers face livelihood crisis during floods because of water entering into their houses, the dampness affects their silk products. Once damaged it results in loss of income. During monsoon it is difficult for traditional weavers to are unable to work thereby affecting their livelihoods.*	*ULB will make arrangements through tankers till pipelines are restored.*	*Long-term solution for flooding is required.*
		Water quality of alternate source	ULB will disinfect the water or will provide disinfectant tablets for use at household. Alternatively a campaign to generate awareness to drink the water only after boiling.	*People in Anna quarters want government to provide a permanent solution for the water scarcity and flooding issue. People in Bangara Esappa Settlement want better quality water as the water is yellowish in colour and cannot be used. People are buying packaged water for drinking. People want water quality issues sorted out before taking up campaigns for management of existing water.* [8]
6	Recovery after an event	Duration of event which caused reduction or stoppage of service delivery	ULB shall inform the likely time for which the service delivery will be reduced and likely time for recovery	

[8] These issues are already addressed in the Water Supply – ESIA, as the WSIS sub-project is proposed to replace the entire d'system.

	Residents felt that there is no mechansims to address greivance. Only after protests by residents that the issues faced during floods including non access to water is addressed.	*During flood in Anna Quarters they do not get water supply because of damaged pipleliens*	*ULB can take measures to expedite the process of complaints to ensure that services are resumed.*	*In both the settlements people have been protesting when the service delivery has stopped to get it resumed. They have organised themselves and also meet the elected representatives to address their issues*
7	Access to priority users	Supply stopped to hospitals and areas who have no access to alternate sources	ULB shall priorities the essential users for whom the minimum quantity of water will be provided and inform the community	
		Flooding in Anna Quarters affects their life and livelihood of the traditional weavers. Flooding results in damage of silk clothes weaved by the traditional weavers.		*Communities insist on finding solutions to ensure that the pipeline does not get damaged or contaminated during floods.*
8	Capacity to withstand multiple events	*The ULB should have a disaster risk reduction (DRR) team to enhance capacities of the ULB officers as well as the Residents Welfare Associations and other CBOs in the community*	ULB shall assess the capacity of the system to withstand the drought/flood and inform the community about the alternate arrangements being made by ULB	*The DRR Team in the ULB can have a plan mapped for the settlements to identify the various risks and map the mitigation measures. The ULB should also strengthen its grievance redress process to ensure that alternate arrangements are made for communities when services are disrupted.*

9	Considerations about the resilience of the community and society.	*Both the settlements where the focus group discussion were facilitated were organised. When they face issues related to sewage or water supply they are able to organise them selves and demand for these services and also reach out to the elected represenatives for the same.*	ULB to build awareness of the event and efforts being made to maintain minimum service delivery . Community will be requested to offer their suggestions to overcome the climate effects.	
10	Stakeholder's role: includes consumers, community networks, civil society organisations,	Water supply constraints and challenges faced by the ULB is informed to the stakeholders. Trade-offs need to be properly analysed to ensure that priority investments can maximize resilience.	ULB shall discuss in FGDs, including a variety of stakeholders from institutions, from the municipality, business, and civil society. Stakeholders and carefully explore the consequences of possible actions, considering cost, reliability, equity, resilience).	*The DRR Team to incorporate the various issues raised by communities in the area Sabha meetings and other stakeholders meetings while drafting the mitigation plan.*

	The stake holders should also include community based organisations like Self Help Groups to ensure increased participation of women in the various discussions	*Local elected representatives of the Council and the Members of the Area Sabhas could be also involved in the process to constantly interact with communities and Area Sabhas are effective platforms for such interactions*	While minimizing costs. Maximizing resilience also requires properly estimating the net economic benefits to society. This will help ps to identify trade-offs and build stakeholders' ownership over the process and choice(s).	*The existing community structures needs to be further strengthened to ensure community ownership on mitigation measures. Community ownership will evolve only when platforms and space for participation is created. Facilitating RWH and empowering members of area sabhas can also be a sustainable measure. Communities have already several informal networks for addressing issues. They have mentioned that in the focus gorup discussions.*
			ULB shall discuss with stakeholders possible alternatives to improve local sources such as roof water/ rainwater harvesting.	Response of community to making the RWH as a regulatory requirements for building permits
11	Role of ULB, Go TN and GoI	Climate change is impacting the natural cycle of water in many locations, with a significant impact projected for the future. .	Adopt sustainable urban water management' (SUWM), Spatial planning, and Conjunctive use of ground water and surface waters an approach that can address the root causes of Climate risks.	

			ULB Engineers and civic officials and Implementing agency Engineers to be trained in SUWM , spatial planning and Conjunctive use of ground water and surface water	

ANNEXURE 4 PUBLIC INFORMATION NOTICE TEMPLATE

Public Announcement
Providing Underground Sewerage Scheme to Added areas of Kancheepuram City Municipal Corporation

Under this project, works are being conducted by xxxx Contractor to provide underground sewerage system in added areas of Kancheepuram Corporation.

As part of this, works for laying pipeline / distribution network will be taken up in -------- road----/ street/ lane ……. From……to (provide dates).

We request you to kindly co-operate for smooth implementation of the works.

We also request you to drive vehicles / pedestrians to walk carefully

Inconvenience caused is regretted.

PIU - Contact No.
Contractor – Contact no.

ANNEXURE 5 - SAMPLE GRIEVANCE REGISTRATION FORM

(To be available in Tamil and English)

The _____Project welcomes complaints, suggestions, queries, and comments regarding project implementation. We encourage persons with grievance to provide their name and contact information to enable us to get in touch with you for clarification and feedback.
Should you choose to include your personal details but want that information to remain confidential, please inform us by writing/typing *(CONFIDENTIAL)* above your name. Thank you.

<table>
<tr><td>Date</td><td>Place of registration</td><td colspan="4">Project Town

Project:</td></tr>
<tr><td colspan="6">Contact information/personal details</td></tr>
<tr><td>Name</td><td></td><td>Gender</td><td>* Male
* Female</td><td>Age</td><td></td></tr>
<tr><td>Home address</td><td colspan="5"></td></tr>
<tr><td>Place</td><td colspan="5"></td></tr>
<tr><td>Phone no.</td><td colspan="5"></td></tr>
<tr><td>E-mail</td><td colspan="5"></td></tr>
<tr><td colspan="6">Complaint/suggestion/comment/question Please provide the details (who, what, where, and how) of your grievance below:

If included as attachment/note/letter, please tick here:</td></tr>
<tr><td colspan="6">How do you want us to reach you for feedback or update on your comment/grievance?</td></tr>
</table>

FOR OFFICIAL USE ONLY

ANNEXURE 6 STAKEHOLDERS ENGAGEMENT PLAN

Pre-Construction

Various stakeholders have been consulted during the project preparation and the comments & suggestions received have been suitably incorporated in the project design.

During Construction

The engagement with the project stakeholders will be continued as required during the project implementation and the strategy is provided as below.

Stakeholder Engagement and Information Disclosure Strategy				
Project: Providing Underground Sewerage Scheme in added areas of Kancheepuram City Municipal Corporation – laying of collection system, pumping main, construction of Lift Stations, Pumping Stations and Sewage Treatment Plant				
Target stakeholders	**Information to be disclosed**	**Proposed engagement & disclosure method**	**Timing of Engagement**	**Responsible Parties**
1. Project Affected Persons- impacted by temporary economic or physical displacement- tenants/ hawkers/ vendors on alignments	• Project design details, alignments and their impacts • Provisions for compensating economic and physical displacement, timelines for completing rehabilitation • Communication on final rehabilitation/ compensation approved by govt. • Grievance mechanism in place	• FGDs and small group consultations • Print-Newspaper, Newsletter / leaflets/ Pamphlet • Radio information capsules	• At least twice- before & after compensating • During alignment/ OHT works	• PIU/ PMC • Contractor
Households / people residing along alignment of sewerline/ pumping main	• Project design details, planned alignments and their impacts • Design and site alternatives explored for impact minimization	• Newsletters/ pamphlets/ flyers • Focus group discussions	• Continuous, as required in construction stage • One week prior to start of construction in the respective stretches	• PIU/ PMC • Contractor

Stakeholder Engagement and Information Disclosure Strategy				
Project: Providing Underground Sewerage Scheme in added areas of Kancheepuram City Municipal Corporation – laying of collection system, pumping main, construction of Lift Stations, Pumping Stations and Sewage Treatment Plant				
Target stakeholders	**Information to be disclosed**	**Proposed engagement & disclosure method**	**Timing of Engagement**	**Responsible Parties**
lines or in proximity to LS/ PS sites	• Accidents and road safety/ traffic management issues and measures planned to be in place; • Information on likely disruptions to services and arrangement during construction including its duration and likely timings • Management of air and noise pollution; Disruption to services and arrangement during construction • Community and Occupational Safety measures planned for; • Excavation works-sludge/ earth disposal plans • Labour management plans/ proposed camp sites • Grievance mechanism process	• TV-Radio-Print- Digital based information dissemination • Helpline/ Toll-free numbers displayed at project locations and prominently accessed areas • Suggestion boxes at site offices	•	
Other Interested Parties: • Resident Welfare Associations (RWAs) • Elected Reps of Municipal Corporation	• Project design details, planned alignments and their impacts • Design and site alternatives explored for impact minimization	• One-on-one meetings • Formal Small group meetings • Open forums and Town-hall meetings for RWAs and ERs	• Continuous, as and when required during construction	• PIU/ PMC • Contractor

