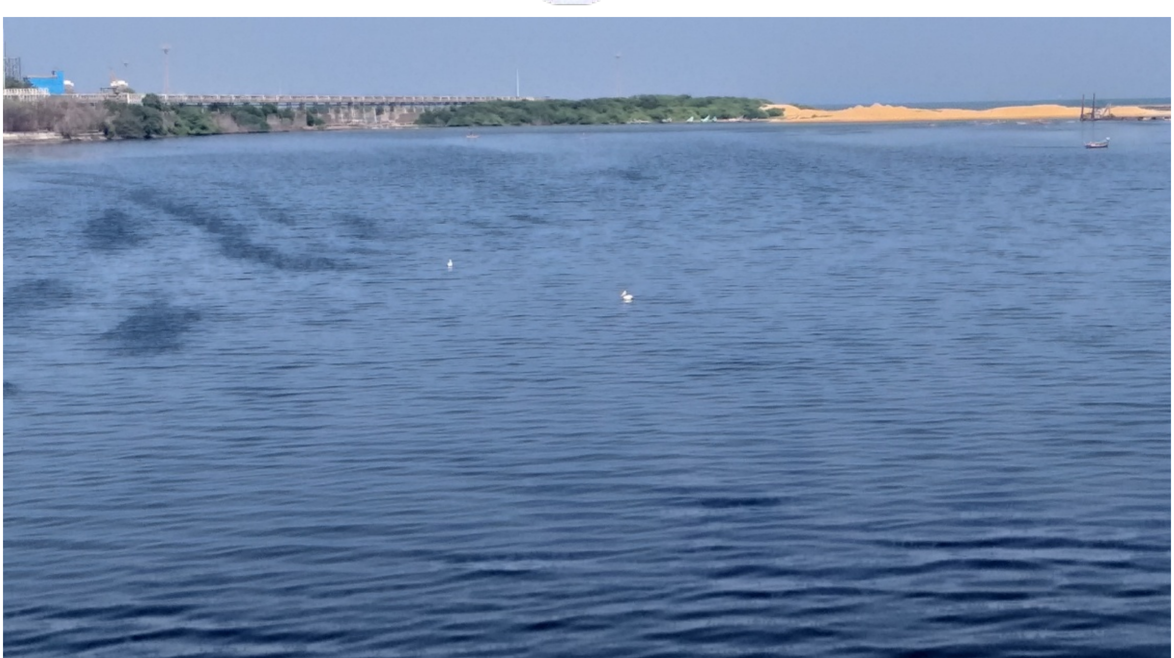
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT FOR

LAYING HDPE PIPE OF 800MM DIA ID ACROSS ENNORE CREEK UNDER BED FOR THE LENGTH OF 850M FOR CONVEYING TTRO WATER TO THE INDUSTRIES.

CHENNAI METRO WATER SUPPY AND SEWARAGE BOARD



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ABBREVIATIONS

BOD	-	Biochemical Oxygen Demand
CMA	-	Chennai Metropolitan Area
CMWSSB	-	Chennai Metropolitan Water Supply and Sewerage Board
CPCL	-	Chennai Petroleum Corporation Limited
COD	-	Chemical Oxygen Demand
CRZ	-	Coastal Regulation Zone
D.G	-	Diesel Generator
dB	-	Decibel
D.I	-	Ductile Iron
EIA	-	Environmental Impact Assessment
EMP	-	Environmental Management Plan
ESIA	-	Environmental and Social Impact Assessment
ESMF	-	Environmental and Social Management Framework
FMB	-	Field Measurement Book
GRC	-	Grievance Redressal Committee
HDPE	-	High Density Poly Ethylene

mg/kg	-	Milligram per Kilogram
MLD	-	Million Liters per day
MPN	-	Most Probable Number
NAAQS	-	National Ambient Air Quality Standard
PPE	-	Personal Protective Equipment
PWD	-	Public Works Department
RCC	-	Reinforced Cement Concrete
SAR	-	Sodium Adsorption Ratio
TNSUDP	-	Tamil Nadu Sustainable Urban Development Programme
TNUIFSL	-	Tamil Nadu Urban Infrastructure Financial Services
TTRO	-	Tertiary Treatment Reverse Osmosis
ULBs	-	Urban Local Bodies
GPS	-	Global Positioning System

EXECUTIVE SUMMARY

Introduction

Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB) constructed a 45 MLD Tertiary Treatment and Reverse Osmosis (TTRO) plant at Kodungaiyur for reuse of the sewage generated in the city. The project is for supplying treated water to industries in Manali- Ennore Area &Manali- Minjur Area, North Chennai, under Tamil Nadu Sustainable Urban Development Project (TNSUDP), funded by the World Bank. The project involves, Design, Build and Operate for 15 years a 45 MLD capacity TTRO Plant at Kodungaiyur including supply, laying and maintenance of D.I.Transmission mains for conveyance of product water to various industries in North Chennai regions. The above work was awarded to the contractor M/s. BGR Energy Systems limited, Chennai and commenced on 21.04.2017 with contract period of 30 months including trial and commissioning of 6 months and laying of conveyance mains is in progress.

Initially, permission / clearance was obtained from various National / State agencies and the World Bank including ESIA for all work items under the project, including laying of pipeline across the Ennore Creek on a pipe carrying bridge. Subsequently Public Works Department (PWD) who owns the creek decided that no more bridges will be permitted across the creek and suggested laying of the pipe at a minimum depth of 2m below the bed level under the creek using appropriate technology for carrying treated water. Subsequently, permissions for shifting the alignment under water were received from National and State level authorities, including fresh CRZ clearance and permission from Inland Waterways Authority of India (IWAI - who manages navigable water channels). A new ESIA for the change in alignment is hence prepared for clearance by the World Bank.

Project Description and Current Status

The project involves the construction of TTRO plant for the Treatment of Secondary treated water (completed) and laying of conveying mains of length 28.5 km from the plant to various industries, power plants and institutions in Manali-Minjur Corridor, Manali- Ennore Corridor in North Chennai. The pipelines are laid along the berm of the road 'without any acquisition of private land'. Permission for laying conveying main along the Buckingham canal and across Ennore creek, near National Highways and railway crossing near CPCL and PWD road was obtained from the concerned authorities. The conveying main of 800mm, 600mm and 300mm dia DI mains were laid almost 23.50 km as per the proposal except at Ennore Creek (850 m), Railway crossings and Buckingham canal crossings. The total length of conveying main was proposed for the project was 28.5 km but during the execution of the work, the total length of the conveying main is only for 25.35 km. The total cost of the project estimated is Rs. **392.61 Crores,** of which Rs.35 Crores will be used for laying of conveying main in Ennore Creek.

Proposed Method for laying of Conveying Main across Ennore creek

The laying of Pipe across Ennore Creek by dredging method does not create any major impact on hydraulic parameters, ecosystem, and livelihood of surrounding hamlets. The minor environmental and social impacts likely to be generated in and around the Creek and to its species are of transient in nature and are studied in detailed in the ESIA report. However, impacts are only temporary and can be abated by implementing adequate Environmental Management Program.

The Dredging & Laying of Pipeline across Ennore Creek will be done by the following methods:

Float & Sink Method (Where Soil Strata does not erode):

Pipes will be laid & joined (Heat Fusion Butt Welding) at shore for total length and then laid in the dredged trench at one go and then backfilling done for whole stretch.

Lay Barge Method (Where Soil Strata erodes/doesn't hold in place):

Dredge will be formed for a minimum length and pipes will be jointed & sunk into the creek. Then the dredged portion will be refilled. Again the next portion will be dredged and same procedure will be carried out for the total length of the Creek.

General notes of the proposal:

- Pipe used is HDPE (High Density Poly Ethylene) of 900mm OD (Outer Diameter) & 800mm ID (Inner Diameter), PN8 & PE 100 which is having a minimum life of 30 to 40 Years.
- To avoid floatation of Pipes in empty & full conditions, anchor blocks made of Concrete in 2 Pieces are casted and anchored to Pipes with Hot Dip Galvanized

Nuts & Bolts at suitable designed and approved intervals.

- Sea High Tide, Low Tide conditions, Highest High Tide, Lowest Low Tide, intervals & seasonal occurrences will be taken into account for executing the above job.

Modular Cutter Suction Dredger will be used for the dredging activity. This machinery is compact and can be transported to Site on a 40 MT & 40 Foot Trailer. It can be assembled at Site for execution of works. It is a Floating Machine provided with vertical legs using to move and holding in position during dredging at a particular location. The components of Floating Dredger are Movable Rotary Cutter, Suction Pipe, Delivery pipe, High pressure pump & Crane. By the time the pipes are aligned & welded, simultaneously the dredging will be completed and also the casting & curing of Anchor Blocks will be completed. Stage wise cutting is done in layers to obtain a 30-35m Width at Top &6m Width at Bottom for a Depth of 4m. The cut material is sucked & pumped to nearby potholes in the creek bed to fill up to bed level up to a length of 400m.

The alignment of Dredger, laying of pipe & depth of laying is monitored with the help of DGPS & Echo Sounding Systems on Board the Dredger. The entire pipeline will be floated and maintained in alignment by suitable anchorage on either side of the pipeline. Both the ends of the pipeline will be fixed with blind flanges with valves so as to enable floating. Once the pipeline is floated, using telemetry the pipeline is positioned above the dredged trench. Once the onshore monitoring station has cleared the pipeline for alignment, pipeline sinking process will commence.

Water will be filled into the pipeline by operating the valve fixed on the flange at the end of the pipeline and controlled filling of water will be done so that the pipeline sinking at controlled rate is achieved. The rate of sinking shall be strictly monitored so as to avoid any humps in the pipeline during sinking process. Once the pipeline gets anchored in the desired position, fresh water purging will be done for the laid pipeline. After completion of purging, the dredger will be redeployed for backfilling of the dredged trench. Further, to avoid Air entrapment, Air Valves will be fixed on each end of the pipeline on both the Banks and RCC Chambers of suitable size will be constructed.

Dredging will be done for the alignment of the pipeline, for that sediment from the creek is to be dredged and it will be stored in a temporary storage area without affecting the water bodies (details given in the chapter 2.0 of the ESIA report). Level bottom capping or combinations of borrow pits & dikes with covering reduce underwater spread of dredged material. After the completion of laying of pipeline, the dredged material will be replaced into the river to cover the pipe and trench. The sediment analysis showed that the underground sediments are free from any hazardous materials like heavy metals, so the activity doesn't create much impact to the water environment. The sediment quality of the creek is compared with USEPA standards and all the samples collected comes in the lowest effect level of the USEPA guidelines.

Environmental Regulatory Framework

The various Environmental regulations and policies followed for the implementation of project involves Environmental and Social Management Framework developed by TNUIFSL, Operational policies of external Funding Agencies, Environmental Policy and Regulatory Frameworks in India and Regulatory Framework in the State of Tamil Nadu.

Applicability of ESMF

The proposed activity of laying of pipeline crossing across Ennore Creek doesn't involves any encroachment or acquisition of land nearer the creek as the area is owned by the PWD. Moreover the proposed activity does not involves any physical or economical displacement of the people from the project area. So there is no need of resettlement plan and the project or its activities don't affect the livelihood of the surrounding people. Some temporary disturbances occurs to the fishing activity during the construction time, no other major impacts envisage during the construction phase. As there is no loss of land/ assets or livelihood, and there is no Project Affected People (PAPs), the project falls under S3 (socially benign) as per Social Categorization of ESMF and is classified as E1 as per Environmental Categorization of ESMF guidelines of TNUIFSL. A detail of categorization is well described in the Chapter 1.0 of the ESIA report.

Description of Environment

An area covering 1.5 km radial distance around Ennore Creek and corresponding micro-water shed around the area is considered as the study area for the purpose of the baseline studies during January - March 2019.

1. Meteorology

The meteorological data for Ennore shows average minimum air temperature varying between 24°C and 31°C and maximum temperature ranging from 27°C to 36°C. The Wind speed, Wind direction, Temperature and Relative Humidity are measured on hourly basis. The climate at Ennore is tropical with high humidity. The coastal area is normally governed by land and sea breezes. The coast of Ennore experiences two distinct monsoons viz., the Southwest (SW) monsoon from June to August and Northeast (NE) monsoon from September to November.

High relative humidity between 61% and 77% prevail throughout the year. Higher rates of relative humidity are observed between November and December i.e., 76% to 77%.

2. Air Quality

Ambient air quality was monitored at sampling locations (four samples) and parameters monitored are Sulphur dioxide (SO_2), NO_x, and particulate matter $PM_{2.5}$ and PM_{10}, Carbon monoxide (CO), TVOC in the study area. The average concentrations of PM_{10} were ranged between 59.4 and 73.8µg/m^3. The maximum and minimum SO_2 concentrations were recorded as 13.2µg/m^3 and 6.9µg/m^3. The maximum and minimum NO_x (oxides of Nitrogen) concentrations were recorded as 22.8µg/m^3 and 13.3µg/m^3.The observed air pollutants were within the limits as per CPCB standards.

3. Water Quality

Surface Water and Ground Water Samples were analyzed for physical and chemical parameters as per the methods prescribed in IS 10500: 2012 and APHA manual. The analysis of groundwater results indicate that the average pH ranges in between 7.60 – 8.51, TDS ranges from 1676 - 3945 mg/l, Total Hardness ranges from 940 - 1500 mg/l, Iron content ranges from 0.11– 0.16 mg/l, Nitrate content ranges from 2- 11 mg/l was observed.

The analysis of Surface water results indicate that the average pH ranges in between 7.68 – 8.17, TDS ranges from 16112 - 25139 mg/l, Total Hardness ranges from 3400-4800 mg/l, DO ranges from 4.9 – 5.7 mg/l was observed.

4. Noise Environment

The noise sampling locations in the study area were identified considering the location of industries and residential areas, highways and institutional areas. Noise level measured using a Sound Level meter. Noise levels during day time were found to be in the range 57.1 to 60.1 dB (A) and in the night time the noise levels observed in the range 46.5 to 48.7 dB (A).

5. Soil Quality

To determine the baseline characteristics of the soil and to find out the any direct impact on the soil due to the proposed project, soil samples were analyzed at four different locations nearer to Ennore Creek. The pH of the soil was ranging from 8.36 to 8.56 indicating the soils nearer to the site are basic in nature. The nutrients contents (Nitrogen, Phosphorus and Potassium) of the observed soils were also in high level. Geotechnical Investigation Report describes the detailed study of creek bed and soil is enclosed as Annexure IX.

6. Biological Environment

Biological survey was done to understand baseline ecological status, important floristic elements, and fauna structures in and around Ennore Creek. The confluence point of Kosastalaiyar River and sea water harbors fringes of mangroves at the upstream stretch of Ennore creek. However in the study area there are patched mangroves that are stunted and sparse. As per baseline studies, some common fishes & animal species were recorded in the study area and no endangered, threatened & protected faunal species observed.

Marine Ecology

The exact location of the proposed project is demarcated as a Creek based on the CRZ map prepared and provided by the Institute of Remote Sensing (IRS), Anna University, Chennai. The CRZ map is attached as Annexure 1 in the report. The project site is located near to the Bay of Bengal, so the influence of HTL and LTL is present at the proposed site. Hence, analyzed the physico-chemical and biological parameters of the Creek, well before the commencement of the work and is as follows.

a) Marine Sediment

The marine sediment samples were collected from Ennore Creek. The area comprises of brown or grey muddy like Sandy Sediment. The pH indicates that the marine sediment in the study areas is non-acidic in nature, with the pH varying in the range of 7.30 to 7.84. The Iron was observed in the range of 0.150 - 2.53 %.

The Total Nitrogen values are in the range of 670 – 1900 mg/kg indicating that soils have very high Nitrogen levels. The Total Phosphorous values are in the range of 253 – 1374 mg/kg indicating that soil sediment has an average Phosphorous level. The sediment samples collected from different locations did not reveal presence of high concentration of metals (lead, copper, iron, nickel, zinc, cadmium, chromium, mercury) in the area. The concentration of Mercury is found in below detectable limit in the monitored locations.

b) Creek Water

The pH of the samples collected from the surface varies between 7.29 to 7.82 and the pH of the bottom samples varies between 7.18 to 7.95. The concentration of iron was observed in the range 0.11to 1.41 in the surface samples and the concentration varies from 0.08 to 1.46 for the samples collected from the bottom of the creek. The percentage of salinity varies between 10.4 to 21.7% in the surface samples and 14 to 32.1 % in the bottom samples. The concentration of heavy metals (mercury, arsenic, selenium lead, cadmium) is in below detectable limit in the samples collected from the Creek. The Dissolved oxygen concentration in all the collected samples is more than 4 mg/l, it indicates the minimum oxygen concentration is available for sustaining life of several aquatic species.

c) Biological Data

The biological parameters considered for the present study were Phytoplankton, Zooplankton and Benthos. The first two reflect the productivity of a water column at the primary and secondary levels. Benthic organisms being sedentary animals associated with sediment/rocky beds, provide information on the integrated effects of stress, if any, and hence these are good indicators of early warning of potential damage.

Fishes in Ennore Creek

Fishing is the one of the major activities in the Ennore Creek up to the area of Ennore Railway Bridge. The January and February is the spawning seasons for the many of the species of fish inhabit in the Ennore Creek and most of the fishes spend the early stages of life cycle in the riverbed mangroves situated at the 40-50 m distance from the project site. So no disturbances occurs to the spawning of fishes due to project activity.

Euthynnusaffinis (LittleTuna), *Sardinellagibbosa* (Sardines),*Etroplus Suratensis* (GreenChromide) are the some of the fish species present in the Ennore Creek.

Birds species visiting Ennore Creek.

Migratory birds are normally visiting during winter season. The laying of pipe line shall be carried out during the period from March to September, therefore there will not be any disturbances for the movement of migratory birds. There are also resident birds like Painted Stork and Grey Herons which can be sighted in the Ennore Creek.

Bathymetry Survey

Bathymetry Survey was carried out along proposed pipe line route in Ennore Creek using Echo sound transducer and GPS. Based on the survey, it was identified that the depth varies between 0.5 m and 0.35 m MSL in the entire survey area.

Tides

The tidal flow at the pipe laying location is almost negligible and the tidal variation close to the site is less significant. Along the Ennore Coast, the tides are semi-diurnal with phase velocity perpendicular to the coast thus resulting in the seasonal residual circulation along the coast. On dry period, i.e. from February to September there is rise of tide up to 0.30m height during spring tidal days and remain dry on other days. But during northeast monsoon days, i.e. from October to January, there will be rainwater flood discharge which will raise the water level up to 2m in this region.

Socio- Economic Environment

A sample survey has been conducted to collect information about socio economic baseline of the project area. The socio-economic baseline for this project area has been developed based on the combination of secondary literature review as well as the inferences drawn from stakeholder consultations undertaken during ESIA study period. It was noted that people around Ennore Creek are mainly involved in fishing activity (capturing of fish).Non-farm activities include the working as agriculture labor and other unskilled labor works. Some temporary disturbances occurs to the fishing activity during construction phase due to less availability of fish in the project area. However the movement of vessels won't be disturbed during the construction time as it is doing in the two phases for ensuring the free access of the vessels.

Environmental Impact Analysis

The 800mm diameter DI pipeline will be laid at either side of the creek and at creek area 800mm Inner diameter HDPE pipe of 50 mm thickness shall be laid to a length of 850m. The likely impact on Ennore Creek due to dredging and pipe laying, includes Topography, Land use Pattern and Surface/ Ground water Quality, Ambient Air Quality, Noise Quality, Ecology, Traffic, Health and Safety etc. will be temporary in nature and minimal on account of the proposed mitigation measures. Dredging and disposal of dredged material may lead to minor impacts on water quality from increased turbidity and from release of contaminants to the water column due to re-suspension of sediments and/or changes of certain chemical compounds in the dredged materials when exposed to different level of oxygenation. The hydrology and water quality of the Ennore Creek affected temporarily during the construction phase and no negative or long term impacts to the Creek due to the proposed project. The most significant potential impact during the project activity would be the release of sediments into the water during dredging. This may causes turbidity in the water which could adversely affect some aquatic organisms present in the water, however, it will be mitigated by using proper dredging methodologies and also implemented by suggested mitigative measures. Dredging material will be stored in the PWD site identified nearby water body without affecting the Mangroves and it will be covered by tarpaulin for avoid dust emission. The placement of dredged material on the temporary storage site may include the generation of sediment-laden runoff. So sedimentation pond type structure will be developed to ensure sediment-free water is released from these structures

Mitigation Measures

The impacts during dredging and due to the laying of pipe line across Ennore Creek are of transient nature and its impacts to the water quality, air, noise, land, hydrology etc. will gradually reduce on completion of the pipe laying.

The laying of the conveying main in the dredged trench and simultaneous backfilling of the dredged area will be complete in the whole stretch. Dredging material will be stored away from the water body and dredged material backfilled in the trench within 20 days. The excess material will be used for giving extra stability to embankments and for other bank reinforcement's structures. Selection of appropriate dredger such as cutter section dredger will help to reduce the release of the sediment and smothering due to the dredged slit. Silt veils/ curtains will be used to contain an area of more turbid water so that it is forced to flow out near the bottom. Before dredging operation, the contractor will identify the highly turbid places in the creek and slit curtains are proposed for arresting the spread of sediments to a larger extent.

Continuous monitoring of the creek environment will be performed periodically to estimate the impacts of the projects to the surrounding environment and to take appropriate mitigation measures to reduce the impacts in the project site. Laying of pipe line across creek will be carried out in 2 phases to ensure the free movement of vessels across the creek for fishing activity. Proper Traffic management plan will be prepared for the Ennore flyover road and it will be implemented only after the approval of concerned authority.

Environmental Management Plan

As the project is proposed to be implemented by the CMWSSB with the help of DBOT contractor, DBOT contractor and the CMWSSB Engineer shall adhere to the EMP envisaged in the report. As the compliance to the EMP has already been included in the agreement for the original contract, no separate amount is included in the additional cost. However, the specific conditions in the EMP for Creek work will be included in the agreement for the additional work of Creek crossing. The compliance to the EMP will also be adhered by the contractor and CMWSS Board will ensure for the compliance of the EMP on the whole.

S. N	Potential Negative Impacts	Mitigation Measures	Time frame	Responsible agencies
Pre - Construction				
1	Clearances/ Permits	IWAI, CRZ, PWD, and Highway clearance required during construction were obtained from the concerned authorities and attached as annexure IV. Permits related to construction and labor shall be obtained and complied with.	Before start of construction	CMWSSB/ Contractor
2	Storage of materials	The contractor will get permission from the PWD, for temporary use of land for construction sites / storage of construction materials, etc. The contractor would ensure stored dredged material in the PWD site will not be create any adverse impact to nearby water body and Soil. The area (20000sq.mtr) selected for temporary storage and its location co-ordinates are given in the Table 2.1 of the ESIA report.	Before start of construction	CMWSSB / Contractor
3	Tree Plantation	No tree cutting involved in this project. If any tree cutting activity in project site, Compensatory plantation will be 10 times to the number of trees bring cut.	Before start of construction	CMWSSB / Contractor
4	Site Clearing	The clearing of bushes and weeds will be necessary from the either side of the creek bed without affecting mangrove species.	Before start of construction	CMWSSB / Contractor
5	Construction of labor Camp	• Contractor will follow all relevant provisions of the Factories Act, 1948 and the Building and the other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 for construction and maintenance of labor camp). • EHS guidelines of the World Bank to the contractor involved in setting	Before start of construction	CMWSSB/ Contractor

		up of the construction and labor camp for keeping the health & Safety of workers and impacts of setting up such camps on the local community in consideration while developing and establishing such camp will be strictly followed. • The location, layout and basic facility provision of each labor camp will be submitted to Engineer prior to their construction. • The construction will commence only upon the written approval of the Engineer. • The contractor will maintain necessary living accommodation and ancillary facilities in functional and hygienic manner as per the requirements of relevant laws like ILO standards and World Bank EHSGs. • All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. The sewage system for the camp must be planned. • Proper health monitoring will be done for the work force, like frequent checkup, counselling support, health education. The layout of the construction camp and details of the facilities provided will be prepared and will be approved by the Engineer. Awareness about HIV/AIDS will be provided, Grievance Redressal mechanism for the camps. • Emergency Number will be displayed in the Labor Camp. • Nearby hospitals may be intimated about the influx of labor.		
6	Requirement of Specialized Officials	• Contractor shall ensure the availability of specialist in marine ecology, hydrology, EHS, structural engineers etc. as required who shall coordinate prior to and during construction & O&M period for effective implementation of the project.	Before Construction	Contractor

Construction Phase				
1	Environmental monitoring	Environmental monitoring will be done & checked to control the Baseline parameters of Air, Water and Noise pollution. Base line parameters recorded will be used for monitoring and conformance be ensured.	During Construction	CMWSSB
a.	Water Quality Monitoring	• The monitoring of the water quality carried out at all locations identified along the project locations. Monitoring parameters are as per IS-10500 for ground water quality and for surface water quality as per CPCB guidelines on Inland Surface Water (IS: 2296-1982).	Before and after Construction	Contractor
b.	Ambient Air Quality Monitoring	• Ambient air quality monitored at different locations in accordance with National Ambient Air Quality (NAAQ) Standards 2009. • Maintenance of DG sets during the construction time to achieve efficient combustion, fuel efficiency and therefore reduce emissions. • Minimize the movement of vehicles and enforce a speed limit around the construction area.	Before and after Construction	Contractor
c.	Ambient Noise Level Monitoring	• The measurement for monitoring the noise levels to be carried out at the work sites / dredging area/and near dumping areas in accordance to the Ambient Noise Standards formulated by CPCB. Noise shall be recorded using digitized noise monitoring instrument. The equivalent Noise Level will be recorded for comparison with prescribed limit and baseline data. • DG sets will be housed in an enclosure and the exhausts will be provided with silencers.	Before Construction and during Construction	Contractor
2	Maintenance of labor camps	• Contractor will follow all relevant provisions of the Factories Act, 1948 and the Building and the other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 for construction and maintenance of labor camp). • The contractor will maintain necessary living accommodation and	During construction	Contractor

		ancillary facilities in functional and hygienic manner and as approved by the Engineer. • The contractor will document and communicate to all employees and workers directly about working conditions and terms of employment-wages, benefits, hours of work, compensation etc. at the minimum comply with national law (IFC performance standard). • All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. Adequate health care is to be provided for the work force. The layout of the construction camp and details of the facilities provided will be prepared and will be according to GIIP and World Bank guidelines. • Awareness about HIV/AIDS will be provided, grievance Redressal mechanism for the camps.		
3	Planning of temporary traffic arrangements	The activities are limited to the project sites and right of way. In case of any need in the site, necessary permissions for temporary diversion will be obtained. Signings and safety measures including flagmen are provided at the site.	During construction	Contractor
4	Barricading site	The activities would be restricted to project sites and right of way for alignment. Barricading with adequate marking, flags, reflectors etc. will be provided along the alignment for safety of restricted traffic movement and pedestrians.	During construction	Contractor
5	Pollution from Construction Wastes	• The contractor will avoid the generation of hazardous and non-hazardous waste materials. • Construction waste (pipe cuttings, scraps) generated properly segregated and stored in designated bins and disposed to the authorized recyclers.	During Construction	Contractor

		• Where waste generation cannot be avoided, the contractor will reduce the generation of waste and recover and reuse waste in a manner that is safe for human health and environment.		
6	Informatory signs and Hoardings	The contractor will provide, erect and maintain informatory/ safety signs hoardings written in English and local language, wherever required or as suggested by the Engineer	During Construction	Contractor
7	First Aid	The contractor will arrange for: • A readily available first aid unit including an adequate supply of sterilized dressing materials and appliances as per the Factories Rules in every work zone. • Availability of suitable transport at all times to take injured or sick person(s) to the nearest Primary Health Centre (nearly 2.5 km from the project site). Emergency number will be displayed in the project site.	During Construction	Contractor
8	Chance finds	Construction contractors to follow these measures in conducting any excavation work • All fossils, coins, articles of value of antiquity, structures and other remains or things of geological or archaeological interest discovered on the site shall be the property of the Government and shall be dealt with as per provisions of the relevant legislation. • The contractor will take reasonable precautions to prevent his work men or any other persons from removing and damaging any such article or thing. He will, immediately upon discovery thereof and before removal, acquaints the Engineer of such discovery and carry out the instructions for dealing with the same. • Stop work immediately to allow further investigation if any finds are	During Construction	Contractor

		suspected; • Create awareness among the workers, supervisors and engineers about the chance finds during excavation work • The Engineer will inform State Archaeological Department if a find is suspected, and seek direction from ASI prior to recommencing the work.		
9	Flora and chance found Fauna	• Any fauna/ flora (aquatic or terrestrial) species or signs of their past presence such as scats observed in the project area during work will be reported to the Environment Management team and on-call field specialist should conduct field monitoring in the case of unusual or for important chance finds; • The Contractor shall take reasonable precaution to prevent his workmen or any other persons from removing and damaging any flora (plant/vegetation) and fauna (animal) including fishing in any water body and hunting of any animal. If any animal is found near the construction site at any point of time, the contractor shall immediately upon discovery thereof acquaint in the Environmental Specialist and carry out his instructions for dealing with the same.	Throughout the project especially in water body	Contractor
10	Waste Disposal	• The contractor will provide garbage bins in the camps and ensure that these are regularly emptied and disposed of in a hygienic manner as per the Comprehensive Solid Waste Management Plan approved by the Engineer. • Unless otherwise arranged by local sanitary authority, arrangements for disposal of night soils (human excreta) suitably approved by the local medical health or municipal authorities or as directed by Engineer will have to be provided by the contractor. • Adequate sanitary, drainage, toilets with septic tanks, refuse collection and disposal facilities shall be provided for the construction workers.	During Construction	Contractor

11	Clearing of project site	• Contractor has to prepare site restoration plans; the plan has to be implemented by the contractor prior to the demobilization. On completion of the works, the left-over construction materials will be removed stored and removed by the contractor from project site for reuse/ proper disposal. • On completion of the works, all temporary structures will be cleared away, all rubbish cleared, excreta or other disposal pits or trenches filled in and effectively sealed off and the site will be left clean and tidy, at the contractor's expenses, to the entire satisfaction of the engineer.	After completion of Construction	Contractor
12	Pollution from Fuel and Lubricants	• The contractor will ensure that all construction vehicle parking location, fuel / lubricants storage sites, vehicle, machinery and equipment maintenance and re fuelling sites will be located at least 500m from rivers and irrigation canal / ponds. • All location and layout plans of such sites will be submitted by the Contractor prior to their establishment and will be approved by the Engineer • Contractor will ensure that all vehicle / machinery and equipment operation, maintenance and re fuelling will be carried out in such a fashion that spillage of fuels and lubricants does not contaminate the ground. • Contractor will arrange for collection, storing and disposal of oily wastes to the pre-identified disposal sites (list to be submitted to Engineer) and approved by the Engineer. All spills and collected petroleum products (if any) will be disposed of in accordance with MoEF and state PCB guidelines.	During Construction	Contractor
13	Safety Aspects	• Adequate precautions will be taken to prevent the accidents and from	During	Contractor

		the machineries. All machines used will conform to the relevant Indian standards Code and will be regularly inspected by the CMWSSB. • If loose soil is met with, shoring /strutting structures will be provided to give temporary support to the sides of the trench. • Protective footwear and protective goggles to all workers employed on mixing of materials like cement, concrete etc. • Welder's protective eye-shields will be provided to workers' who are engaged in welding works. • Earplugs/ear muffs will be provided to workers exposed to loud noise, and workers working in crushing, compaction, or concrete mixing operation • The contractor will supply all necessary safety appliances (PPE) such as safety goggles, helmets, safety belts, ear plugs, life jackets, mask etc. to the labors working in creek and to the staffs. • The contractor will comply with all the precautions as required for ensuring the safety of the workmen as per the International Labor Organization (ILO) Convention No.62 as far as those are applicable to this contract. • The contractor will make sure that during the construction work all relevant provisions of the Factories Act, 1948 and the Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996 and adhered to. • The contractor will not employ any person below the age of 18 years for any type of work. • Work shall follow the recommendation of Geo Technical investigation report while carrying out the work in the Creek.	construction	

		• Safety measure around pillars/piles of existing bridge (32m away) to protect them from any adverse impact due to the operation of dredger will be ensured during the work time. • Rescue facilities, including sufficient stretcher(s), portable resuscitation equipment and first aid facilities, should be provided and kept readily accessible for emergency use for labors/employees working for the project. • Safety measures like High top boots will be provided to the workers to avoid any snake bites while working in Creek and contractors will be instructed to keep proper antidote in hand, in case of emergency. • Contractor will practice work rotation system among the workers to reduce health impacts related to prolonged exposure to noise or water (as work is in Creek). • The State and National Guidelines on COVID 19 pandemic will be strictly followed during the working hours and in the labor camp.		
14	Accessibility to sites /traffic	• Adequate road facilities have been provided in project site for movement of vehicle and unloading of materials without disturbing of existing features and activities. • The Contractor shall take all necessary measures for the safety of traffic during construction and provide erect and maintain such barricades, including signs, markings, flags, lights and flagmen as proposed in the Traffic Control Plan. • The fishermen should be informed well in advance in local language	Construction Phase	Contractor and CMWS&SB

		regarding the two stage construction process and makes them aware that there is no access / movement restriction during both phases. • The information regarding the dates of works will be displayed in the project site and will announce through notice in local newspapers in local language.		
15	Environmental Monitoring	The water, air, soil, noise quality and biological environment will be monitored in pre-construction and Construction phase as detailed in Table 6.2.	Pre-construction & Construction	CMWS&SB & Contractor.
16	Storage of construction material	Site for storage of construction materials to be identified in consultation with Engineer in charge, without affecting the nearby water bodies, traffic and other common utilities.	During construction	Contractor
17.	Risk from electrical equipment	The Contractor shall take all required precautions to prevent danger from electrical equipment and ensure that – No material shall be so stacked or placed as to caused anger or inconvenience to any person or the public. All necessary fencing and lights shall be provided to protect the public in construction zones. All machines to be used in the construction shall conform to the relevant Indian Standards (IS) codes, shall be free from patent defect, shall be kept in good working order, shall be regularly inspected and properly maintained as per IS provision	During Construction	Contractor
18	Water Pollution From Construction	• The Contractor shall take all precautionary measures to prevent the wastewater generated during construction from entering into streams, water bodies or the irrigation system.	During construction	Contractor and CMWSSB

	Wastes	• All waste arising from the project is to be disposed of in the manner as per regulatory norms.		
19	Dredging materials from laying of conveying main	• Dredging material will be stored away from the water body and dredging material backfilled in the trench within 20 days. • Dredging material will be stored in the PWD site identified nearby water body without affecting the Mangroves and it will be covered by tarpaulin for avoid dust emission. • Wherever dredging materials are more likely to generate the airborne particles during operations, nominal wetting by water could be practiced to ensure compliance to ambient air quality standards. • The placement of dredged material on the temporary storage site may include the generation of sediment-laden runoff. So sedimentation pond type structure will be developed to ensure sediment-free water is released from these structures.	During construction	Contractor and CMWSSB
20	Dredging activity	• Cutter -Suction dredger must be selected to minimize re-suspension of sediments. • Timing of dredging (March to September) and disposal must be considered at most favorable points in the tidal cycle to limit extent of effects. • Silt curtains can be used where practicable. • The timing of the dredge must be considered to avoid species of benthic communities in the maintained channels and allow these species to vacate the area. The November to February is the peak monsoon period in the project area, the fresh water influx to the creek will be high, as a result turbidity will be more so this peak time will be avoided for dredging.	During construction	Contractor and CMWSSB