Stakeholder Engagement and Information Disclosure Strategy				
Project: Providing Underground Sewerage Scheme in added areas of Kancheepuram City Municipal Corporation – laying of collection system, pumping main, construction of Lift Stations, Pumping Stations and Sewage Treatment Plant				
Target stakeholders	**Information to be disclosed**	**Proposed engagement & disclosure method**	**Timing of Engagement**	**Responsible Parties**
• Civil Society Organisations • Print and Tele Media • Staff of Line departments • Service providers and duty bearers • Staff of Municipal Corporations • Community / Religious leaders • Regulatory agencies	• Accidents and road safety/ traffic management issues and measures planned to be in place; • Information on likely disruptions to services and arrangement during construction including its duration and likely timings • Community and Occupational Safety measures planned for OHT constructions and transmissions; • Excavation works-sludge/ earth disposal plans • Labour management plans/ proposed camp sites • Grievance mechanism process	• Formal presentations to closed groups like regulators, service providers and duty bearers		
Civil Works Contractor, staff & subcontractors	• Project design details, alternatives, planned alignments and their impacts • Baseline information on environmental and social aspects • Project's induced environmental and social risk • Accidents & road safety/ traffic management measures planned • Orientation on EHS provisions	• Provisions in Bid/ contract documents • One-on-One and formal small group meetings/ discussions • Formal presentations/ training to contractors project management team	• Once, at the time of contract signing and orientation during pre-construction phase • Periodic briefings and orientation at site • Feedback as and when required on site and monitoring reports	• PIU/ PMC • Contractor

Stakeholder Engagement and Information Disclosure Strategy				
Project: Providing Underground Sewerage Scheme in added areas of Kancheepuram City Municipal Corporation – laying of collection system, pumping main, construction of Lift Stations, Pumping Stations and Sewage Treatment Plant				
Target stakeholders	**Information to be disclosed**	**Proposed engagement & disclosure method**	**Timing of Engagement**	**Responsible Parties**
	• Sexual harassment provisions and requirements • Labour Management Procedures • Orientation on RAP implementation and requirements • ESIA requirements and measures proposed • Grievance mechanism proposed under the project, requirements • Feedback on consultant/ contractor implementation and supervision reports			

S. No.	Aspect	Mitigation measures	Responsibility	Implementation stage	Monitoring method	Performance Indicator	Frequency
1	Public disclosure	Placement of hoarding at public and prominent places indicating in English and Tamil language project details, name and contact number of Convenor and the Contractor.	Convenor/Contractor	Pre-construction phase	No. of hoardings and locations chosen	Effectiveness of message communicated	Once
2	Grievance Redressal Conduct consultations with the beneficiaries, local communities and other stakeholders	Understand the perception of stakeholders, the positive and negative impact of the project; Analyse the concerns and issues of s, local communities and other stakeholders; Address the concerns raised as per ESMP provisions; and Implementation of project with a Gender responsive Approach.	PMC E&S experts, Contractor EHS officer/ Project Manager and Convenor of PIU	Project life cycle beginning from the early stage of pre-construction	Site observations, Review of available documents; Support or opposition of stakeholders in project activities; Project progress level; And Consultations conducted with stakeholders.	Procedure followed for conducting consultation; No. of meetings/ consultations held; No. of participants in each meeting; Profile of participants such as male and female; Type and severity of issues raised; Response and action taken;	

						Awareness level about the project; Temporary loss of POTENTIAL TEMPERARY ECONOMIC IMPACTs compensated Favourable social atmosphere towards project and support to participation in project activities; and Increased engagement in terms of number and level of stakeholders and women in the project activities.	
3.	Effective functioning of GRC	Resolve the E&S related complaints and disputes in a time bound manner amicably without any cost.	GRC members headed by the authority	Project life cycle beginning from the early stage of pre-construction.	Site inspections; Consultations held with and other stakeholders; Project related E&S complaints received in writing or verbally.	Adequacy of information & dissemination about the GRC and its objectives among the stakeholders; No. of GRC meetings held and timeframe; GRC members present in each meeting;	Whenever required

						No. of complaints/grievances received and resolved; Time taken; Satisfaction of affected parties; and Court cases filed or withdrawn.	
4.	Organize meetings with line departments to seek project support as required	Coordination and meetings with the line departments, namely District Administration, SPCB, PWD, Traffic Police, GCC/ ULBs/ Town Panchayat and line agencies; Understand the role of line department and support envisaged for project implementation and operation; and obtain an update related to POTENTIAL TEMPERARY ECONOMIC IMPACTs, beneficiaries and other stakeholders.	CE, EE/ PIU, PMC	Project Planning stage onwards	Review the feedback of participants of the meeting; Date, time, and venue fixed as per suitability of other departments; Communicated information in advance (letter signed by the CE/EE of the PIU); Presentation about the project (PPT), including objectives of the meeting, expectations from the	No. of officials participated in the meetings and signed the attendance sheet; Relevant information shared; Comments/suggestions offered, Effectiveness of meeting in project implementation and operation; Improved communication, coordination helpful in project activities; Increased understanding about the project related tasks; and Other facilitation roles.	Semi annually

					participants; and Q&A details.		
5.	Public awareness about the project	Organize public events and engage all stakeholders like related government departments, local communities, beneficiaries of the project, women's group, NGOs in project areas.	PIU, PMC, Contractors	Pre-construction stage and onwards	Review the public awareness activities undertaken; Feedback of target groups to assess the effectiveness of such activities.	People understand importance of project and need for environmental and social sustainability;	Semi annually

Stakeholder engagement format

S.No.	Activities	Details of Meetings/Consultations
1.	Officials who conducted meetings and consultations with the PAPs and other stakeholders in project villages	
2.	Name of locations and number of person participated	
3.	Profile of stakeholders (shopkeepers, residents, women, officials from other department, etc. as applicable)	
4.	Date of meetings/ consultations held	
5.	Issues and demands raised by the PAPs and other stakeholders	
6.	How these problems and demands are being solved?	

ANNEXURE -7 WASTE MANAGEMENT PLAN

S. No.	Aspect	Mitigation measure/Procedure	Responsibility	Implementation	Monitoring methods	Performance indicators	Frequency
1.	Up keep of storage/yard	Dispose-off the waste from the material storage to the designated site; and Ensure regular collection and removal of refuse and litter from the working site, office, labour accommodation, etc.	Contractor	Construction phase	Visual Inspection	Incidence of contamination	Daily
2.	Labour accommodation	Place sufficient number of garbage bins/containers at prominent locations of the project working sites and labour accommodations; Ensure emptying the garbage bins and dispose-off from the labour accommodation regularly in a hygienic manner; Dispose-off domestic waste water into drainage; Ensure sufficient number of bathing and ablution facilities in labour accommodations, sheds, and all the site staff;	Contractor	Construction phase	Visual inspections; and Records of waste disposal.	Incidence of staff not using facilities; and Incidence of pollution.	Daily

		Create awareness about the importance and safe disposal of waste at work sites, labour accommodation and surroundings among the workers; and Impart training about handling the different types of wastes, waste management, including hazardous waste.					
3.	Waste management measures	Collect all waste bins, containers from all sites; Collect recyclable wastes separately and arrange for its collection by the authorized vendor; Prevent littering and pollution by construction staff at work sites by providing bins or waste bags in sufficient locations; Provide separate bins/containers for hazardous materials and mark these clearly;	Contractor	Throughout project life cycle	Regular audits of the CWMP implementation; Visual inspection of waste collection and disposal; and Construction areas for littering	CWMP in place; Extent to which CWMP is complied with; Presence of litter; Extent of filling rubbish bins; Total volume of general and hazardous waste storage capacity on sites;	Daily/ weekly as applicable

		Store hazardous / polluting materials on impermeable ground until disposed-off or collected by the authorized vendor; Do not allow any burning or burying of waste on site; and Disposal of rubble and other waste construction materials at the designated site.				Extent of waste segregation; and Frequency of waste collection and disposal	
4.	Disposal of residual construction debris, excess soil and other materials	The contractor shall identify the site for debris and waste disposal that should be finalized prior to start of the earthworks; Apply good practices and minimize the construction debris by the optimum use of material; Reuse the excavated soil and other material in backfilling, landscaping, filling low lying area and public places. Yet the unused residue of soil and sedimentation left will be disposed of;	Contractor	Construction phase	Audit of excess and residual construction material disposal records and data; and Visual inspection.	Excavated soil and other wastes visible; and Cleanliness and maintenance of sites.	Daily and regularly.

		Ensure that disposed waste do not cause soil and ground water pollution; Contractor should ensure that designated landfill site should be located in non-residential area at least 1000 meter away so that residents, flora and fauna are not impacted; Regularly clean up concretes pilled during construction; Sweep / rake / stack excess aggregate / stone chip / gravel / pavers into piles; Emptied cement and other material bags, containers and unusable bins sold to a licensed vendor; Dispose excess and residual waste to the designated site; The training should be imparted to all staff about the effects of waste and litter and follow the					

		appropriate disposal procedures; and Construction waste at site should be handled as per Construction and Demolition Waste Management Rules, 2016.					
5.	Hazardous waste disposal	Ensure that contaminants (including cement) are not placed directly on the ground to prevent runoff reaching the water resources; Ensure that the spillage of fuels, oil, lubricants collected does not contaminate the soil and water; Ensure the training work force about environmental pollution and its management; Ensure disposal of hazardous waste at the designated site by the authorized vendor and prevention of pollution therein; Ensure hazardous materials such as solvent based paints,	Contractor	Construction and operation phases	Audit of hazardous material disposal records and data; and Visual inspection of hazardous materials handling, storage areas and disposal practices.	Incidence of non-compliance with safety procedures concerning hazardous waste material; Availability of spillage kits; Incidence of spillage of hazardous materials on site; and Evidence of leaks and contamination	Daily or as required

		fuel, cleaning and polishing chemicals are handled with extreme precaution during their storing, transportation, and usage. Such material should be stored on impervious space/ floor; Ensure that only trained workers are involved in collection, storage, and disposal process; All precautions, safety and health measures are followed; Dispose of non- recyclable and recyclable metal objects through authorized vendor; and Regularly audit the records maintained for hazardous and other waste generated and disposal to designated site.				of soil and water	
6.	Closure and rehabilitation of construction and labour sites	Contractor to restore the original condition of the site prior to demobilization; Upon works completion, clear all structures, rubbish, fill-in	Contractor	After completion of the civil works in construction phase	Physical verification of the site as well as items listed in the records of contractor; and	Clean and clear site; Site rehabilitated; and Original	Onetime

		and seal all the pits and trenches; Remove all construction equipment, vehicles, equipment, waste and surplus materials, temporary fencing and other items from the site; Clean up and remove any spills and contaminated soil in the appropriate manner; Do not bury discarded materials on site or any other land not designated for this purpose; Handover the completed construction site and the sites used for materials to rage and labour accommodations and sheds will be handed over; and Handover the project site after completion of operation phase.			Rehabilitation measures conducted after completion of construction and operation works.	condition of construct ion and other sites restored	

ANNEXURE 8 LABOUR MANAGEMENT PLAN

LMP shall be prepared by the contractor following the requirements of the ESS2 on Labour and Working Conditions. The LMP is a living document, which is initiated early in project preparation, and is reviewed and updated throughout development and implementation of the project. Outline for LMP is provided below which is indicative and shall be made specific to the sub-project.

Description	Mitigation Measures	Responsibility	
		Implementation	Supervision
Applicable Laws	The contractor should ensure the compliance of applicable Indian Labour Laws such as Factories Act 1948, Building and Other Construction Workers Act 1996, Inter State Migrant Workmen Act 1979, Contract Labour (Regulation & Abolition) Act 1970, Workmen Compensation Act 1923, Child Labour (Prohibition & Regulation) Act 1986, Minimum Wages Act 1948, Employee State Insurance Act 1948, Employees Provident Fund Act 1991, Payment of Wages Act 1936, Payment of Bonus Act 1965, Equal Remuneration Act 1976, Payment of Gratuity Act 1972 and other International Labour organization conventions as ratified by India.	Contractor	PIU/PMC
Applicable Licences	Labour Licence and all other statutory work permits including Contract Labour& Interstate Migrant Worker License. Workmen compensation Insurance / Accident Insurance, EPF and ESIC.	Contractor	PIU/PMC
Site layout	The location of the site, design and basic facility provision in the labor accommodation will be reviewed and approved by the PIU prior to the construction;	Contractor	PIU/PMC

Facilities	Maintain necessary living accommodation and ancillary facilities in functional and hygienic conditions; Provide adequate number of toilets separate for men and women workers, bathing area, kitchen, safe fuel/LPG for cooking and uncontaminated water for drinking, cooking and washing; Ensure adequate water supply in all toilets and urinals; The labour camp should have protection from heat, rain, flooding, insects, snakes and mosquitoes. It should have adequate provisions for emergency such as fire safety, security, etc; Require the non-discrimination and harassment and should be socialized/basis for training, and covers potential ethnic discrimination.	Contractor	PIU/PMC
Health and Safety	Provide first aid medical kit at labour accommodation; train the labour for usage of items in injury, emergency, coordinate with nearest government and private medical centers for the medical services, display the contact number of medical doctor(s) and keep a vehicle for emergency travel all the time; necessary HIV/AIDS prevention measures will be taken at labour camp;	Contractor	PIU/PMC

	HIV/AIDS awareness program will be organized by the contractor's Environment & Safety Officer; Where feasible, manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas; ULB shall ensure proper segregated storage, collection, transport, treatment and disposal of all wastes following the SWM / C&D waste Rules 2016; remove all wreckage, rubbish, or temporary structures which are no longer required;		
Labour use	The total number of workers to be employed on the project, and the different types of workers: direct workers, contracted workers, temporary or seasonal workers and community workers. (Where numbers are not yet firm, an estimate should be provided) broad description and an indication of the likely characteristics of the project workers e.g. local workers, national or international migrants, female workers, workers between the minimum age and 18; details of the migrant workers, labour camp location should be shared with local Police station as per regulatory norms.	Contractor	PIU/PMC

Grievance	Establish a mechanism for grievance redressal for both direct and contract labourers, disclose contact details of officials concerned. Sign boards and GRC name boards should be written in local, multilingual languages and English at the labour camp.	Contractor	PIU/PMC
Policies and Procedures	Provide workers with contracts with fair terms and conditions Require the contractor to preferentially engage unskilled local workforce form the local communities Make all contracted workers to follow the rules for on-site behaviour (with colleagues) and conduct in the community. Conduct induction and toolbox talks outlining expected conduct and local community values. Introduce disciplinary measures for violations and misbehaviours. Set the minimum age of project workers eligible for any type for work. Train the labour for environmental protection, occupational and community health and safety and gender equality. Follow the equal wages policy without any discrepancies or gender partialities.	Contractor	PIU/PMC

	Ensure minimum legal labour standards as per ILO regulations (child/forced labour, no discrimination, working hours, minimum wages) are met with. Contractors shall implement codes of conduct concerning employment and workforce behaviour (including but not limited to safety rules, zero tolerance for substance abuse, environmental sensitivity of the area, dangers of sexually transmissible diseases and HIV/AIDS, gender equality and sexual harassment, respect for the beliefs and customs of the populations and community relations in general).		

ANNEXURE 9 IMMEDIATE INCIDENT NOTIFICATION FORM

Any Major Incident occurring on the Construction site of the Sub-Projects or caused by the Construction activities shall be reported by the Contractor/ Borrower / PIA to the Project Executing Agency (PEA) as soon as possible and not later than 24 hours after the incident occurred.

Definition of Major Incident:

Any social, labour, health and safety, security or environmental incident or accident having or which would reasonably be expected to have a negative impact on the Project. This may include explosions, fires, spills or workplace accidents which result in serious or multiple injury or major pollution. Any Injury of any employee (of Contractor or subcontractors/ suppliers) that causes loss of working time (Loss Time Injury) is considered as a major Incident.

Guidance for Accidents and Incidents Reporting

1 Basic Information

- *date, time, weather / lighting / conditions*
- *statement of facts*
- *details of deaths, injuries, damage, immediate losses*
- *details of witnesses*
- *details of whether scene was secured / photographed*
- *details of any item tested / sampling / sent for testing / removed from scene*
- *details of person leading investigation*
- *time lapse between accident and investigation*

Basic data should be clear, unambiguous, and factual (i.e. free from interpretation). Any gaps in the data should be highlighted and addressed in the investigation.

2 Investigation

- *reconstructed timeline of events, with the incident/accident in the mid-point, and linked events streamed either side, with clear identification of individuals/teams/third parties (e.g. contractors) that are linked and therefore require interviewing*
- *robust but sensitive questioning of witnesses and linked individuals/third parties to*
- *clarify facts, assist with timeline reconstruction and advance the investigation. Statements/ notes of interviews to be included.*

The investigation must follow the facts, witnesses and linked individuals/third parties and the timeline, and not be constrained by the incident/accident event in isolation.

In case publications on the event are available, these should be attached to the report (e.g. press articles, online articles, radio and TV- spots).

3 Analysis

- *using basic data, interview outcomes and reconstructed timeline, identification of:*
  - *immediate causes*
  - *underlying causes (actions in the past that have allowed or caused undetected unsafe conditions/acts)*
  - *root causes (generally organisational/management failings, sometimes not directly/ obviously in relation to accident/incident regarding location/time)*
  - *identification of absent/inadequate/failed/unused risk identification,- management- and control measures, reference/gap analysis against relevant national legislation and against the international standards as applicable and agreed upon for the Project*
- *conclusions and summary of root causes and underlying causes for the accident/incident.*

Analysis must be sufficiently rigorous to go wherever the investigation has led. Identification of root, underlying and immediate causes must be sufficiently credible and robust to withstand third-party scrutiny.

4 Way forward

- *for EACH root cause, underlying and immediate cause, a corrective/preventive action is required (these may be numerous and interlinked)*
- *for EACH action, a named person with sufficient resource to deliver upon it and a clear timeline (action plan) is required. In addition, a named person should have overall responsibility for monitoring / reporting on progress (with timelines).*
- *demonstration, that all actions together will prevent recurrence; evidence that current risk assessments/procedures have been revised to reflect this*
- *details of communications to stakeholders, to include a concise summary of the investigation, including the action plan, and lessons learned.*
- *details of ongoing support and assistance to those impacted directly or indirectly by the accident.*

Types of reportable injury

The death of any person

All deaths to workers and non-workers, with the exception of suicides, must be reported if they arise from a work-related accident, including an act of physical violence to a worker.

Specified injuries to workers

- fractures, other than to fingers, thumbs and toes
- amputations
- any injury likely to lead to permanent loss of sight or reduction in sight
- any crush injury to the head or torso causing damage to the brain or internal organs
- serious burns (including scalding) which:
  - covers more than 10% of the body
  - causes significant damage to the eyes, respiratory system or other vital organs
- any scalping requiring hospital treatment
- any loss of consciousness caused by head injury or asphyxia
- any other injury arising from working in an enclosed space which:
  - leads to hypothermia or heat-induced illness
  - requires resuscitation or admittance to hospital for more than 24 hours

Source:http://www.hse.gov.uk/riddor/reportable-incidents.htm

IMMEDIATE INCIDENT NOTIFICATION

1. Incident Details					
Project Company		**Date of incident**			
		Time of Incident			
Location of incident		**Type of Incident**	**Environmental**	☐	
			Injury	*Workforce*	☐
				Public/Local community	☐
			Social incident (e.g. violent labor unrest)	☐	

2. WHAT HAPPENED
Brief description of incident

3. INJURED WORKERS						
Employee / Contractor	**Sex**	**Age**	**Job Title / Description**	**Time with company**	**Cause**	**Injury Type (Major / Fatal)**

4. INJURED MEMBERS OF PUBLIC						
Name	**Sex**	**Age**	**Community**	**Place of Residence**	**Cause**	**Injury Type (Major / Fatal)**

5. ENVIRONMENTAL INCIDENT			
Type (Spill / Gas Release)	**Total Loss (Litres /kG)**	**Cause**	**Damage**

6. WITNESSES TO INCIDENT			
Name	**Sex**	**Place of Residence**	**Description of incident**

7. OTHER RELEVANT INFORMATION				
Have the authorities been informed?	**Yes**	☐	**No**	☐
Please provide further information here				
Media attention?	**Yes**	☐	**No**	☐
Please provide further information here				
Any effects off-site?	**Yes**	☐	**No**	☐
Please provide further information here				
Photographs taken? *(please include them in this report)*	**Yes**	☐	**No**	☐
Date				

Which immediate corrective actions have been taken after the accident? By whom?
Please describe here if the accident lead to changes into the works organisation or process, if specific equipment has been acquired/mobilised, if protection measures were implemented, if works have stopped etc.