		• Use excavation tools /dredger heads appropriate to minimize the turbidity. • Minimize overflow by e.g. recirculation of overflow water. • Dredging activity will be carried out outside the migratory period (November to February).		
21	Solid Waste	To ensure the minimum impact on marine water quality, the following measures will be followed by the contractor during the construction time: • No garbage would be disposed to the Creek. • The solid waste like packing materials, paper plastics, tins, glass etc. generated during the Construction time will be segregated and stores it on-board facility (appropriate containers) and transported back to the shore where they will be recycled or disposed in the land based disposal facility (land fill). • If any plastic, scrap metal and other non-combustibles should be segregated and sent to authorize recyclers. • Waste management registers will be maintained along with photographic evidence.	Throughout the Construction phase	Contractor
22	Risk force measure	• Contractor shall take all reasonable precautions to prevent danger to the workers and public from fire, flood etc. resulting due to construction activities. • Contractor shall make required arrangements so that in case of any mishap all necessary steps can be taken for prompt first aid treatment. • Construction Safety Plan prepared by the Contractor shall identify necessary actions in the event of an emergency	Throughout the Construction phase	Contractor
23	Sediment	• Geochemical and texture analysis were carried out for understanding the	Prior to	Contractor

	Quality analysis	characteristics of sediment, and for choosing the suitable site for the storage by the NABL Accredited Laboratory. • Based on the sediment quality only, the dredging disposal site is selected for temporary storage. • Heavy metal parameters shall be compared with US EPA standard on sediment quality.	dredging activity	and CMWSSB
24	Safety measures in Creek	• All PPEs (Hand gloves, life buoy and life jacket) will be in good condition. • Ensure that the area is properly barricaded to avoid unauthorized entry of vessel/boat. • Divers should have previous experience of similar jobs and certified by recommended medical specialist only. • Under medication divers are not allowed to take diving operations. • Boat will be kept operational condition during pulling of pipeline. • Concrete blocks will be fitted with suitable anti-friction strip to avoid sliding. • Transfer of personnel only when secure and under supervision. • Hands to be free from any luggage during transfer from barge to boat. • Long working hours shall be controlled and where ever possible all diving task should be finished in the day hours. • Rescue/evacuation teams (including first aiders) will be organized to deal with emergency situations. • The occurrence of an emergency situation will be informed immediately to the rescue team for immediate launching of rescue procedure. • CMWSSB Engineer will report emergency situations immediately to the	During Construction	Contractor

		public emergency authorities, i.e. Fire Services Department and/or Police, Ambulance for immediate assistance. These personnel will be alerted well before start of works. • Sufficient rescue/evacuation boat(s) will be provided and kept ready for immediate use in case of emergency. Any injured people will be evacuated immediately from the spot according to the OHS guidelines. The contractor will make use of ambulance service of nearest primary health center (2.5 km) located nearest to the project site for emergency purposes. • Emergency procedures, including rescue/evacuation procedures, would be formulated and reviewed regularly in the safety plan for, but not limited to, adverse weather, fire, injuries of workers, etc. • An emergency contact list (internal and external) will be displayed on board. • Basic facilities such as toilet, drinking water, electricity, health, eye shower, first aid facility and safety gadgets, personal protective equipment (Safety Glasses, Splash-proof Goggles, Gloves, Hearing Protection, Safety Shoes or Boots and Respirators/ underwater breathing apparatus) will be provided. • To prevent drowning personal flotation devices (PFD) for work activities on or near water shall be provided. PFDs must be worn with all straps, zippers, and ties fastened. Tuck in any loose strap ends to avoid getting hung-up. • Will provide a floating ring buoy close to the work areas. • Checklist for safety will be prepared and safety be ensured every day during work		

		• Training for special work conditions will be provided for workers.		
25	Unforeseen Impacts	Unforeseen impacts (flooding of nearby areas, rupturing of pipe, tsunami) encountered during implementation will be brought to the notice of respective concern department as well as safeguard specialist of the CMWSSB. Mitigation measures shall be adopted accordingly, as per the direction from respective authority or addressed in accordance with the principles of ESMF.	During construction	Contractor and CMWSSB
26	Compliance to EMP measures	Contractor shall ensure that all the measures identified in the updated ESIA report for pipe laying across Ennore Creek will be complied.	During Construction	Contractor
27	Closure activities	• On completion of the works, the left-over construction materials will be removed stored and removed by the contractor from project site for reuse/ proper disposal. On completion of the works, all temporary structures will be cleared away, all rubbish cleared, excreta or other disposal pits or trenches filled in and effectively sealed off and the site will be left clean and tidy.	After Construction	Contractor and CMWSSB
Operation Phase				
28	Environmental Monitoring	The water and marine parameters will be monitored periodically. Detailed monitoring record will be maintained. Periodical report will be send to the Environmental Monitoring Cell and to the concerned Engineer. The frequency and parameters for Environmental Monitoring detail is given in Table 6.3 of the updated ESIA report.	During Operation	CMWSSB /Contractor.
29	Flora and fauna	Studies of flora and fauna to ensure the creek features are returned to normal after the construction.	After Construction activity	CMWSSB /Contractor

30	Operation& Maintenance	• CMWSSB/Contractor shall ensure display of Emergency number in the Creek during O & M. • Any major damage occurs to the pipe, the pipe will be returned back to the supplier and if only minor damage is there in the pipe, it will be disposed to Treatment, Storage and Disposal Facility (TSDF) approved by TNPCB and in consultation with engineer concerned. • Suitable sign-boards will be placed at both edges and at points along the pipe alignment to demarcate this and to prevent impacts due to other dredgers, boats etc., during operation phase as well.	Operation & Maintenance	Contractor

Social Impact Assessment

The proposed project involves the following activities

1. Dredging of Ennore Creek along the proposed pipeline route.
2. Laying of 900 mm OD &800m ID HDPE pipe line at the creek area.

There are no encumbrances or disturbances during dredging or laying of conveying main across the Ennore Creek. The Ennore Creek and both sides of the creek (river bed) are owned by PWD, Government of Tamil Nadu, thus Private Land Acquisition is not involved in this project. The project does not have any social impacts i.e. the number of Project Affected People (PAPs) in this project is nil, hence the proposed project can be categorized under S-3 category as per ESMF of TNSUDP. Social Screening is carried out for the project and is attached to the updated ESIA report as Annexure V.

Permission for laying conveying main in the right of way of the existing roads in National High ways and railway crossing near CPCL and PWD road, IAWI and CRZ clearance have been obtained from the concern authorities. Necessary provision for the Traffic Congestion Management likely to happen on Ennore flyover is explained in Chapter 7 of the ESIA report.

Grievance Mechanism

1. The CMWSSB have Grievance Redressal mechanisms to address the grievance related to the employees of the project.
2. A grievance redressal committee (GRC) has been already setup for the project and the members are as follows (Preferably one of them as women)
    a. Superintending Engineer (Projects -CMWSSB)
    b. Executive Engineer (Projects- CMWSSB)
    c. A person who is publicly known in the local area (local Gram Panchayat person).
    d. A person from CMWSSB who is not directly involved in the implementation of the project.

The complaints will be acknowledged to the complainant. Grievance handling procedure should be based on following principles like accessibility, regular communication in the local communities, transparency, efficiency, fairness and written records. Efforts will be made by CMWSSB to ensure closure of complaint within a period of 30 days from the date of its receipt. If not satisfied with the resolution provided by GRC (site level), the complaints shall be handled at higher level i.e., Chief engineer of CMWSSB.CMWSSB shall submit monthly reports on the status of compliance with the ESMF requirements to TNUIFSL.

The contact details of the Grievance Addressal Committee are given below:

Chief Engineer,

Chennai Metropolitan Water Supply and Sewerage Board

NO.1 Pumping Station Road,

Chindatripet,

Chennai-600002

To register complaints through internet, visit the following link:

http://www.chennaimetrowater.tn.nic.in/services/complaint.htm

Implementation of the proposed project and Institutional Arrangements at CMWSSB

The proposed project involves dredging of Ennore Creek along the proposed pipeline route and laying HDPE pipe line at the either side of the creek and at the creek area to a length of 850m. The project will be implemented by CMWSSB under the scheme of Tamil Nadu Sustainable Urban Development Project (TNSUDP) at an estimating cost of Rs.392.61 Crores, of which laying of conveying main cost Rs.35 Crores.

The management measures of Ennore Creek will be implemented with the help of experts (hydrologist, biologist & structural engineers) by the contractor shall be ensured by CMWSSB and report on ESMF compliance shall be submitted to TNUIFSL periodically. The implemented management measures will be taken up by the CMWSSB & D.B.O.T contractor upon completion of construction activities.

Public Consultation

Public Hearing Meeting conducted for the Laying of Conveying Main across Ennore Creek for the Distribution of TTRO Water to various industries in and around Ennore Area. The Public Hearing was arranged by Chennai Metropolitan Water Supply & Sewerage Board (CMWSSB) on 11/01/2020 at St. Joseph Church, Ennore. The concerned persons having plausible stake in environment aspects were requested to attend the meeting. The public consultations were presided over by Superintendent Engineer, CMWSSB. The Environmental Engineers, Assistant Environmental Engineers and other concerned persons, local persons surrounding the creek were attended the meeting. The list of the people participated and the summary of key issues raised during the Public Consultation and the responses provided by the Project Proponent and the Engineers are given as annexure in the ESIA report. The members from CMWSSB explained the salient aspects of the proposed project during the meeting. The stake holders /beneficiaries were asked to offer their views on the proposed project.

Project Benefits

The successful completion of project enables diversion of 30MLD of drinking water to the public use and it will be a relief to the Chennai City facing shortage of water supply on every summer season. The project will also be able to meet industries increasing water demands in future.

1. INTRODUCTION

1.1 Preamble

Chennai Metropolitan area (CMA) spread over an area of 1189 sq.km and comprises of Chennai City, Municipalities, Town Panchayats and Village Panchayats comprised in Panchayat unions and one cantonment namely St. Thomas Mount. The city population as per the 2011 census was about 4,646 million and that of the Chennai Metropolitan area was 8.653 million.

Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB) is a statutory responsible body for providing water supply and sewerage infrastructures for the entire city and CMA. Though its present operation is limited to the Greater Chennai Corporation City limit, the Board is extending its services to entire CMA according to the need in phased manner.

1.1.1 Source of Water Supply

Chennai is entirely dependent on ground water resources to meet its water needs. Ground water resources in Chennai are replenished by rain water and the city's average rainfall is 1,276 mm. Chennai receives about 985 million liters per day (MLD) from various sources against the required amount of 1,200 MLD. Water to the city's residents is being supplied from desalination plants at Nemelli and Minjur, Cauvery water from Veeranam Lake, Krishna River from Andhra Pradesh, Poondi reservoir, and lakes at Red Hills, Chembarambakkam and Sholavaram.

Supply of ground water to the residents and sewage management in Chennai is taken care of by the Chennai Metropolitan Water Supply and Sewage Board (Metro Water). With the expansion of the corporation area from 174 sq. km to 426 sq. km, which increased the number of wards of the Chennai Corporation from 155 to 200 and the number of zones from 10 to 15, Metro Water's customer base is expected to increase by an additional 1.7 million when the new areas are covered. As of 2012, Metro Water supplies about 830 million liters of water every day to residents and commercial establishments of about 800 MLD supplied to the city, nearly 710 MLD is transmitted through pipeline. It is estimated that the demand of the expanded city would be 1,044 MLD. Similarly, Metro Water has to provide infrastructure to treat and dispose an additional 219 MLD of sewage estimated to be generated in the merged areas.

1.1.2 Sewerage System of Chennai

The Sewerage System for Chennai City has been divided into 5 drainage zones. These zones of macro systems covering the entire city have independent zonal collections conveyance, treatment and disposal facilities. There are 14 plants in Chennai city having a total treatment capacity of 794 MLD. Details of STPs available in Chennai region is given in **Table 1.1**.

Table 1.1-Availability of Treated Effluent with STP details

S.No	Location of STPs	Existing Capacity (in MLD)	Remarks
1	Zone I & II at Kodungaiyur	270	Operation
2	Zone-IIIatKoyambedu	214	Operation
3	Zone-IV at Nesapakkam	117	Operation
4	Zone-V at Perungudi	126	Operation
5	Tiruvottiyur	31	Operation
6	Sholinganallur	36	Operation
Total		**794**	

1.2 Demand & Assessment of TTRO Water

Demand assessment from industries in North Chennai city was the entrusted to M/s ITCOT Consultancy and Services Ltd and after a detailed survey of the industries in Manali – Ennore corridor, Manali-Minjur Corridor. The consultants have furnished the anticipated water demand for 2015, 2020 & 2030. As per the report of demand assessment the 45 MLD capacity TTRO plant was proposed at Kodungaiyur.

The details of the beneficiaries and the quantity requirement as of now are detailed below:

Table 1.2-TTRO Project Water Beneficiaries

S.N	Name of the industry/ Company	Quantity in MLD	Remarks
1	CETEX	0.60	Industries Located before Ennore Creek
2	Chennai Petroleum Corporation Ltd	10.0	
3	Manali Fertilizer Ltd	7.0	
4	Manali Petrochemical Ltd (Plant 1&2)	2.0	
5	Tamil Nadu Petroproducts Ltd	2.75	
6	Indian Additives Ltd	0.15	
7	North Chennai Thermal Power Station	15.0	Industries Located After Ennore Creek
8	Tamil Nadu Energy Company Ltd	10.0	
9	L&T Ship Building	0.20	

Total (A)		**47.70**	
1	Indian Oil Petronas Ltd	0.20	No transmission main available. Will be supplied by providing Filling Points (after Ennore Creek)
2	SRF Limited	0.50	
3	Supreme Petrochemical Ltd	0.25	
4	Natco Pharma Ltd	0.20	
5	Balmer Lawrie	0.15	
6	Kothari Petro products Ltd	0.75	
Total (B)		**2.05**	
Total (A+B)		**49.75**	

The total water requirement for the beneficiaries is 49.75 MLD, but the treated water will be supplied to the industries only on their daily demand basis.

1.3 Need for the TTRO Project

The Chennai, which has been in the grip of an acute water crisis every year and cost of water supplied by private tankers was very high. Moreover, there was no guarantee in the quality of water supplied by them and there was no reliability on the supply. One has to treat the wastewater generated in order to protect the water sources and improve the hygiene and sanitation conditions.

The CMWSSB have constructed a Tertiary Treatment Reverse Osmosis plant (TTRO) at Kodungaiyur. The plant which has a feed capacity of 63.5 MLD and the efficiency to produce 45MLD per day of water from secondary treated water from existing sewage treatment plants and treated water is distributing to industries with good quality of water and helping to decrease the burden on ground water.

1.4 TTRO plant at Kodungaiyur

CMWSSB had proposed a TTRO Plant of capacity 45 MLD at Kodungaiyur and supply of treated water to industries, power plants and institutions located in Manali-Minjur Corridor, Manali-Ennore Corridor in North Chennai through conveying main of length 28.5 km and accordingly a 45 MLD capacity TTRO plant has been constructed at Kodungaiyur. The conveying pipeline is laid belowground level along the Buckingham canal side of the Buckingham canal road and to be laid below bed level across Ennore Creek.

Features of the TTRO plant

- Construction of 45 MLD capacity of TTRO plant.
- Total area of TTRO plant is 28340 Sq.m

- Total length of the Conveying main is 28.5 km.
- Secondary treated water 63.5 MLD from Kodungaiyur treatment plant
- Reject from RO plant 18.5 MLD.
- CRZ and Non CRZ area details are given in Table 1.3

Table 1.3-CRZ and Non CRZ area details

S.No	Length of pipeline (m)	Pipeline under CRZ	Location
1	300	CRZ I	Inter tidal zone
2	10945	CRZ II	In CMDA area
3	7000	CRZ III	Outside CMDA area
4	850	CRZ IV	Water area at Ennore creek
5	9405	Nil	Non CRZ area
Total	**28500**		

Figure 1.1 -Satellite Imagery of TTRO Plant

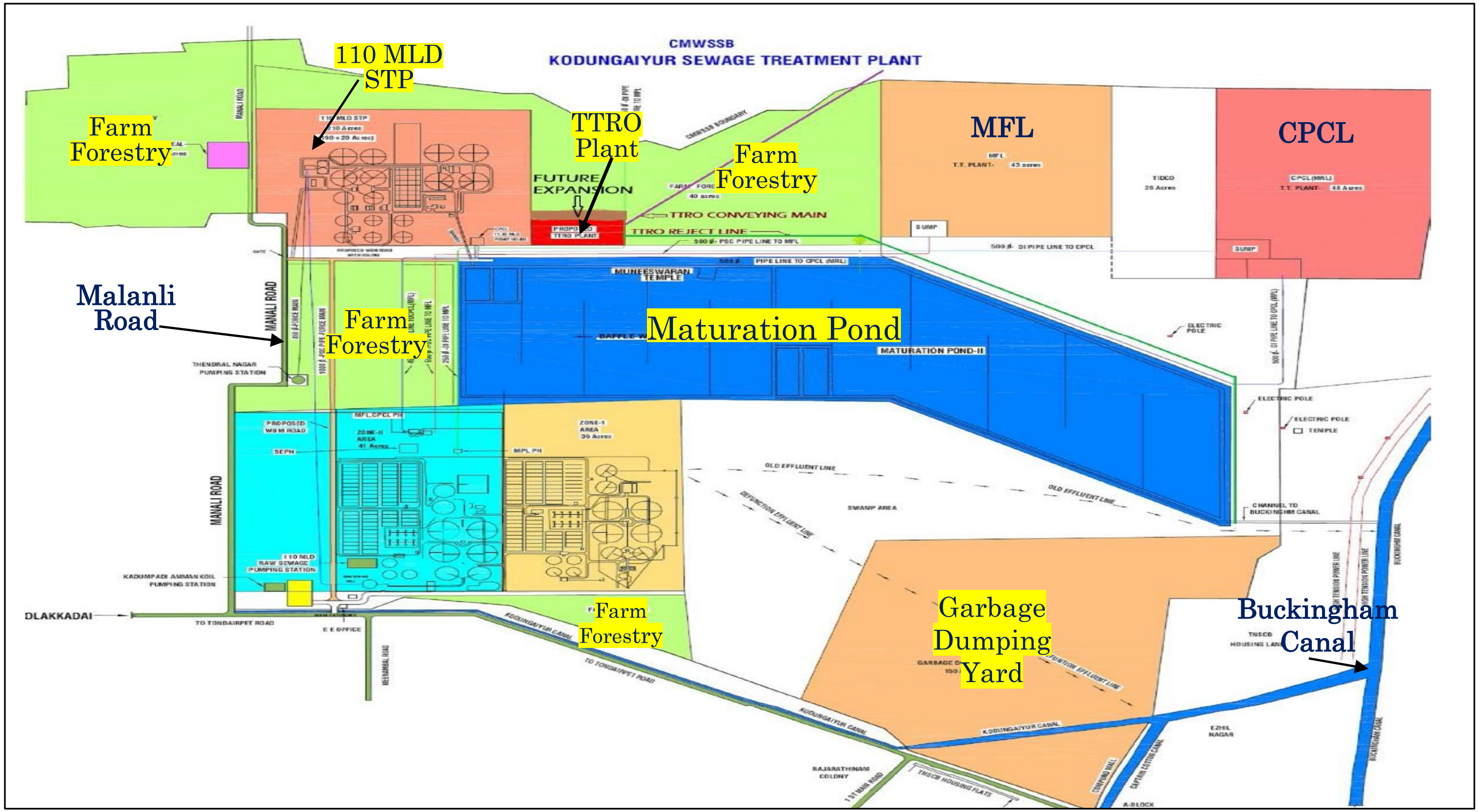


Figure 1.2- Site Layout

1.4.1 TTRO Process Details

The secondary treated water received under pressure is sent to equalization tanks to reduce variation in characteristics. Pre-treatment is the first stage of treatment and consists of removal of settable suspended matters and removal of impurities. Chlorine dioxide dosing in the equalization tank help to remove organics and also helps to prevent micro biological growth. The equalized effluent is then routed to a rapid gravity filtration system through filter feed pumps.

The filtered water is then routed under pressure to an ultra-filtration (UF) system. The UF treated water is stored in a UF permeate storage tank to supply water to industries. Backwash and reject from RO and UF system is within the prescribed limits of CPCB and blended with secondary treated water and disposed into the Buckingham canal.

1.4.2 Inlet and outlet water quality of TTRO plant

The TTRO plant inlet and outlet water quality details given in **Table1.4.**

Table 1.4 -TTRO Plant Inlet and Outlet Water Quality

S.N	Parameters	Unit	Inflow Characteristics	Out flow Characteristics
1	Flow	MLD	Phase I: 63.5 MLD Phase II: 84.3 MLD	Phase I: 45 MLD Phase II: 60 MLD
2	TDS	Mg/l	1500	<70
3	TSS	Mg/l	30	BDL
4	BOD	Mg/l	20	BDL
5	COD	Mg/l	160	BDL
6	Total Silica	Mg/l	40	<2
7	Ca Hardness/ Mg Hardness	Mg/l	300/130	<5
8	Sodium	Mg/l	310	<12

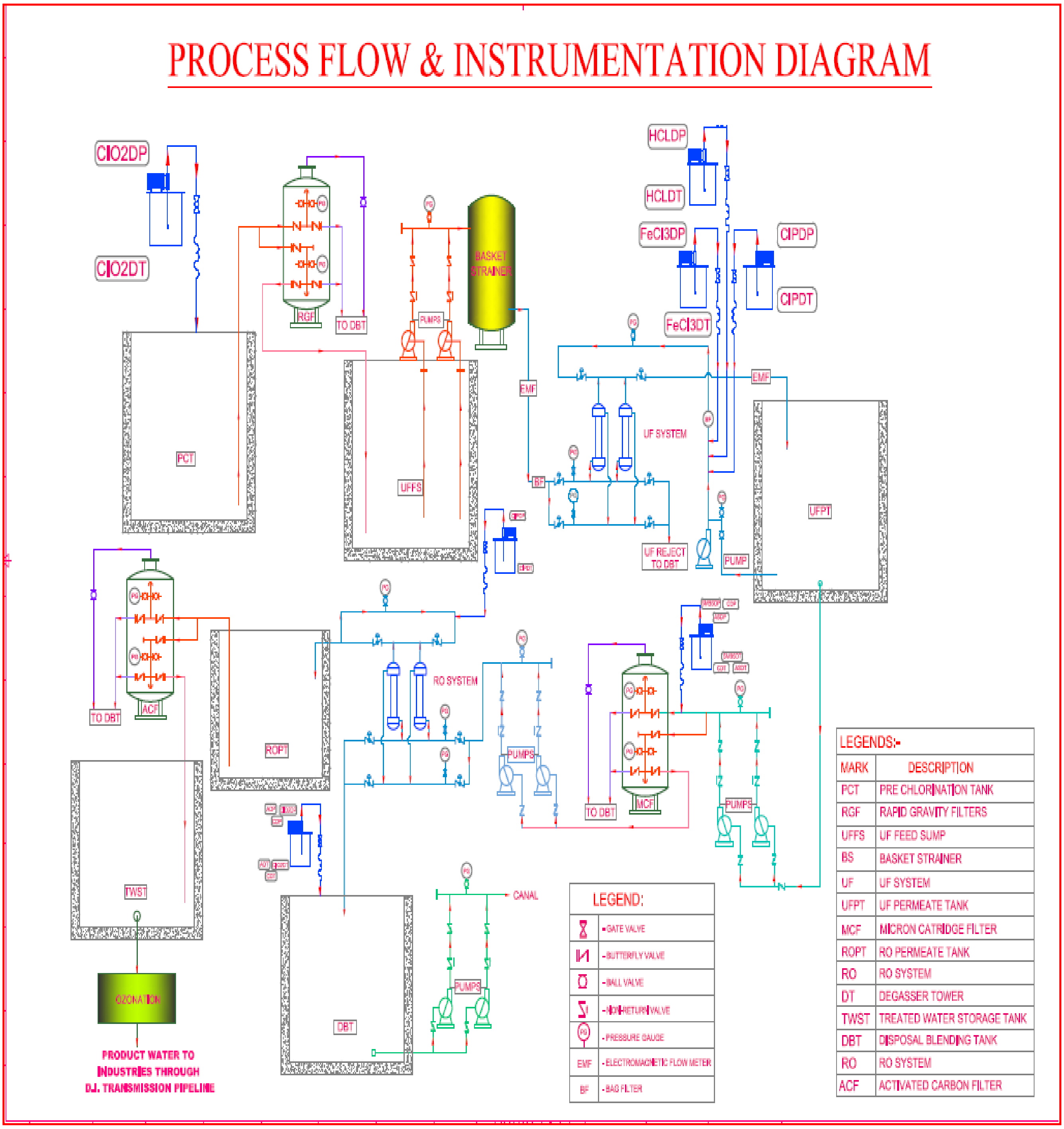


Figure 1.3-Process flow diagrams of Treatment methods.

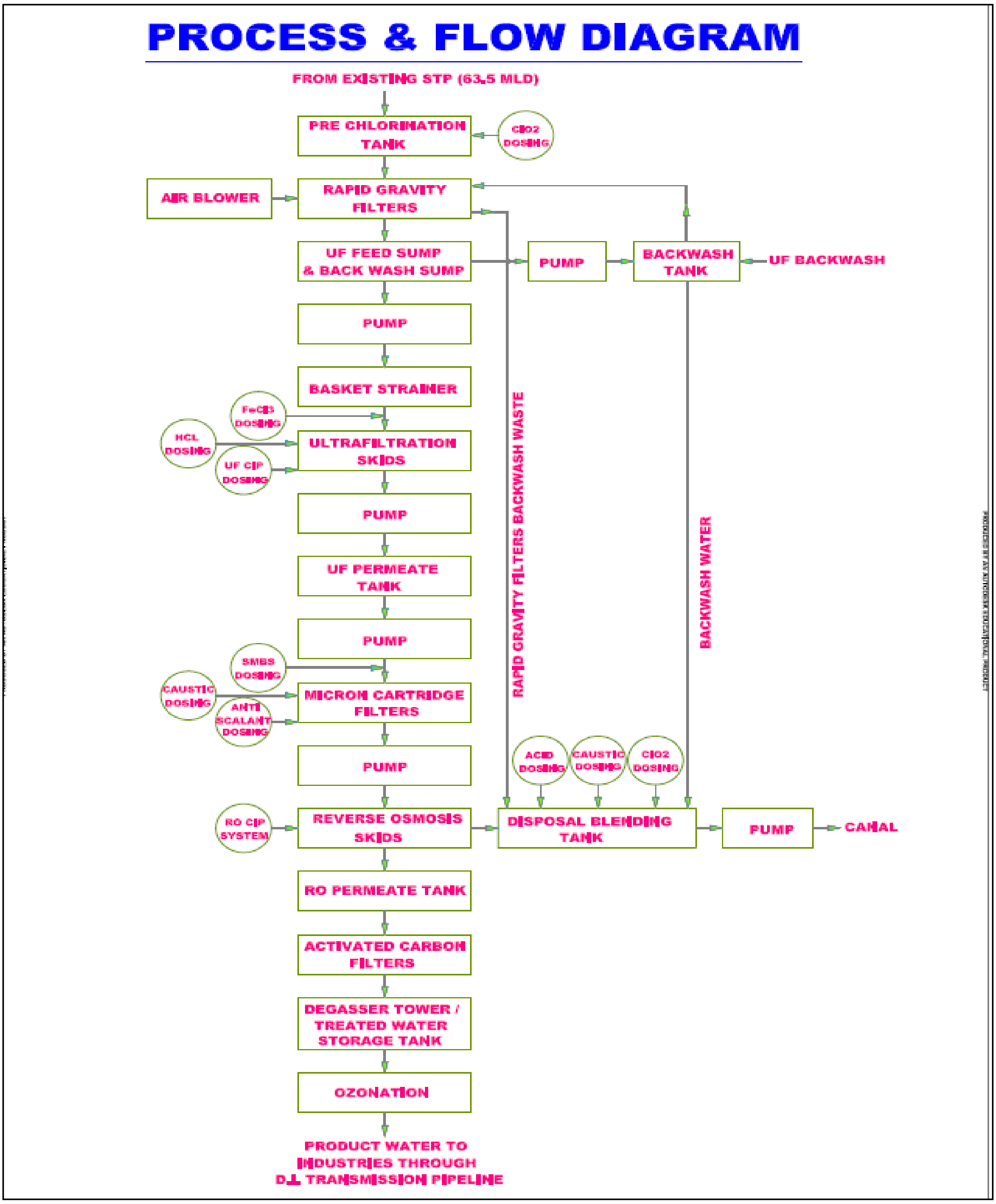


Figure 1.4 Process Flow & Instrumentation Diagram

1.4.3 Treated water conveying main

Collection sump has been constructed with pump sets suitable for conveying the 45 MLD of TTRO water to industries initially and 60MLD of TTRO water latter during 2030. An 800 mm dia DI pipeline for conveying main was provided for a length of 15.85

km, 600 mm dia DI pipeline for a length of 7.0 km and 300 mm dia DI conveying main for a length of 2.5 km for distributing the TTRO water to Industries in North Chennai. The total length of conveying main was proposed 28.5 km but during the execution of the work, the total length of the conveying main is 25.35 Km.

1.5 Status of the TTRO Plant

The Construction of 45 MLD capacity Tertiary Treatment Reverse Osmosis plant (TTRO) has been completed including erection and commissioning of Electromechanical and instrumentation works. The conveying main of 800mm, 600mm and 300mm dia DI mains were laid almost 23.50 km as per the proposal except at Ennore Creek (850 m), Railway crossings and Buckingham canal crossings.

The plant was inaugurated by The Chief Minister of Tamil Nadu on 01.10.2019, in order to supply the TTRO water to the industries located in Manali – Minjur corridor before Ennore Creek. The supply of TTRO water to the industries at Manali area which are located before Ennore Creek viz, Chennai Petroleum Corporation Ltd, Madras Fertilizers Ltd, Manali Petrochemical Ltd, CETEX, Indian Additives Ltd, Tamil Nadu petro products Ltd. was commenced from 14.10.2019 onwards. The RO reject water is being discharged into Buckingham canal after blending with the available secondary treated sewage.

1.6 Treated Water Conveying Main

An 800 mm dia DI pipeline for conveying main will be provided for a length of 15.85 km, 600 mm dia DI pipe line for a length of 7.0 km and 300 mm dia DI conveying main for a length of 2.5 km for distributing the TTRO water to Industries in North Chennai. The total length of conveying main was proposed 28.5 km but during the execution of the work, the total length of the conveying main is 25.35 Km.

Table 1.5-Land Ownership of the TTRO Conveying main

S.No	Location	Size of Main (mm)	Start Chainage	Final Chainage	Length (m)	Regulatory Authority	Work Status
1	Inside Kodungaiyur STP Land	800	0	1528	1528	CMWSSB's Own Land	Completed
2	MFL & CPCL, TT Plant Road	800	1528	3379	1851	MFL & CPCL	Completed
3	B'Canal Crossing	800	3379	3425	46	PWD	Completed
4	IOCL Road	800	3425	3570	145	Corporation of Chennai	Completed
5	Highways Crossing Manali Road	800	3570	3615	45	National Highway	Completed
6	PWD 'B'Canal Road	800	3615	4425	810	PWD	Completed
7	Railway Crossing	800	4425	4566	141	Southern Railway	Completed
8	PWD 'B' Canal road	800	4566	6187	1621	PWD	Completed
9	Highways Crossing Basin Bridge - Manali Road	800	6187	6264	77	State Highway (Gov. of TN)	Completed
10	PWD 'B' Canal Road	800	6264	12658	6394	Govt. of India	Completed
11	Kathivakkam Highroad	800	12658	12778	120	State Highway (Gov. of TN)	Completed
12	Railway Subway	800	12778	12843	65	Southern Railways	Not Completed
13	Kathivakkam Highroad	800	12843	13193	350	State Highway (Gov. of TN)	Not Completed
14	Ennore Creek (under water)	800	13193	14043	850	PWD	Not Completed

15	Highways Road(Upto NCTPS)/ Beach – Ennore Port Road	800	14043	15850	1807	State Highway (Gov. of TN)	Completed
	Total (800mm)				**15850**		
16	Old Ennore port road (NCTPS to Ennore Kamarajar port	600	15850	18225	2375	NCTPS	Approval obtained
17	L&T Port Road	600	18225	22850	4625	State Highway (Gov. of TN)	Approval obtained
	Total (600mm)				**7000**		
18	Highways Road Basin Bridge - Manali Road	300	0	2500	**2500**	State Highway (Gov. of TN)	Approval obtained

Permissions for laying conveying main along the Buckingham canal and across Ennore Creek, near National Highways and railway crossing near CPCL and PWD road were obtained from the concerned authorities. Approvals for laying the conveying main along the National Highways Authority, Public Works Department, Government of Tamil Nadu, are given in **Annexure IV.** The conveying main will be constructed during non-monsoon period.

1.7 Environmental Categorization of the project

As outlined in ESMF, TNUIFSL categorized the projects into different categories – E1, E2 and E3 on basis of environmental screening and S-1, S-2 & S-3 based on social screening of the project which is linked to severity of impacts and regulatory requirements.

Table 1.6 Environmental and Social Categorization of the project

Category	Description	Type of project	Actions
Environmental			
E-1	Major environmental issues expected	• Projects impacting sensitive environmental components • Projects triggering the World Bank	Project specific EA by an independent agency

		OPs 4.01, 4.11, 4.04, 4.36. • Projects requiring Environmental Clearance as per EIA notification of MoEFCC.	
E-2	Moderate environmental issues expected	• Projects with impacts less adverse than E1 category and mostly generic in nature. • Projects triggering the World Bank OP 4.01	Project specific EA along with the DPR
E-3	Minor environmental issues, if any expected	• Projects with minor environmental impacts expected.	Generic EMP.
Social			
S-1	Significant with adverse irreversible social impacts	• If it involves acquisition of private land and affects more than 200 persons or 50 households. • If it involves physical displacement.	Significant with adverse irreversible social impact
S-2	Moderate with minimized social impacts	If impacts are limited to less than 200 persons or about 50 household of minor nature	Moderate with minimized social impacts
S-3	Minor with direct or indirect social impacts.	No private land acquisition or no loss to PAPs.	Minor with direct or indirect social impacts

The proposed project is of supplying treated water from the TTRO plant and laying of Conveyance main in Ennore Creek below bed level falls under "E1" category as per Environmental and Social Management Framework (ESMF) of TNSUDP.As the number of Project Affected People (PAPs) and the acquisition of any private land in this project is nil, project comes under S3 category of Social Categorization. The

Environmental & social screening checklist undertaken has been presented as **Annexure V and VI**.

As per the Environmental and Social Management Frame Work (ESMF) for TNSUDP E1 projects (similar to the Environmental Category A project of the World Bank Safeguard Policy) require Environmental Assessment to be carried out, and necessary management measures are to be prepared for implementation. TTRO project as it is categorized as E1 as per ESMF, Environmental and also Social Impact Assessment was carried out and management measures were identified. The ESIA report was approved by World Bank and disclosed in the websites of CMWSSB and TNUIFSL.

1.7.1 Need for additional ESIA

It was initially envisaged that for Supply, laying D.I. Transmission mains for conveyance of Product water to various industries in Manali – Ennore Area &Manali – Minjur Area, North Chennai, the laying of 800mm diameter DI transmission main across the Ennore Creek will be through a Pipe carrying Bridge. However, PWD the owner of Ennore Creek, while issuing permission for crossing the Creek vide G.O dated 14.02.2019 has suggested to lay pipelines at a minimum depth of 2m below the bed level of Creek using appropriate technology instead of Pipe Carrying Bridge.

On analyzing the methods for laying of pipeline underground, considering the technical and operational feasibility, it is found that following three methods are applicable for the proposed project:

1) Horizontal Drilling method
2) Push through method
3) Dredging method.

Of the above three methods, the Horizontal drilling method and push through method can be adopted only when the alignment of the pipeline is straight or if adopted, there will be need to construct a concrete structure called driving pit and receiving pit at the point of change of alignment. In this case, as the alignment profile of the Ennore Creek is of curved nature, there is no possibility for adopting the Horizontal drilling method and push through method at Ennore Creek and also there is no possibility for constructing driving pit or receiving pit at the middle of Creek. Whereas, dredging method can be adopted in any profile, as the dredging activity can be done according to the alignment of the pipeline. Hence it is now proposed by CMWSSB to cross the Ennore Creek below the bed level at (-) 6 m using dredging technology.

As the original proposal changed, from construction of Pipe carrying bridge to laying of pipe line below bed level using dredging technology, the revised application was submitted to MoEF& CC for according amendment in CRZ clearance. The proposed project was considered by Expert Appraisal Committee (EAC) in its 198thmeeting held on 17 September 2018 for issuing CRZ clearance with proposed changes. The amendment of CRZ clearance was accorded by MoEF& CC in vide letter no: F.No. 11 -23/2016-1A-lll dated 26-10-2018 and the copy of the letter is enclosed in **Annexure II**.

The purpose of this ESIA report is to present the details of the laying of 850 m conveying main across Ennore Creek using dredging technology and to assess the environmental impacts and its mitigation measures.

1.8 Scope of the Study

- To assess the effect on Land, Air, Water and Noise environment and measures proposed and to take mitigation measure for any adverse effects.
- To collect available water quality data; observe and analyze water quality at the project area and to collect information on known pollution sources in the area.
- To address the natural conditions like topography, geology, hydrogeology, meteorology, hydrology, environment and land use etc. in the project alignment.
- To asses terrestrial and aquatic flora & fauna and micro flora and fauna within the study area.
- To assess the quality of the soil on land at two locations and in creek at different locations during soil quality sampling. The sediments in the creek shall be assessing for nutrients, heavy metals and macro benthos.
- To monitor the noise and vibration at different locations in the project alignment.
- To evaluate the aquatic life present in the tidal water body in different stretches including migratory species.
- To evaluate the impact of the project on public health, quality of life etc. during construction and after commissioning of the project.
- To assess impact of project and its activities on the proposed location.
- Analysis of Census data for demographic profile.

- Construction and operational phases identifying mitigation measures.
- Prepare sound Environment Management plan (EMP) outlining additional control technologies to be adopted for mitigation of adverse impacts, if any.

1.9 Structure of the Report

The structure of ESIA report in given below

Executive Summary

Chapter 1 – Introduction

Chapter 2 – Project Description

Chapter 3 – Environmental Regulatory Framework

Chapter 4 – Baseline Environmental Profile

Chapter 5 – Environmental Impact Analysis

Chapter 6 – Environmental Management Plan

Chapter 7 – Social Impact Assessment Report

Chapter 8 – Public Consultation at Ennore

Chapter 9 –Implementation of the Project and Institutional Arrangements at CMWSSB

Chapter 10 – Project Benefits

Chapter 11– Disclosure of Consultant

2. PROJECT DESCRIPTION

The proposed project is laying a HDPE water pipeline below the Ennore Creek bed using Modular Cutter Suction Dredger. The pipe line proposed to lay in Ennore Creek is of total length 850m.

2.1 Silent Features of the project-

- Laying a HDPE water pipeline below Ennore Creek bed.
- The pipe line will be laid to a length of 850m in the Ennore Creek.
- The depth of laying of conveying main is 6 m and width at top & bottom is 35m and 4m respectively.
- Two air release valves are provided in the project, one each at start point and end point (outside the Creek area).
- The laying of 800mm ID HDPE pipeline of 50 mm thickness across Ennore Creek using Dredging technology including O & M for 30 years.

2.2 Project Location

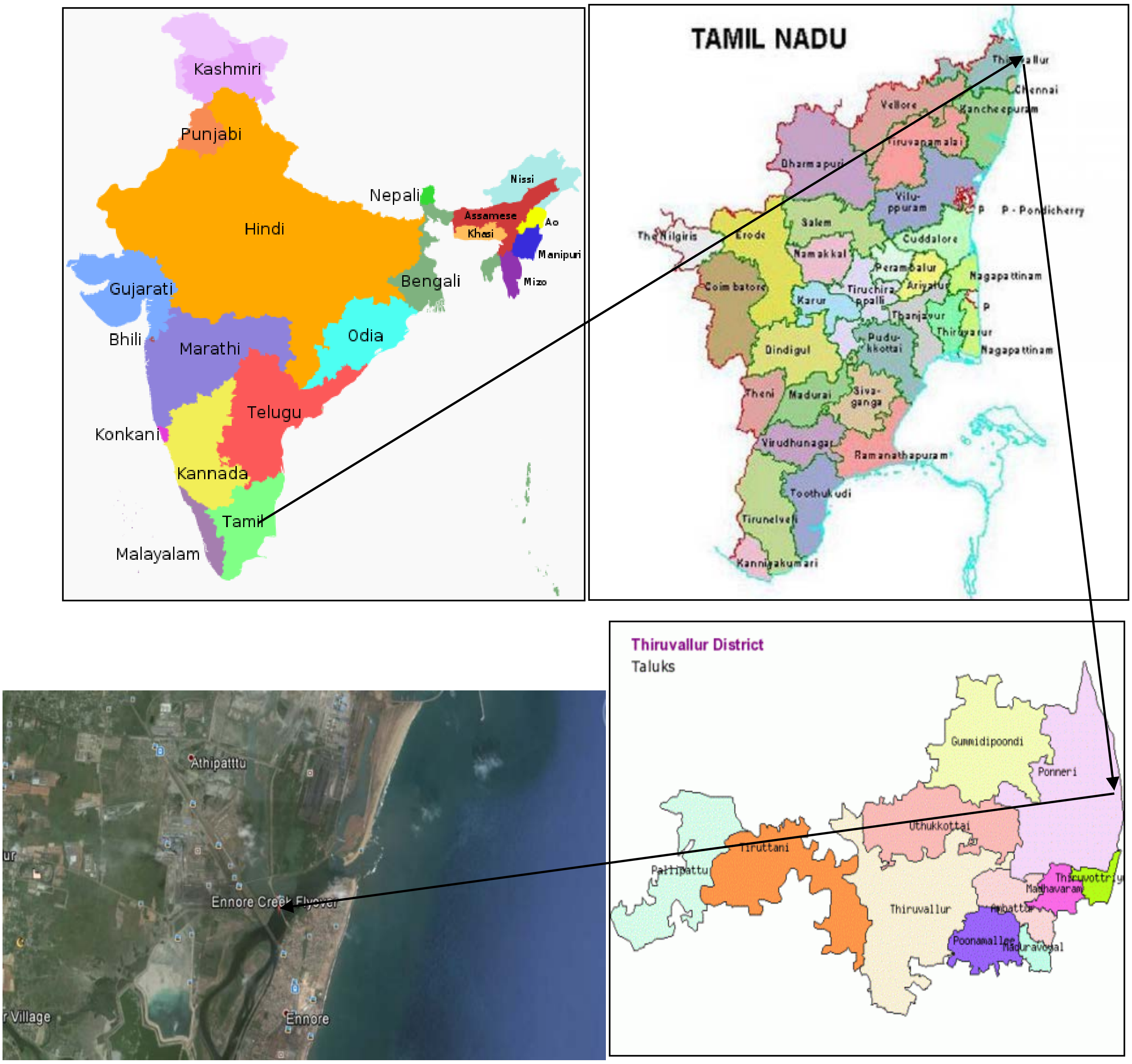


Figure 2. 1- Project Location

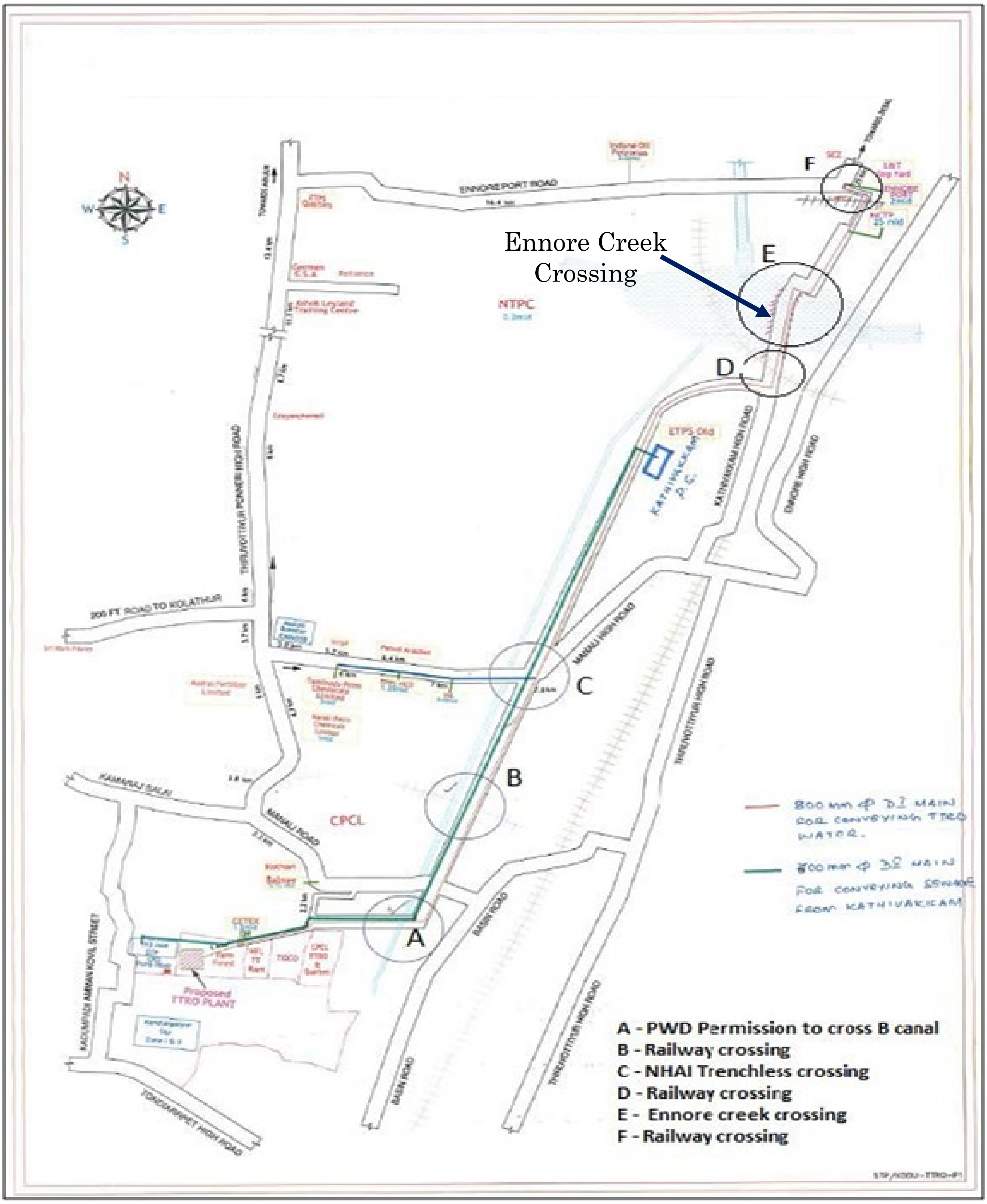


Figure 2. 2 Details of Crossings of the Conveying main

Figure 2. 3 Location of Conveying Main

Figure 2. 4 Satellite Image of the location where proposed Pipe Line is going to be laid in Ennore Creek

2.3 Laying of Conveying main at Ennore Creek below bed level.

Total length of the laying of conveying main in below bed level will be 850m, width to be dredged at top of the bed level is 35 m, bottom is 4m and depth is -6m, dredged by Cutter Suction Dredger. The starting point and end point of the conveying main latitude and longitude is $13^{0}13'34.33''$N & $80^{0}19'14.23''$E and 13013'54.70"N & $80^{0}19'03.23''$E. Both the float n Sink and Lay-Barge methodologies will be used for laying water pipe line (850 m) in Ennore Creek. The methods of laying pipe and when and where these methodologies are being used are described in detail under **section 2.4**.

Figure 2.5Photograph of starting point of the laying of Conveying main

Figure 2.6 Photograph of end point of the laying of Conveying main

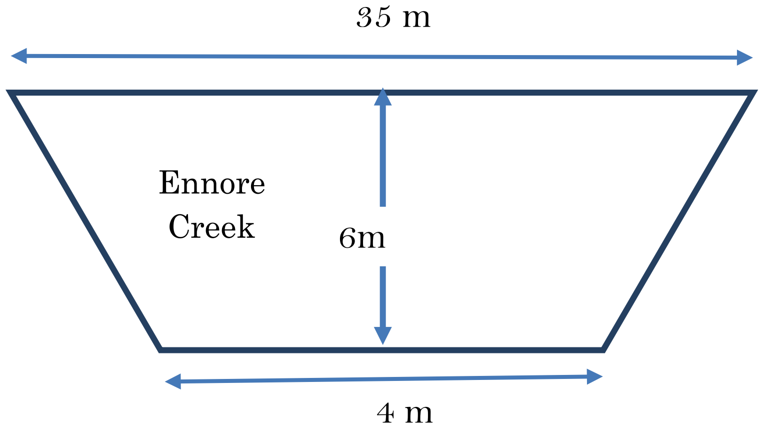
2.3.1 Installation of dredging Equipment in Project site

The dredger will be deployed to the project site with the help of platform of MS sheet of size30m x12m. Initially only bottom section of the dredger is to be installed on the Platform at the place nearer to the project site. As the proposed work is in the Ennore Creek, the installation of the bottom section of the dredger will be carried out at the North East part of the Ennore Flyover and then it will be carried to the North West part of the bridge for the installation of the other accessories of the dredger. Minimum water level 1.5m is required for handling the dredging equipment. The selected installation point is free of any sort of fisherman activities like docking of boats, selling, sorting or packing of fishes.

Figure 2.7Dredger Installation Site

2.3.2 Planning of laying of Conveying main

The entire laying of conveying main activity is planned to be carried out in two stages. In the first stage, 50 percentage of the total length to be dredged i.e. 425m will be done. Then the laying of the conveying main in the dredged trench and simultaneous backfilling of the dredged area will be complete in the whole stretch. In the second stage, the remaining 425m will be dredged for the laying of conveying main. The pipe used in the project is of HDPE (High Density Poly Ethylene) of specifications 12m length & diameter 800mm.The information regarding the dates of works will be displayed in the project site and will announce through notice in local newspapers in local language.



2.4 Methodology for Laying of Conveying Main

On analyzing the methods of laying pipeline underground, it is found that there are three methods available:

1) Horizontal Drilling method
2) Push through method
3) Dredging method.

1) Horizontal Drilling method

This method involves construction of RCC Driving pit at the starting point of the Creek and RCC Received pit at the end point of the Creek. The horizontal drilling by using Augur boring commence from the Driving pit for2.0 times diameter of the pipe. The drilling will be carried out till reaching the receiving pit. The casing pipe of diameter 2 times the diameter of pipe will be placed along with the drilling. Then the pipeline will be laid inside the casing pipe for the total length of the crossing. This method can be adopted when the alignment of the crossing is straight as the crossing will be done at straight horizontal alignment only.

2) Push through method

This method involves construction of temporary Driving pit at the starting point and temporary Received pit at the end point. The pushing of casing pipe of using Augur boring commence from the Driving pit for 2.0 times diameter of pipe will be carried out by pushing the pipe using hydraulic jack. The boring will be carried out till reaching the receiving pit. Then the pipeline will be laid inside the casing pipe for the total length of the crossing. This method can also be adopted when the alignment of the crossing is straight.

3) Dredging method.

Dredging is the process in which the sediments are picked up using mechanical tools such as buckets, grabs etc. Dredging is usually carried out near the shore line. Hence for removing sediment on land or shoreline, mechanical dredging is used.

Proposed methodology

Of the above three methods, the Horizontal drilling method and push through method can be adopted only when the alignment of the pipeline is straight or if adopted, there will be needed to construct a concrete structure called driving pit and receiving pit at the point of change of alignment. In this case, the alignment profile of the Ennore Creek is of curved nature and hence there is no possibility for adopting the Horizontal drilling method and push through method at Ennore Creek and also there is no possibility for constructing driving pit or receiving pit at the middle of Creek. Whereas, dredging method can be adopted in any profile, as the dredging activity can be done according to the alignment of the pipeline. Hence it is now proposed by CMWSSB to cross the Ennore Creek below the bed level at (-) 6 m using dredging technology. The two methodologies adopted for the laying of pipeline are described below:

2.4.1 The Float and Sink Methodology

This methodology is the most convenient, thus making it more popular Method and the following steps will explain the method in brief. A Welding & Launching Earthen Platform of about 10 M widths X 20 M Length will be constructed on the Left Bank, on the East of the Bridge where the Pipes can be welded &directly launched in the Creek. The HDPE pipes & CC anchor blocks will be shifted to the platform and welding will be carried out to make a Single String of pipeline measuring about 850 Meters As welding progresses, the CC Blocks will be progressively fixed on to the pipe and the Pipe string will be floated across the Creek and anchored safely using Nylon/PP Ropes. The string will have Stubs and GI Flanges on both ends which will be sealed using Blind Flanges, so as to allow floatation.

As the Pipe trench is completed, inspected & cleared for laying, the Pipe String will be shifted on to the trench alignment and one end of the line pulled in position on the western bank. About 100 Meter span of the pipe string will be aligned on the excavated route using the Motor Tugs.

The Pipe positioning will be carried out using a Satellite based Telemetry System where the Pipeline position is guided using Probes on the pipe, connected with the DGPS on board of a small vessel. As the Pipe position is confirmed by the Telemetry System, the End-valve on the pipe will be opened to allow Sea Water to fill the pipe, thereby sinking the pipe on the Trench Bed. Water entry shall be monitored by the Air Vent Valve on the other end which will be closed when the first 100 Meter span is sunk. This procedure will be repeated systematically till the entire pipe string is safely sunk on the Trench Bed.

2.4.2 The Lay-Barge Methodology

This methodology is adapted in areas where the Trench retention is not possible due to very loose soil conditions. In this method, the welding & Block fixing operations are carried out in the Creek itself and hence a large fleet of Marine equipment is needed. This makes the Lay-Barge Method more expensive than the Float-n-Sink Method. The following steps will explain the Lay-Barge method in brief. A Pipe Loading Platform of about 10 M width X 20 M Length will be constructed on the Left Bank, on the East of the Bridge where the Pipes/Blocks can be stacked & directly loaded on the Flat Top Barges for ferrying them in to the Creek.

If this Methodology is adapted, the Trench Dredging shall commence from the bank and first about 100 meter length shall be dredged. The pipe shall have to be welded, loaded with blocks and sunk in this region before the trench collapses or gets filled. This will be achieved by the following process.

A Floating Platform shall be deployed with Two Small Cranes and the Welding Machine with Generator shall be installed on this Platform. The HDPE Pipes shall be fed on this Platform and the Pipe welding will be carried out on the Platform, progressively lowering the Pipe in water. The CC Anchor Blocks shall be shifted to the Crane Barge which was initially used for Boulder Clearing and the Blocks will be fixed on to the pipe by Divers/Riggers. The Eastern end of the pipe shall have Stub and GI Flange which will be sealed using Blind Flange, so as toallow the line to float.

As the Pipe length of about 75-80 meters is laid in trench, the Dredger will commence excavation of further trench which shall be followed in Synchronism by progressively welding, loading & lowering of the Pipe. The Trench & Pipe positioning shall be monitored by the DGPS & Telemetry System as before. With a meticulous planning & working in synchronism, the entire length of the pipe shall be lowered in the trench.

At Ennore Creek, both the methods will be adopted, initially with the float and Sink method at the middle of the Ennore creek (400 m) and then with the Lay Barge Method both the ends (450m) to avoid collapse of trench as the soil at both ends will be loose.

2.4.3 Procurement of Pipes

As the proposed Pipeline would lay in the corrosive Saline Waters, it is proposed to use Corrosion Resistant High Density Polyethylene (HDPE) Pipes for the Creek Portion. The transmission main size on the Land portion is 800 mm NB. Hence matching size of HDPE Pipes with 900 mm OD & 800 mm ID, PN-8, PE-100 are proposed to be procured from a Reputed Vendor possessing the BIS License. The Pipes will be received at site and stacked neatly on a soft ground to prevent any damage to the pipe surface due to sharp edges.

2.4.4 HDPE Pipe Welding

The pipes will be joined by Heat Fusion Butt Welding procedure to form the Pipe String as per guidelines of the Installation Process adapted.

2.4.5 CC Anchor Weight Blocks

HDPE Pipes are light in weight due to which it is necessary to add dead-weight to the pipeline to prevent it's up lift. CC Anchor Blocks specially custom made for this purpose will be firmly attached on to the pipeline by Hot-Dip GI Studs. The sizing of the Block is done with the consideration that the weight of the CC Block coupled with the Overburden Load of the Backfill soil should be sufficient to prevent rising of the pipeline even when it is fully empty, although occurrence of such condition is very unlikely due to the barometric profile of the pipeline in the creek.

The CC Anchor weights will be pre-cast at a suitable location where proper curing by approved quality of water can be offered. These Pre-case Anchor Blocks will be transported to site by Trucks with utmost care to cause minimal damage during transport.

The Pre-cast Anchor weights will be firmly attached to the 900 mm Pipeline using 25 mm dia GI Bolts of suitable length as per the finalized design of the Block. A 3 mm thick Neoprene Rubber Sheet will be used to prevent bruising of the pipe due to fixing of the block.

2.4.6 HDPE Fittings & Air Valves

Due to the complexity of the terrain, few flanged joints will be necessary while erecting the pipeline. HDPE Long Neck Stub Ends (Collars) with GI Back up Flanges will be used and fixed with GI Bolts and Nuts.

Further, to avoid Air entrapment in the Creek Zone pipe, it is necessary to provide professional Air release Valves on both ends of the Pipeline (On the banks). Sophisticated Kinetic Air-release Valves shall be installed on both banks enveloped inside RCC Chambers.

2.5 Trench Preparation for Pipeline

2.5.1 Clearing Boulders

The site has a history of large boulders straying in to the Bridge adjoining area during the construction phase. Hence a Pontoon Barge will be mobilized to the Creek through sea way, unless any other equipment/vessel is suggested to be more suitable after the bathymetry. A Grab Crane will be mounted on this vessel to carry remove the Boulders out and clear the Trench route for the Cutter Suction Dredger to work safely.

2.5.2 Pipe Trenching

The Pipe trench is proposed to be done using a Modular Cutter Suction Dredger, as the available Draft in the Creek is expected to be low. This Dredger will be transported by Trailers and assembled on site. The Dredger will be aligned on the Pipe route & dredging of the trench of dimensions as per the specifications will be carried out. The dredged material will be dispersed sideways towards the sea to avoid it filling back in to the trench due to low tide currents.

The Trench alignment & depth shall be monitored with the help of DGPS & Echo Sounding Systems on Board the Dredger. The trenching job will be scheduled in such a way that the entire length across the river will be completed by the time the pipe strings are welded/tested.

The methods for protecting employees from cave-ins, from material that could fall or roll from an excavation face or into a trench, or from collapse of adjacent structures will be considered while trenching the pipe. Protective structures include shoring, sloping, benching systems, and shield systems that provide the necessary temporary protection to trench from danger of collapse or any alterations will be provided in the trenched area.

2.5.3 Trench Backfilling

After the successful laying of entire length of pipe in the trench, hook-up with the shoreline will be completed, then the pipe trench will be backfilled by moving the dredger along the previously dumped area to lift the soil and fill back in the trench. Refilling the trench often the completion of protection works provides the additional stability even after the completion of the process.

2.5.4 Fixing Air Valves & Trial Run

As the pipeline burial is in progress, the Air Valves will be fixed on both the Banks and RCC Chambers will be constructed. It is very much doubtful if the entire stretch of the Pipeline will be ready for commissioning at the time the Creek zone line is completed. If so, an Integrity Test run will be carried out by using the Dredger Pump to pump pure water by positioning the idling Cutter much above the bed level to draw pure water. By controlling the pump speed, flow will be matched with the design flow of the pipe and Trial Run will be conducted for 2 Hours duration.

After successful trial run, the Land & Marine equipment will be demobilized from site, handing over the pipeline, fully backfilled and secured.

2.5.5 Alignment of the Proposed HDPE pipes:

The alignment of transmission main of 800mm dia DI pipe has been completed up to the Kathivakkam High School at Kathivakkam High road. The balance length of DI pipe upto the end of existing compound wall will be laid between the compound wall and the road at a depth of 1.50m from the ground level. At Creek portion the depth of the HDPE pipe at starting portion will be 1.50m and will be increased gradually up to

6.0m depth at the middle of the creek. Then the depth will be reduced to 1.50m at the end of the creek portion.

The alignment of the proposed HDPE will be 32.00m away from the existing piers of the Creek Flyover. Jointing of DI pipes the with the proposed 800mm dia ID HDPE pipe at both ends will be done after completing the work of Crossing Ennore Creek by dredging method.

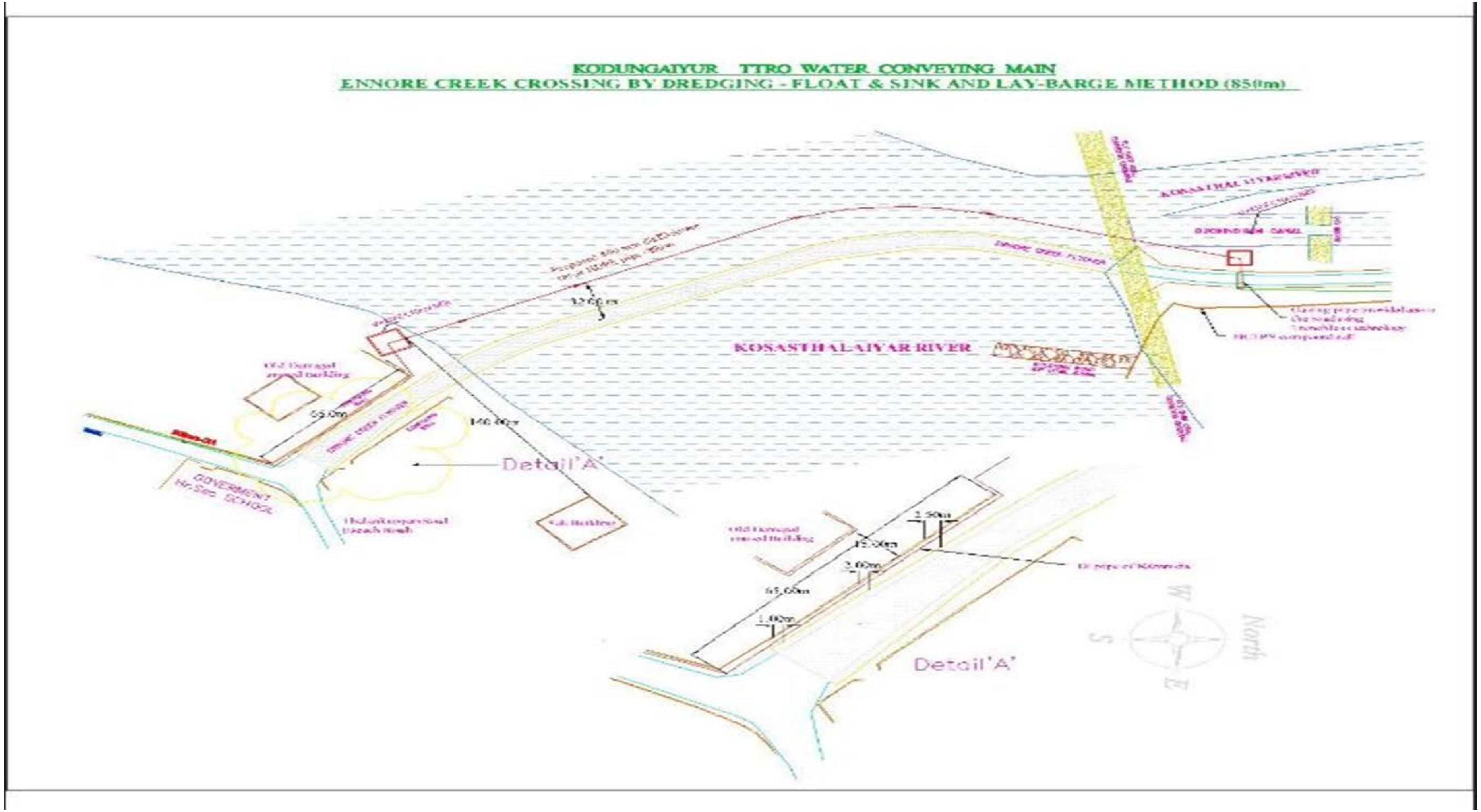


Figure 2.8: Alignment of Proposed HDPE pipe in Ennore Creek

2.5.6 Basic Design and Installation Steps

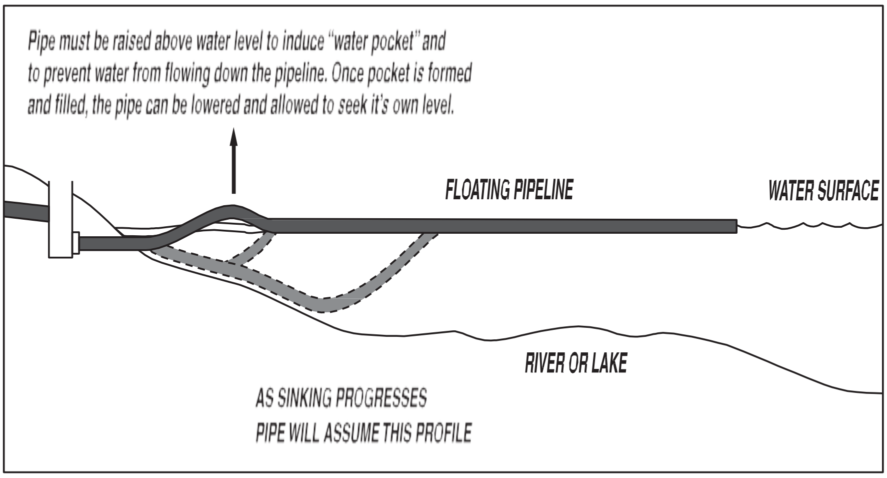


Figure 2.9Water pocket initiates the submersion of the pipe

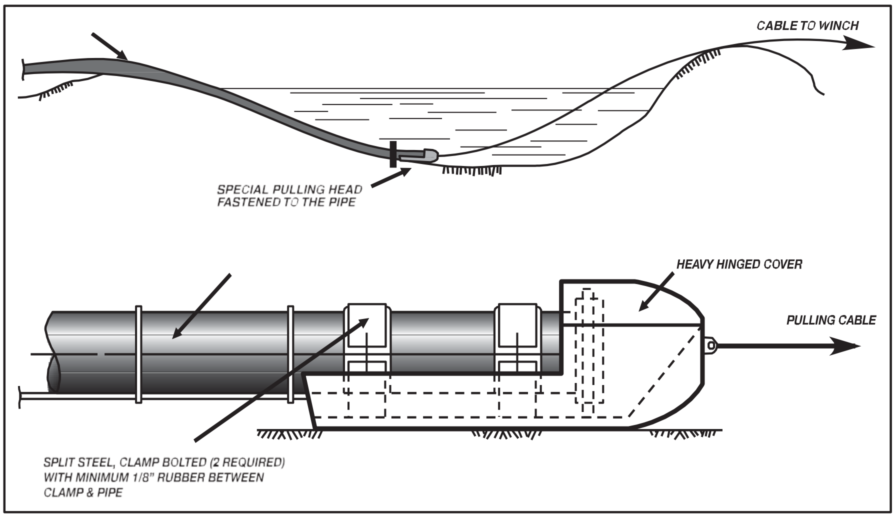


Figure 2.10"Bottom-Pull" Installation of HDPE Pipe

Figure 2.11Unballasted HDPE Pipeline Being Floated Out to Marine Construction Barge Where Ballast Weights are installed

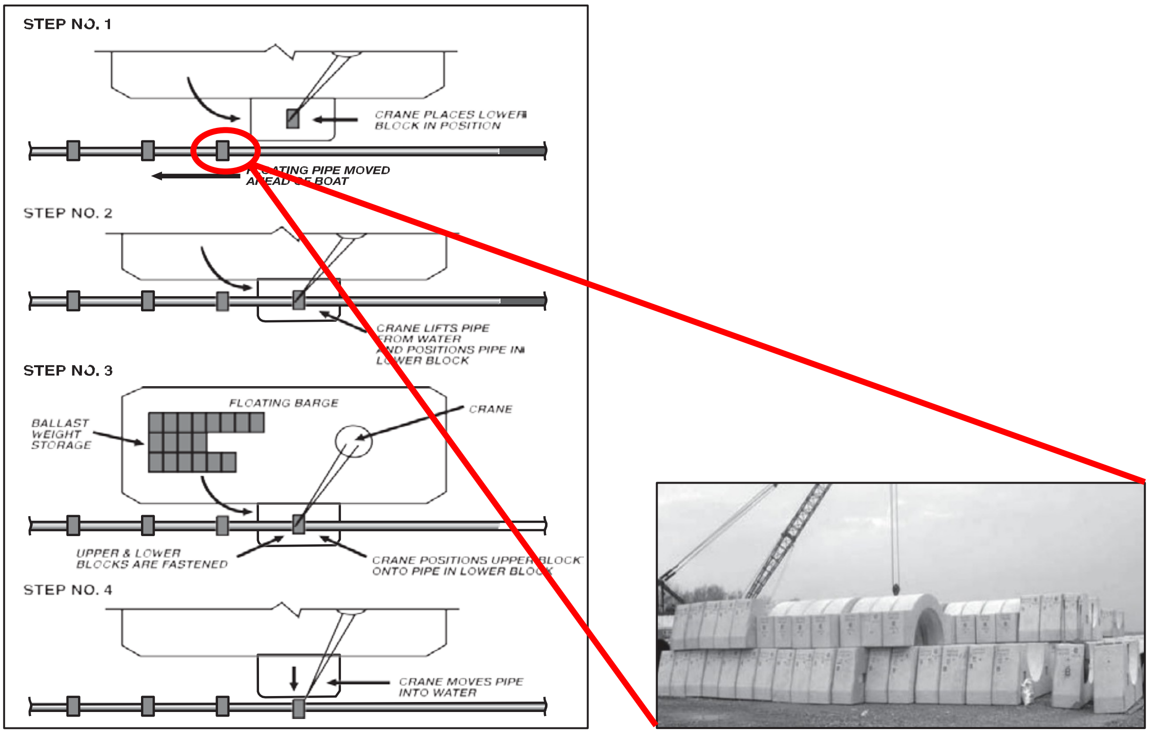


Figure 2.12 Installation of ballast weights from a raft or barge (Concrete Anchors)

Ballast Weight

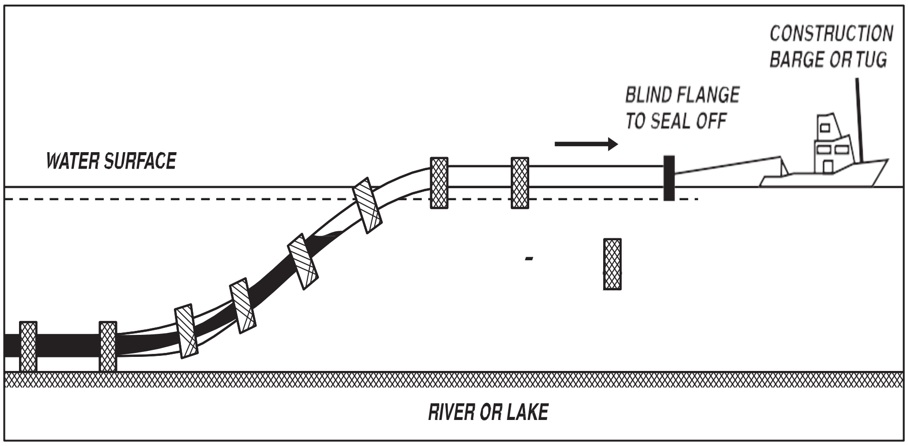


Figure2. 13Pulling the pipe during submersion is a means for avoiding excessive bending that could risk buckling of the pipe.