Person completing form:				
Name and position:				
Contact details:	**Phone**		**Email**	

ANNEXURE 10 ADDITIONAL MEASURES TO ESMP- SAFETY AT SITE

Safety at Site

1. Safety Officer

The Contractor shall appoint an Environmental expert & Safety officer meeting statutory competence requirement, with a minimum experience of five years of safety management in comparable contracts, approved by the Employer on the basis of his qualification and experience. The Safety Officer shall give his whole time to the superintendence of the 'Health and Safety Programme' of the Contractor.

Responsibilities of The Contractor's Safety Officer

He is responsible and accountable for:

- Preventing injury to personnel, damage to plant and equipment and fires.
- Instituting ways to improve existing work methods from safety point of view.
- Legal and contractual requirements affecting safety, health, and welfare of his workmen
- Provision and use of protective clothing and equipment and use of fire fighting equipment
- Suitability of new and hired equipment from a safety viewpoint
- Identifying potential hazards.
- Changes in safety requirements and fire precautions
- Carrying out site surveys to see that only safe work methods are in operation, health and safety requirements are being observed and welfare and first aid facilities are adequate and properly maintained.
- Determining the cause of an accident or dangerous occurrence and recommend means of preventing recurrence.
- Supervising the recording and analysis of information on injuries, damage and production loss. Assess accident trends and review overall safety performance.
- Assisting with training of employees at all levels. Organising periodic demonstration of practising safe working conditions by experienced safety instructors.
- Taking part in discussions on injury, damage and loss control.
- Keeping up-do-date with recommended codes of practice and safety literature. Circulating information applicable to each level of employees.
- Fostering within the company an understanding that injury prevention and damage control are an integral part of business and operational efficiency.
- Attending job progress meetings where safety is an item on the agenda. Report on job safety performance.

2. Employee Consultations, Safety Committee & Communication

The Contractor shall ensure full involvement of all his employees recognising their right to consultation on health and safety matters.

The Contractor shall communicate to the employees regularly on job hazards applicable to their tasks in hand. Safety officer shall hold 'Toolbox Talks' for this purpose on a routine basis before undertaking any safety critical and/or non-routine activities. Weekly meetings of the Contractor and his Sub-Contractors attended by safety officer shall include safety as a key item in the agenda to discuss hazards and risk assessments, job safety analysis and control procedures and to review accidents and incidents (Near-miss) for remedial measures to prevent such occurrence. The minutes of the meeting shall be submitted to the Employer/Engineer. The Safety officer shall maintain the records.

3. Contractor's Safety Reports

The Contractor shall submit a monthly written report to the Employer/ Engineer, which shall be due on the fifth workday of every month. The health and safety of all full time, part-time, permanent, temporary, contract employees and any outsourced employee undertaking any part of the Contract works shall be included in the safety report. The report shall include the total number of working hours for the month, the number of recordable accidents and the number of lost-time accidents. The Contractor shall arrange to display the safety statistics.

Contractor's Accident/ Incident Report

'Accident' for the purpose of this para is defined as 'Undesired Event Giving Rise to Death, Ill- health, Injury, Damage or other Loss' and 'Incident' is defined as 'Event that gave rise to an Accident or had the Potential to lead to an Accident'. An accident where no ill health, injury, damage or other loss occurs is also referred to as 'Near-Miss'. Incident includes Near-Miss. The Contractor shall report orally, to the Employer/Engineer regardless of their extent, duration and severity, immediately on occurrence of all accidents resulting in:

- Personal injury
- Property damage
- Fires
- Spills
- Near-Misses

The Contractor shall submit the accident and incident report in writing to the Employer/Engineer within 24 hours of its happening in the form as prescribed by the governing statute or in the absence of which, in the form prescribed by the Employer/Engineer. The Contractor shall detail in the 'Accident/Incident Report', the particulars of the dangerous occurrence leading to the accident, lost time of absence due to accident, root cause analysis and the corrective and preventive actions to prevent such recurrence. In addition, the Contractor shall include his estimate of the impact of accident on project schedule. Incidents shall also be reported in the same manner identifying root cause/s to eliminate such potential occurrence or risks.

4. First-Aid Personnel & Facilities

The Contractor shall make available first-aiders, first-aid boxes and or first-aid stations as per statutory requirements. The persons holding current certificates of competency of recognised institutions in prescribed numbers as per any governing statute and in the absence of such

regulatory requirement a minimum of two first-aiders for each area of work for every hundred workmen. First-aiders' names shall be prominently displayed. The first-aid boxes shall display contents of medical and medicinal articles with quantity maintained, which shall be in accordance with governing statute. Nominated first-aider shall replenish stock promptly. The first-aid refresher training shall be provided at least once in a year and all employees shall be encouraged to undergo first-aid training. A record shall be kept of all first aid treatments with particulars of treatment and personnel providing the treatment.

The site shall have emergency lifesaving aids and appliances to handle head and spinal injuries, severe fractures, snake bites, burns of all nature, electric shocks, cases of asphyxiation and such other severe injuries as could be reasonably anticipated at the facilities and shall meet provisions of any governing statute.

5. Ambulance Room & Ambulance Vans

The Employer shall arrange for an ambulance room and an ambulance van directly or outsource the facilities meeting the governing statutory needs for prompt transportation of serious cases accident and or sickness to the hospital. Such facilities shall be maintained in good repair and equipped with facilities such as dry powder type extinguishers, flashlights, portable oxygen unit, self-contained breathing apparatus etc. as prescribed by the governing statute.

6. Induction And Job-Safety Training

The Contractor shall maintain a procedure for identification of the training needs and training his employees to create a health and safety conscious work-force that will comply with the law and safety requirements of the Organisation. He shall also maintain a procedure for safety induction and initial training as well as follow-up training on the job safety for new entrants. All employees shall receive effective training and periodic refresher training on the operation control procedures specific to their tasks designed to control the job-safety risks. A booklet of such operation control procedures and safety rules with need based pictorial illustrations shall be made available to all employees who are to learn and be familiar with such procedures. All training shall be monitored for effectiveness as per established procedures. The Contractor shall maintain records of all training. The Safety officer shall conduct regular fortnightly or weekly mock-safety drills for different imaginary accident scenarios, in premeditated work areas to provide on-job training such as:

- Use of safety appliances such as water monitors, hydrants, hydrant pumps, fire-hoses, extinguishers, breathing apparatus and safety harness for working at height,
- Response to health and safety emergencies,
- Fighting fires using various equipment and
- First-aid

Participants shall receive training during mock drills through role-play of their normal expected tasks during emergencies and firefighting. The degree of demonstrated ability in the chosen tasks during such safety drills shall be recorded as participants' competence level for planning his further training. The experience gained in mock drills shall be used to update of operational control procedures and the training needs. The roster of participants and contents for routine mock-drills

shall be appropriately planned to cover all employees in the training at least once in four months. The SR and the SAs shall be trained on a standardised comprehensive advanced training programme covering safety management, legal aspects, techniques of hazard identification and risk assessment and specific job-safety in various disciplines such as Civil, Electrical, Instrumentation and Mechanical plant and equipment of the Contractor. The training records shall be maintained subject to audit by the Employer/Engineer. Training effectiveness shall be assessed and recorded and used as input for further training plans of the employee.

7. Health And Safety Promotion

Safety posters, banners and slogans displayed for safety promotion shall be rotated at frequent intervals. The Contractor is encouraged to include safety promotion programmes such as: safety bulletins, magazines, competitions in slogan and poetry writing on safety, screening of safety films, celebration of national safety and environmental day, safety suggestion schemes and safety library etc.

8. Purchase And Procurement Control

The Contractor shall maintain a procedure for control of his purchases to ensure that all safety requirements are appropriately vetted by the safety personnel during all stages of procurement including planning of specifications, inspection for acceptance and commissioning in order that threats to safety are not overlooked and appropriate attention is paid to the training of personnel in the operation of the Contractor's new or changed machinery and their operation control procedures, to prevent/control risks.

The Contractor shall exercise due diligence in appointing his Sub-Contractors and outsourcing contract services, that no new health and safety threats are created. The Contractor shall ensure personnel of Sub-Contractors and outsourced contract services are competent in health and safety management to meet the Policy requirements. They shall be made aware of the safety rules, emergency procedures and any information that will have a bearing on the safety, health and related contractual obligations.

9. Hazard Identification & Risk Assessment

The contractor shall ensure that his key personnel and safety personnel are trained to be competent in hazard identification, risk assessment and risk control processes. The CONTRACTOR shall on a routine basis identify, evaluate and control all health and safety risks especially in the hazardous work activities and also to validate the previous risk assessments. Elements such as hazard identification, evaluation of risks with existing control measures in place and estimate of tolerability of the residual risks shall be an ongoing process. Any additional/New control measures shall be designed based on this process on need basis. Records in the form of a Hazard Identification, Risk Analysis and Risk Control Manual pertaining to all his activities shall be maintained.

10. Work Permits

The Contractor shall maintain a work permit procedure to limit the hazardous processes and high risks tasks to authorised personnel, who shall be informed of the job safety analysis and the job specific safety precautions, on issue of a work-permit. The work permit issued under the procedure shall be valid for a specified period and shall be issued only after all safety precautions are fulfilled and duly verified by the safety officer who is authorised for safety certification as a prerequisite for issue of a work permit. The work permit shall be appropriate for the purpose for which it is issued. Various work-permits are:

Safety Work Permit (SWP)

SWP is mandatory for working at heights, on fragile roofs such as asbestos or such roofing works, steel erection, work over water, a live substation or switch-yard even if section of work is not electrically charged, demolition, blasting and such potentially hazardous contract works in the opinion of the Employer/Engineer.