2.6 Storage of Construction Material

The construction Material HDPE pipe, joints and CC Anchor etc. will be stored nearer to the project. The Construction/dredged material is stored in the area owned by PWD, hence prior permission will be sought from PWD for storage of construction material. The construction material storage area detail is given in Table: 2.1.

2.7 Quantity of Dredging Material

The quantity of the material excavated from the Ennore Creek will be approximately 86,700m^3.

2.8 Storage of Dredging Material

The dredged (excavated) material will be stored in areas nearby project site (200m & 1050m distance from both ends) without affecting the water bodies and nearby mangroves (located 40-50 m away from the project site). The storage area (20000sq.mtr) selected and its location co-ordinates are given in the Table 2.1. Dredged material will be spread in a manner that material/ sediment mobilization is minimal in the specified area. The capping of sediment containments with clean materials should be considered. Level bottom capping or combinations of borrow pits and dikes with capping reduce the underwater spread of dredged material.

The stored dredged material will be maintain in slurry form (easy for backfilling) and used for the backfilling of the dredged trench after the laying of pipeline. Dredger will be used for backfilling of the dredged material.

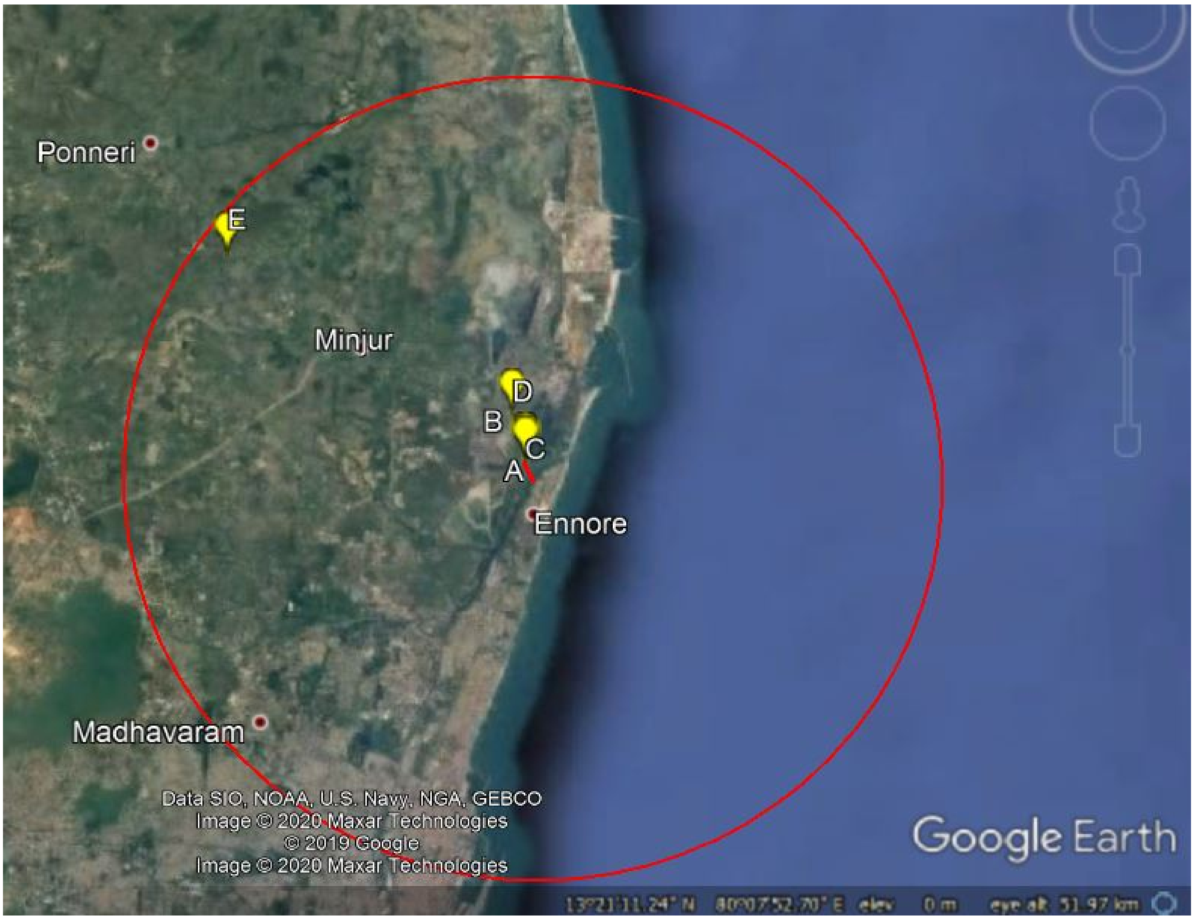


Figure 2.14SatelliteImage of Construction and dredged material Storage Area

The dredged material storage area detail is given in Table 2.1

Table 2.1Storage area details of Construction material and Dredged material.

Pt.	Description	Area In sq. mtr.	Location coordinates	
			Latitude	Longitude
A	Primary Launching Pad	500	13°13'55.29"N	80°19'4.27"E
B	Temporary Pipe Storage	500	13°13'58.86"N	80°19'4.86"E
C	Dredged Soil Temporary Storage	20000	13°14'0.52"N	80°19'3.42"E
D	Alternate Fabrication & Launching Yard	7000	13°14'51.39"N	80°18'48.77"E
E	Block Casting & Storage Yard	3000	13°17'59.95"N	80°13'8.50"E

2.9 Land details

The length of the conveying main 850m and additional 50 m required for the joining the pipeline in both side. The nod of IWAI is mandatory for the construction of any structures or activities on or across waterways. The Buckingham Canal near the project area is under the control of Central Government, so any activities in this canal require the NOC from IWAI. The Ennore Creek and the both sides of the creek (river bed) where pipe is laying are owned by PWD and permission is obtained from the Inland Waterways Authority of India, Delhi, copy of the letter is enclosed under **Annexure IV**.

2.10 Manpower Requirement

The project will provide up to more than 25 Employment opportunities in Construction Phase.

S. N	Description (Operation Phase)	Number of Person (In Nos)
1	Assistant Engineer	1
2	Dredger operator	2
3	HDPF pipe welder	10
4	Helper	12

2.11 Project Cost

The total project cost is Rs. 392.61 Crores, of which Rs. 35 Crores will be used for laying of conveying main in Ennore Creek.

2.12 Duration period for laying of conveying main

It is programmed to implement the laying conveying main of 800mm OD, 50 mm Thick HDPE pipe across Ennore Creek in 75 days. The works for all the components would be commenced simultaneously and completed in the specified period. The construction period details is given in Table 2.2.

Table 2.2 -Construction Schedule

S. No	Activity	Period in days
1	Pipe string fabrication	15
2	Dredger Mobilization & Assembly	5
3	Trench dredging	15
4	Block fixing, alignment & sinking of pipe string	10
5	Backfilling of Trench	10
6	Air valve chamber construction	15
7	End connection &Trial Runs	5
	Total	**75**

3. ENVIRONMENTAL REGULATORY FRAMEWORK

3.1 Introduction

This section reviews the policies, regulations and administrative framework within which the project works are to be implemented. The review includes the Environmental and Social Management Framework (ESMF) developed by World Bank, sector – specific Environmental Policies & Regulations of the Government of India and Government of Tamil Nadu.

3.2 Environmental Policies and Regulations

The environmental policies and regulations reviewed are broadly divided into the following four categories:

- Environmental and Social Management Framework
- Operational policies and environmental and social safeguard policies of World Bank.
- Environmental Policy and Regulatory Frameworks in India
- Regulatory Framework in the State of Tamil Nadu

3.2.1 Environmental and Social Management Framework

TNUIFSL has an Environmental and Social framework to address Environmental and Social issues and safeguards management under TNSUDP. The proposed activity of laying pipe to cross Ennore Creek below bed level doesn't requires acquisition or encroachment of land. So there is no direct social risks/social impact such as livelihood of fishing families. Also the storage area proposed for the project is owned by PWD, so no encroachment of land involved for the temporary storage of dredged material. Hence the project falls under S3 as per **Social Categorization of ESMF** and is classified as **E1** as per **Environmental Categorization of ESMF**. The project involves some temporary impacts to the fishing activity, hydrology and quality of the creek during the construction time. Hence this project requires detailed Environmental& Social Impact Assessment and preparation of management measures.

3.2.2 Operational Policies and Directives of World Bank

- **OP 4.01** for safeguard policies of World Bank which provides for the environmental assessment guidance for the lending operations is applicable. This OP 4.01 requires the borrower to screen projects for potential impacts and through appropriates EA assess, minimize and mitigate potentially adverse impacts from the project

- The Environmental Assessment (EA) leads to be integrated in the project development process such that timely measures can be applied to address the identified impacts
- Environmental Health and safety guidelines of the World Bank are applicable for the project which will be ensured during project implementation.
- **OP 4.04** for natural habitat is also applicable for the project implementation.
- Natural habitats comprise many types of terrestrial, freshwater, coastal, and marine ecosystems. Operational Policy 4.04 sets out the World Bank's policy on supporting and emphasizing the precautionary approach to natural resource management, take into account the conservation of biodiversity, and ensure opportunities for environmentally sustainable development. As per this policy, projects that involve significant conversion or degradation of critical natural habitats are not supported by the Bank. Projects involving non critical habitats are supported if no alternatives are available and if acceptable mitigation measures are in place.
- Two major directives of the bank applicable to the project are the bank directives addressing risks and impacts on Disadvantaged/Vulnerable individuals or Groups and project induced Labor Influx, 2016.
- The directives on vulnerable group establishes directions regarding due diligence obligations relating to the identification of, and mitigation of risks and impacts on, individuals or groups who, because of their circumstances, may be disadvantaged or vulnerable.
- Labor influx guidance provides guidelines to address issues and risks arising from the influx of labor leading to gender- based violence, forced labor etc.

Table below shows the applicability of World Bank operation policies to the implementation of the project.

Analysis of World Bank safeguard policies and its applicability

OP	Title	Comments/ impact
4.01	Environmental Assessment (The objective of this policy is to ensure that the Bank financed project is environmentally sound and sustainable.)	Applicable. As a result of environmental and social screening, the project is identified as Category
4.04	Natural Habitat (The policy prioritizes conservation of Natural Habitats for long term project sustainability).	Applicable - As there is presence of natural habitat at the project site.
4.09	Pest Management (This policy seeks to minimize and manage the environmental and health risks associated with pesticide use and promote and support safe, effective, and environmentally sound pest management.)	Not Applicable- The project will not involve any pest management.
4.10	Indigenous people (The policy aims at restoring the rights and cultural dignity of the indigenous people while ensuring receipt of proper social and economic benefits.)	Not Applicable for the proposed project as no indigenous population is anticipated to be impacted from the project.
4.11	Physical Cultural resources (The policy emphasizes preservation of cultural property in the project area, restoration of archaeological monuments and unique environmental features).	Not applicable- Site monitoring/ inspection has not indicated the presence of any cultural (historical/ archeological) sites in the construction area. However to manage "Chance finds" an appropriate procedure is included in the ESIA report. This procedure to

		be strictly followed by contractor during the Construction phase
4.12	Resettlement (The policy objective is to avoid involuntary displacement and resettlement as far as practicable by exploring viable alternatives. It also emphasizes approach to improve the living standards of the displaced people, encourages community participation in implementation of resettlement activities and help the affected people regardless of their legal status on title of the land).	Not Applicable. The site is Ennore Creek; currently no ongoing activity in the selected area. Therefore no settlements or economic activities requiring relocation to pave wave for the project
4.36	Forest (The policy gives importance to restoration of forest eco-system, which entails management and conservation methods of forest flora fauna and wildlife. No reserve forest will be affected).	Not Applicable. No forest area is coming under the project area.

3.2.3 Environmental Policy and Regulatory Frameworks in India

The following environmental regulations are reviewed for their applicability to the proposed sub-project.

- Constitutional Provisions
- The Environment (Protection) Act, 1986
- Forest (Conservation) Act, 1980 - as amended in 1988.
- The Water (Prevention and Control of Pollution) Act, 1974 – and Tamil Nadu Water (Prevention and Control of Pollution) Rules, 1974
- The Air (Prevention and Control of Pollution) Act, 1981 and Tamil Nadu Air (Prevention and Control of Pollution) Rules, 1983.
- Ancient Monuments & Archeological Sites and Remain Act (AMSAR Act).
- The Treasure Trove Act, 1878
- Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989

- Noise Pollution (Regulation and Control) Rules, 2000
- Coastal regulation Zone (CRZ) Notification, 2011
- Construction &Demolition Waste Management Rules 2016.
- Biodiversity Act,2002
- Building & Other Construction workers Act,1996 (BOCW Act)

Constitutional provisions

The Constitution of India in its Article 48 provides for the protection and preservation of the environment and states that "the state will endeavor to protect and improve the environment and to safeguard forests and wild life of the country." Further Article 51-A (g) on fundamental duties emphasizes that, "It will be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wild life and to have compassion for living creatures."

Forest (Conservation) Act, 1980.

The Act pertains to diversion of forestland and felling of roadside plantation. Depending on the size of the tract to be cleared, clearances are to be obtained. Restrictions and clearance procedures proposed in the Forest (Conservation) Act apply to the natural forest areas, even in case the protected/designated forest area does not have any vegetation. The laying of conveying main of the proposed project does not cross any natural forest areas/ mangrove forest. The confluence point of Kosastalaiyar River and sea water harbors fringes of mangroves situated at the upstream stretch of Ennore creek. The presence of Mangroves is seen 40-50 m away from the project area;that are stunted and sparse. It will be properly managed and covered with tarpaulin to avoid dusting of leaves.

The Water (Prevention and control of Pollution) Act, 1974

Water Act is the first environmental regulation that brought at the state and center levels, pollution control boards to control / regulate environmental pollution in India. The Act was amended in 1978 and 1988. Salient features of the Act are the following:

- Section 25 of the Act requires an application to be made to the state board to establish any treatment and disposal system that is likely to discharge sewage or trade effluent in to a stream or well or sewer on land.

These laws seek to control pollution of water and enhance the quality of water. The proposed activity will not be generating any wastewater from the project site. The proposed pipeline crossing does not attract the provisions of this act.

The Air (Prevention and control of pollution) Act, 1981 amended in 1987

This Act provides prevention, control and abatement of air pollution. With a framework similar to the Water Act, the Air Act gave the central and State Board's authority to issue consents to industries operating within the designated air pollution control areas. The State also prescribes emission standards for stationary and mobile sources. Since the proposed project involves operation of DG sets in construction phase only, the above said Act and emission standards will be complied.

The Environmental Protection Act 1986 & Notifications

In order to create national environmental legislation, the EPA articulates a policy for Environmental protection covering Air, Water and Land and provides a framework for Central Government to coordinate between Central and State Authorities established under various laws, including the Water Act and Air Act. Under this umbrella Act, the Central Government must set National Ambient and Emissions Standards, establish procedures for managing hazardous substances, regulate industrial sites, investigate and research pollution issues and establish laboratories and collect and disseminate information.

Among other relevant legislation, the Public Liability Insurance Act (PLIA) of 1991 mandates that business owners operating with hazardous substances take out insurance policies covering potential liability from an accident and establish Environmental Relief Funds to deal with accidents involving hazardous substances. The National Environmental Appellate Authority Act of 1997 requires the Central Government to establish an authority to hear appeals on area restrictions where operations will not be carried out or will be carried out with certain safeguard measures.

Ancient Monuments & Archeological Sites and Remain Act.

The Ancient Monuments and archeological Sites and Remains Act, 1958in order to bring the legislation on par with constitutional provisions and providing better and effective preservations to the archeological wealth of the country, The Ancient

Monuments and Archeological Sites and Remains Act 1958 9No 24 of 1958) was enacted on 28th August 1958. This act provides for preservation of ancient and historical monuments and archeological sites and remains of national importance, for regulation of archeological excavations and for protection of sculptures, carvings and other like objects. Subsequently, the Ancient Monuments and Archeological sites and Remains Rules 1959 were framed. The Act along with Rules came into force with effect from 15 October 1959. This Act repealed the Ancient and historical monuments and Archaeological sites and remains (Declaration of National Importance) Act, 1951.An 100 year old building is located 140 m from the proposed project site, the building or place that located is not notified as Archaeological building or place by Department of Archaeology, Government of India. The proposed laying of conveying main and dredging activity will not create any adverse impact on old building (Salt building).Built in 1902, it served for decades as resting quarters for officials of the Salt Department. The project activity is carrying out 140m from the salt building and there is no storage of dredged material and construction material in this area.

The Treasure trove Act, 1878

The Indian Treasure Trove Act, 1878 (Act No. VI of 1878) was promulgated to protect and preserve treasure found accidentally but having the archaeological and historical value. This Act was enacted to protect and preserve such treasures and their lawful disposal. In a landmark development in 1886, James Burgess, the then Director General succeeded in prevailing upon the Government for issuing directions forbidding any person or agency to undertake excavation without prior consent of the Archaeological Survey and debarring officers from disposing of antiquities found or acquired without the permission of the Government.

The Antiquities and Art Treasures Act, 1972

The Antiquities and Art treasurers Act (No. 52 of 1972) is the latest act enacted on 9th September 1972 for effective control over the moveable cultural property consisting of antiquities and art treasurers. The act regulates export trade in antiquities and art treasurers, provides for prevention of smuggling of and fraudulent dealings in antiquities, authorizes compulsory acquisition of antiquities and art treasurers for preservation in public places and provides for certain other matters connected therewith or incidental or ancillary thereto. This act was supplemented with the Antiquities and Art Treasure Rules 1973. The act and rules have been in force with effect from 5th April 1976. This legislation repealed the Antiquities Export Control Act, 1947 (Act No. XXXI of 1947An article, object, or thing of archeological interest finds during dredging activity in Creek should report to Archeological Survey of India.

The Noise Pollution (Regulation and Control) (Amendment) Rules, 2002

In order to curb the growing problems of noise pollution, the government of India has enacted the noise pollution rules 2000 that includes the following main provisions.

The state government may categorize the areas as industrial or commercial or residential. The Ambient air quality Standards in respect of Noise for different areas has been specified. Areas not less than 100 m around Hospitals, Educational institutions and Court is declared as silence area under these rules. A person found violating the provisions as to the maximum noise permissible in any particular area will be liable to be punished for it, under the provision of these rules and any other law in force.

Manufacture, storage and Import of Hazardous Chemical rules, 1989

These rules aim at controlling the generation, storage and import of hazardous chemicals. These Rules are applicable to an industrial activity or isolated storage in which there is involved a quantity of hazardous chemical listed in the Schedule of the Rules which is equal to or more than the quantity specified in the entry for that chemical in the Schedule. According to these rules, the user of hazardous chemicals has to perform the following and dispose hazardous waste as mentioned in the rules.

Identify the potential hazards of the chemicals and take adequate steps to prevent and control such hazards.

Develop or provide information about the chemical in the form of safety data sheets.

Label the specified information on the container of the hazardous chemical.

Coastal regulation Zone (CRZ) Notification, 2011

As per CRZ 2011 notification, the coastal land up to 500m from the High Tide Line (HTL) and a stage of 100m along banks of creeks, estuaries, backwater and rivers subject to tidal fluctuations, is called the Coastal Regulation Zone(CRZ). CRZ along the country has been placed in four categories. The notification imposed restriction on the setting up and expansion of industries or processing plants etc. in the said CRZ. Coastal Regulation Zones (CRZ) are notified by the Govt of India in 1991 for the first time. Under this coastal areas have been classified as CRZ-I, CRZ-II, CRZ-III, CRZ-IV. And the same they retained for CRZ in 2011 notifications as well.

CRZ-I: these are ecologically sensitive areas and geomorphologic features which play a role in the maintaining the integrity of the coast. The area between low tide line and high tide line is included as CRZ-I.

CRZ-II: The area that has been developed upto or close to the shoreline.

CRZ-III: Areas that relatively undisturbed and those do not belong to either CRZ –I or II which include coastal zone in the rural areas and also areas within municipal limits or in other legally designated urban areas, which are not substantially built up

CRZ-IV: The water area from Low tide line to twelve nautical miles on the seaward side. This shall include the water area of the tidal influenced water body from the mouth of the water body at the sea upto the influence of tide which is measured as five parts per thousand during the driest season of the year.

The Laying of pipeline 850 m is falls under CRZ IV, so CRZ clearance is required from MOEF&CC.

CRZ clearance obtained from MoEF in it's vide letter no: F.No.11-23/2016-IA-III dated 5-09-2017and Amendment to the clearance for the proposal for laying pipeline below the bed was obtained on letter no: F.No. 11 -23/2016-1A-lll dated 26-10-2018and is enclosed as **Annexure I.**

(Note: CRZ notification 2019 is not implemented because due to incomplete public consultation and not approved CZMP 2019 Map by MoEF&CC).

Construction and Demolition Waste Management rules, 2016

The rules shall apply to every waste resulting from construction, re-modeling, repair and demolition of any civil structure of individual or organization or authority that generates construction and demolition waste such as building materials, debris, rubble. Wastes also include surplus and damaged products and materials arising in the course of construction work or used temporarily during the course of on-site activities. On completion of the works, the left-over construction materials will be removed stored and removed by the contractor from project site for reuse/ proper disposal.

Activities which generate C & D waste in cities / towns are mainly from:

i. Demolition of existing, old dilapidated structures;

ii. Renovation of existing buildings (residential or commercial);

iii. Construction of new buildings (residential or commercial or hotel etc.);

iv. Excavation/ reconstruction of asphalt/ concrete roads;

v. Construction of new fly over bridges/ under bridges/ sub-ways etc.; and

vi. Renovation/ Installation of new water/ telephone/ internet/ sewer pipe lines etc.

vii. Present collection and disposal system.

Biological Diversity Act, 2002

An Act to provide for conservation of biological diversity, sustainable use of its components and fair and equitable sharing of the benefits arising out of the use of biological resources, knowledge and for matters connected therewith or incidental thereto.

Building & Other Construction workers Act, 1996 (BOCW Act)

This act to regulate the employment and conditions of service of building and other construction workers and to provide for their safety, health and welfare measures and for other matters connected therewith or incidental thereto. "The BOCW Act stipulates health, safety and welfare measures applicable to building/construction workers. Provisions applicable for implementation are to be abided by the contractor. The employer should follow these conditions under this act;

1. Maintenance of registers and records.
2. The employer shall make necessary arrangements for sufficient supply of wholesome drinking water.
3. In every place where building or other construction work is carried on, the employer shall provide sufficient latrine and urinal accommodation of such types as may be prescribed and they shall be so conveniently situated as may be accessible to the building workers at all times.
4. Safety Committee and Safety Officers.

Labour Laws

Review of various Labour laws is provided in **Annexure- IX** for guidance. Provisions applicable for implementation are to be abided by the contractor.

3.3 Regulatory framework in the state of Tamil Nadu

i. PWD

Laying of TTRO Water Pipeline by CMWSSB along Buckingham Canal & crossing of Ennore Creek and storage of Construction Material and dredged material.

3.3.1 Clearances / NOC Required from Competent Authority

The summary of applicable Clearance /NOC required for the proposed project is given in Table 3.1.

Table 3. 1: Clearance / NOC required from Competent Authority

S.N	Activity	Clearance / NOC required	Statutory Authority	Status
1.	Laying of TTRO Water Pipeline by CMWSSB along Buckingham Canal & crossing of Ennore Creek and storage of Construction Material and dredged material.	Permission Letter	Public Work Department	Permission obtained
2.	Laying of TTRO Water Pipeline by CMWSSB along Buckingham Canal & crossing of Ennore Creek	No Objection Certificate	Inland Waterways Authority of India	Permission obtained
3	Laying of TTRO Water Pipeline by CMWSSB along Buckingham Canal & crossing of Ennore Creek	CRZ Clearance	MOEF&CC	Permission obtained

Clearance/NOC Permission Letter enclosed as **Annexure IV.**

4. DESCRIPTION OF THE ENVIRONMENT

4.1 Scope of Study

For studying the baseline of the environment before the commencement of the work, the environmental screening of the project area should be done as per ESMF guidelines. An area covering a 1.5 km radial distance around Ennore Creek and micro-water shed nearer to the project location is considered as the study area for the purpose of the baseline studies. As part of Environmental and Social Impact Assessment, this study was undertaken for a period from January 2019- March 2019. As the laying of pipe line across Ennore Creek is a site specific activity, the baseline studies includes site specific detail and its surrounding areas.

4.2 Collection of Primary and Secondary Data

The Primary data on Water, Air, Land, Noise, Terrestrial Flora, &Fauna, Marine Samples (water and sediments) were collected through site visits and on sampling basis, interaction with local people and discussion with project authority, stakeholder consultation, by the project engineers. Secondary data was collected from various Departments of State/ Central Government Organization, Semi – Government and Public Sector Organizations. **Table 4.1** gives various environmental attributes considered for formulating environmental baseline, frequency and monitoring methodology for various environmental attributes.

1	Primary data- Analyzed from field	Water, Land, Noise, Air, Soil, Flora,& Fauna, Marine (water and sediments)
2	Secondary data-refers to data was collected from various Departments	Wind Rose data, Ecology, Aquatic Data, and Social economic

Table 4.1 Baseline Environmental Components, Frequency & Monitoring Methodology

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
Air Environment				
Meteorological Data				
• Wind speed • Wind direction • Dry bulb temperature • Wet bulb temperature • Relative humidity • Rainfall	Requisite locations in the project influence area.(Ennore area, Chennai)		Weather Monitoring Station	IS 5182 Part 1-20 Site-specific Primary data is essential.Secondary data from IMD-Regional Meteorological Centre, Chennai.
Ambient Air Quality				
• Suspended Particulate Matter (SPM) • Particulate Matter (PM_{10}) • Particulate Matter ($PM_{2.5}$) • Sulphur Di-oxide (SO_2) • Oxides of Nitrogen (NO_X) • Ammonia	Requisite locations in the project influence area.(Around Ennore Creek)	24 hourly(Twice a week) 8 Hourly(Twice a week)	• Gravimetric (High–Volume) • Gravimetric (High– Volume with Cyclone) • EPA Modified West & Geake method • Arsenite Modified Jacob &Hochheiser • Nessler's method.	As per CPCB Standards under November 18th 2009 Notification for NAAQS
Noise Environment				
Hourly equivalent noise levels	Requisite locations in the project influence area. (Ennore Flyover bridge)	One day Continuous on a working and non-working day.	Sound level meter.	IS: 4954-1968
Vibration				
Vibrational intensity in terms of peak ground particle	Ennore Creek (Project Site) and nearby Structures	Construction Phase	Vibration Meter	ISO:10816

velocity (PPV) in mm/s				
Water environment				
Parameters for water quality: pH, temp, turbidity, Total hardness, total alkalinity, chloride, Sulphate, nitrate, fluoride, sodium, potassium, Electrical Conductivity, Ammonical nitrogen, Nitrate-Nitrogen total phosphorus, , BOD, COD, Calcium, Magnesium, Total Dissolved Solids, Total Suspended Solids.	Set of grab samples at different locations for ground and surface water.(in and around Ennore Creek)	Once	Samples for water quality collected and analyzed as per Standard methods for examination of water and wastewater analysis published by American Public Health Association.	
Marine Sediment Quality sampling and Analysis and its Biological Parameters.	Set of samples from Ennore Creek and Stored in Ice box and sent to laboratory Analysis	Once	Sampling performed with help of Van Veen Grab Sampler (sediment sampler)	IS 2720 (Part 26):1987
Land Environment				
• Soil quality • Particle size distribution • Texture • pH • Electrical conductivity • Cation exchange capacity (CEC) • Alkali metals • Sodium Absorption Ratio (SAR) • Permeability • Porosity	Requisite soil samples be collected as per BIS specification within project influence area.(near by areas of Ennore Creek)	Once	Collected and analyzed as per soil analysis reference book, M.L. Jackson	
Land Use				
• Location code	-	-	• Global	From land use

• Total project area • Topography • Drainage (natural) • Cultivated, forest plantations, water bodies, roads and settlements			positioning system • Topo-sheets • Satellite Imageries	maps sensitive receptors (forests, parks, mangroves etc.) can be identified.
Biological Environment				
Terrestrial				
Vegetation – species, list, economic importance, forest produce, medicinal value, Importance value index (IVI) of trees, forest types (reserved/protected), sensitive habitat. **Avifauna** Rare and endangered species Sanctuaries/National park/Biosphere reserve/migratory species/marine species.		dry season for terrestrial biota	• Point centered quarter plot-less method for Terrestrial vegetation survey. • Secondary data to collect from Government offices, NGOs, published literature	
Socio-Economic				
• Demographic structure • Infrastructure resource base • Economic resource base • Health status: Morbidity pattern • Cultural and aesthetic attributes	Socio-economic survey is based on proportion ate, stratified and random sampling method (around Ennore Creek)		• Survey is based on personal interviews and questionnaire. • Secondary data from census records, statistical hard books, health records and relevant official records available with Govt. agencies	

4.3 Sampling Locations

Sampling locations are selected for Air, Water, Noise and Soil. All the samples are analyzed and results are shown below:

The Air, Noise, Water and Soil Sampling locations were selected based on the following criteria. The Ambient air quality monitoring locations have been designed keeping in view the available climatologically norms of predominant wind direction and wind speed of the area.

The following points were also taken into consideration in designing the sampling locations

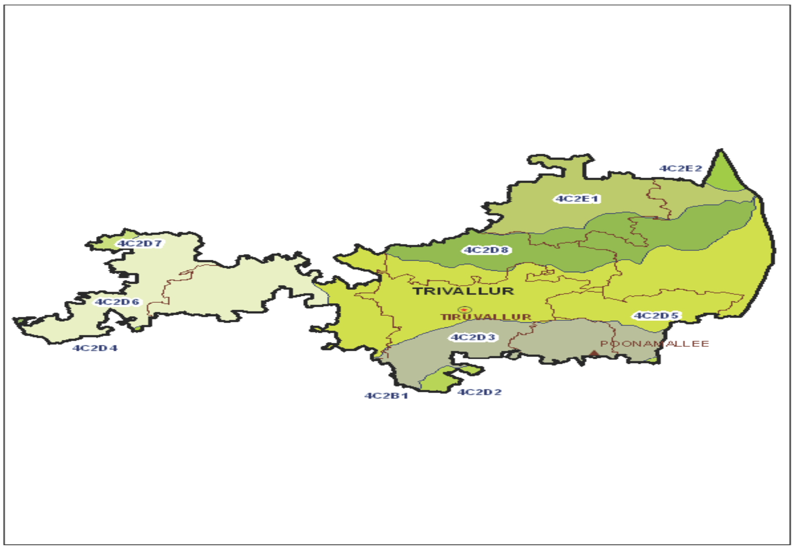
- Topography and terrain of the study area.
- Populated areas around the study area.
- Residential and sensitive area around the study area.

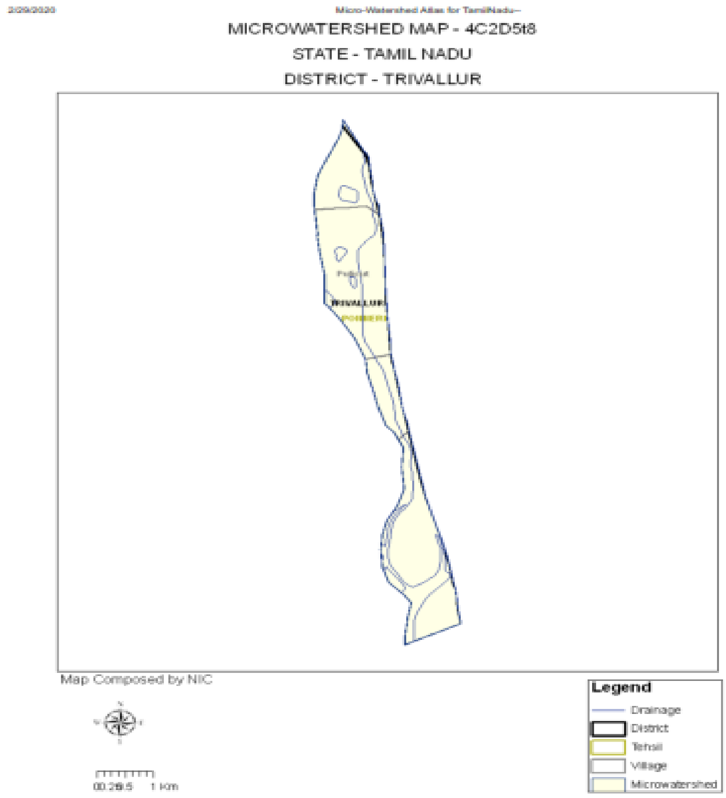
For the noise monitoring locations the above factors has been considered. Water sampling locations were collected based on the availability of the bore wells / open wells in the area. Geological environment has been considered for the collection of Soil sample collection.

4.3.1 Micro-Water Shed

The study area comes in the micro-watershed Map-4C2D5t8 of Thiruvallur District, Tamil Nadu. Athipattu, Pudunagar, Katupalli, Ennore and Kalanji are the villages coming under this area. The Arani River and the Kosasthalayar River are the two seasonal rivers flowing through this region. The confluence point of Kosasthalayar River and sea water harbors fringes of mangroves situated at the upstream stretch of Ennore creek. Ennore comprises of lagoon and salt marshes and back waters. The area is a well-developed region with industrial units in Manali- Minjur Region, utilities, suburban residential areas and fishing hamlets. The two major developments in the region are North Chennai Thermal Power Plant and the Ennore Port. Development in the northern area is likely to intensify with a major industrial park being proposed, having power utilities, petro chemical industries and chemical storage units.

Water Shed map of Thiruvallur District





Impacts of Modernization

An impact to micro-watershed due to these major developments is reduction in the depth and width of the natural catchment area / water-shed. The ground water recharge /catchment area reduces as the precipitation reaches the ground decreases due to the change in land use/modernization. The other impacts include water erosion, a decline in the soil fertility and disturbances to the eco system function. Any major intrusion into a watershed is likely to impact on some major components of the ecosystem(s).

Mitigation Measures

Regular maintenance of drains by removing the silt and dirt before the start of monsoon will prevent choking of drains.

4.4 Physiographic

Ennore Creek is located in Thiruvallur district of Tamil Nadu with the geographical coordinates of North Latitude 13º 14' and East Longitude 80º 20'. This zone that surrounds Ennore comprises of salt marshes and backwaters which are submerged during high tide and forms an arm of the sea with the opening to the Bay of Bengal at Ennore Creek. The total area of the creek is 4km² which lies 20 km north of Chennai. Its north-south trending channels connecting it to the Pulicat Lagoon in north and to the distributaries of Kosasthaliyar River in the south. The depth of the creek ranges from 1- 2 m and is shallow near the mouth.

4.4.1 Topography

The Ennore Creek is bound on the north by the Pulicat Lake and to the south by the Manali marshlands. The Arani River enters the creek's northern edge below Lake Pulicat. To the south, Kosasthalaiyar River and the surplus course of the PuzhalLake enter the creek. To the south of the Creek, the residential villages like Voc Nagar, TulsiKuppam, and Kamraj Nagar, and some schools like V.O. C schools, Kathivakkam higher Secondary school (130m) is located. The Ennore Railway Bridge is located on the west of the Ennore Creek in 320m. The North Chennai thermal Power station (NCTPS) is located to the northern part of the creek within 1.0 km. The mouth of the creek is located in the eastern side of the project area. Six revenue villages, namely, Kathivakkam, Ennore, Puzhudhivakkam, Athipattu, Pudunagar, Katupalli and Kalanji are located around the Creek.

4.4.2 Geology

The geology of Chennai comprises mostly clay, shale and sandstone. The city is classified into three regions based on geology, namely, sandy areas, clayey areas and hard-rock areas. Sandy areas are found along the river banks and the coasts. The total area of the Creek is 4 sq. km and is nearly 800 m wide. Araniar and Kosataliyar are the two seasonal rivers that traverse Ennore Creek. Ennore comprises of lagoon and salt marshes and back waters. Sandy areas are found along the river banks and coasts. The region has the oldest rocks in the country dating back to nearly a billion years.

4.4.3 Hydrogeology

The Thiruvallur district is underlain by both porous and fissured formations. The important aquifer systems in the district are constituted by i) unconsolidated & semi-consolidated formations and ii) weathered fissured and fractured crystalline rocks. The main geological formations along the coast include sandstones and clays of Jurassic age (Upper Gondwana), marine sediments of Cretaceous age, Sandstones of Tertiary age and Recent alluvial formations. Quaternary formations comprising mainly sands, clays and gravels are confined to major drainage courses in the district. The maximum thickness of alluvium is 30.0 m. whereas the average thickness is about 15.0 m. Ground water occurs under phreatic to semi-confined conditions in these formations and is being developed by means of dug wells and filter points. Alluvium, which forms a good aquifer system along the Araniyar and Kosattalaiyar river bed, is one of the major sources of water supply to urban areas of Chennai City and also to the industrial units. The coast consists of sandy beaches.

Ground water generally occurs under phreatic conditions in the weathered mantle and under semi-confined conditions in the fissured and fractured zones at deeper levels. The thickness of weathered zone in the district is in the range of 2 to 12 m. The depth of the wells ranged from 8.00 to 15.00 m bgl.

4.5 Meteorology

The meteorological parameters were recorded at site on hourly basis during the study period and consists of parameters like wind speed, wind direction, temperature and rainfall. The site specific data is given below in **Table 4.2**

Table 4.2-Site Specific Meteorological data from January-December2019

Month	Temperature			Relative humidity (%)	Rainfall (mm)	Max Wind speed (m/s)
	Maximum	Minimum	Average			
January	27	23	26	69	3.1	5.4
February	30	25	28	72	2.7	5.4

March	32	27	30	67	2.3	6.1
April	34	28	31	69	1	6.8
May	36	29	33	66	7.4	7.9
June	36	29	33	61	48.9	7.7
July	33	31	27	66	148.7	7
August	32	26	30	67	208	7.2
September	30	25	28	74	205.2	6.5
October	30	26	28	77	319.3	5.6
November	29	25	28	76	296.9	6
December	27	24	26	76	261.4	6.3

Source: Indian Meteorological Data (secondary data)

4.5.1 Temperature

The mean maximum and minimum temperatures of Chennai, during summer and winter vary between 38°C and 21°C. The highest temperature ever recorded is 41°C. The meteorological data for Ennore shows average minimum air temperature varying between 24°C and 31°C and maximum temperature ranging from 27°C to 36°C.

4.5.2 Rainfall

Chennai district generally experiences hot and humid climatic conditions. The district receives the rain under the influence of both South east and North east monsoons. Most of the precipitation occurs in the form of cyclonic storm caused due to the depression in Bay of Bengal chiefly during Northeast monsoon period. The Southwest monsoon rainfall is highly erratic and summer rains are negligible. The average normal rainfall of the district is 1104 mm. out of which 52% has been received during Northeast monsoon period and 41% has been received during Southwest monsoon period.

The climate at Ennore is tropical with high humidity. The coastal area is normally governed by land and sea breezes. The coast of Ennore experiences two distinct monsoons viz., the Southwest (SW) monsoon from June to August and Northeast (NE) monsoon from September to November. The seasons of Ennore influences its oceanographic characteristics, i.e., strong winds during the SW and NE monsoon and cyclonic winds producing larger waves.

4.5.3 Relative Humidity

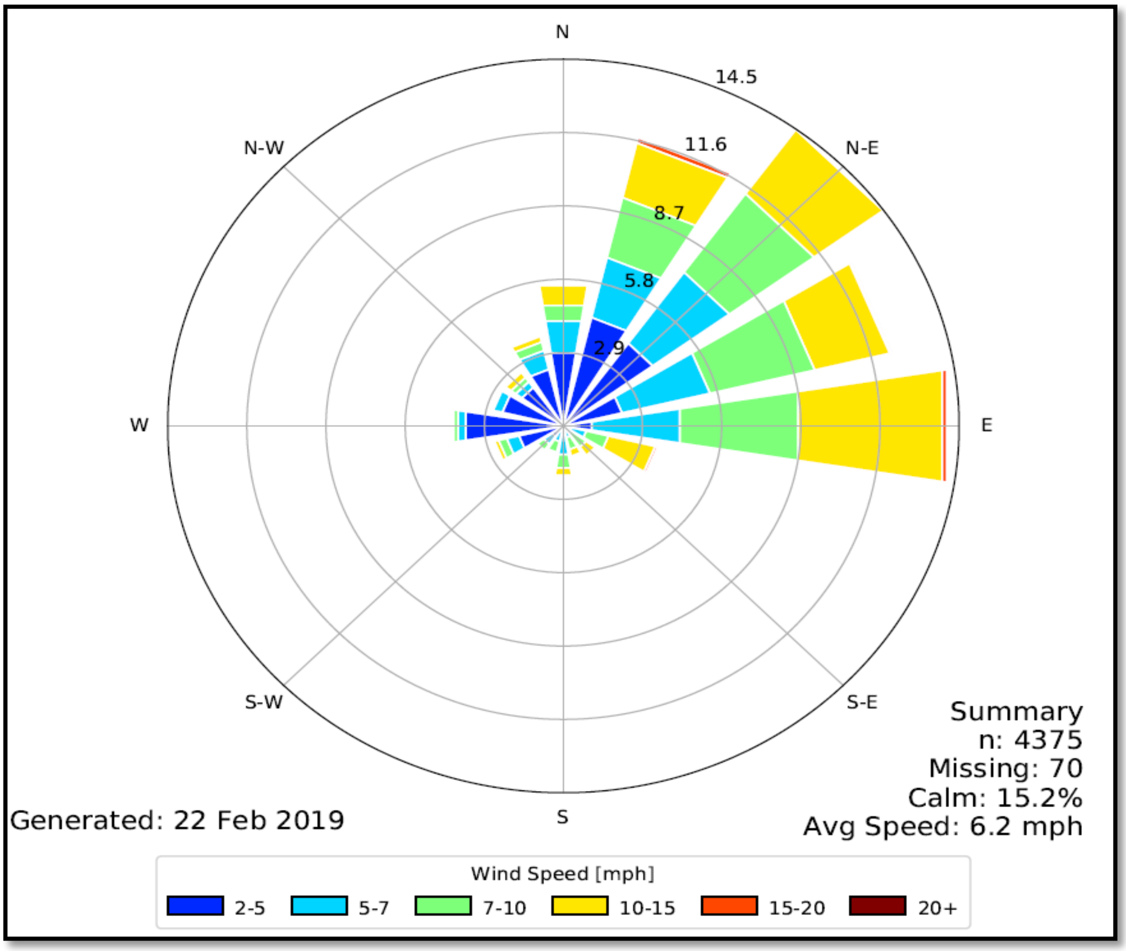
High relative humidity between 61% and 77% prevail throughout the year. Higher rates of relative humidity are observed between October and December i.e., 76% to 77%. In the month of May and June, the humidity is lower i.e., around 61 to 66%.

4.5.4 Wind Speed & Direction

Meteorological station was set-up at site, to record surface meteorological data, during the study period from **January 2019 to March 2019.**

Wind speed and wind direction data recorded during the study period has enabled identifying the influence of meteorology on the air quality of the area. Based on the collected meteorological data, relative percentage frequencies of different wind directions were calculated and plotted as wind roses for 24hr duration.

Wind rose for the period of **January 2019 to March 2019** is given in **Figure 4.1**



Source: IOWA Environmental Mesonet Website

Figure 4. 1 Wind rose diagram for the period of January 2019 to March 2019

4.6 Land Use / Land Cover

The area to the west of Ennore port on the landward side is barren salt marsh with little or no vegetation. Agriculture is the major occupation of the people to the north and west of Ennore Creek. Cultivation is generally dependent upon monsoon and the major crops grown are millets, groundnuts and paddy. During non-monsoon, cultivation is carried out in reduced area using Ground water. The primary resource utilization from the creek is shell fishing, industrial cooling water intake and discharge and saltpans. The land use distribution (satellite map 1:50000) consists of built-up settlements, agricultural lands, wetlands/water bodies, creeks/canals, forests, and Industrial establishments.

The residential areas, vegetation, wasteland, water bodies, scrub land, and wetland are various categories of land use/ land cover. The coastal land use types like wetlands, scrub land; wasteland is drastically reduced because of rapid increase in population and urbanization. There is a significant increase in the built up land witnessed in the nearby areas of the Ennore Creek due to the increase of occupants in the residential complexes and due to the shoot up of industries.

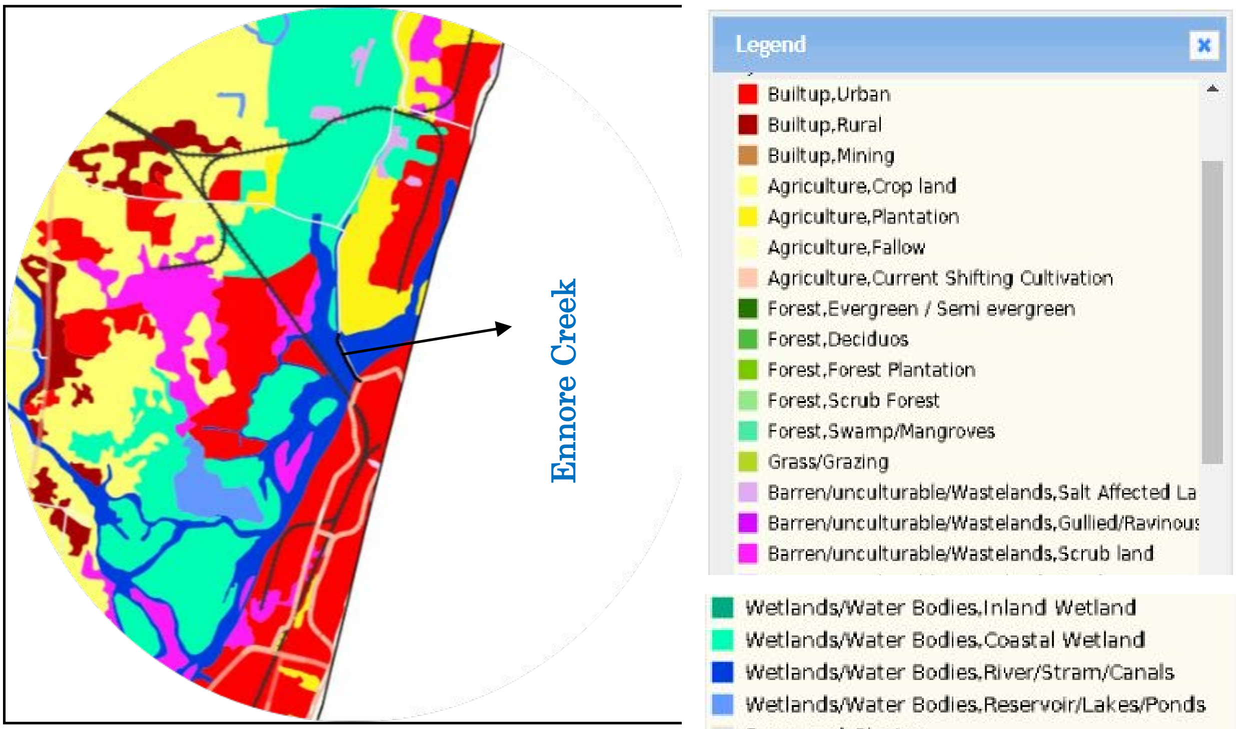


Figure 4. 2Land Use/ Land Coverage image around 10km radius of Ennore Creek

Traditional and Current uses to which to Ennore creek is put in different stretches.

Fishing used to be one of the major activities in the Ennore Creek up to the area of Ennore Railway Bridge. The southern part of the Ennore Creek, fringing the northern areas of the City of Chennai, is well developed with industries, utilities, suburban residential areas and fishing hamlets. The northern section of the creek or Kosathalaiyar River is connected to the Pulicat Lake and has two major developments- the North Chennai Thermal Power Plant and the Ennore Port. Development in the northern area is likely to intensify with a major industrial park being proposed, having power utilities, petro chemical industries and chemical storage units.

The Ennore Industrial Complex is located adjacent to Manali Industrial Complex. It includes pharmaceuticals, chemicals, fertilizers; automotive manufacturing unit and a coal fired thermal electricity station-ETPS. The Ennore Thermal Power Plant uses the creek water as coolant and discharge of hot water into creek. Apart from this, mixing of fly ash with water and the careless disposal of waste into the waterbody from the plant is taking place in the Ennore Creek Stretch. Wastewater enters the creek through the Buckingham canal, a waterway that was built for navigation. The canal section that traverse between Chennai and Ennore now serve as an open sewer, receiving municipal and industrial wastewaters.

Two power utility companies (NCTPS, ETPS) withdraw cooling waters from the creek, while traditional fishermen use the areas near the mouth for fishing. The creek once encompassed with rich biodiversity of vegetation types and associated fauna contribute an excellent green belt would be totally deteriorating due to blooming of the petrochemical complexes and other industries.

A schematic flow diagram of the various discharges and intakes of the Ennore Creek is shown in the **Figure 4.3.**

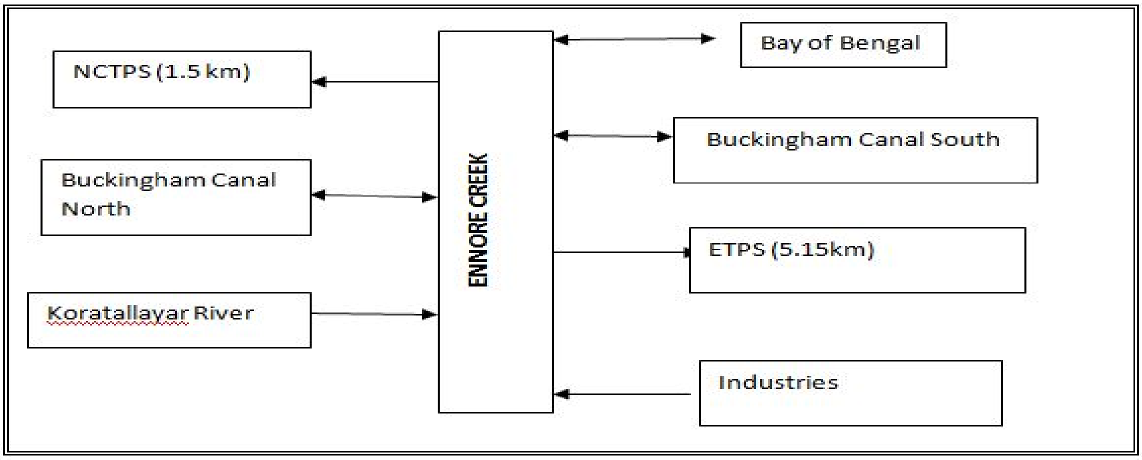


Figure 4.3 Schematic flow diagrams for Ennore Creek.

4.6.1 Physical and Cultural Resources in and around Ennore Creek

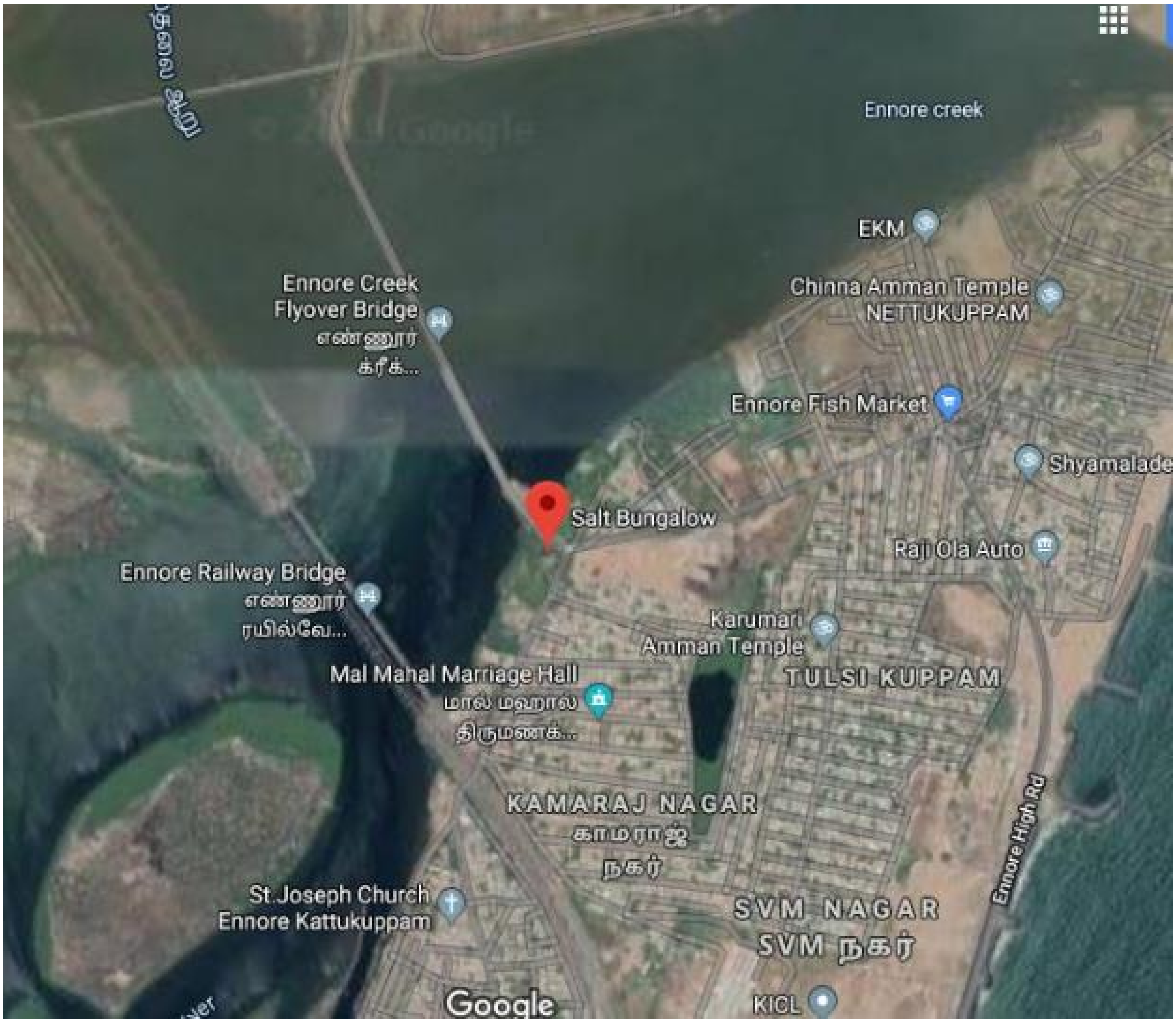


Figure 4.4Physical and Cultural Resources in and around Ennore Creek

The Ennore railway bridge is situated within 400m from the project site. Some cultural and religious buildings like St. Joseph Church, ChinnaAmman Temple, Karumari Amman Temple are situated nearer to the project site. Also some residential buildings, schools and markets are in and around the proposed project alignment site.

4.7 Air Environment

The prime objective of baseline air monitoring is to evaluate the existing air quality of the area. This will also be useful for assessing the conformity to standards of the ambient air quality during the construction and operation of the proposed project. This section describes the selection of sampling locations, methodology adopted for sampling, analytical techniques and frequency of sampling. The methodology adopted for Air quality survey is given below.

4.7.1 Selection of Sampling Locations

The locations for air quality monitoring were scientifically selected based on the following considerations using climatologically data.

- Topography / Terrain of the study area
- Human Settlements
- Health status
- Accessibility of monitoring site
- Resource Availability
- Representativeness of the region for establishing baseline status
- Representativeness with respect to likely impact areas.

The Ambient Air Quality monitoring locations are given in **Table 4.3 & Figure 4.5**

Table 4.3-Ambient Air Quality Monitoring Location

Sl. No	Sampling location	Geographical location
1	Ennore Flyover (A1)	13°13'32.59"N 80°19'15.29"E
2	V.O.CNagar(A2)	13°13'28.81"N 80°19'14.98"E
3	Tulsikuppam (A3)	13°13'35.82"N 80°19'30.87"E
4	Attipattu (A4)	13°15'4.23"N 80°18'19.17"

Figure 4.5 Air Sampling Locations *Source: Google Earth*

4.7.2 Parameters for Sampling

The parameters chosen for assessment of ambient air quality were Particulate Matter<10 (PM_{10}), Particulate Matter<2.5 ($PM_{2.5}$), Sulphur dioxide (SO_2), Oxides of Nitrogen (NO_x), Carbon Monoxide (CO), Total Volatile Organic Compounds(TVOC).

4.7.3 Instruments used for Sampling

Respirable Dust Samplers APM- 460 BL of Envirotech was used for monitoring Particulate matter (PM-10), gaseous pollutants like SO_2 and NO_x. Fine Particulate Samplers APM 550 of Envirotech was used for monitoring $PM_{2.5}$.

Table 4.4-Techniques used for Ambient Air Quality Monitoring

S. No	Parameters	Technique
1	Particulate Matter (PM_{10}), µg/m^3	Gravimetric (High- Volume with Cyclone)
2	Particulate Matter ($PM_{2.5}$), µg/m^3	Gravimetric (Fine particulate Sampler)
3	Oxides of Sulphur (SO_2), µg/m^3	EPA Modified West &Gaeke method
4	Oxides of Nitrogen (NO_x), µg/m^3	Arsenite Modified Jacob &Hochheiser
5	Total Volatile Organic Compounds (TVOC), µg/m^3	ION Sense PID Detector
6	Carbon Monoxide, mg/m^3	Gas Analyser (NDIR)
7	Ozone, µg/m^3	UV Photometric

4.7.4 Results

Various parameters like maximum, minimum and average have been computed from the monitored data for all the locations and summary of Ambient Air Quality Monitoring locations and results were included in the **Table 4.5**

Table 4.5-Air Quality Monitoring Results.

Location Code	Location	PM_{10}, µg/m^3				$PM_{2.5}$, µg/m^3				SO_2, µg/m^3				NO_x, µg/m^3				O_3, µg/m^3			
		Min	Max	Avg	98 %ile	Min	Max	Avg	98 %ile	Min	Max	Avg	98 %ile	Min	Max	Avg	98 %ile	Min	Max	Avg	98 %ile
AAQ1	Project Site	48	67	59	66.4	29	38	33.5	37.1	8.1	10.9	9.4	10.6	15.8	21	18.6	20.2	12.5	14.8	13.7	14.6
AAQ2	VOC Nagar	45	63	53	62.7	25	35	30.4	35.7	7.8	10.1	9.2	9.9	14.4	18.9	16.7	18.6	11.8	13.6	12.6	13.5
AAQ3	TulsiKuppam	43	60	51	59.4	24	31	27.3	30.6	6.9	8.5	7.8	8.4	13.3	17.5	15.3	17.3	11	13	12.1	12.8
AAQ4	Athipattu	51	75	62.8	73.8	31	40	35.7	39.7	8.9	13.2	11.1	13	19	22.8	21.1	22.5	13	15.2	14.1	15
CPCB / MoEF Standards																					
Industrial /Residential / Rural and Other Area		100				60				80				80				100			

Location Code	Sampling Location	Ammonia µg/m³	Carbon monoxide, mg/m³				Lead, µg/m³	Arsenic ng/m³	Nickel ng/m³	Benzene, µg/m³	Benzo[a]pyrene ng/m³
			Min	Max	Avg	98 %ile					
AAQ1	Project Site	BDL(<5)	0.20	0.56	0.38	0.54	BDL(<0.1)	BDL(<1)	BDL(<1)	BDL(<0.1)	BDL(<0.1)
AAQ2	VOC Nagar	BDL(<5)	0.17	0.48	0.30	0.46	BDL(<0.1)	BDL(<1)	BDL(<1)	BDL(<0.1)	BDL(<0.1)
AAQ3	TulsiKuppam	BDL(<5)	0.14	0.26	0.21	0.25	BDL(<0.1)	BDL(<1)	BDL(<1)	BDL(<0.1)	BDL(<0.1)
AAQ4	Athipattu	BDL(<5)	0.32	0.54	0.43	0.52	BDL(<0.1)	BDL(<1)	BDL(<1)	BDL(<0.1)	BDL(<0.1)
CPCB / MoEF Standards											
Industrial /Residential / Rural and Other Area		400	2				1	6	20	5	1

4.7.5 Observations

PM_{10}: The maximum and minimum concentrations of PM_{10} were recorded as 75µg/m^3 and 43µg/m^3 respectively. The maximum concentration was recorded at Athipattu and the minimum concentration was recorded at TulsiKuppam. The average concentrations were ranged between 59.4 and 73.8µg/m^3.

$PM_{2.5}$: The maximum and minimum concentrations for $PM_{2.5}$ were recorded as 40µg/m^3 and 24µg/m^3 respectively. The maximum concentration was recorded at the Athipattu and the minimum concentration was recorded at TulsiKuppam. The average values were observed to be in the range of 30.6 and 39.7µg/m3.

SO_2: The maximum and minimum SO_2 concentrations were recorded as 13.2µg/m3 and 6.9µg/m3. The maximum concentration was recorded at Athipattu and the minimum concentration was recorded TulsiKuppam. The average values were observed to be in the range of 7.8 and 11.1µg/m3.

NOx: The maximum and minimum NOx (oxides of nitrogen) concentrations were recorded as 22.8µg/m^3 and 13.3µg/m3. The maximum concentration was recorded at Athipattu and the minimum concentration was recorded at TulsiKuppam. The average values were observed to be in the range of 15.3 and 21.1µg/m3.

CO: The maximum and minimum CO concentrations were recorded as 0.56µg/m3 and 0.14µg/m3. The maximum concentration was recorded Ennore (project site) at and the minimum concentration was recorded at TulsiKuppam. The average values were observed to be in the range of 0.21 and 0.43µg/m3.

Ammonia,Lead& Benzene: The Lead level in and around the Project site are Below Detection Level BDL(<0.1).The Concentration of Ammonia is in the BDL (<5)

Arsenic & Nickel: The Lead level in and around the Project site are Below Detection Level BDL (<1).

4.8 Noise Environment

The main objective of monitoring of ambient noise levels was to establish the baseline noise levels in the surrounding areas and to assess the total noise level in the environment of the study area.

4.8.1 Identification of Sampling Locations

A preliminary reconnaissance survey was undertaken to identify the major noise sources in the area. The sampling location in the area was identified considering the location of industry, residential area, Highways and Institutional areas. The noise monitoring locations are presented in **Table 4.6 & Figure 4.6.** The photographs taken during the site visit is given as the **Figure 4.7**

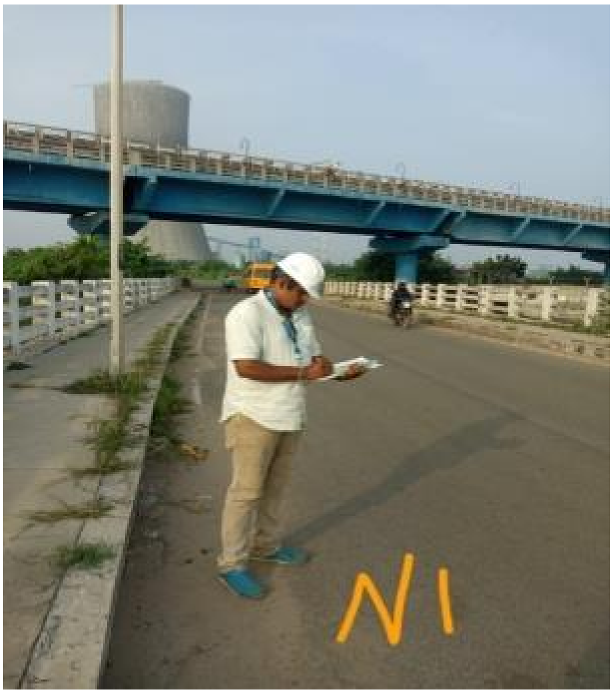
4.8.2 Instrument used for Sampling

Noise levels were measured using a Sound Level meter. The sound level meter measures the equivalent continuous noise level (Leq) by switching on the corresponding function mode.

Table 4.6-Noise Monitoring Locations

Sl.No	Sampling Location	Geographical Locations
1	N1(South Side)	13°13'32.89"N 80°19'15.33"E
2	N2 (Ennore Fly Over) Bridge Middle -1	13°13'39.89"N 80°19'10.38"E
3	N3 (Ennore Fly Over)Bridge Middle-2	13°13'49.28"N 80°19'5.66"E
4	N4 (North side)	13°13'56.62"N 80°19'4.22"E

Figure 4.6Noise Sampling Locations



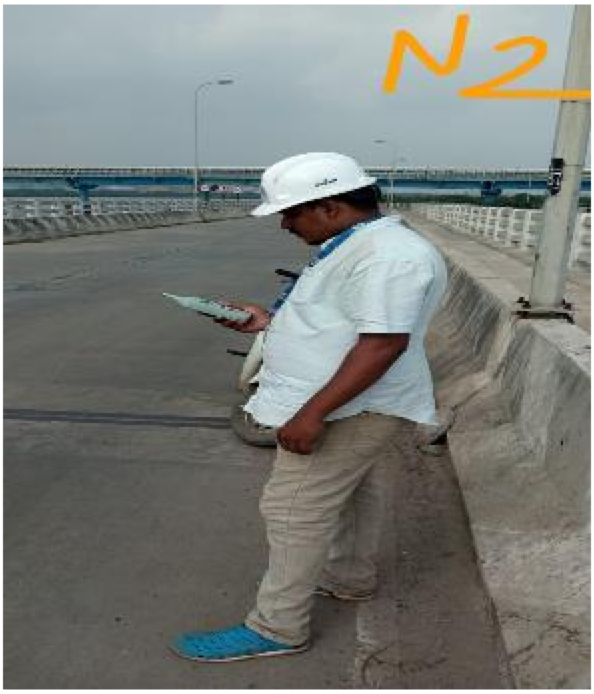


Figure 4.7 Photographs of Noise Monitoring

4.8.3 Method of Monitoring

Noise, in general, is sound which is composed of many frequency components of various types of loudness distributed over the audible frequency range. Various noise scales have been introduced to describe, in a single number, the response of an average human to a complex sound made up of various frequencies at different loudness levels. The most common and universally accepted scale is the 'A' weighted Scale which is measured as dB (A). This is more suitable for an audible range of 20 to 20,000 Hz. The scale has been designed to weigh various components of noise according to the response of a human ear.

Sound Pressure Level (SPL) measurements were measured at all locations. The readings were taken for every hour for 24 hours. The day noise levels have been monitored during 6 am to 10 pm and night levels during 10 pm to 6 am at all the locations covered in a 1.5-km radius of the study area. The noise levels were measured once during the study period. These readings were later tabulated and the frequency distribution table was prepared. Finally, hourly and 24 hourly values for various noise parameters viz. Lday and Lnight were calculated.

For noise levels measured over a given period of time, it is possible to describe important features of noise using statistical quantities. This is calculated using the percent of the time certain noise levels exceed the time interval. The notations for the statistical quantities of noise levels are described below:

- L_{10} is the noise level exceeded 10 percent of the time
- L_{50} is the noise level exceeded 50 percent of the time and
- L_{90} is the noise level exceeded 90 percent of the time

The Leq is the equivalent continuous sound level, which is equivalent to the same sound energy as the actual fluctuating sound measured in the same period. This is necessary because the sound from noise source often fluctuates widely during a given period of time.

This is calculated from the following equation:

$$\mathbf{Leq = L50 + (L_{10} - L_{90})^2/60}$$

Parameters Measured During Monitoring

For noise levels measured over a given period of the time interval, it is possible to describe important features of noise using statistical quantities. This is calculated using the percent of the time, certain noise levels are exceeded during the time interval. The notation for the statistical quantities of noise levels is described below:

Hourly

Leq day: Equivalent noise levels between 6.00 hours to 22.00 hours.

Leq night: Equivalent noise levels between 22.00 hours to 6.00 hours.