Hot Work Permit (HWP)

HWP shall be used where hot working, like electric or gas welding, gas cutting, or burning or any other operation involving heating, open flames or electric arcs, grinding and electrical works etc. are potentially dangerous in areas such as inflammable materials storage, plant and pipe lines handling inflammable and or explosive materials either presently or in the past, or where new works are undertaken adjoining such works which in the opinion of the Employer/Engineer are potential risks. A HWP shall be deemed mandatory in all such potentially dangerous areas. The Contractor shall get areas such as welding shops or maintenance areas approved by the Employer/Engineer for 'Permit-Free' operation.

- Confined Space Entry Permit (CSP) CSP is issued for entering and carrying out tasks in confined space. Confined space for the purpose of this para is defined as an enclosed or partially enclosed space which is not intended or designed primarily as a work place and
- is at atmospheric pressure during occupancy
- has restricted entry and exit
- has potentially harmful level of toxic or inflammable contaminant or unsafe level of oxygen
- is of a nature that could contribute to overwhelming a person by an unsafe atmosphere
- has a potential that safety on entry could be affected by unsafe conditions stated above by accident or due to human errors

Confined spaces shall include but not limited to storage tanks, process vessels, bins, boilers, ventilation or exhaust ducts, sewers, underground utility vaults, tunnels, pipelines and open top spaces more than 4 feet in depth such as pits, tubs, vaults and vessels.

Electrical Safety permits/Lock-out and Tag out (ESP/LOTO)

The Contractor shall institute an electrical safety permit system to ensure safe electrical isolation. Safety permits shall not be issued until safe release tag is placed on the equipment isolated on all isolating points. The safety permit shall be returned on satisfactory completion of the job by the executing agencies duly signing off indicating that all shorts and grounds and men and materials are removed from the job and that the job safe for energising. This is a prerequisite to energise the isolated equipment. The safety tags shall be collected in the order first the isolated equipment and lastly the tag on the main control of the equipment the tags and permit system shall be auditable.

11. Safety Audits

The Contractor shall undertake periodic safety audits to confirm through investigative methods the effectiveness of the measures set out in the Policy. In order to be effective such safety audit shall be comprehensively covering all aspects detailed in this specification to ensure effective loss-control/accident prevention programme. Safety audits shall take into account the safety inspection

records, remedial measures and effectiveness of the safety programme. Effectiveness of safety programme shall be based on the Contractor's effective hazard identification and risk assessment processes for design of operation control procedures and on the safety statistics. Audit reports and preventive actions and safety improvement programmes shall be submitted to the Employer/Engineer. The Employer/Engineer shall retain their right to audit the Contractor's Safety Management System either directly by their employees or his nominated representatives for its effectiveness.

12. Mechanical Safety

The Contractor shall ensure that all his equipment and machinery are safe to use while in motion or working. Operators shall have received training or instruction on operation of the machinery and the regulatory requirements. The Contractor shall have adequate procedure to ensure the stability and securing of his working machinery during operation. He shall restrict repair and maintenance of the machinery to trained personnel and maintain records of repairs and maintenance. The equipment shall have appropriately designed means of isolating from sources of energy and shall have emergency stop control, which is easily accessible. All controls shall be clearly and uniformly marked. All operation controls, interlocks, sensing devices and guards on tools and equipment shall be functional and their status shall be regularly checked and recorded. The Contractor shall provide evidence of compliance to these requirements in any contractual write-ups submitted to the Employer/ Engineer for approval in respect of critical construction/contract works. The Contractor shall provide only good quality hand tools and ensure control of condition, storage, routine inspection and use of such hand-tools. Unsafe tools such as with cracked or broken handles, mushroomed chisels and punches, worn screwdrivers, hardened hammerheads; power tools with unsafe resistance to earth or without safety guards shall be prohibited. All safety ladders, scaffolding and such access equipment shall meet requirements of IS 3696 and IS 4014 and such standards as the Employer/Engineer may stipulate. The safety work permits shall be issued only after ensuring that all safety requirements of access equipment are complied with. Access equipment shall be inspected on a routine basis to prevent injuries caused by falls. The Contractor shall ensure safety of all those concerned with lifting and those who may be affected by material hoisting, lifting and handling using various mechanical aids. All lifting equipment such as cranes, hoists, lifting shackles, hooks chains and links shall be designed as per appropriate International codes of construction. Operators shall have been trained in operation and maintenance of such equipment besides training on standard hand signals to be employed during the hoisting and lifting operations. Safe Working Loads (SWL) shall be marked on equipment prominently. SWL shall be evidenced to have been established by test procedures in accordance with acceptable codes of practices. Riding on construction equipment, forklifts and cranes shall be prohibited unless such vehicles are provided with passenger seats. Pressurised gas and air systems shall be maintained safe in good working order and shall meet the requirements of the Factories Act 1948, The Static and Mobile Pressure Vessels Rules 1984 and the Gas Cylinder Rules 1934 as applicable. The safety relief valves, safety appurtenances and isolation systems shall be compliant with safety code of practices. Any statutory register of pressure vessel records and the code of practices shall be subject to periodic auditing by the Employer/Engineer. The areas of highly dangerous activities like hoisting, lifting and rock blasting, and radiation, shall be appropriately barricaded to protect personnel and machinery and guided by work permit discipline. Emergency plans shall cater to emergencies arising out of such activities. Signs, barricades, barrier tapes and warning or entry restriction devices or accessories shall be provided to minimise work related risks of accidents and injuries. Signage shall meet all regulatory requirements such as under The Building and other construction workers Act 1996,

Factory Act 1948, Manufacture, Storage, Import of Hazardous Chemicals Rules under Environmental Protection Act 1986, Indian Explosives Act 1984 and Gas Cylinder Rules 1981 and Indian Electricity Act 1910 and Rules thereof and any other safety requirement of the Employer / Engineer.

13. Electrical Safety

The Contractor shall provide only such equipment for work that is electrically safe to work. The Contractor shall have a procedure to identify and record all his electrical equipment in a register, with provisions to record his periodic inspections of such equipment. Inspection shall cover cables, extension leads, all electrical equipment drawing power from socket outlet. He shall identify and maintain in good working order all electrical installations such as distribution panels and major switchgear ensuring safe accessibility. A clear area shall be maintained around panels and switchgears. The installed equipment shall be periodically inspected by qualified personnel to ensure their continued safe operating condition. Inspection shall include earth polarity checks, continuity checks and earth resistance checks. The Contractor shall ensure use of flameproof and explosion proof switchgears and lighting fittings where required as per governing codes. Approved earth leakage relays or alternative safety devices to relevant IS and International codes shall be used on all portable electrical hand tools. Where possible low-voltage electric power supply shall be used for hand tools, earth leakage units shall protect electrical installations in workshops, kitchens, cafeterias, first-aid rooms, laboratories and offices. Record of regular checks shall be maintained. The Contractor shall comply with 'Code of Practice for Earthing' as per IS 3043 Safety rubber matting of appropriate voltage rating conforming to IS 5424 entitled 'Rubber Mats for Electrical Purposes' shall be provided in front of all switchgears and power distribution panels for the safety of personnel operating such equipment.

The Contractor shall arrange displaying signage under Indian Electricity Act 1910, such as:

- Danger notices as per IS 2551 in conspicuous places on all low, medium and High voltages as per Rule 35,
- Instruction of restoration of persons suffering from electric shock in English and local languages as per Rule 44 in switchgear rooms, substations and places where electricity is used.
- Notice prohibiting unauthorised entry in areas where electrical apparatus are used.

All power cables providing construction power to various construction machinery and the connectors shall be in safe and sound condition. Cables shall be routed through cable trays supported on appropriately designed structures, duly clamped, secured and identified. Road crossing cables shall be laid in conduits buried at least 600 mm below the surface to prevent damage due to vehicular traffic. All cables shall be off the floor to avoid damage or tripping hazard. Cables shall be terminated at the switchgear and sockets in a workman like manner to prevent loose contacts and flashover. Only safety receptacles shall be used for providing power connection to hand-tools. All switches and distribution boards shall be clearly marked. All electrical distribution and panel wiring diagrams shall be available with the electrical maintenance personnel.

The Contractor shall maintain a safe electrical isolation/lockout procedure. The Contractor shall ensure lighting circuits are not used for hand-tools No electrical equipment shall be overloaded. Tools and test equipment used on electrical systems shall be insulated.

14. Substances Abuse Programme

The Contractor is encouraged to have a 'Substance Abuse Programme', and pre-employment drug testing. Drinking during working hours shall be strictly prohibited. The Contractor shall promote through poster and other publicity, awareness on abuse of substances such as alcohol and such depressant drugs that slows the activity of brain and spinal cord on abusive usage endangering the safety and health of users and others affected by their work.

15. Hazardous Substances Control

The Contractor shall prevent all injuries, illnesses and damage to property or the environment caused by any article or substance, which proves to be hazardous. The code of practices of construction and operation and maintenance and control procedures shall meet required statutory and regulatory requirements. Personnel shall be trained on use, handling, storage, disposal and emergency spillage procedures.

The Contractor shall detail and deploy operational controls to reduce hazardous wastes and their disposal as required by the statute 'Hazardous Waste (Management and handling) Rules 2016'. Oil wastes, used oils, soil and cotton soaked in oil consequent to handling operations, grease and many class of paints and asbestos sheets and gaskets are typical hazardous wastes.

The Contractor shall identify, contain and control all sources of radiation. Appropriate regulatory approvals shall be obtained before commencement of work involving radiation sources. Radiation protection advisors suitably qualified and experienced shall be appointed whose names shall be submitted to Employer/Engineer. Dosimetry and surveillance of personnel engaged in such work shall be maintained in accordance with regulatory requirements.

16. Personal Protection Equipment (PPE)

General

The Contractor shall provide his employees required PPE meeting the requirements of the stated IS specifications and guidelines or equivalent International Standards as may be prescribed by the Employer/ Engineer from time to time. The Contractor shall have instituted good working procedures and practices in providing PPE, maintenance, issue and training on their use. All PPE shall be periodically checked to ensure worn, damaged equipment are replaced expeditiously.