4.8.4 Results

The summary of computed ambient noise level parameters like L_{day} and L_{night} are presented in **Table 4.7** and compared to the standards specified by CPCB mentioned below in **Table 4.8**

Table 4.7-Ambient Noise Level

Location Code	Sampling Location	Leq day [dB(A)]	Leq Night [dB(A)]	Leq [dB(A)]
N1	Near Project Site (South Side)	58.6	47.6	57.0
N2	Bridge Middle -1	57.1	46.5	55.5
N3	Bridge Middle-2	57.8	47	56.2
N4	Near Project Site (North Side)	60.1	48.7	58.5

Table 4.8 Ambient Noise Quality Standards

Category of Area / Zone	Limits in dB (A) Leq	
	Day Time	Night Time
Industrial Area	75	70
Commercial Area	65	55
Residential Area	55	45
Silence Zone	50	40

Source: Central Pollution Control Board

Note: *Daytime shall mean from 6.00 a.m. to 10.00 p.m.*

Night time shall mean from 10.00 p.m. to 6.00 a.m.

4.8.5 Observations

Daytime Noise Levels

Noise levels during day time were found to be in the range 57.1 to 60.1 dB (A). The maximum noise level was observed to be 60.1 dB (A) at Near Project Site (North Side) and a minimum of 55.5dB (A) was observed at Bridge Middle-1.

Night time Noise Levels

Noise levels observed to fall in the range 46.5 to 48.7 dB (A) during the night time. A maximum of 48.7 dB (A) was observed at Near Project Site (North Side) and a minimum of 46.5 dB (A) was observed at Bridge Middle -1. Measured noise levels are observed to be in compliance with prescribed standards for ambient noise for the respective applicable categories.

4.9 Water Environment

Water sampling has been conducted to establish baseline water quality in the area. Water analysis was carried out for physical and chemical parameters as per the methods prescribed in Indian Standards and "Standard Methods for the Examination of Water and Wastewater (American Public Health Association Manual)".

4.9.1 Sampling Locations

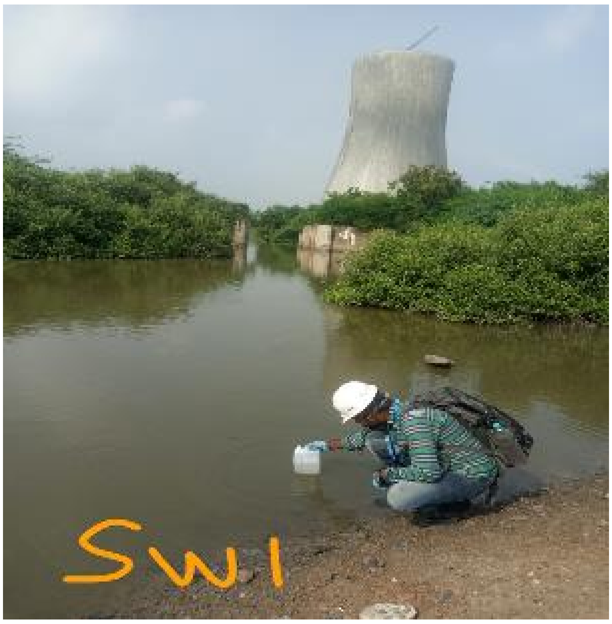
The details of the water sampling stations are presented in the **Table 4.9** and shown in **Figure 4.8**

Table 4.9- Water Quality Monitoring Locations

Sl.no	Sampling locations	Geographical location	Type of water
1	SW1	13°14'24.60"N 80°18'57.70"E	Surface Water
2	SW2	13°14'51.50"N 80°18'51.01"E	Surface Water
3	SW3	13°13'17.93"N 80°19'6.51"E	Surface water
4	GW1	13°13'29.82"N 80°19'17.73"E	Ground Water
5	GW2	13°13'43.72"N 80°19'33.16"E	Ground Water
6	GW3	13°13'34.16"N 80°19'30.54"E	Ground Water

.

Figure 4.8Ground Water & Surface Water Sampling Locations around Ennore Creek


SW1


SW2

Source: ABC Techno Labs Private Limited

Figure 4.9Photographs of Surface water and Ground water Collection

4.9.2 Results

The physicochemical characteristics of water in the study area are presented in the **Tables 4.10** and in **Table 4.11** and is compared with the standards (IS 10500:2012 Indian Standards/Specifications for Drinking Water) reference values.

Table 4.10-Ground Water Sampling Results

S. No	Parameters	Unit	Test Method	Limit as per IS 10500 : 2012	GW1	GW2	GW3
1	Colour	Hazen	IS 3025:1983 Part 4	5	<2	<2	<2
2	Odour	-	IS 3025:1984 Part 5	Agreeable	No Odour Observed	No Odour Observed	No Odour Observed
3	Taste	-	IS 3025:1984 Part 5	Disagreeable	Disagreeable	Disagreeable	Disagreeable
4	pH at 25°C	-	IS : 3025 Part 11- 1983 (Reaff:2017)	6.5-8.5	7.60	7.57	8.51
5	Electrical Conductivity,	µS/cm	IS : 3025 Part 14- 1984 (Reaff: 2019)	Not Specified	3080	6360	2750
6	Turbidity	NTU	IS : 3025 Part 10-1984 (Reaff: 2017)	1	1	1.3	1.6
7	Total Dissolved Solids	mg/l	IS : 3025 Part 16-1984 (Reaff: 2017)	500	1842	3945	1676
8	Total Suspended Solids	mg/l	IS : 3025 Part 17-1984 (Reaff: 2017)	Not Specified	<2	<2	<2
9	Total Hardness as CaCO3	mg/l	IS : 3025 Part 21-2009 (Reaff: 2019)	200	1000	1500	940
10	Total Alkalinity as CaCO3	mg/l	IS : 3025 Part 23-1986(Reaff:2019)	200	400	900	500
11	Chloride as Cl	mg/l	IS : 3025 Part 32-1988 (Reaff: 2019)	250	559	1478	320
12	Sulphate as SO_4	mg/l	APHA 23rd EDN -4500- SO_4^{2-} E	200	415	659	492
13	Fluoride as F	mg/l	APHA 23rd EDN -4500-F B&D	1.0	0.72	0.91	0.85
14	Nitrate as NO_3	mg/l	APHA 23rd EDN -4500-	45	11	2	7

S. No	Parameters	Unit	Test Method	Limit as per IS 10500 : 2012	GW1	GW2	GW3
			NO_3^- B				
15	Ammonia as N-NH3	mg/l	APHA 23rd EDN -4500-NH_3 B&C	0.5	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)
16	Sodium as Na	mg/l	IS : 3025 Part 45-1993 (Reaff:2019)	Not Specified	320	900	230
17	Potassium as K	mg/l	IS : 3025 Part 45-1993 (Reaff:2019)	Not Specified	12	23	14
18	Calcium as Ca	mg/l	IS : 3025 Part 40-1991 (Reaff:2019)	75	240	360	202
19	Magnesium as Mg	mg/l	APHA 23rd EDN Mg B	30	97	145	105
20	Iron as Fe	mg/l	APHA 23rd EDN -3111 B	1	0.16	0.11	BDL (<0.05)
21	Manganese as Mn	mg/l	APHA 23rd EDN -3111 B	0.1	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)
22	Phenolic compounds as Phenol	mg/l	APHA 23rd EDN 5530 B,C,D	0.001	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)
23	Copper as Cu	mg/l	APHA 23rd EDN -3111 B	0.05	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)
24	Mercury as Hg	mg/l	APHA 23rd EDN -3112B	0.001	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)
25	Cadmium as Cd	mg/l	APHA 23rd EDN -3111 B	0.003	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)
26	Selenium as Se	mg/l	APHA 23rd EDN -3113B	0.01	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
27	Total Arsenic as As	mg/l	APHA 23rd EDN -3113 B	0.01	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
28	Cyanide as CN	mg/l	APHA 23rd EDN -4500-CN E	0.05	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)
29	Lead as Pb	mg/l	APHA 23rd EDN -3111 B	0.01	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)

S. No	Parameters	Unit	Test Method	Limit as per IS 10500 : 2012	GW1	GW2	GW3
30	Zinc as Zn	mg/l	APHA 23rd EDN -3111 B	5	0.11	0.16	0.12
31	Total Chromium as Cr	mg/l	APHA 23rd EDN -3111 B	0.05	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
32	Nickel as Ni	mg/l	APHA 23rd EDN -3111 B	0.02	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
33	Aluminum as Al	mg/l	APHA 23rd EDN -3500-Al-B 2012	0.03	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)
34	Dissolve Oxygen as O2	mg/L	IS:3025:Part-38:1989 (Reaff:2019)	Not Specified	5.9	5.1	5.3
35	Bio-Chemical Oxygen Demand	mg/L	IS:3025:Part-44:1993 (Reaff:2019)	<2	<2	<2	<2
36	Chemical Oxygen Demand	mg/L	IS:3025:Part-58:2006 (Reaff:2017)	<4	<4	<4	<4
37	Total Coliforms	MPN/ 100ml	IS 1622 (1981) (Reaff – 2014)	Absent/100ml	<2	<2	<2
38	E coli	MPN/ 100ml	IS 1622 (1981)(Reaff – 2014)	Absent/100ml	<2	<2	<2

Table 4.11-Surface Water Sampling Results

S. N	Parameter	Unit	Test Method	Results		
				SW1	SW 2	SW 3
1	Temperature	°C	APHA 23rdEdn- 2550B	27.1	27.2	26.9
2	Colour	Hazen	IS:3025:Part-14:1984 (Reaff:2019)	1	7	10
3	Conductivity @25 °C	µS/cm	IS:3025:Part-14:1984 (Reaff:2019)	42900	39600	27500
4	Total Dissolved Solids	mg/L	IS:3025:Part-16:1984 (Reaff:2017)	25139	22825	16112
5	Salinity	g/kg	APHA 23rdEdn - Electrometric Method	2.9	22.6	15.9
6	pH	-	IS:3025:Part-11:1983 (Reaff:2017) Electrometric Method	8.17	7.68	7.96
7	Total Suspended Solids	mg/L	IS:3025:Part-17:1984 (Reaff:2017)	5	9	4
8	Turbidity	mg/L	IS:3025:Part-10:1984 (Reaff:2017)	3.9	3.3	2.6
9	Dissolve Oxygen as O2	mg/L	IS:3025:Part-38:1989 (Reaff:2019)	4.9	5.7	5.5
10	BOD	mg/L	IS:3025:Part-44:1993 (Reaff:2019)	<2	2	3.3
11	COD	mg/L	IS:3025:Part-58:2006 (Reaff:2017)	14	18	24
12	Nitrite as NO_2	mg/L	APHA 23rdEdn - 4500-NO_2-B.	0.08	0.15	0.12
13	Nitrate as NO_3	mg/L	APHA 23rdEdn 4500-NO3- B	2.33	9	10
14	Phosphate as PO_4	mg/L	IS:3025:Part-31:1988 (Reaff:2019)	0.14	0.20	0.26
15	Total Nitrogen as N	mg/L	IS:3025:Part-34:1988(Reaff:2019)	6	20	17
16	Ammonia as NH_3	mg/L	APHA 23rdEdn -4500- Norg B	0.13	1.1	2.2
17	Total Hardness as CaCO3	mg/l	IS : 3025 Part 21-2009 (Reaff: 2019)	4800	4400	3400
18	Total Alkalinity as CaCO3	mg/l	IS : 3025 Part 23- 1986(Reaff:2019)	240	300	500
19	Chloride as Cl	mg/L	IS : 3025 Part 32-1988 (Reaff: 2019)	13587	12692	8869

20	Sulphate as SO4	mg/L	APHA 23rd EDN -4500- SO_4^{2-} E	1710	1450	1237
21	Sodium as Na	mg/L	IS : 3025 Part 45-1993 (Reaff:2019)	8100	7100	4600
22	Potassium as K	mg/L	IS : 3025 Part 45-1993 (Reaff:2019)	280	196	112
23	Calcium as Ca	mg/L	IS : 3025 Part 40-1991 (Reaff:2019)	388	330	400
24	Magnesium as Mg	mg/L	APHA 23rd EDN Mg B	930	868	583
25	Arsenic as As	mg/L	APHA 23rd EDN -3113 B	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
26	Mercury as Hg	mg/L	APHA 23rd EDN -3112 B	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)
27	Iron as Fe	mg/L	APHA 23rdEdn-3111B	0. 10	0.11	0.32
28	Zinc as Zn	mg/L	APHA 23rdEdn-3111B	0.23	0.14	0.17
29	Manganese as Mn	mg/L	APHA 23rdEdn-3111B	BDL(<0.02)	0.06	0.05
30	Lead as Pb	mg/L	APHA 23rdEdn-3111B	0.10	0.02	0.07
31	Cadmium as Cd	mg/L	APHA 23rdEdn-3111B	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)
32	Nickel as Ni	mg/L	APHA 23rdEdn-3111B	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)
33	Copper as Cu	mg/L	APHA 23rdEdn-3111B	0.03	0.004	0.05
34	Chromium as Cr	mg/L	APHA 23rdEdn-3111B	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
35	Total Petroleum Hydrocarbon	mg/L	APHA 23rdEdn-6440 B	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)
Microbial Population in Water						
1	Total Coliform	MPN/ 100ML	APHA 23rdedn 9221	900	1100	1400
2	Faecal Coliform	MPN/ 100ML	APHA 23rdedn 9221	40	170	350

4.9.3 Observations

Ground Water

The analysis of groundwater results indicate that the average pH ranges in between 7.60 – 8.51, TDS ranges from 1676 - 3945 mg/l, Total Hardness ranges from 940 - 1500 mg/l, Iron content ranges from 0.11– 0.16 mg/l, Nitrate content ranges from 2- 11 mg/l was observed. The observed values are compared with drinking water standards (IS 10500: 2012); only the values of pH and Nitrate are coming under the acceptable limits and all other parameters like TDS, Total Hardness, and Iron contents are exceeding the acceptable limits. The higher concentration of Iron and TDS in ground water may be due to the seepage of fertilizers from the agriculture land and moreover iron and manganese are naturally occurring minerals in the subsurface data.

Surface Water

The analysis of Surface water results indicate that the average pH ranges in between 7.68 – 8.17, TDS ranges from 16112 - 25139 mg/l, Total Hardness ranges from 3400-4800 mg/l, DO ranges from 4.9 – 5.7 mg/l was observed. The observed values are compared with drinking water standards (IS 10500: 2012); only the value of pH is coming under the acceptable limits and all other parameters like TDS, Total Harnesses are exceeding the acceptable limits. The high concentration of TDS and total hardness is mainly due to the carrying of liquid and solid waste by the rain water. The Dissolved oxygen concentration in all the collected samples is more than 4 mg/l, the minimum oxygen concentration required for the sustaining life of several aquatic species.

4.10 Soil Environment

4.10.1 Soil analysis

The present study of the soil quality establishes the baseline characteristics and this will help in future in identifying the incremental concentrations if any, due to the operation of the proposed Project. The sampling locations have been identified with the following objectives;

- To determine the baseline soil characteristics of the study area and
- To determine the impact of proposed project on soil characteristics

Five locations within the study area were selected for soil sampling. At each location, soil samples were collected from three different depths viz., 30 cm, 60 cm and 100 cm below the surface. The samples were analyzed for physical and chemical characteristics. The details of the soil sampling location are presented in **Table 4.12 &Figure 4.10.**The results are given in **Table 4.13** and compared with Standard Soil Classification presented in **Table 4.14.**

Figure 4.10 Soil Sampling Locations around Ennore Creek

Source: ABC Techno Labs Private Limited

Figure 4.11Photographs taken during Collection of Soil Samples.

Table 4.12 Soil Monitoring Locations

Sl.No	Sampling location	Geographical Locations
1	S1Near Project Site (South Side)-1	13°13'55.07"N 80°19'3.01"E
2	S2Near Project Site (South Side)-2	13°13'54.04"N 80°19'4.45"E
3	S3Near Project Site (North Side) -1	13°13'33.50"N 80°19'13.78"E
4	S4Near Project Site (North Side)-2	13°13'35.33"N 80°19'13.82"E

4.10.2 Soil Results

Table 4.13 Soil Monitoring Results

S.No	Parameters	Test Method	S1	S2	S3	S4
1	pH (1:5 Soil Suspension)	IS -2720(Part 26) 1987(RA 2011)	8.56	8.36	8.49	8.52
2	Bulk Density, g/cc	FAO Chapter 3, ABCTL/SOIL/SOP 1	1.17	1.15	1.19	1.21
3	Electrical Conductivity, mS/cm (1:5 Soil Suspension)	IS -14767:2000 (RA 2010)	1.245	1.379	1.856	1.741
4	Total Nitrogen as N, kg/ha	IS -14684:1999, Reaff:2008	404	369	512	478
5	Available Phosphorous as P, kg/ha	FAO Chapter 3, ABCTL/SOIL/SOP 2	51.6	41.8	32.6	45.5
6	Available Potassium as K , kg/ha	FAO Chapter 3, ABCTL/SOIL/SOP 7	1050	960	870	1120
7	Exchangeable Calcium as Ca,m.eq/100g	FAO Chapter 3, ABCTL/SOIL/SOP 4	18.2	16.3	17	16.1
8	Exchangeable Magnesium as Mg, m.eq/100g	FAO Chapter 3, ABCTL/SOIL/SOP 5	7.78	7.69	8.22	7.96
9	Exchangeable Sodium as Na, m.eq/100g	FAO Chapter 3, ABCTL/SOIL/SOP 6	4.56	5.11	4.79	5.22
10	Organic matter (%)	IS 2720 (Part 22):1972, Reaff:2010	1.63	1.82	1.66	1.57
11	Texture Classification	Robinson Pipette Method	Clay	Clay	Clay	Clay
12	Sand (%)		27.1	22.8	25.7	28
13	Clay (%)		65.4	58.7	61.6	62.8
14	Silt (%)		7.5	18.5	12.7	9.2

4.10.3 Observation

- The soil results were compared with soil standards. It has been observed that the pH of the soil was ranging from 8.36 to 8.56 indicating the soils are basic in nature. The conductivity of the soil ranges from 1.245 to 1.856 mS/cm. Since the EC value is less than 2000 µS/cm, the soil is said to be Nonsaline in nature.
- The texture of the soil sample is predominantly clay. Soil organic content varied from 1.57 to 1.82 % which indicates the very low level of organic matter.
- The available nitrogen content ranges between 369 to 512 mg/kg in the locality and the value of phosphorus content varies between 32.6 to 45.5 mg/kg. This indicates that the soil has very high quantities of Nitrogen and Phosphorus.
- The potassium content varies from 870 to 1120 mg/kg which indicates that the soils have high quantities of potassium.

From the above observations, it was found that the soil in the Study area shows moderate fertility.

4.10.4 Geotechnical Test Report

The physical condition of the creek bed is analyzed to examine the possible impacts during pipe laying and operation /maintenance.

1. Scope of work
    - Conducting four soil investigations bore holes of 150mm diameter up to 10m depth below the creek bed level.
    - Conducting Standard Penetration Test (SPT) within borehole at every 1.0m depth interval up to borehole termination depth.
    - Collection of SPT soil Sample.
    - Collection of Water samples if groundwater table met within the investigation depth.
    - Natural Moisture Content of sediment (It is the ratio of the weight of the water to the weight of solids in a given mass of soil. Geotechnical studies done by Anna University and it is always represented as a percentage)
    - Chemical Analysis test on soil and water samples to analyze the different parameters and the concentration of heavy metal contents in it.

Geotechnical investigation carried out at a specific site provides location specific subsurface Engineering Characteristics. Geologically, the present site is located in a coastal region with sub surface consisting of sedimentary deposits. Detailed Study report describes the methodology adopted for drilling, Equipment used, Standard penetration tests, collection of Soil Samples and Ground water samples, results of Laboratory test is attached as **Annexure IX.**

Inferences from Geotechnical test

1. The deep dredging operation should not be carried out near the abatements of the existing bridge at both ends. Hence, sufficient precaution is to be taken to end the deep excavation well before approaching the abutment that is at a safe distance of about 10m to 20 m from the abutments.
2. The allowable safe bearing capacity at 6.0m depth is 60 kPa.

4.11Major Rivers Drains into Chennai Metropolitan Area (CMA)

The Chennai Basin comprises of the four Rivers namely: Araniar, Kosasthalaiyar, Coovum, and Adyar River. The Rivers originate from North to South on the Western side from the hills of altitude ranging from 100 m to 200 m and flows to the Bay of Bengal on the East to North-East. Chennai city is usually considered as a plain land surface with a gentle slope towards Bay of Bengal. The land elevation is within 10 m and the maximum elevated lands are located on the South-Western part of the City.

The Ennore Creek is situated between Kosasthalaiyar River (fresh water body) and the Bay of Bengal intercepted by the Buckingham Canal (tidal water body).

Kosasthalaiyar River, which has its origin near Kaveripakkam and has catchment area in North Arcot District, has a branch near Kesavaram Anicut and flows to the city as Cooum River and the main Kosasthalaiyar river flows to Poondi reservoir. Poondi Regulator was constructed in 1943. From Poondi reservoir, Kosasthalaiyar River flows through the Thiruvallur District, enters CMA, and joins the Sea at Ennore.

Buckingham Canal is a man-made canal, which was constructed during the year 1806. It originates at the place called Bedhakanjam in Andhra Pradesh and runs along the area very close to the east coast, enters CMA at Athipattu village, passes through the Chennai City and leaves CMA at Semmencheri village, and it finally connects to Ongur River at YedayanthittuKaliveli near Cheyyar. Its total length is 418 km and in CMA its length is 40km. It runs in the north south direction and connects all the major three rivers in CMA. It was dug for the purpose of navigation and transport of goods and also to accommodate flood. But within CMA for various reasons it now serves as flood accommodator only.

The project site is falling under Kosasthalaiyar River within the Ennore area. The site specific hydrogeology is well described in the page no: 53 of the ESIA report.

4.12 Biological Environment

An ecological survey was undertaken in the study area around 10 km radius to understand and establish the prevailing ecological baseline as input to impact assessment of proposed project on biological environment-species and habitat in surrounding areas. The published literatures of Botanical Survey of India (BSI) and Zoological Survey of India (ZSI), were reviewed. RED data book (BSI publication), IUCN threatened species list and available reference list about endemic and endangered plant species of the region were also referred while compiling the results from the study area. As per records and available recently published literature pertaining to the study area and current detailed study of project site, no threatened, endangered and rare species were observed from the study area.

Schedules of the Wildlife (Protection) Act, 1972 for wild animal species have been referred. No reserve forest, protected forest, turtle breeding ground, elephant and / or tiger reserve is within 10 km radius of the Project site. However the alignment of pipe line runs below the Ennore Creek for distribution purpose, an ecological survey was undertaken to understand the ecological baseline (species and habitats) of the nearby surrounding area and the detail are given below.

Methodology Adopted for the Study

Terrestrial investigations for flora and fauna records were collected by random field survey and a checklist was prepared. During field survey, discussions with the local people were carried-out and collected information related to local biodiversity in and around the creek. The ecological status of the study area has been assessed based on the following methodology:

- Primary field surveys to establish primary baseline of the study area;
- Compilation of secondary information available in published literatures.

- Site Verification and finalization in consultation with local inhabitants.
- Vegetation analysis through quadrate method using sampling plots of 20m x 20m.
  - ✓ 20m x 20m for tree species (record trees >20 cm in GBHOB /species);
  - ✓ 5m x 5m [four plots] was laid along diagonals wherein all the shrubs recorded.
  - ✓ 1m x 1m [five plots], one at the centre and four at one per quadrate was laid and herbs, grasses in five plots to be noted.

The stretch of Ennore Creek where conveying main has been proposed to be laid, does not have any significant impact on flora and fauna. Birds like Green Shank, Purple Moorhen, Barbet and Cormorant are spotted in North Chennai occasionally and some common birds like Coot, Egret and Kingfisher are always seen in the area during the study period. Mangroves, which are a part of marine ecosystem, serve as breeding, feeding and hiding places for fishes, crabs, oysters, prawns, etc. Apart from protecting the coastline from erosion, they control flood also. In our project area, 40-50m distance from project area fringes of mangroves are situated and it will be maintained properly without any negative impact on it during the construction time. The existing Flora and Fauna in the study area is mentioned in **table 4.14**

4.12.1 Flora

Field studies conducted to assess flora in the study area. On the basis of field studies and secondary sources, there are no rare, endangered, threatened /conservational plant species presented in the study area.

Some of the common plant species found in the study area are *Arecaceae, Tamarindusindica, Eucalyptus sp., Azadirachtaindica* etc.

- ➢ *Acacia arabica*
- ➢ *Bambusaarundinacea*
- ➢ *Pongamiapinnata*
- ➢ *Euphorbia hypericifolia L.*

4.12.2 Fauna

Field studies conducted to identify faunal species from the terrestrial, freshwater, and marine ecosystem during the survey.

Table 4.14-List of Fauna in the study area

Scientific Name	English Name/Local Name
Aves	
Quiliscontronix	Grey quail
Corvussplendens	House crow
Pycnonotusjokokus	White browed bulbul
Tchitrea paradise	Paradise flycatcher
Passer domisticus	House sparrow
Cinnyrisasiatica	Purple sunbird
Megalaimamerulinus	Indian cuckoo
Hierococysvarius	Common Hawk Cuckoo
Centropussinensis	Crow pheasant
Reptiles	
Ptyasmucosus	Rat snake
Nerodiapiscator	Fresh water snake
Naja	Cobra
Viperarusseli	Viper
Calotes versicolor	Garden lizard
Amphibian	
Rana hexadactyla	Frog
Rana tigrina	Bull frog
Mammals	
Funambulus Sp.	Squirrel
Rattusnorvegicus	Field mouse

4.12.3 Marine Ecology

The creek bed materials (sediment) in a significant amount will be dredged during the construction process. This dredged material is stored on land for a period and then replaced into the creek to cover the pipe and trench. So it is significant to analyze the riverbed material before the construction for the safe disposal of dredged material on land and its reuse as the refilling material.

a) Marine Sediment

The marine sediment samples (10 Nos.) were collected from Ennore Creek. The area comprises of brown or grey muddy like Sandy Sediment. The location and result of the sediment samples are given in **Table 4.15.** The sediment samples (5 Nos.) were collected from the eastern side of the Ennore Bridge and remaining 5 of samples was collected from the western side. During sampling time, a distance of 500m covered in eastern side as enough water was available in that area (adjacent to the Bay of Bengal).

But in western side, water level was very low so only upon a distance of 200 m were considered for the collection of samples.

Figure 4.12Marine Sampling Locations

Sediments Sampling in Ennore creek

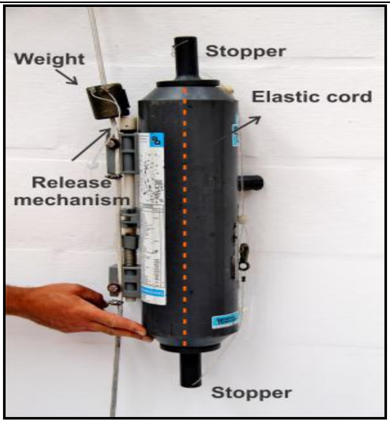
The Van Veen grab sampler was used for the collecting sediments samples. This device simply grabs a sample of the topmost layers of the waterbed by bringing two steel clamshells together and cutting a bite from the soil. The grab sampler comprises two steel clamshells acting on a single or double pivot. The shells are brought together either by a powerful spring (the Shipek type) operated from the support vessel.

The Van Veen grabs operate in the same way. At the surface, the jaws are opened and fixed into position using a catch. The Van Veen grab must be lowered slowly and steadily to prevent the catch from being released too early (difficult on a boat that is moving about in rough water). Sediment residues on the outside of a closed (and empty)

Van Veen grab indicate that the sampler was closed too early. There are holes in the jaws so that air can escape while the sampler is being lowered and water can escape while the sample is being taken. As soon as the jaws make contact with the bottom the catch is released. When the grab is raised on the cable, the jaws close automatically due to the lever effect of the rods. The quantity of sample that is taken mainly depends upon the compactness of the soil. A heavier grab takes a larger sample than a light one. Therefore all versions are equipped with weights. The cable also has a weight to reduce the deviation from the vertical in stronger currents.

Marine Water Samples Collection

Niskin water sampler was used for the collecting the marine samples. A Niskin bottle is a plastic cylinder with stoppers at each end in order to seal the bottle completely. This device is used to take water samples at a desired depth without the danger of mixing with water from other depths. The two stoppers at each end of the Niskin bottle, are held open by plastic cords attached to a release mechanism. In addition, the stoppers are connected by an elastic cord at the inside of the bottle. Attached to a cable, the open bottle(s) are lowered to a discreet depth in the water. When a small weight encircling the hydrographic line is released down the line, it strikes the release mechanism resulting in the two stoppers being pulled into the ends of the cylinder. As a result the water from that depth is trapped inside the Niskin bottle. When the Niskin bottles are grouped in a rosette, distinct weights can strike each individual reease mechanism on the carrousel. In this way, water samples are collected from various water depths.



Van Veen grab sampler and Niskin sampler

Water and Sediment Sampling

Water samples were collected and transferred to clean polypropylene and glass containers. Sediment samples were collected in clean polythene bags and transported to the laboratory. The samples were air-dried. The plant root and other debris were removed and stored for further analysis.

Preservation and Laboratory Analysis

After collection, all samples were immediately cooled to 4°C and then brought to the laboratory in an insulated thermocool box. In the laboratory, water samples were filtered using Whatmann filter paper and analyzed for organic matter and all other nutrients. Water samples collected for dissolved oxygen estimation were transferred carefully to BOD bottles. The DO was immediately fixed and these were brought to the laboratory for further analysis.

Figure 4.13 Monitoring team collecting water samples and sediments from the Creek.

Table 4.15-Marine Sediments Analysis results

S.N	Parameter	Unit	Results					Test Procedure
			ECR 1	ECR 2	ECR 3	ECR 4	ECR 5	
1	pH	-	7.67	7.60	7.48	7.84	7.40	IS 2720 (Part 26):1987
2	Manganese as Mn	mg/kg	61.8	37.2	152	132	181	USEPA 3050B & USEPA 7000B
3	Nickel as Ni	mg/kg	6.17	5.11	14	16.1	18.5	
4	Iron as Fe	%	0.67	0.15	1.21	1.42	1.74	
5	Cadmium as Cd	mg/kg	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	
6	Magnesium as Mg	mg/kg	4820	5012	4625	5274	6210	
7	Chromium as Cr	mg/kg	15.4	9.88	21.9	27.8	32.1	
8	Copper as Cu	mg/kg	34.8	25.6	32.2	42.6	28.6	
9	Zinc as Zn	mg/kg	112	92	114	85	148	
10	Lead as Pb	mg/kg	9.58	12.7	15.6	18.4	21.1	
11	Mercury as Hg	mg/kg	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	USEPA 3050B & USEPA 7471B
12	Inorganic Phosphorous as P	mg/kg	240	144	479	285	395	FAO Chapter 3/ ABCTL/SOIL SOP 2
13	Total Phosphorous as P	mg/kg	362	253	680	411	612	EPA 365.1
14	Ammoniacal Nitrogen as N	mg/kg	162	183	207	194	231	APHA 22ND EDN 4500 N-NH_3-B&C
15	Total Nitrogen as N	mg/kg	908	670	1462	761	1163	IS 14684
16	Texture	mg/kg	Sand	Sand	Clay	Clay	Clay	Robinson Pipette Method

S. No	Parameter	Unit	Results					Test Procedure
			ECR 6	ECR 7	ECR 8	ECR 9	ECR 10	
1	pH	-	7.52	7.30	7.32	7.27	7.45	IS 2720 (Part 26):1987
2	Manganese as Mn	mg/kg	130	136	48	166	126	USEPA 3050B & USEPA 7000B
3	Nickel as Ni	mg/kg	15.9	19.4	8.91	25.9	24.1	

4	Iron as Fe	%	1.40	1.54	0.65	2.53	1.87	
5	Cadmium as Cd	mg/kg	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	
6	Magnesium as Mg	mg/kg	5741	4913	6174	5234	6541	
7	Chromium as Cr	mg/kg	22.9	29.8	10.9	50	49	
8	Copper as Cu	mg/kg	31.1	51.6	27.4	40.9	52.8	
9	Zinc as Zn	mg/kg	163	95	130	163	124	
10	Lead as Pb	mg/kg	17.1	21	10.4	26.6	31	
11	Mercury as Hg	mg/kg	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	USEPA 3050B & USEPA 7471B
12	Inorganic Phosphorous as P	mg/kg	473	115	634	1074	745	FAO Chapter 3/ ABCTL/SOIL SOP 2
13	Total Phosphorous as P	mg/kg	538	247	827	1374	871	EPA 365.1
14	Ammoniacal Nitrogen as N	mg/kg	171	144	193	168	283	APHA 22ND EDN 4500 N-NH3-B&C
15	Total Nitrogen as N	mg/kg	1064	1018	1091	795	1900	IS 14684
16	Texture	mg/kg	Clay	Clay	Clay	Clay	Clay	Robinson Pipette Method

USEPA guidelines for sediment screening quality

Metals	**Lowest effect level (mg/kg, dry weight)**	**Severe Effect level, SEL (mg/kg, dry weight)**
Cadmium	0.6	10
Chromium	26	110
Copper	16	110
Lead	31	250
Mercury	0.2	2
Nickel	16	75

4.12.4 Results and Discussion

The pH indicates that the marine sediment in the study areas is basic in nature, with the pH varying in the range of 7.30 to 7.84. The Iron was observed in the range of 0.150 - 2.53 %.The Total Nitrogen values are in the range of 670 – 1900 mg/kg indicating that soils have very high Nitrogen levels. The Total Phosphorous values are in the range of 253 – 1374 mg/kg indicating that soil sediment has an average Phosphorous level. The results of monitoring of basic parameters and metal contents in the sediment samples indicate no harmful concentration in any of the samples including the mercury concentration. Water species are at potential risk if site-related sediment concentrations of heavy metals like mercury, cadmium, zinc, chromium are at or above the Severe Effect Level, SEL. All the samples collected from the creek compared with sediment quality analysis guidelines of USEPA and all the readings coming under the stipulated values of USEPA.

b) Creek Water

The results of Ennore Creek water samples are given in **Table 4.16.**

Table 4.16-Creek Water Sample Results

S.N	Parameters	Unit	Test method	ECR1 Surface	ECR1 Bottom	ECR2 Surface	ECR2 Bottom	ECR3 Surface	ECR3 Bottom
1	Temperature	°C	APHA 22ND EDITION	27.5	26.8	28.5	26.2	28.5	26.3
3	Turbidity	NTU	IS : 3025 Part 10-1984 (Reaff: 2012)	5.4	7.2	2.6	3.1	5.5	3.3
3	pH at 25°C	-	IS : 3025 Part 11- 1983 (Reaff: 2012)	7.42	7.63	7.47	7.95	7.46	7.58
4	Electrical Conductivity,	µS/cm	IS : 3025 Part 14- 1984 (Reaff: 2013)	27190	38960	37120	53100	34800	44100
5	Salinity	%	APHA 22nd EDITION-2520B	15.8	22.7	21.7	32.1	20.3	25.8
6	Total Dissolved Solids	mg/l	IS : 3025 Part 16-1984 (Reaff: 2012)	16043	22990	21904	32213	20538	26045
7	Chloride as Cl	mg/l	IS : 3025 Part 32-1988 (Reaff: 2014)	8636	13286	12010	17654	11321	14244
8	Sulphate as SO_4	mg/l	APHA 22ND EDITION -4500-SO_4^{2-} E	1303	1513	1330	2128	1174	1629
9	Nitrate as NO_3	mg/l	APHA 22ND EDITION -4500-NO_3^- B	2	1	2.3	1	4.6	1.56
10	Ammonia as NH_3	mg/l	APHA 22ND EDITION -4500-NH_3 B&C	8	7.8	2.33	5	4.47	1.66
11	Total Phosphate as PO_4	mg/l	IS : 3025 Part 31-1988 (Reaff:2014)	1.23	2.38	2.06	0.26	1.22	10
12	Sodium as Na	mg/l	IS : 3025 Part 45-1993 (Reaff:2014)	4870	6280	6820	10100	6540	7920
13	Potassium as	mg/l	IS : 3025 Part 45-1993	110	380	400	515	388	440