Control Issue, Use And Maintenance Of The PPE

Employees shall be responsible for the PPE issued to them. The Contractor shall meet requirements of IS 8519 entitled 'Guide for Selection of Industrial Safety Equipment for Body Protection' or any equivalent specification that the Employer/Engineer may prescribe.

Head Protection

The Contractor shall comply with requirements of IS 2925. Hard hats shall be used and worn where a hazard of falling or flying objects exist. Hard hats intended for use by visitors shall have replaceable paper lining.

Eye And Face Protection

Eye protection shall be worn during all operations by operators and people in the vicinity, where there is a danger of flying particles of metal such as generated during use of hand tools such as chisels, grinding, welding and cutting lathe work on brass and cast iron acid and alkali splash, high pressure jet cleaning or insulation removal from heights using high pressure jets. The Contractor shall meet the requirement of IS8520 entitled "Guide for Selection of Industrial Safety Equipment for Eye, Face and Ear Protection".

Footwear

Safety shoes, boots and gumboots fitted with steel toe-caps of approved quality conforming to prescribed Indian or international standards. Wearing of unsafe safety shoes such as jogging shoes, tennis shoes, slippers and sandal etc. are prohibited. The Contractor shall meet the requirements of IS 10667 entitled 'Guide for Selection of Industrial Safety Equipment for Protection of Foot and Leg".

Protective Clothing

The Contractor shall prevent hazards of loose clothes worn by workmen getting caught in moving machine parts. Loose and thin garments such as dhoti and pyjamas are prohibited. While the Contractor shall ensure that all workmen wear long sleeved shirts, jackets or the like with the sleeves rolled down and secured at the cuff, long pants/ trousers extending upto the top of the safety shoes so as to prevent injuries caused by contact with heat, cold abrasive

and sharp surfaces shall be strictly enforced. Such protective clothing shall be mandatory in hazardous areas especially during start-up operations involving hot, inflammable, and other chemical hazards, furnaces and Boilers and such fired equipment and asphalting plants. Personnel exposed to acids and alkalies hot fluids and steam during such operations shall be provided with appropriate heat or corrosion resistant clothing. The CONTRACTOR shall meet the requirements of IS 8990 entitled 'Maintenance and Care of Industrial Safety Clothing'

Hand Protection

The Contractor shall provide appropriate hand gloves as per IS 8807 entitled 'Guide for Selection of Industrial Safety Equipment for Protection of Arms and Hands' to prevent injuries to hands during work. The Contractor shall maintain appropriate inventory of gloves for different applications like acid and alkali handling, general-purpose work gloves and asbestos or heat resistant hand gloves etc.

Safety Harness Or Fall Arrest

The Contractor shall provide safety harness or means of restraint such as safety belts, harness and lifelines etc. to workmen engaged to work in heights such as open-sided floors, open-sided scaffoldings, floor and roof openings, overhead construction works of various nature etc. where there is a falling hazard of two metres or above. Storage, issue, wearing and maintenance of safety harness shall be under strict supervision and records shall be maintained. All fall arrests shall consist of full-body harnesses, lanyards with shock absorbers, lifelines, rope grabs and associated hardware. Two alternate lanyards shall be used to facilitate tying off at a new location before disconnecting from the previous location. Practices for safety harnesses and fall arrests shall conform to IS 4912, IS 11972 and IS 8519 or equivalent international codes.

Falling Object Protection

Where work is in progress in elevated areas, barricades, barrier tapes, signs and such entry restriction devices shall be used to keep area below clear of personnel to prevent injury due to falling objects. If work is required in the area below elevated work area, it shall be scheduled at a time different from elevated works. The workmen below shall be protected from falling objects by the debris net or a catch platform with an adequate toe board to prevent material from falling off. Use of safety net for elevated works shall be considered in the work-permits where appropriate. Where a lift is made above a working area, the area below the path of the lift shall be cleared of personnel during the lift and barricaded and guarded to prevent entry of persons generally in conformity with IS 4912, IS 11972 and IS 13416 for protective barriers in and around building and

preventive measures against safety hazards in work places and safety requirements for floor and, wall opening, railings and teo-boards.

Respiratory Equipment

The Contractor shall maintain where appropriate, procedures for training and use of Self- Contained Breathing Apparatus (SCBA). The SCBA shall be provided together with lifelines and rescue teams to safeguard personnel working in areas where gases such as carbon monoxide, methane chlorine and such life endangering atmospheres are present. The Contractor shall meet requirements of IS 9623 for 'Selection, Use and Maintenance of Respiratory Protective Devices'. The Contractor shall have trained adequate number of personnel including the identified firefighting teams, hose teams and SAs in the use of the SCBA. The Contractor shall use the periodic safety drills to demonstrate, train and establish competence of personnel in the use of SCBA.

Hearing Conservation

The Contractor shall ensure reasonable precautions are taken to avoid injury to the hearing of the employees. All noise levels shall be controlled within 85 dBA. The Contractor shall identify noise areas where noise levels exceed prescribed safe level for arranging for appropriate engineering revision. Where this is not feasible, appropriate earmuffs or protectors shall be provided to workmen ensuring these are worn by those exposed to noise levels beyond safe levels. Periodic hearing acuity tests shall be conducted on such persons exposed to high noise levels to ensure that they do not suffer any hearing impairment as per requirement of IS8520.

Manual Handling - Ergonomics

The Contractor shall have procedures to identify risks involved in manual handling operation and tasks. The Contractor shall ensure appropriate training to prevent any possible injury. Full use of mechanical aids shall be made to avoid risks arising out of such manual handling. Employees shall be adequately trained on such manual tasks and related safety precautions to reduce the risk of injury to personnel engaged in such work. The Contractor shall undertake ergonomic study of manual operations to prevent musculoskeletal injury during manual handling, besides visual fatigue and mental stress giving considerations to matters such as seating lighting and ventilation etc.

17. General Requirements of Fire Protection And Prevention

Where the Employer maintains the fire protection equipment, the Contractor shall comply with the Employer's fire regulations, warning signals and procedures. The Contractor shall arrange to train his personnel meeting the prescribed qualifying competence needs, in requisite numbers in the operation of such fire protection equipment and systems. Risk assessments shall be carried out to identify potentially vulnerable areas to provide sufficient quantities of correct type of extinguishers and ancillary equipment to deal with various types of fire hazards Where required under the Contract the Contractor shall provide appropriate type of extinguishers close to areas of fire hazard but not too close they are cut off from use during a fire. Water based extinguishers shall not be positioned close to or used on electrical equipment. Extinguishers shall be marked/labelled and recorded with location particulars in a register. These shall be inspected at monthly intervals to ensure they are in operable sound condition. There shall be a systematic plan for servicing, repairing and recharging fire extinguishers and for recording such dates on the register and equipment. The location of firefighting equipment shall quickly and easily be identifiable especially in emergencies in a conspicuous manner painted as high as possible to identify the location of the extinguisher to prevent it from being obscured by machinery and goods stacked in front and to return the equipment to its location after emergency use in other locations. In order to ensure this, 'Keep Clear'

area shall be demarcated and maintained. Location plans of extinguishers and fire-fighting equipment shall be prominently displayed when desired by the Employer/Engineer. SR and SAs shall be trained on firefighting techniques who shall co-ordinate and control fire protection and prevention programmes. Where required under the Contract, the Contractor shall maintain alarm systems powered by mains and by battery for back-up. Where required under the Contract, emergency lighting shall be provided to aid evacuation in poor lighting conditions following the alarm. The alarm system shall be made known to all employees. When the Employer extends these facilities for use by the Contractor, he shall provide appropriate training to his personnel in the use of such emergency facilities and duties.

A clear written procedure for action in the event of fire should be produced. Fire teams and hose teams shall be identified and their responsibilities during emergencies shall be detailed in writing. Personnel shall be trained on their fire duties and use of fire-fighting equipment. Regular drills shall be conducted to test procedures and to validate them. Fire instructions and emergency procedures shall be displayed throughout the premises. A means of escape shall be provided in all work areas and storages and maintained and kept free from obstruction. All exits shall be clearly marked and kept unlocked whilst the premises are in use. Escape routes shall be protected from fire.

When a hot work permit is issued, the Contractor shall ensure (a) Identification of combustibles such as paper, cardboard and wood and moving away from area where hot work is undertaken using open flame or electric arc.

- Determination that flammable vapours and liquids are not present
- Protection of floor and wall openings to keep out sparks
- Determination that sprinkler and hydrant and other installed fire systems are functional
- Establishing a fire-watch with fully loaded extinguishers or charged water-hoses throughout the operation and 30 minutes after completion of operation
- Adequate ventilation for welders, by means of natural air movement local exhaust ventilators or air-line respirators as required
- Workmen performing the task are adequately briefed on job safety analysis, hazards and risks and the safeguards against risks.

18. Security

Where required under the contract, security personnel shall do all that is reasonably practicable to ensure the safety of employees and property of the company in the face of accidents by fighting fires and containing losses due to pilferage, theft, vandalism and industrial espionage both by employees and external elements. Security personnel shall be appropriately competent and receive adequate safety training. Security personnel shall routinely report on a standardised basis on aspects such as violation of fire-protection rules, use of alcohol and narcotic drugs, condition of security fencing, floodlighting and storages etc.

Where the project is located where a number of other companies are in operation, the Contractor shall plan for mutual assistance programmes in cases of emergencies, as are practiced in the area in conjunction with the Employer.

Where common boundaries exist between companies, the Contractor in conjunction with the Employer shall co-ordinate security control over factors common: such as floodlights, fencing,

pipelines containing gas, fuel and electricity Security personnel shall be represented in the SC through the SA nominated from the area.

19. Emergency Planning (EP)/ Emergency Response (ER)

The Contractor shall plan to deal with emergencies. An EP/ER specific to the job site shall be written and communicated to all employees. The EP/ER shall identify for the potential for and responses to incidents and emergency situations and for preventing and mitigating the likely illness and injury that may be associated with them.

The Contractor shall review his emergency preparedness and response plans and procedures in particular after occurrence of incidents or emergency operations

The Contractor shall designate his emergency team with their duties during emergencies defined, Including those of the hose teams, medical personnel, first-aiders and security. The Contractor shall maintain a procedure as to how his emergency organisation shall liaise with the Employer's representatives in the EP/ER.

The Contractor shall also periodically test such emergency procedures by conducting mock- drills and use the experience for updating the EP/ER and for training the employees on the perceived competence needs.

The EP/ER of the Contractor shall be under the control of the Safety Officer who shall be able to co-ordinating with the Employer/Engineer for liaising with government agencies, neighbouring industries and community.

The EP/ER shall be designed to allow people to work under disaster conditions when normal services such as telephone water, light power, transport and sanitation are not available and first aid and fire- fighting facilities are not able to cope with sudden demand on services. The telephone numbers of ambulance, police, managers and the Employer’s key executives shall be prominently displayed in the identified Emergency Response Center.

20. Premises & House-Keeping

The Contractor shall maintain a well-managed safe working place in sound clean condition. The Contractor shall ensure that there is a place for everything and everything in its place so that optimum use is made of valuable floor space with commensurate cleanliness and reduced handling time. He shall ensure that his entire infrastructure including temporary and semi- temporary building are kept clean and good repair.

Good Lighting-Natural & Artificial

The Contractor shall provide lighting natural or artificial to enable work Processes are carried out safely. Artificial lighting shall be adequate especially in the nights and emergencies. The lumen levels shall meet the statutory requirements.

Ventilation-Natural & Artificial

The Contractor shall ensure that workplaces are ventilated with at least prescribed amount of clean or cleaned fresh air of a suitable temperature, especially where toxic or irritating substances are present such as welding, vehicle exhaust fumes, irritating dusts, organic solvents or any other inimical atmosphere creating health hazards or safety.

Welfare & Hygiene Facilities

The Contractor shall provide welfare facilities to ensure a high standard of cleanliness for all activities and rest. The Contractor shall provide facilities for his employees such as ablutions, toilets change rooms, kitchens and cafeteria adequate and in a clean and hygienic state.

Pollution to Ground, Air & Water

The Contractor shall strive to exceed established minimum performance norms in waste and pollution control. All drains shall be identified as clean water and foul water to aid non-harmful disposal.

Traffic Routes & Aisles

The Contractor shall arrange to separate pedestrian and vehicular including material handling equipment traffic wherever possible and maintain the routes clear of obstruction. To ensure safety of users clear painted demarcation is encouraged as a discipline to be enforced.

Stacking & Storage Practice

The Contractor shall ensure stacked material is bonded on a stable and level footing capable of carrying the mass of the stack. Adequate clearances shall be provided between the sides of the stack and top to facilitate unimpeded access to service equipment like overhead wiring, cranes, forklifts and firefighting equipment, and hoses. Circular items shall be sufficiently choked with wedges not with odd bits of materials. Free-standing stacks of gunny bags and sacks such as cement bags shall be stacked to prescribed safe-stack heights with layers formed for stable bonding, preventing slippage causing accidents. Stacking against walls shall not be permissible. The Contractor shall maintain the premises and surrounding areas in clean and clear manner with safe access and egress. There shall be sufficient and adequate storage racks, shelving, bins and pallets and material handling equipment to stack his construction materials such as pipes structural and construction enabling materials. Unwanted materials shall be promptly moved away for efficient material movement.

21. Materials Storage of Hazardous

Hazardous materials shall be stored on solid bases. Solid bases shall include compacted earth, pallets, concrete or asphalt platforms or paving. Hazardous materials shall be stored, stacked and secured to prevent toppling, spillage or other unintended dislodgement. Aisles and clearances shall be as detailed under 6.6 above. Hazardous materials shall be stacked in such a manner that an observer standing in the aisle can read their labels and legend. Each hazardous material contained hall be identified by a legible or legend as per governing statute, code or regulation. The label shall identify the item, quantity and appropriate warnings.

Hazardous materials which if brought in contact with each other could react or pose equal or greater hazard than either material stored alone shall be stored at a distance not lesser than twenty feet apart. Warnings shall be posted and maintained in a legible condition at all access points clearly defining the specific hazardous nature of the stored materials such as ‘Corrosive’, ‘Flammable’, ‘Explosive’, ‘Oxidising’, ‘Compressed Gas’ or other hazardous nature. Where hazardous materials are unloaded in the Contractor 's storage maintained at site in a semi- permanent installation, such installations shall be approved by relevant statutory bodies. Copies of licences for storage shall be lodged with the Employer. The containers and storage shall display quantities stored with name of the hazardous material and the UN hazard classification label in prescribed colour code prominently painted in a conspicuous manner. The Contractor shall inspect the hazardous storages and installations on a daily basis and hall undertake any requisite preventive action necessary to avoid safety risks.

Storage of Flammable & Explosive Materials

The Contractor shall secure flammable and or explosive materials against accidental ignition. Storage facilities for flammable liquids such as petrol, diesel kerosene and lubricants as well as the quantities stored shall meet the legal and statutory requirements. These shall be stored in approved fire-resistant rooms with a sump of sufficient volume to contain any spillage. The electrical fittings to be flame -proof and on a strict maintenance schedule. Containers shall be appropriately bonded in receptacles into which low flash point fuel is decanted.

Compressed Gas Cylinders

Compressed gas cylinders shall be stored and secured in the upright position at safe distances from shielded from welding and cutting operations. Compressed gas cylinders in storage shall be shut off and torches, hose and manifolds removed and capped. Cylinders shall be periodically checked for leakages.

Storage shall meet requirements of Gas Cylinder Rules 1981.Compressed gas storages shall be provided with safety relief valves, Safety valves and rupture disc to protect them overpressures. appropriately designed to ensure their continued availability in the face of process changes.

Scrap & Refuse Bins-Removal System

The Contractor shall ensure that he has sufficient waste bins that are identified for different wastes and maintained in clearly demarcated areas. Wastes with oily or other ignitable materials such as oily cotton wastes and hand gloves shall be stored separately with covers to prevent fires and shall be made of metal. Different wastes shall be segregated and stored separately and disposed off. These shall be emptied at routine intervals to prevent that they do not overflow with wastes.

22. Safety Conditions for Undertaking Site Work

Each Contractor at site shall organise a Safety Group headed by a Safety Officer who shall be responsible for providing, supervising and monitoring safe working conditions at all times for their workers. The Safety Officer shall be experienced in maintaining safe conditions for workers at site and shall be responsible for and shall have authority to enforce safe conditions for the workers.

The Contractor shall have a declared Safety Policy and shall get the same approved by the Employer/Engineer. The approved Safety Policy shall be displayed prominently in the Contractor site office. The Contractor shall take active interest and participate in the development and operation of safety programs at site. His responsibility does not cease with establishment of Safety Group and approval of its various activities. He shall demonstrate his involvement by regular participation in safety meetings, review of safety records and taking corrective action where required, introduction of safety promoting bulletins, posters, suggestions and awards and by setting example by strictly observing safety rules. The Contractor shall remove all waste material and debris from and around the work area and properly clean up the area at the end of each day before leaving the work site. The Contractor shall take all necessary precautions not only for safe working of his own workmen but also deploy all precautions to ensure safety of structures, equipment and workmen of other agencies in and around his work site.

The Contractor shall ensure that his workmen do not trespass into prohibited areas.

The Employer/Engineer shall have the right to inspect at any time, all items of machinery or equipment brought to site by the Contractor, his agents or workmen and to prohibit the use on the site of any item, which in the opinion of the Employer/Engineer is or may be detrimental to the safety of the site. The exercise of such right or the omission to exercise it in any particular case shall

not absolve the Contractor or his agents or workmen of their responsibility of adhering to the safe working practices. The Contractor shall execute the work in a manner causing the least possible interference with the business of the Employer/Engineer, or with the work of any other Contractor who may be engaged on the premises and shall at all times co-operate with the other Contractors working at site.

The Contractor shall obtain work permit from the Employer/Engineer before starting any work at site. The work permits are issued to prevent the Contractor from working in unauthorised areas and shall be valid for specific area for a stipulated period.

The Contractor shall ensure at all times that his workers do not lie down or sleep under or around any machine, equipment, vessel or vehicle in his work area.

Working At Heights

For carrying out work at heights exceeding 1.8 - 2 meters or near openings in floors and roofs etc. precautions as given in following paras shall be taken. Adequate safety precautions like use of safety belts, crawling-ladders, safety nets etc. shall be taken. The workers shall wear safety belts with hook properly fastened.

All workmen engaged on work at heights shall be experienced in such work. Written permission of the Employer/Engineer shall be obtained before undertaking work on roofs. Wherever possible, steel staging or platform shall be erected. Staging with toe guards shall be provided with simple safety rails or ropes at waist height throughout its length on all open sides. Staging supports shall be All Purpose Scaffolding (APS) steel tubes scaffolding, safety secured and supported on firm level footings or slung from overhead beams. The supports shall be situated at maximum distance of 2.5 metres apart and the staging shall be secured to each support.

Wherever it is not possible to put up staging and/or use of safety belts and safety nets, steel sheets shall be slung beneath the place of work for safety. When working over open process vessels or tanks, safety belts and safety nets shall always be used whether or not staging and scaffolding is provided.

Safe access to all points of works shall be provided in the form of suitable ladders and stairways etc. Area around the work place shall be barricaded suitably or fenced off to avoid injuries to personnel passing by. Suitable warning boards and signs shall be put up.

Excavation

In the event of an excavation or removing a manhole cover, the Contractor shall ensure that any opening, sump or pit caused is securely fenced and covered as required by the Factory Act before leaving the workplace for the day. Suitable warning boards and signs shall be put up near such opening while work is in progress to warn persons passing by.