	K		(Reaff:2014)						
14	Calcium as Ca	mg/l	IS : 3025 Part 40-1991 (Reaff:2014)	321	320	280	440	254	360
15	Magnesium as Mg	mg/l	APHA 22ND EDITION	681	960	864	1176	611	1152
16	Iron as Fe	mg/l	IS : 3025 Part 53-2003	0.42	0.52	0.19	0.29	0.124	0.10
17	Manganese as Mn	mg/l	APHA 22nd EDN -3500-Mn D	0.09	BDL(<0.02)	0.02	0.05	0.04	0.09
18	Copper as Cu	mg/l	IS:3025 Part 42 (Reaff:2003)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)
19	Mercury as Hg	mg/l	APHA 22nd EDN -3112B	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)
20	Cadmium as Cd	mg/l	APHA 22nd EDN -3113 B	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)
21	Selenium as Se	mg/l	APHA 22nd EDN -3113B	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
22	Total Arsenic as As	mg/l	APHA 22nd EDN -3113 B	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
23	Cyanide as CN	mg/l	APHA 22nd EDN -4500-CN E	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)
24	Lead as Pb	mg/l	APHA 22nd EDN -3113 B	0.14	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
25	Zinc as Zn	mg/l	APHA 22nd EDN -3111 B	0.37	0.31	0.28	0.28	0.44	0.44
26	Total Chromium as Cr	mg/l	APHA 22nd EDN -3113 B	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)
27	Nickel as Ni	mg/l	APHA 22nd EDN -3113 B	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)
28	Total Kjeldahl Nitrogen as N	mg/l	APHA 22nd EDN, 4500-Norg	10	10.6	16	8	19	11.7
29	Total Suspended	mg/l	IS : 3025 Part 17-1984 (Reaff: 2012)	16	56	34	44	40	26

	Solids								
30	Dissolved Oxygen as O_2	mg/l	IS:3025:Part-38:1989 (Reaff:2014)	5.4	4.7	6.1	4.9	5.2	5.4
31	Chemical Oxygen Demand	mg/l	IS:3025:Part-58:2006(Reaff:2012)	24	16	14	20	24	18
32	Bio-Chemical Oxygen Demandat 27°C for 3 days	mg/l	IS:3025:Part-44:1993 (Reaff:2014)	2.8	<2	<2	2	2.5	<2
33	Oil and Grease	mg/l	IS:3025:Part-39:1991 -Reaff:2014)	<4	<4	<4	<4	<4	<4
34	Total Coliforms	MPN/100ml	IS 1622 (1981) -Reaff – 2014	130	90	110	170	240	50
35	E coli	MPN/100ml	IS 1622 (1981)-Reaff – 2014	14	2	4	21	60	2

S.N	Parameters	Unit	Test method	ECR4 Surface	ECR4 Bottom	ECR5 Surface	ECR5 Bottom	ECR6 Surface	ECR6 Bottom
1	Temperature	°C	APHA 22ND EDITION	28.6	27.4	27.8	27.1	28.4	26.5
3	Turbidity	NTU	IS : 3025 Part 10-1984 (Reaff: 2012)	5	7.3	5.4	6.3	4.2	6.9
3	pH at 25°C	-	IS : 3025 Part 11- 1983 (Reaff: 2012)	7.37	7.40	7.82	7.44	7.64	7.60
4	Electrical Conductivity,	µS/cm	IS : 3025 Part 14- 1984 (Reaff: 2013)	18340	32600	21500	28650	22800	24160
5	Salinity	%	APHA 22nd EDITION-2520B	10.4	19	12.5	16.7	13.3	14
6	Total Dissolved Solids	mg/l	IS : 3025 Part 16-1984 (Reaff: 2012)	10638	19290	12640	16905	13487	14190

7	Chloride as Cl	mg/l	IS : 3025 Part 32-1988 (Reaff: 2014)	5813	10670	6055	9330	7542	7941
8	Sulphate as SO_4	mg/l	APHA 22ND EDITION - 4500- SO_4^{2-} E	546	1400	903	1354	967	1161
9	Nitrate as NO_3	mg/l	APHA 22ND EDITION - 4500- NO_3^- B	5	1.3	1	3.4	3.2	2.4
10	Ammonia as NH_3	mg/l	APHA 22ND EDITION - 4500- NH_3 B&C	17	11	10	0.81	1	1.1
11	Phosphate as PO_4	mg/l	IS : 3025 Part 31-1988 (Reaff:2014)	1.12	4.35	1.98	0.42	0.47	0.22
12	Sodium as Na	mg/l	IS : 3025 Part 45-1993 (Reaff:2014)	3120	5560	3040	4620	3780	3880
13	Potassium as K	mg/l	IS : 3025 Part 45-1993 (Reaff:2014)	160	360	220	270	220	230
14	Calcium as Ca	mg/l	IS : 3025 Part 40-1991 (Reaff:2014)	230	280	237	246	240	240
15	Magnesium as Mg	mg/l	APHA 22ND EDITION	504	720	729	826	437	535
16	Iron as Fe	mg/l	IS : 3025 Part 53-2003	0.12	0.33	0.10	0.08	0.21	0.121
17	Manganese as Mn	mg/l	APHA 22nd EDN -3500-Mn D	BDL(<0.02)	0.05	0.03	0.03	0.02	BDL(<0.02)
18	Copper as Cu	mg/l	IS:3025 Part 42 (Reaff:2003)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)
19	Mercury as Hg	mg/l	APHA 22nd EDN -3112B	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)
20	Cadmium as Cd	mg/l	APHA 22nd EDN -3113 B	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)
21	Selenium as Se	mg/l	APHA 22nd EDN -3113B	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
22	Total Arsenic as As	mg/l	APHA 22nd EDN -3113 B	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
23	Cyanide as CN	mg/l	APHA 22nd EDN -4500-CN	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)	BDL(<0.05	BDL(<0.0

			E					)	5)
24	Lead as Pb	mg/l	APHA 22nd EDN -3113 B	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.0 1)
25	Zinc as Zn	mg/l	APHA 22nd EDN -3111 B	0.28	0.62	0.35	0.28	0.29	0.25
26	Total Chromium as Cr	mg/l	APHA 22nd EDN -3113 B	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.0 3)
27	Nickel as Ni	mg/l	APHA 22nd EDN -3113 B	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)	BDL(<0.0 2)
28	Total Kjeldahl Nitrogen as N	mg/l	APHA 22nd EDN, 4500-Norg	19	14	13	1.8	6.87	2.2
29	Total Suspended Solids	mg/l	IS : 3025 Part 17-1984 (Reaff: 2012)	28	54	7	10	11	16
30	Dissolved Oxygen as O_2	mg/l	IS:3025:Part-38:1989 (Reaff:2014)	5.2	4.6	5.8	4.8	5.7	5
31	Chemical Oxygen Demand	mg/l	IS:3025:Part-58:2006(Reaff:2012)	24	30	15	17	20	22
32	Bio-Chemical Oxygen Demand at 27°C for 3 days	mg/l	IS:3025:Part-44:1993 (Reaff:2014)	3.1	4.1	<2	2.2	2.2	2.5
33	Oil and Grease	mg/l	IS:3025:Part-39:1991 - Reaff:2014)	<4	<4	<4	<4	<4	<4
34	Total Coliforms	MPN/ 100ml	IS 1622 (1981) -Reaff – 2014	170	350	110	50	130	70
35	E coli	MPN/ 100ml	IS 1622 (1981)-Reaff – 2014	23	50	14	4	11	8

S. No	Parameters	Unit	Test method	ECR7 Surface	ECR7 Bottom	ECR8 Surface	ECR8 Bottom	ECR9 Surface	ECR9 Bottom	ECR10 Surface	ECR10 Bottom
1	Temperature	°C	APHA 22ND EDITION	28.6	27.2	27.8	26.9	28.1	27	27.5	27
3	Turbidity	NTU	IS : 3025 Part 10-1984 (Reaff: 2012)	4.7	5.5	5.5	7.2	4.2	6.3	4.4	5.5
3	pH at 25°C	-	IS : 3025 Part 11-1983 (Reaff: 2012)	7.80	7.77	7.70	7.75	7.29	7.18	7.50	7.51
4	Electrical Conductivity,	µS/cm	IS : 3025 Part 14-1984 (Reaff: 2013)	26480	26140	26560	25700	29210	33120	25930	26100
5	Salinity	%	APHA 22nd EDITION-2520B	15.5	15.2	15.4	14.7	17	19.3	15.4	15.7
6	Total Dissolved Solids	mg/l	IS : 3025 Part 16-1984 (Reaff: 2012)	15625	15424	15672	14914	17234	19544	15504	15984
7	Chloride as Cl	mg/l	IS : 3025 Part 32-1988 (Reaff: 2014)	8338	8300	8397	8048	9456	10697	8147	8048
8	Sulphate as SO_4	mg/l	APHA 22ND EDITION -4500-SO_4^{2-} E	1277	1386	1055	907	1370	1687	1145	1244
9	Nitrate as NO_3	mg/l	APHA 22ND EDITION -4500-NO_3^- B	1.9	2.2	1.1	2.1	3.6	2.3	1.82	1.75
10	Ammonia as NH_3	mg/l	APHA 22ND EDITION -4500-NH_3 B&C	1	1.3	12	2	14	21	18	20
11	Phosphate as PO_4	mg/l	IS : 3025 Part 31-1988 (Reaff:2014)	0.07	0.66	0.56	0.42	1.45	1.38	1.72	1.68
12	Sodium as Na	mg/l	IS : 3025 Part 45-1993 (Reaff:2014)	4880	4540	5050	4750	5100	5700	4750	4820
13	Potassium as K	mg/l	IS : 3025 Part 45-1993 (Reaff:2014)	250	260	280	240	230	270	210	220
14	Calcium as Ca	mg/l	IS : 3025 Part 40-	240	255	220	200	241	264	300	280

			1991 (Reaff:2014)								
15	Magnesium as Mg	mg/l	APHA 22ND EDITION	437	483	468	564	584	643	600	600
16	Iron as Fe	mg/l	IS : 3025 Part 53-2003	0.11	0.18	1.04	1.46	1.41	1.36	0.82	0.93
17	Manganese as Mn	mg/l	APHA 22nd EDN - 3500-Mn D	BDL(<0.02)	BDL(<0.02)	0.094	0.02	0.214	0.185	0.23	0.181
18	Copper as Cu	mg/l	IS:3025 Part 42 (Reaff:2003)	BDL(<0.03)	BDL(<0.03)	0.06	0.03	0.16	0.18	0.11	0.14
19	Mercury as Hg	mg/l	APHA 22nd EDN - 3112B	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)
20	Cadmium as Cd	mg/l	APHA 22nd EDN - 3113 B	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)
21	Selenium as Se	mg/l	APHA 22nd EDN - 3113B	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
22	Total Arsenic as As	mg/l	APHA 22nd EDN - 3113 B	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
23	Cyanide as CN	mg/l	APHA 22nd EDN - 4500-CN E	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)
24	Lead as Pb	mg/l	APHA 22nd EDN - 3113 B	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	0.10	BDL(<0.01)
25	Zinc as Zn	mg/l	APHA 22nd EDN - 3111 B	0.24	0.32	0.63	0.52	0.93	0.74	0.57	0.42
26	Total Chromium as Cr	mg/l	APHA 22nd EDN - 3113 B	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)
27	Nickel as Ni	mg/l	APHA 22nd EDN - 3113 B	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)
28	Total Kjeldahl Nitrogen as N	mg/l	APHA 22nd EDN, 4500 - Norg	1.5	2.6	15	26	27	26	21	24
29	Total Suspended Solids	mg/l	IS : 3025 Part 17-1984 (Reaff: 2012)	8	10	59	96	50	44	22	30
30	Dissolved	mg/l	IS:3025:Part-38:1989	6.1	5.4	4.9	4.1	4.5	4.1	4.9	4.2

	Oxygen as O_2		(Reaff:2014)								
31	Chemical Oxygen Demand	mg/l	IS:3025:Part-58:2006(Reaff:2012)	16	18	40	44	38	34	26	32
32	Bio-Chemical Oxygen Demandat 27°C for 3 days	mg/l	IS:3025:Part-44:1993 (Reaff:2014)	<2	<2	5.6	5.9	5	4.3	3.4	4.2
33	Oil and Grease	mg/l	IS:3025:Part-39:1991 -Reaff:2014)	<4	<4	<4	<4	<4	<4	<4	<4
34	Total Coliforms	MPN/ 100ml	IS 1622 (1981) -Reaff – 2014	140	170	500	900	350	500	50	90
35	E coli	MPN/ 100ml	IS 1622 (1981)-Reaff – 2014	14	23	60	110	50	80	8	23

Source: ABC Techno Labs Private Limit

4.12.5 Results and Discussion

The water samples were collected from the creek to identify any heavy metals present in the water and their level of concentration. The samples were collected from the surface and from the bottom of the creek and analyzed for the all basic parameters. The pH of the samples collected from the surface varies of 7.29 to 7.82 and the pH of the bottom samples varies of 7.18 to 7.95.The concentration of iron was observed in the range 0.11to 1.41 in the surface samples and the concentration varies from 0.08 to 1.46 for the samples collected from the bottom of the creek. The percentage of salinity varies between 10.4 to 21.7% in the surface samples and 14 to 32.1 % in the bottom samples. The concentration of heavy metals (mercury, arsenic, selenium lead, cadmium) is in below detectable limit in almost all the samples collected from the Creek.

The observed values are compared with drinking water standards and water quality standards for coastal waters. The observed range of pH is conducive for propagation of aquatic species and restoring natural system. The Dissolved oxygen concentration in all the collected samples is more than 4 mg/l, the minimum oxygen concentration required for the sustaining life of several aquatic species. All the collected samples are relatively free from heavy metals like mercury, lead, cadmium and arsenic during the study period.

c.) Biological Data

The biological parameters considered for the present study were Phytoplankton, Zooplankton and Benthos. The first two reflect the productivity of a water column at the primary and secondary levels. Benthic organisms being sedentary animals associated with sediment/rocky beds, provide information on the integrated effects of stress, if any, and hence are good indicators of early warning of potential damage.

a) Phytoplankton

Samples were collected from two locations. One at Ennore Creek mouth and another at Northern part of the North break water. Plankton samples were collected by using Plankton net of 20 cm. The diameter of the mouth of net is 40 cm and length is 100 cm. The speed of net towed was restricted to <5 knots. The collected sample was filtered through net and was stored in sterile bottle, after preserving the same with the addition of Lugol solution.

The volume of water was determined by using following formula:

$$V = r^2.d$$

Where:

V = Volume of water filtered through net.

r = Radius at the mouth of the net.

d = Distance through which the net towed.

The collected samples

The diversity of plankton species was evaluated by the most widely used Shannon Diversity Index. The formula for the calculation of the Shannon diversity index is given below:

$$H = -\sum_{i=1}^{i=s}(Pi * \ln Pi)$$

Where:

H = the Shannon diversity index

P, = fraction of the entire population made up of species

i = number of species encountered

Σ = sum from species `1' to species‘s’

The list of Phytoplankton species identified and its diversity and density are given in **Table 4.17.** It can be inferred from the table that the diversity of phytoplankton species at sampling ECR 8 was minimum and the highest diversity was observed at ECR 2. The density ranges from 5300 – 7100 c/m^3.

Table 4.17 -Diversity and Density of Phytoplankton in Project site

S. No	Parameter	Unit	Results										Test Procedure
			ECR 1	ECR2	ECR3	ECR4	ECR5	ECR 6	ECR 7	ECR 8	ECR 9	ECR10	
	Marine Ecology :												
1	Phytoplankton: (16 genus present in the marine water samples *Trichodesmiumerythraeum, Cosmarium, Microasterias, Spirogyra, Coscinodiscus, Chaetoceros.socialis, Hemidiscus,Dinophysissp,Skeletonemacostatum,Thalassiothrix sp. Anabena sp. Rhizosoleniaalata,Ceratiumtripos,Thalassiosirasp, Coscinodiscussp, C. massiliensis*)	c/m³	5600	7100	6500	6100	6400	5900	5400	5300	6000	6400	APHA 23RD EDN

b) Zooplankton

Sample collection was carried out in the similar method as that of the Phytoplankton. The result of the zooplankton analysis is tabulated in **Table 4.18.** The least biodiversity(DiversityIndexDI—1) was observed at sampling location ECR3 and the highest biodiversity was observed at ECR5.The density was in the range of 5400 – 7000 c/l. Locations of marine samplings are shown in the **Figure 4.12.**

Table 4.18 -Diversity and Density of Zooplankton in Project site

S. N	Parameter	Unit	Results										Test Procedure
			ECR 1	ECR 2	ECR 3	ECR 4	ECR 5	ECR 6	ECR 7	ECR 8	ECR 9	ECR 10	
	Marine Ecology :												
1	Zooplankton: (9 Genus present in the marine water samples *Coelenterata,Chaetognatha,Copepoda,Protochordata,Pteropoda,Annelida,Decapoda,Protozoa, Ostracoda*)	c/l	5800	6200	5400	6000	7000	6500	6300	5900	6000	6700	APHA 23RD EDN

c) Benthics

The lists of Benthics in the Project site are given in **Table 4.19.**

Table 4.19 -List of Benthic Species in the Project site

Sl. N	Parameter	Unit	Results										Test Procedure
	Marine Ecology - Benthics:												
	Macrobenthos		**ECR 1**	**ECR 2**	**ECR 3**	**ECR 4**	**ECR 5**	**ECR 6**	**ECR 7**	**ECR 8**	**ECR 9**	**ECR10**	
1	Foraminifera, Bivalves, Fish eggs, Ampharetide, Pilargidae, Onuphidae, Sabellidae, Capitellidae, Spionidae&polycheates Larvae	Nos/M^2	98	87	90	78	93	89	74	68	87	92	**APHA 23RD EDN**
	Meiobenthos												
2	Nematoda, Copepoda, Amphipods, Diatom, Gastrotrich, Pseudocella, Enopluils, Oncholaimu, Laimella&Comesoma	Nos/M^2	63	71	89	74	63	78	87	83	94	72	APHA 23RD EDN

In freshwater biology, benthos refers to the organisms found at the bottom of freshwater bodies of water, such as lakes, Rivers, and streams. These are the organisms which live on, in, or near the benthic zone. Most organisms in the benthic zone are scavengers or detritivores. Different types of Zoobenthos and Phytobenthos exist in the aquatic part of the study area. Benthic macrofauna is a good indicator of the variability of environmental conditions. The species richness/ abundance depend on variety of factors like temperature variation, high nutrients and the water level of the Creek. In the present study, species of meiobenthic fauna were recorded in Ennore coastal waters. Of these, foraminiferans topped the list among thespecies. Nematodes were found to be the next dominant group in the order of abundance among species. Among the groups, foraminiferans were found to be the dominant group followed by nematodes, harpacticoids and ostracodes. Among the foraminiferans, Astrorotalia inflate, Diffusilina sp., Leptohalysis scotti, Loxostoma perrectum, Rotalia translucens were found to occur in all the stations. With respect to nematodes, Gonionchus sp.,Greeffiella sp., Pselionema sp. Spirinia sp. Stephanolaimus sp. Synonchus sp. were found to be the common species in the samples collected in various stations. Coming to ostracodes, Basslerites liebaui, Diasterope schmitti and harpacticoids, Heterotanais oerstedi, Apseudes setosus were found to be the common species in the collection.The nearby our project site during the study time species abundance was less, this may be due to thefluctuation of flow.

These invertebrates play several important roles in aquatic ecosystem of the Ennore Creek. They are instrumental in cleaning excess living and nonliving organic material from water column. Water quality degradation of the Creek due to any reasons, adversely impacts the health of these aquatic communities including fish and invertebrates. So that these above listed benthic invertebrate communities of the Creek are valuable indicators of water quality monitoring in future.

4.13 Fishes in Ennore Creek

Fishing is the one of the major activities in the Ennore Creek up to the area of Ennore Railway Bridge. The local fisher folk use catamaran and canoes for fishing. Previously, fishermen used this area for fishing craft parking. Near the Railway Bridge oysters are abundant and hence shell fishing is one of the main sources of income to the local fishermen. Fishermen previously used Ennore Creek as a passage to sea with their mechanized country boat and catamaran. At present, only catamaran is used with the shallow depths available due to mouth closure. The January and February is the spawning seasons for the many of the species of fish inhabit in the Ennore Creek and and most of the fishes spend the early stages of life cycle in the riverbed mangroves situated at the 40-50 m distance from the project site. So no disturbances occurs to the spawning of fishes due to project activity. As the dredging process is carrying out avoiding these period, no effect of dredging on the species is anticipated. As the proposed work is doing in the 2 stages, the movement of vessels in the Creek won't effect. During the Construction in the first part, the boats and other vessels will get access to the Creek, through the area proposed for the second phase and vice versa.

Table 4.20List of fishes inhabiting in the Ennore Creek

Sl.No	Species Name	Other name
1.	*Euthynnusaffinis*	Little Tuna
2.	*Sardinellagibbosa*	Sardines
3.	*Decapterusrusselli*	Russell's Scad
4.	*Rastrelligerkanagurta*	Indian mackerel
5.	*Trichiuruslepturus*	Ribbonfish
6.	*EtroplusSuratensis*	Greenchromide
7.	*Leiogtiathusfasciatus*	Striped Pony fish
8.	*Tilapia mossambica*	Oreochromismossambicus
9.	*Triacanthusbiaculeatus*	short nosed tripod fish
10.	*Tachysurusjella*	Cat fish
11.	*Tachysurusdusssumieri*	Marine catfish
12.	*Rogadius Serratus*	Serrated flat head
13.	*Ambassisambassis*	Glassy perchelet
14.	*Anguilla bicolar*	Shortfin eel
15.	*Scylla Serrata*	Mud crab/ mangrove crab
16.	*Mugilcehalus*	Grey mullet
17.	*Meriterixmeriterix*	
18.	*Sillago ciliate*	Sand whiting
19.	*Scomberscombrus*	Mackerel
20.	*Penaeus monodon*	Tiger prawn
21.	*Striped Crab*	
22.	*Portunuspelagicus*	Blue Swimmimg Crab
23.	*ScomberomousGuttatus*	Seer Fish

4.14 Birds Species visiting Ennore Creek

A wide variety of migratory water fowls, notably pelicans, herons and egrets, storks, flamingoes, ducks, shore-birds, gulls and terns, are found. In the migratory season, waterfowl of different varieties, thousands of Sandpipers, Golden plover and shanks, Long-legged waders and varieties of duck flock to this feeding ground. There are also resident birds like Painted Stork and Grey Herons can be sighted in the EnnoreCreek.The rainfall in September and October has been scanty, forcing the initial set of migratory birds to return. However, the November rain in Chennai region attracts more winged species, mostly open bill storks and little cormorants (chinnaneerkagam) thus kick starting the season. Migratory birds are normally visiting during winter season. According to bird watchers, if there are no major cyclones, the productive breeding season of migratory birds is from December to February. The laying of pipe line will be carried out during the period from March to September as there will not be any movement of migratory birds during that period.

Figure 4.14Birds seen in Ennore Creek during Study

Table 4.21List of Birds seen in EnnoreCreek

S.No	Name Of The family	Common Name	Scientific Name
1	Phoenicopteridae	Flamingo (shallow water)	Phoenicopterusruber
2	Laridae	Black-headed gull (mud flat/shallow water) River tern	Larusridibundus Sterna aurantia
3.	Columbidae	Blue rock pigeon	Columba livia
4.	Strigidae	Spotted Owlet	Athene brama
5.	Ardeidae	Cattle egret	Bubulcus ibis
5.	Ciconiidae	Openbill stork	Anastomusoscitans
6	Alcedinidae	Common kingfisher	Aalcedoatthis
6	Corvidae	House Crow	Corvussplendens
7	Sturnidae	Indian myna	Acridothersestristis
8	Cuculidae	Indian Cuckoo	Cuculusmicropterus
9	Scolopacidae	Wood sandpiper	Tringaglareola
10	Laridae	Whiskered tern	Chlindoniashybrida
11	Laridae	Gullbilled tern	Gelochelidonnilotica
12	Pittidae	Indian pitta	Pitta brachuyura
13	Corvidae	Vaal kakkai	Indian treepie

Source : Envis Center on Wild Life Protected Areas and from some research publications.

4.15 Bathymetry

Bathymetry Survey was carried out for the proposed pipe line route using Echosound transducer and GPS. HYPACK survey software was used for data collection and processing. The study includes the methodology, survey techniques, tidal correction and results of bathymetry survey.

4.15.1 Bathymetry Survey

The bench mark is located at top level of the pedestrian‘s path of bridge entrance and opposite to police both at Attipattu-Ennore road junction. The static data on vertical elevation were recorded continuously for a period of 10 hr at 1.0 s interval. The arrived reference level is (+) 3.360m MSL.

Details of Benchmark

Location	Geographical Coordinates (WGS 84)		UTM Coordinates (Zone -44)		Reference level w.r.t MSL (M)
	Latitude, N	Longitude, E	X (m)	Y (m)	
Ennore Creek	13°13'33.09"	80°19'15.50"	426430.9	1462212.6	+3.36 m

4.15.2 Area of the survey

The survey boundary is covering an area of 800 m along the bridge and 110m width. The survey was covered 5 m line spacing and tie up lines was covered in 100 m line spacing. The detail of survey area coordinates area given below:

Location	Geographical Coordinates (WGS 84)		UTM Coordinates (Zone -44)	
	Latitude, N	Longitude, E	X (m)	Y (m)
Point A	13°13'33.6"	80°19'13.2"	0426362	1462229
Point B	13°13'30.8"	80°19'12.1"	0426328	1462144
Point C	13°13'56.6"	80°19'03.4"	0426068	1462935
Point D	13°13'55.8"	80°19'00.4"	0425977	1462912

The bathymetry map is prepared in WGS84 spheroid with UTM (Universal Transverse Mercator) coordinates and supplemented with geographical coordinates indicating the latitude and longitude. The bathymetry map prepared in 1:1000 scale and depths are presented in 5mx5m grid spacing and map prepared with reference to Chart Datum.

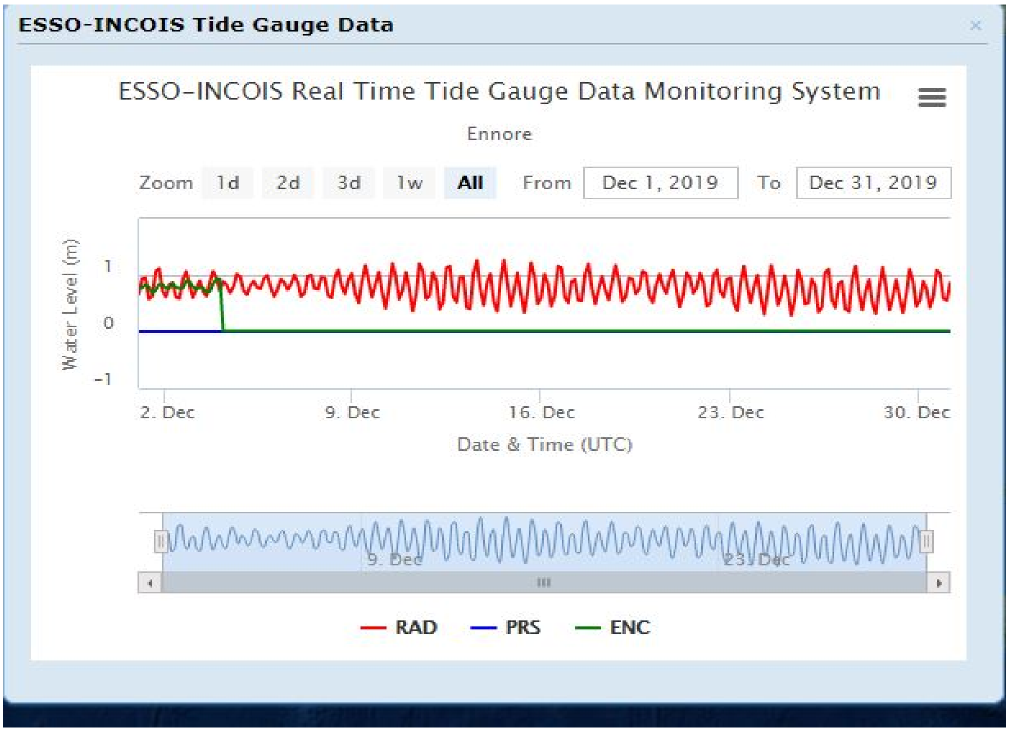
The bathymetry chart shows the southern side of survey area is very shallow and it has an elevation of about 0.2 m MSL, which sets dried up during low tide. A mud patch is noticed along the mid part of survey area. The depth varies between 0.5 m and 0.35 m MSL in the entire survey area.

During the survey period scatted concrete debris were noticed near the bridge pillars and it is visible during low tide. Due to the scatted debris the proposed alignment of pipe should be placed minimum10m way from the existing bridge pillars.

The seabed morphology of Ennore Coast is complex with varied slopes. The slope is steep at Ennore Creek, while the slope on the northern side is flat with submerged shoals. These shoals might have been formed due to the interaction of northerly coastal currents and sediment supply through Ennore Creek.

4.16 Tides

The tide enters through the Ennore Creek makes the circulatory system along its stretch. The location for laying of pipe line is so selected, that it will not affect the flow of tidal water along the circulatory hydrodynamic system caused by the Ennore Creek through the Kosasthalaiyar River and Buckingham Canal. The tidal flow at the pipe laying location is almost negligible and the tidal variation close to the site is less significant. Along the Ennore Coast, the tides are semi-diurnal with phase velocity perpendicular to the coast thus resulting in the seasonal residual circulation along the coast. The secondary data obtained from the Tide Gauge installed at Ennore by Indian National Centre for Ocean Information Services (INCOIS) is shown in **Figure 4.15**. On dry period, i.e. from February to September there is rise of tide upto 0.30m height during spring tidal days and remain dry on other days. But during northeast monsoon days, i.e. from October to January, there will be rainwater flood discharge which will rise the water level up to 2m in this region.



Source: ESSO- INCOIS Website

Figure 4.15Tidal Charts from INCOIS for Ennore Creek.

4.17 Socio Economic Environment.

Review of secondary data (District Census Statistical Handbook – 2011) with respect to population, occupation structure and infrastructure facilities available for 10 km radius study area. The socio-economic profile of the study area is based on 2011 Census of India. The study area lies within the Thiruvallur District. The district spreads over an area of about 3422 Sq.kms. As per District wise Census 2011, the total population of Ennore area is 11034 out of which 5623 are male and 5411 are female. The Total Scheduled Caste population of the study area is 4505 out of which the Total Scheduled Castes Male Population is 2251 and the total Scheduled Castes Female Population is 2254. The Total Scheduled Tribes Population in study area is 299 out of which 147 are male and 152 are female.

The data on baseline status of the study and basic information about the socio-economic profile has also been collected during the site visit and from secondary sources like Census of India, 2011. The database, thus generated in the process include Demographic structure; Infrastructure base in the study area, Economic attributes and Socio-economic status with reference to Quality of Life. The major villages nearer to the study area are Attipattu, Vallur 02, Vallur 03, Nappalayam, Kathivakkam, Vichoor and Gounderpallayam. The major occupation in the study area is agriculture. Apart from the agriculture, poultry, fishing and labor work also provides employment to significant number of villagers in the study area. Salt manufacturing, lime shell quarrying and fishing remains the chief occupations of the region. In most of the habitations there is no middle and higher Secondary schools within the habitation. Although primary educational facilities are there in all the villages there is also a need for the development of higher level of educational institutes.

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Table 4.22 Population details in Ennore villages

Sl No.	Name of the village	Fishermen families	Traditional fishermen families	Below Poverty level families	Fisher folk population	Male	Female	Sex ratio (females per 1000 males)	Full time fishing	Part Time fishing	Marking Of Fish - Female Worker	Fisheries Co-Operative
1	Ennore Kuppam	205	205	204	731	360	371	1031	162	3	21	339
2	Kasivisalatchipuram	104	104	104	394	208	186	894	97	12	68	218
3	Kasiviswanatharkoil kuppam	255	255	253	1082	556	526	946	249	72	167	593
4	Kathivakkam Chinnakuppam	131	131	131	499	252	247	980	144	43	96	251
5	Kathivakkam Periya Kuppam	156	156	156	593	303	290	957	156	48	60	305
6	ErnavoorKupam	135	135	70	466	246	220	894	129	10	68	266
7	Indira Gandhi Kuppam	70	70	97	253	129	124	961	70	5	19	155
8	Kattupallikuppam	97	97	330	319	161	158	981	80	5	6	196

Table 4.23: SC/ST population details in Thiruvallur District

Village Name	Total Geographical Area (in Hectares)	Total Households	Total Population of Village	Total Male Population of Village	Total Female Population of Village	Total Scheduled Castes Population of Village	Total Scheduled Castes Male Population of Village	Total Scheduled Castes Female Population of Village	Total Scheduled Tribes Population of Village	Total Scheduled Tribes Male Population of Village	Total Scheduled Tribes Female Population of Village
Kattupalli	996.31	534	1911	1096	815	856	445	411	46	24	22
Puzhuthivakkam	457										
Ennore	724.43		11034	5623	5411	4505	2251	2254	299	147	152
Vallur	1994.42	2993	11935	6089	5846	7803	3958	3845	29	14	15
Vichoor	894.97	1437	5765	2868	2897	2925	1443	1482	9	5	4
Village Name	**Govt Pre-Primary School (Nursery/LKG /UKG) (Status A(1)/NA(2))**	**Govt Pre - Primary School (Nursery/LKG/UKG) (Numbers)**	**Private Pre - Primary School (Nursery/LKG/UKG) (Status A(1)/NA(2))**	**Private Pre - Primary School (Nursery/LKG/UKG) (Numbers)**	**Primary Health Centre (Numbers)**	**Primary Health Centre Doctors Total Strength (Numbers)**	**Primary Health Centre Doctors In Position (Numbers)**	**Primary Health Centre Para Medical Staff Total Strength (Numbers)**	**Primary Health Centre Para Medical Staff In Position (Numbers)**	**Primary Heallth Sub Centre (Numbers)**	**Primary Health Centre Doctors Total Strength (Numbers)**
Kattupalli	1	1	2	0	0	0	0	0	0	0	0
Puzhuthivakkam											
Ennore											
Vallur	1	7	2	0	2	4	3	12	11	8	4
Vichoor	1	1	1	1	1	1	1	3	2	1	1

Source: Census 2011

5. ENVIRONMENTAL IMPACT ANALYSIS

5.1 Introduction

Environmental Impact can be defined as "any alteration of environmental conditions or creation of a new set of environmental conditions, adverse or beneficial, caused or induced by the action or set of actions under consideration". Generally environmental impact can be classified as primary and secondary impacts. Primary impacts are those, which are attributed directly by the project while secondary impacts are those, which are induced by primary impacts and include the associated investments and changed pattern of the social and economic activities by the action.