Lifting Gear

The Contractor shall submit a valid Test Certificate to the Employer/Engineer, from approved certifying authorities for all of his lifting gear and hoists, slings, chains, wire ropes, hooks, chain-pulley blocks, winches, hoists and cranes etc. before commencing work.

These certificates shall be available at site in the Contractor’s office for inspection as and when required.

Pressure & Leak Testing

Pressure and leak testing of equipment shall be carried out hydraulically. However, in special cases where pneumatic testing is specified, written approval shall be obtained from the Employer/Engineer before starting work. Under no circumstance gases other than nitrogen, carbon dioxide, air or steam shall be used for testing.

In case nitrogen or carbon dioxide is used for testing, the equipment shall be adequately ventilated and gas tested to ensure oxygen content of 21% before permitting a worker to enter the equipment.

Work Inside An Equipment Or Sewage System

All equipment and associated piping shall be isolated, completely drained, purged and well ventilated before entry of a worker. The atmosphere inside the vessel or equipment shall be tested to ensure absence of toxic and flammable gases.

Toxic and flammable liquids and gases in the equipment shall be safely disposed off as per the instructions of the Employer/Engineer. Workers carrying out drainage, purging and testing operations shall wear gas masks and other protective gear appropriate to the material being handled. While a worker has entered an equipment or a drainage system, another worker shall be present outside at all times to assist the worker inside in the event of an emergency.

23. ELECTRICAL

Portable power tools rated for above 50 V supply and hand lamps rated for above 24 V supply shall not be used at site. An armoured cable with a 3 pin Reyrolle type plug, properly earthed shall be provided between the Contractor's DG set and step down transformer.

All power supply and distribution boards shall have canopy for protection and all the distribution boards shall be earthed securely. All supply points shall have proper plug and socket.

The Contractor shall check tightness of connection of cable terminations and joints before starting the work.

Welding

Only qualified welders shall be employed at the work site. The Contractor shall organise the qualifying test at site for his welders and the Employer/ Engineer shall approve the welders. All welders shall have to undergo qualifying test and only on passing the test, they shall be allowed to work at site. For all welding work at site, generator sets shall be used instead of AC transformer sets. AC transformer sets are banned for welding jobs inside vessels (both open and closed top type).

The Contractor shall get his welding sets certified by the Employer/Engineer before starting work. These certificates shall have to be renewed every two months. A copy of the certificates shall be displayed on respective welding sets.

Only cables in good condition and insulated holders shall be used. The length of supply cable to welding site shall not exceed 8 metres and the welding set body shall be properly earthed.

A charged fire extinguisher of CO_2 type shall be carried with each welding set. The Contractor shall keep Halon or equivalent type fire extinguishers near hot jobs like cutting oil lines.

The welder shall not use a building structure, pipeline or railway track etc. as a return path of the current. Adequately rated circuit breaker shall be provided in the power circuit for human protection on all power supply points.

Hot Work

Before starting any hot work like gas cutting, welding and grinding etc., the Contractor shall obtain hot work permit from the Employer/Engineer. The permit shall be renewed on day- to-day basis.

The Contractor shall ensure purging of piping and equipment to make it totally safe before carrying out any hot work Smoking is strictly prohibited in work areas except at designated locations.

Smoking areas shall be prohibited and conractor shall ensure that no material or item that could start a fire is left at site. Special attention shall be paid to collection and disposal of oil soaked cotton waste or rags. On no account are these to be dropped into corners, pushed below equipment or left hanging on pipes.

Gas cylinders shall be used in a safe manner. These shall not be dropped from heights or dragged on the floor. Trolley with rubber rimmed wheels shall be used for transporting gas cylinders within the site. Acetylene cylinders shall be kept in upright position. Oxygen cylinders shall not be kept near inflammable materials like oil etc.

Tarpaulins shall not be used in the vicinity of welding and gas cutting jobs. The Contractor's supervisor of the rank of a foreman or equivalent shall examine the arrangements made for hot work before commencement of work and shall satisfy himself that all reasonable safety precautions have been taken.

The Contractor shall return the hot work permit after completion of welding work.

Personal Protective Equipment

Workmen shall wear protective clothing, head, leg and eye protection safety equipment at all times as per the job requirements. These are to be supplied and provided by the Contractor.

Adequate number of IS approved safety helmets shall be available at site.

Welders shall wear good quality insulated welding gloves, goggles, face shield, shoes and overalls while at work.

24. Accidents

In case of injury or serious illness of a worker, the Employer/ Engineer shall be notified immediately. All accidents shall be recorded by filling in the 'Accident Report' form, which shall be kept in easy accessible location in the site office of the Contractor. Any 'Near Miss' incident shall also be reported by the Contractor and recorded.

Insurance

All the Contractor's workmen shall be covered under the Employees State Insurance Scheme, Janata Policy or any other scheme which may be specified by the Statutory Authorities from time to time.

25. Review Meeting

The Employer/Engineer shall conduct fortnightly Safety Review Meeting to review the safety conditions practised at work areas by the

26. Contractor Work After Normal Working Hours

Extra care shall be taken for jobs to be carried out after normal working hours with due revalidated work permit and supervised by the Contractor's site-in-charge. The site-in-charge shall make available his residential address and telephone number to the Employer/Engineer so that he can be contacted in case of an emergency.

Proper lighting shall be ensured at the workplace for any work carried out after the normal working hours.

27. Conveyance For Emergency

The Contractor shall ensure that conveyance and person with driving license is available at site at all times of work execution so that in case of an accident, the victim can be rushed to nearest medical centre.

28. Safety Practices

Avoid working under un-insulated live conductors or working on freshly painted steel, which is still wet. Avoid working under un-insulated live conductors or working on freshly painted steel, which is still wet.

The Contractor shall advise his workmen to take the following precautions while using ladders:

- While ascending or descending, face the ladder. Use both hands for holding.
- Do not climb higher than the third rung from top on straight or extension-ladders and second rung from top on set ladders.
- Step-ladders shall be fully open before use.
- Sliding down a ladder shall be prohibited.
- Make shift ladders such as clear fastened across a single rail and short ladders spliced together shall never be used.
- Ladders shall be kept free from dirt and grease.
- Defective ladders shall be removed from use.
- Ladders shall not be left un-attended unless these are securely anchored at top and bottom.
- While using ladders, shoes shall not be greasy, muddy or otherwise slippery.
- Ladder shall not be used during severe windy conditions.

Lumber shall be piled out of the work area. Nails shall be removed or bent while handling lumber to avoid injury to workmen. While tearing down plaster or brickwork, dust shall be controlled with water. Walls shall not be subjected to lateral pressure or impact from materials stored or falling materials.

The safety valves for boilers shall be set by trained personnel and shall be sealed or padlocked at safe working pressure. Only authorised person shall change the setting of safety valves. The safety valve relieving pressures shall be checked as recommended by the manufacturer and applicable codes.

Blow down valves shall be operated strictly as per instructions. If blow cock is not marked with an arrow to show open and close position, the same shall be marked at site.

Safety slogans and safety instructions shall be prominently displayed in English, Hindi and local language at strategic locations.

29. Emergency Procedures

The Contractor shall familiarize himself with the emergency procedures, which apply to plants and areas in which his men are working.

First Aid Box shall be kept in the Contractor's site office. The Contractor's site-in-charge and his key supervisors shall be trained in administering first aid, preliminary treatment for electrical shocks, fall from height and burns etc.

When an emergency condition exists or on hearing the 'Stop Work Alarm' every supervisor shall ensure:

- All work is stopped at once.
- All equipment is shutdown.
- All men are evacuated to a pre-determined assembly point.
- A roll call is taken and every man is accounted for.
- No one shall be permitted to return to work until notification has been received from a responsible authorised agency that it is safe to do so.

30. Responsibility of the Contractor's Site Incharge/Safety Officer

His primary responsibility is safety of personnel and equipment. He shall:

- Understand the company's policy on maintaining safe working environment and appreciate the responsibility allocated to each grade of supervision. Know the safety requirements and relevant Government Regulations, and ensure their implementation.
- Ensure that sound, safe working methods and reasonable welfare facilities are provided for workers.
- Determine at the planning stage the following:
  a. The most appropriate order and method of working
  b. Allocation of responsibilities to supervisors
  c. Storage areas and access etc.
  d. Hazards which may arise from overhead or underground services
  e. Facilities for welfare, first aid and sanitation
  f. Work permit procedures and requirements
  g. Basic fire precautions
  h. Provide written instructions to establish work methods, to explain the sequence of operations, to outline potential hazards at each stage and to indicate precautions to be adopted.

ANNEXURE 11 – ENERGY SAVING CALCULATION USING VFD STARTERS

S. No	Description	Present Flow (mld)	Ultimate Flow (mld)	Head (m)	Running Hours	Pump HP	Energy Consumption per day using conventional starter	Energy Cost per day @ Rs.8.40 using conventional starter	Energy Cost per Year using conventional starter	Energy Consumption per day using VFD starter	Energy Cost per day @ Rs.8.40 using VFD starter	Energy Cost per Year using VFD starter	Energy Cost Saving	% of energy efficiency for one year (2025)
1	SPS-5 (Near Collectorate Ground)	7.13	11.15	15	20	3 HP (3 Nos)	134.23	1127.50	411536.85	69.80	586.30	213999.16	197537.69	52
2	SPS-6 (Near Templecity 5th cross Street)	12.79	19.92	15	20	5 HP (3 Nos)	223.71	1879.16	685894.74	109.62	920.79	336088.42	349806.32	49
3	MPS-7 (Vishnu Nagar)	19.83	30.73	20	20	7 HP (3 Nos)	313.19	2630.83	960252.64	140.94	1183.87	432113.69	528138.95	45
4	SPS-8 (Near Pachaiyappas College Ground)	2.75	4.2	20	20	2 HP (3 Nos)	89.48	751.67	274357.90	38.48	323.22	117973.90	156384.00	43
5	MPS-9 (Near Nathapettai WSP)	2.82	4.43	15	20	2 HP (3 Nos)	89.48	751.67	274357.90	41.16	345.77	126204.63	148153.26	46