This section identifies and assesses the potential changes in the environment that could be expected from the proposed project. The impact have been predicted for the proposed activities assuming that the impact due to the existing activities has already been covered under base line environmental monitoring and continue to remains 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 the 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, 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.

The proposed pipe line to across Ennore Creek will best laid using Modular Cutter Suction Dredger. The total length of the laying of conveying main in below bed level will be 850m, width to be dredged at top of the bed level is 35 m, bottom is 4m and depth is (-) 6m, and dredged by Cutter Suction Dredger. At either side of the Creek, 800mm dia DI pipeline and at Creek area 800mm Inner dia HDPE pipe of 50mm thickness will be laid. The latitude and longitude of starting point and end point of the conveying main is 13^{0}13'34.33"N & 80^{0}19'14.23"E and 13013'54.70"N & 80^{0}19'03.23"E. A Google Earth Map showing the existing features surrounding the project site is shown below.

5.2 Review of Alternatives

Different Alternatives including the no- project Scenario and the available methodologies for pipe crossing were considered for their impacts on environment and is provided in the **Table 5.1.**

Table 5.1Analysis of Alternatives

Sl.no	Description	No project scenario	Trenchless method	Pipe carrying bridge	Adopted technology (Dredging)
1	**Methodology and types**	-	1. **Horizontal Drilling method-** This method involves construction of RCC Driving pit at the starting point of the Creek and RCC Received pit at the end point of the Creek. The horizontal drilling by using Augur boring commence from the Driving pit for2.0 times diameter of the pipe. The drilling will be carried out till reaching the receiving pit. The casing pipe of dia 2 times the diameter of pipe will be placed along with the drilling. Then the pipeline will be laid inside the casing pipe for the total length of the crossing. This method can be adopted when the alignment of the crossing is straight as the crossing will be done at straight horizontal alignment only. 2. **Push through method-** This method involves construction of temporary Driving pit at the starting point and temporary Receiving pit at the end point. The pushing of casing pipe of using Augur boring commence from the Driving pit for 2.0 times	The method of construction of pipe carrying bridge involves construction of deep foundation i.e. piles, pile caps, columns, beams, top slab, and supports for pipe. In order to mobilize the piling equipment and other construction equipment, the creek portion will be filled with earth in order to make the floor motorable and stable. After completing construction of piles the earth will be excavated upto the level of pile cap and construction of pile caps will be completed	**Dredging** is the process in which the sediments are picked up using mechanical tools such as buckets, grabs etc. Dredging method can be adopted for the curved laying of pipelines, i.e. accordingly to the alignment of the pipeline and there is no need of constructing driving pit or receiving pit at the middle of Creek.

			dia of pipe will be carried out by pushing the pipe using hydraulic jack. The boring will be carried out till reaching the receiving pit. Then the pipeline will be laid inside the casing pipe for the total length of the crossing. This method can also be adopted when the alignment of the crossing is straight.		
2	**No of days**		150	450	75
3	**Cost (Crores)**		34.85	10.72	35
4	**Technical Limitation**	None	Adopted only when the alignment of the pipeline is straight. Or in between the creek a RCC structure has to be constructed.	None	None
5	**Environmental aspects**				
a	Water Resource	1ndustries depends on fresh water sources for their needs.	Enables reuse of treated water and protects the freshwater source	Enables reuse of treated water and protects the freshwater source	Enables reuse of treated water and protects the freshwater source
b	Flow of Water	Nil	Negligible	Obstruction for free flow of water. But it is minimal with proper design of piles.	Obstructions to the flow temporary till the laying of pipe
c	Flora and Fauna in the Creek	Nil	Negligible	Temporary	Temporary
6	**Social aspects**				

a	Drinking water demand	Difficulty in meeting the water demand.	Water can be diverted for meeting drinking water demand.	Water can be diverted for meeting drinking water demand	Water can be diverted for meeting drinking water demand
b	Fishing activity	Nil	Nil.	Negligible and temporary disturbances to the fishing activity and movement of boats.	Temporary Obstruction however can be minimised with implementation in sections and through the proper selection of period.
c	Land Acquisition	Nil	Nil	Nil	Nil. No encroachment of land for storage/ camp site.

5.3 Identification of Likely Impacts

Every activity and operation has either adverse or beneficial impacts on the environment. The environmental impact identification has been done based on proposed project activities. All the activities from construction phase to operational phase of the project have been broadly covered which is given in **Table 5.2** .The activities and operations are considered based on the basis of proposed process as described in the project description **section 2.**

Table 5.2 -Activity – Impact Identification Matrix for Construction Phase of the proposed project

Construction phase		Potential impacts													
Main Activities	Sub Activities	Land use	Landscape	Land/Soil environment	Surface /Ground water	Water Quality	Air Quality	Solid waste generation	Ambient Noise level	Traffic and transport density	Resource use (Energy)	Ecology	Socio – economic	Culture/ Heritage	Agriculture in the surroundings
Site Preparation	Site Clearing & Cleaning Ground leveling Waste handling and its transportation Soil Compaction	✓	✓				✓	✓	✓			✓			
Labour deployment camp siting	Construction of Labour sheds to accommodate labor Supply of water Supply of fuel/ Energy Waste handling & its disposal Sewage disposal		✓	✓	✓	✓	✓	✓			✓		✓	✓	
Material handling & Storage	Transportation and Unloading of material from trucks Storage &Handling of HDFC pipes, joints, etc., Conveyance of material within the project site.			✓		✓	✓		✓	✓	✓		✓		

Excavation	Moving of Heavy Machinery Soil Extraction and Slacking Soil Loading and Transportation for Disposal Various Tools Like Crow Bar Foundations for heavy machinery installation Construction Power through onsite Diesel Generators			✓			✓	✓	✓	✓	✓				✓
Erection of sheds, installation of Machinery	Erection of sheds -welding/ cutting onsite Installation .of heavy machinery, pumps Mechanical installation and Disposal of Wastes.						✓	✓	✓		✓				
Laying Conveying Main	HDPE pipe fabrication, trench dredging, Back filling of trench.	✓	✓				✓	✓	✓			✓	✓		

5.4 Impacts Identified

Based on activity – impact interaction matrix for construction phase of the proposed project as shown in **Table 5.2**, following impacts on different environment have been identified.

I. **Construction phase of the proposed project would have impacts on the following:**
- Topography, land use pattern and Landscape
- Land / Soil environment
- Surface /Ground water resources
- Water quality Ambient Air Quality
- Ambient Noise Quality
- Traffic and Transport
- Ecology
- Socio – Economic
- Occupational Health and Safety

II. **Operation phase of the proposed project would have impacts on the following:**
- Water Quality
- Ecological
- Occupational Health and Safety

5.4.1 Construction Phase

The execution period for the laying of conveying main across Ennore Creek is 75 days. Design of conveying main will be done so as to avoid any obstruction in the free flow of water in Ennore Creek.

The likely temporary and permanent changes on the topography of the site would be following:

- Local labors will be employed for the unskilled work.
- Temporary – Movement of construction vehicles like excavators, pay loaders, trucks, other vehicles for bringing construction material and construction work may bring minor temporary change in the land use in and around the site by parking the vehicles on the open spaces and roads near the site.

5.5 Air Environment

a) Impact on Air quality

Air quality in and around the project site would be impacted to some extent due to construction and construction related activities. The main impact will be during site leveling, excavation, construction material handling etc., the likely emissions from construction activities would include the following:

- Dust emissions from dredging material, storage of dredging material, backfilling of dredging material, handling of construction material, transportation of material.
- Emission due to movement of vehicles and plying of heavy construction machinery.
- Gaseous emissions from operation of diesel generators for power requirement during construction phase.
- Vehicular movement at the site and also increase in traffic volume on the connecting roads will rest in increase in vehicular emissions.
- Traffic Movement at the site and also increase in traffic volume on the connecting roads will rest in increase in vehicular emissions.

b) Mitigation Measures

- Dredging material will be stored in the PWD site identified for the storage, away from water bodies & Mangroves and it will be covered by tarpaulin for avoid dust emission.
- Wherever dredging materials are more likely to generate the airborne particles during operations, nominal wetting by water could be practiced
- The impact of emissions both from tyre movements and vehicular emissions required to be minimized by proper maintenance of vehicles, sprinkling of water on unpaved roads, at the construction site and planned movement of vehicles.
- The emissions from diesel generators need to be controlled to minimize impacts of air emissions by optimized operations, orientation at the site and providing adequate stack height for wider dispersion of gaseous emissions.
- Drawn conclusion is that no significant impact on air quality is envisaged due to construction and related activities. Any impact on air quality will likely be

restricted within the localized area. Application of adequate mitigation measures by the Construction Management Contractors will further reduce the intensity of such impacts.

- Workers / Labor should be given proper air masks and helmets.
- Material stockpiled alongside trenches should be covered entirely by impermeable sheeting.
- All dusty materials shall be sprayed with water prior to any loading, unloading or transfer operation so as to keep the dusty materials wet.
- Pipes will be brought to the site in well-maintained trucks.

c) <u>Operation Phase</u>

Impacts

No impact on air quality is anticipated along the project site.

5.6 Noise Environment

a) <u>Construction Phase</u>

Impacts

- Use of heavy machineries and vehicles during construction activity of laying of conveying main.
- The construction works will however present a short term noise to the public. It is envisaged that operation of this construction activity will generate noise levels between 75-80 dB (A). The combined effect of these noise sources may cross 90 dB (A) at the machines operating site, however noise dissipates as it spreads in area beyond the study area.
- Noise generation from operation of diesel generators for power requirement during construction phase.

Mitigation Measures

- Avoid construction during night time so that the noise levels are reduced to the permissible limits.
- Vehicles used for transportation of construction material should be well maintained.

- The diesel generators (DG Sets) to be installed will be in conformance with recent requirement of acoustic enclosure to achieve 75 dB (A) level at 1m from its enclosure.
- Avoiding construction during night time so that the noise levels area reduced to the permissible limits.
- Considering the onsite noise levels, it is recommended to provide Personal Protective Equipment (PPE) such as ear muffs, etc. to the construction workers.

b) Operation Phase

Impacts

No impact on Noise quality is anticipated along the project site.

5.7 Land Environment

a) Construction Phase

Impacts

- Oil spillage / leakage from vehicles or other equipment used throughout the project area.
- Major impact on land environment due to proposed project during construction phase would be from the waste generated from construction materials and substratum removed during excavation for lying down of pipe.
- Solid waste generated during site preparation and dredging/excavated material during laying of conveying main.
- Throughout construction, the workforce would generate general refuse, comprising food scraps, paper, empty container etc.

Mitigation Measures

- Spillage of oil and grease from the vehicles will be washed and collected separately.
- Dredging material will be stored away (temporarily) from the water body at the PWD owned site and this will be backfilled in the trench within 20 days.
- After completion of work excess material and solid waste will be removed from the project site.
- Delivery of material on site to be done over a durable, impervious and level surface, so that first batch of material does not mix with the site surface. Availability of covered storage to assured.

- If any major damage occurs to the pipe, the pipe will be returned back to the supplier and if only minor damage is there in the pipe, itwill be disposed to Treatment, Storage and Disposal Facility (TSDF) approved by TNPCB and in consultation with engineer concerned.
- The waste of food, scraps, paper, empty container will be stored and handover to authorized person.

5.8 Water Environment

a) Impact

- However, during construction of the laying of conveying main, care will be taken to avoid dumping of construction debris, accidental spill of materials etc. into the Ennore Creek.
- Spillage of oil and grease from the vehicles from vehicles washing, workshop etc.
- Improper disposal of construction debris leading to contamination of water bodies.
- Generation of wastewater from the labor camps.
- Water leakage from Conveying main.

Mitigation Measures

- Spillage of oil and grease from the vehicles shall be washed and collected separately.
- Proper mitigation measures like provision of septic tank and soak pit for treatment and disposal for the waste water generated onsite during the construction phase. This will minimize any potential impact owing to the escape/discharge of untreated waste water into the nearby land or drain ensuring minimum impact.
- After completion of construction work, construction material will be removed from the project site.
- As the water passing through the pipeline across Ennore Creek is a tertiary treated water, any leakage will not affect the water body.

5.9 Impact on Water quality during dredging activity

a) Impacts of Dredging

The laying of conveying main will be carried out in the Ennore Creek. The hydrology and quality of Ennore Creek will be affected temporarily for a short period of time during the laying of water pipe and is described below with mitigation measures. Construction activities (preparation of the site, dredging) and operational activities can result in increased turbidity via suspension of sediment in the water column. Dredging and disposal of dredged material may lead to minor impacts on water quality from increased turbidity and from release of contaminants to the water column due to re-suspension of sediments and/or changes of certain chemical compounds in the dredged materials when exposed to different level of oxygenation. The impact due to dredging is short term as they will be limited to the construction phase. The anticipated impact from the construction of terrestrial components would be insignificant. Nevertheless, for good site practice and appropriate mitigation measures are recommended to be implemented during the laying of pipe carrying treated water.

i. Removal of benthic animals:

Dredging may initially result in the complete removal of habitats from the excavation site. This is due to the removal of material from the creek which also removes the animals living on and in the sediments (benthic animals).However it is observed that the benthic species are less near our project site due to the fluctuations of flows, therefore dredging activity may not cause much impact.

Mitigation

The timing of the dredge must be considered to avoid species of benthic communities in the maintained channels by considering the migratory pattern/breeding season and allow these species to vacate the area. Marine invertebrates lack sensory organs to perceive the sound, but many do have organs or tactile hairs that are sensitive to hydrostatic disturbances.

ii. Increase in suspended sediments, turbidity:

Dredging and laying of pipeline at the dredged area in the Creek result in increase in suspended sediments and turbidity. This affects the water quality and reduces the depth of light penetration into the water column. Along with the physical disturbance, this may under certain conditions have short–term effects on marine animals, submerged seaweeds and other plants.

Marine plants and animals living in areas where the waters are normally clear may be especially vulnerable to the effects of increased suspended sediments as follows:

a) Temporary reduction of algal/plant growth due to increased turbidity

b) Disturbance to sensitive benthic animals and fish due to suspended sediments, which may cause temporary disruption of migration of fish

c) Filter feeding organisms such as shellfish, can be affected by clogging and damaged feeding and breathing equipment. Similarly, young fish can be damaged if suspended sediments become trapped in their gills

The finer the material and greater the energy at the disposal site, the greater is the possibility of increased suspended sediments and of far-field effects.

iii. Re-suspension of sediments:

The degree of re-suspension of sediments and turbidity from dredging and disposal depends on the following four main variables:

a) the sediments being dredged (size, density and quality of the material),

b) method of dredging (and disposal),

c) the existing water quality and characteristics (background suspended sediment and turbidity levels),

d) If it is moved out of the immediate dredging location by tidal processes.

The re-suspension of sediments during dredging and disposal may also result in an increase in the levels of organic matter and nutrients available to marine organisms. This can result in two main effects:

a) Eutrophication – algal blooms are formed which severely affect the water quality by depleting the oxygen available for other aquatic species; the algal blooms can also occasionally release toxins which disturb marine wildlife.

b) In other cases, increased organic material, nutrients and algal growth as a result of the dredged silt may provide more food for zooplankton, benthic communities, and higher organisms. However, if the communities present in the vicinity of the disposal sites rely on low nutrient levels, so any nutrient enrichment may likely to impact such communities.

iv.Smothering caused by settling of dredged silt

Sediments dispersed during dredging and disposal may get distributed widely within the creek and settle over the seabed, and the animals and plants forming that live on and within it. This blanketing or smothering of benthic animals and plants may cause stress, reduced rates of growth or reproduction and in the worse cases the effects may be fatal.

Mitigation

1. Selection of appropriate dredger such as cutter section dredger reduces the release of the sediment and smothering due to the dredged slit. Thus, major loss of shell fish or fish stocks can be eliminated by the usage of cutter section dredger.
2. As slower dredging speeds may reduce impacts; limiting the speed of the cutter head reduces the amount of material entering the water column;
3. By changing dredging schedules based on tide, wind, and background/natural turbidity help to minimize effects due to increases in turbidity levels.
4. The dredging activities will generate local turbidity around the cutter heads of the dredges, but this turbidity will not significantly spread beyond the dredging trenches or channels because the bulk of the dredging takes place below the creek bed.
5. Contained sediment transport system (through pipeline) to minimize adverse impacts on aquatic life from dredging and the re-suspension of sediments
6. Silt veils/ curtains (where practicable) will be used to contain an area of more turbid water so that it is forced to flow out near the bottom. Silt curtain height is determined on the basis of the minimum water level at the location during the operation of dredger.
7. Before dredging operation, the contractor will identify the highly turbid places in the creek and slit curtains are proposed for arresting the spread of sediments to a larger extent.
8. Inspection and monitoring of dredging activities (turbidity sensors for suspended sediment concentration, Multipara meter sondes for measuring water quality) will be conducted regularly to evaluate the impact of operations, the effectiveness of mitigation measures, and the need for technical adjustments to avoid and minimize impacts to sensitive aquatic receptors, if any.

5.10 Impacts due to Noise Generation

The Construction process (dredging of Creek and laying of pipe line) will be done by contractor with minimum disturbances to the hydraulic regime and aquatic environment. The noise and vibration sources associated with dredging of the Ennore Creek will likely include from the following equipment:

1. Modular Cutter suction dredger
2. Lay Barge

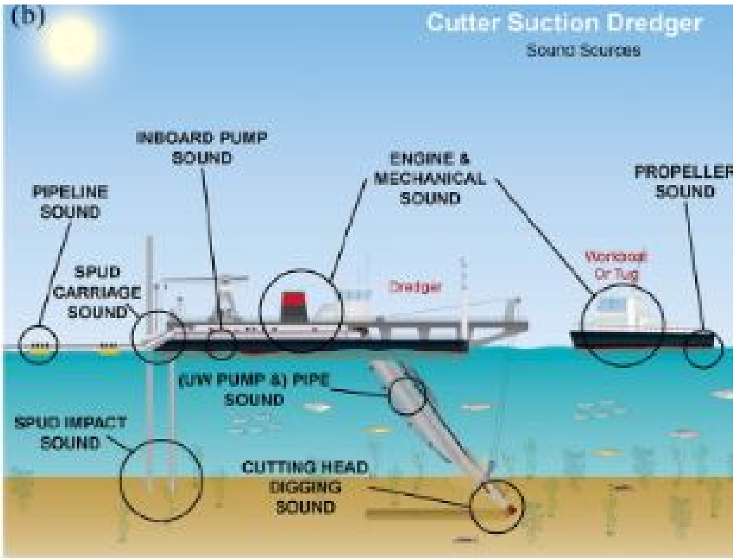
There will also be workboats, survey boats and tug boats associated with the project.

Noise Generation

The Cutter Suction Dredger (CSD) has a powerful engine, which generates high level of noise. The CSD is a stationary vessel or move at slow speeds, which can be employed may generate a continuous source of significant noise levels, reaching 100 to 115 dB in the immediate vicinity of the dredger. This noise level diminishes to acceptable levels (50—70 db) a few hundred meters from the dredging site. As the dredging technique is proposed to be done in the Ennore Creek, the environment likely to impact due to noise generation is the Marine Environment. Marine invertebrates lack sensory organs to perceive the sound, but many do have organs or tactile hairs that are sensitive to hydrostatic disturbances.

Underwater noise caused by the cutting action and the presence of underwater engines on many of the larger cutter suction dredgers will be higher and for hydraulic dredging operations, the major process contributing to underwater sounds include:

1. Dredged material collection sounds originating from the rotating cutter head in contact with bed and intake of the sediment-water slurry.
2. Sounds generated by pumps and impellers driving the suction of the material through the pipes.
3. Transport sounds involving the movement of sediments through the pipes.
4. Ship and machinery sounds, including those associated with the lowering and lifting of spuds and moving of anchors by dredge tenders.



Mitigation Measures

- To mitigate noise impacts during construction all equipment will be kept in good working order and maintained regularly.
- Based on evidence presented, and given that active dredgers are stationary, or move at slow speeds, if dredging is well managed, avoids critical habitats, or areas where fish species are abundant, risk of collision between marine species and active dredgers is minimal.
- Dredging activities will be managed so that underwater sound increases incrementally during the laying of pipe line to allow mobile marine fauna in the vicinity the opportunity to move away before sound levels reach maximum.
- To minimize the impacts due to noise and vibration the following devices are suggested in the pumping station and conveying main.
  1. Slow closing valves
  2. Variable frequency devices
  3. Pressure release valves

5. Sounds associated with the pipeline installation activities should temporarily deter marine species from entering the immediate areas of activity. For these reasons; the magnitude of impact to the marine environment is assessed as low.

6. Noise from dredging activities must not cause an environmental nuisance at any "noise sensitive place" as defined under the Environmental Protection (Noise) Policy1997. But no such sensitive place comes in the Project Site.

5.11 Impacts due to Vibration

The value of vibration depends on a lot of factors like type of soil, adjacent environment, distance at which vibration effect is to be checked etc., therefore putting a definite number on it is difficult.

There is no impact of vibration due to the machinery movement inside the Ennore creek as the installation of major machine parts is taking at the project site after deploying the bottom section of dredger with the help of MS sheet platform. Hence the vibration impact due to the machine movement is negligible inside the Creek. The vibration study is necessary when the pipeline laying involves any blasting during dredging activity. But as per geotechnical test report, no blasting is required for laying pipeline across Ennore Creek and hence impact due to vibration is not envisaged. However, if any vibration generates due to the vehicular movement will be controlled by restricting the movement to the project site and ensure no infrastructures, marine fauna in the vicinity is affected. As the dredging is carrying out in the Ennore Creek (during construction), the only infrastructures that may likely affect due to the vibration is Ennore Flyover situated near the alignment and Railway line situated 400m from the site. The operation of dredging equipment and other pipe laying works in Ennore Creek will be carried out without affecting either of these structures. The vibrations from underwater dredging are likely to be significantly lower than onshore cutting equipment like tunnel bores because amount of energy generated is dissipated into the water column around the rotary cutter. During Operation of dredger, as the point of origin of vibration is in water body, the probability of transfer is less and it may save the nearby structures from damage. Hence the overall activities will result nil or negligible vibration effects on Flyover Bridge or Railway line.

Mitigation measure during operation phase

- Ensure that equipment using in dredging activity is well maintained and is of good condition to avoid vibrations during the operation phase.

- Additionally, machinery will be muffled, if possible, to further reduce noise/ vibration impacts.

5.12 Impact on Creek/ Canal

Conveying main is proposed across Ennore Creek. Construction will be carried out below water bed level, pipe main may affect water regime temporarily and necessary management actions are to be taken during pre-construction and construction phase.

With respect to the crossing at creek, the proposed conveying main will be laid along the existing Ennore creek fly over,except temporary, no prolonged impacts are envisaged on the water flow during construction. Operations will need to ensure that optimal amount of silt be dredged without destroying the benthic habitat in project site as these are necessary for the survival of plankton, which are important components of the food-chain and ecological balance.

Migratory birds are normally visiting during winter season. But however there will not be any disturbances for the migratory birds for their movement as the visit of the migratory birds is rare and almost nil from March to September and therefore construction of conveying main will be carried out during the period from March to September.

Mitigation:

- Appropriate dredger must be selected to minimize re-suspension of sediments.
- Timing of dredging and disposal must be considered at most favorable points in the tidal cycle to limit extent of effects.
- Silt curtains can be used where practicable. Before dredging operation, the contractor will identify the highly turbid places in the creek and slit curtains are proposed for arresting the spread of sediments/turbid particles to a larger extent.
- The timing of the dredge must be considered to avoid sensitive species of benthic communities in the maintained channels and allow these species to vacate the area.
- During dredging activity, impact on marine organisms will be affected temporarily because of the dredging operations. Subsequently, the marine organisms returned to the normal behavior after the removal of disturbances. Thus the environmental conditions will be improved by providing stable conditions for the breeding of marine organisms.

- Sea-water inflow during high tides will improve the ecological conditions and additionally, the navigation of boats and rafts will be made smooth for accessing fish produce.

Minimize increases in turbidity

- Use excavation tools /dredger heads appropriate to minimize the turbidity.
- Minimize overflow by e.g. recirculation of overflow water.
- Avoid the use of agitation dredgers which introduce large amounts of suspended sediments into the water column where this may lead to problems with oxygen depletion or contamination. Cutter - Suction Dredger is using for the dredging activity as it is suitable for dredging in wide range of sediments.

Effective dredging process control

- Continuous on-line measurements and presentation of area, heading, speed of the dredgers and position of the suction head/buckets/cutter/backhoe/grab/ wheel/...
- Measurement of mixture velocity and concentration & hopper-measurement system monitoring the filling process.

5.13 Impact on migratory birds

- Disturbance to the migratory birds in the Ennore Creek. The migratory birds start arriving in September/October each year, and their numbers reach a peak in December/January. By late February/March the birds will return back to Northern region.

Mitigation Measures

- Dredging activity will be carried out without affecting the migration of birds. The construction will be carried out strictly exempting the migratory season of the birds.

5.14 Workforce Wastes

Maximum 40 workers will be working at a given point of time in water body during the peak construction period. Throughout construction, the workforce would generate general refuse, comprising food scraps, paper, empty containers etc., The amount of general refuse which is likely to arise will be largely dependent on the size of the workforce employed by the contractor. Though with the implementation of waste management practices at the site, it is not expected that there would be any adverse environmental impacts arise from the storage, handling and transportation of workforce wastes.

5.15 Impact on Ecology

There is no activity of tree cutting for the proposed project site. Hence no impact is envisaged on the vegetation in the project site.

5.16 Impact on Hydrology

During the construction time, there is no withdrawal of water from the creek. At the place of laying pipe (850 m) in Ennore Creek, due to the diversion of flow, flow velocity of the creek water may be disturbed for a short period of time. It is a temporary phenomenon and the flow of water will be normal, once the laying of pipe gets over.

5.17 Impact of Traffic Congestion

Due to the excavation work which will take place on the main roads of the city, there will be a disturbance in the traffic movement. People may experience some inconvenience during the morning and evening peak hours.

Mitigation Measures of Traffic Congestion

Traffic must be re-routed to facilitate ease of movement. Proper signage should provide detailed information on the dates and duration of road closures and which detours will be available, ideally well in advance of actual construction so residents can plan accordingly. Strategic placement of traffic police at critical intersections will also facilitate better flow of traffic. The construction site is being barricaded at all time in a day with adequate marking, flags, reflectors etc. for safety of general traffic movement and pedestrians.

Adequate measure will be taken in the water body for the movement of vessels and all the construction activities involving laying of pipe will be done in two phases to ensure the free movement of vessels in the Creek. So in the first phase; the vessels will get access through the second phase area and vice versa. Moreover fishermen should be informed well in advance in local language regarding the two stage construction process and makes them aware that there is no access / movement restriction during both phases. The information regarding the dates of works will be displayed in the project site and will announce through notice in local newspapers in local language.

5.18 Impact on Occupational Health and Safety

a) Safety during Construction

- Adequate precautions to be taken to prevent the accidents and from the machineries. All machines used will conform to the relevant Indian Standards Code and will be regularly inspected by the CMWSSB.
- Standard PPE like life jackets, general safety ring buoy etc. shall be provided to workers for working in Ennore Creek.
- Shoring and Strutting will be provided to avoid the collapse of the soil in case of loose soil.
- Barricading of Construction Site / Manholes at all times in a day with adequate signage, reflectors (also in water).
- Protective footwear and protective goggles to all workers employed on mixing of materials like cement, concrete etc.
- Welder's protective eye-shields will be provided to workers' who are engaged in welding works.
- Earplugs will be provided to workers exposed to loud noise, and workers working in crushing, compaction, or concrete mixing operation.
- The contractor will supply all necessary safety appliances such as safety goggles, helmets, safety belts, ear plugs, mask etc. to workers and staffs.
- The contractor will comply with all the precautions as required for ensuring the safety of the workmen as per the International Labour Organization (ILO) Convention No.62 as far as those are applicable to this contract.
- The contractor will make sure that during the construction work all relevant provisions of the Factories Act, 1948 and the Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996 are adhered to.
- The contractor will not employ any person below the age of 18 years for any work and no woman will be employed on the work of painting with products containing lead in any form.

b) Facility for Workers.

- Only 40 numbers of labors will be employed for working in water body and for operating dredger equipment. The working hours will be from 9.00 am to 5.00 pm.
- Long hours of working/standing in water body may create some skin related issues to the labors, so work shift will be provided for the workers and periodic health checkups will be arranged.
- Standard PPE like life jackets, general safety ring buoy etc. shall be provided for working in Ennore Creek.
- Rescue/evacuation teams (including first aiders) of suitable capacity should be organized to deal with emergency situations.
- The occurrence of an emergency situation should be informed immediately to the rescue team for immediate launching of appropriate rescue procedure.
- Emergency situations should be reported immediately to the public emergency authorities, i.e. Fire Services Department and/or Police, Ambulance for immediate assistance. These personnel will be alerted well before start of works.
- Sufficient rescue/evacuation boat(s) should be provided and kept ready for immediate use in case of emergency.
- Absolute safety measures should be taken to avoid snake bites while working in the water body.
- Emergency procedures, including rescue/evacuation procedures, would be formulated and reviewed regularly in the safety plan for, but not limited to, adverse weather, fire, injuries of workers, etc. An emergency contact list (internal and external) would be displayed on board.
- Basic facilities such as toilet, drinking water, electricity, health, eye shower, first aid facility and safety gadgets, personal protective equipment' (Safety Glasses, Splash-proof Goggles, Gloves, Hearing Protection, Safety Shoes or Boots and Respirators) will be provided.
- Training for special work conditions will be provided for workers.

c) Other item of safety equipment should include

(a) First aid kits (b) stretchers (c) fire extinguishers, (d) Gas and fire alarms, (e) portable combustible gas indicators, (f) hose and gas makes, (g) emergency portable lights, (h) an oxygen efficiency indicator.

5.19Impact on Socio – Economic Culture

As the proposed project is located at Ennore village, local people would also get job opportunities during construction of the project. There is no issue of resettlement or rehabilitation as the Ennore Creek belongs to the PWD. The project will provide up to more than 35 employment opportunities in Construction Phase. Constructional phase of the project will lead to air pollution, noise pollution in their respective areas. Dust problem will arise which may affect some people.

Communication and power supply facilities are likely to get affected in the areas during construction. Improper planning of construction activities may lead to traffic jam, diversion of traffic and related problems cause trouble to public movement. Potential road safety risks from construction vehicles and trucks delivering material to the construction sites. Maintain speed limit in construction area.

5.20 Impact on nearby Infrastructure

The Railway Bridge situated near the project area is situated 400m away from the proposed alignment. Hence construction work will not cause any impact.

With respect to the Ennore Flyover in the Creek, the outermost edge of the trench will be 32 m away from the piles and hence no impact on the structural stability is envisaged.

6. ENVIRONMENTAL MANAGEMENT PLAN

6.1 Objectives

The Environmental Management Plan (EMP) is required to manage environmental impacts from the proposed project. It is a site specific plan developed to ensure that all necessary measures are identified and implemented in order to protect the environment. Site specific EMP is formulated to mitigate significant adverse environmental impacts that are identified and qualified in the process of baseline and impact assessment. An EMP also ensures that the resources are utilized to maximum extent, waste generation is minimized, residuals treated adequately and by- products are recycled to the extent possible. The plan outlines existing and potential problems that may adversely impact the environment and recommends corrective measures where required. Also, the plan outlines roles and responsibility of key personnel and contractors who are charged with the responsibility to manage the proposed project site and its surroundings.

6.2 Environmental Management and Monitoring Plan

Environmental Management and Monitoring Plan is essential for effective implementation of identified mitigation measures during the construction and operation phase. Construction of laying of conveying main below bed level will be carried out by the contractor. The contractor will be selected by the competent authority of CMWSSB based on the technical capability and price quoted. The successful contractor will train the technical staff of the local concern bodies and CMWSSB during the construction and operation phase of sewage scheme. Once the contractual obligation is over, then the trained technical personnel will undertake the job of operation and maintenance of the entire project scheme.

Table 6. 1-Environmental Management Plan for Pre- Construction Phase

S. N	Potential Negative Impacts	Mitigation Measures	Time frame	Responsible agencies
Pre - Construction				
1	Clearances/ Permits	IWAI, CRZ, PWD, and Highway clearance required during construction were obtained from the concerned authorities and attached as annexure IV. Permits related to construction and labor shall be obtained and complied with.	Before start of construction	CMWSSB/ Contractor
2	Storage of materials	The contractor will get permission from the PWD, for temporary use of land for construction sites / storage of construction materials, etc. The contractor would ensure stored dredged material in the PWD site will not be create any adverse impact of nearby water body and Soil.	Before start of construction	CMWSSB / Contractor
3	Tree Plantation	No tree cutting involved in this project. If any tree cutting activity in project site, Compensatory plantation will be 10 times to the number of trees bring cut.	Before start of construction	CMWSSB / Contractor
4	Site Clearing	The clearing of bushes and weeds will be necessary from the either side of the creek bed without affecting mangrove species.	Before start of construction	CMWSSB / Contractor
5	Construction of labor Camp	• Contractor will follow all relevant provisions of the Factories Act, 1948 and the Building and the other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 for construction and maintenance of labor camp). • EHS guidelines of the World Bank to the contractor involved in setting up of the construction and labour camp for keeping the health & Safety of workers and impacts of setting up such camps on the local	Before start of construction	CMWSSB/ Contractor

		community in consideration while developing and establishing such camp will be strictly followed. • The location, layout and basic facility provision of each labor camp will be submitted to Engineer prior to their construction. • The construction will commence only upon the written approval of the Engineer. • The contractor will maintain necessary living accommodation and ancillary facilities in functional and hygienic manner as per the requirements of relevant laws like ILO standards and World Bank EHSGs. • All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. The sewage system for the camp must be planned. • Adequate health care is to be provided for the work force. The layout of the construction camp and details of the facilities provided will be prepared and will be approved by the Engineer. Awareness about HIV/AIDS will be provided, as Grievance Redressal mechanism for the camps. • Emergency Number will be displayed in the Labor Camp. • Nearby hospitals may be intimated about the influx of labor.		
6	Requirement of Specialized Officials	• Contractor shall ensure the availability of specialist in marine ecology, hydrology, EHS, structural engineers etc. as required who shall coordinate prior to and during construction & O&M period for effective implementation of the project.	Before Construction	Contractor
Construction Phase				

1	Environmental monitoring	Adequate measures will be taken and checked to control the Baseline parameters of Air, Water and Noise pollution. Base line parameters recorded will be used for monitoring and conformance be ensured.	During Construction	CMWSSB
a.	Water Quality Monitoring	• The monitoring of the water quality will be carried out at all locations identified along the project locations during construction and operation phase. Monitoring parameters will be as per IS-10500 for ground water quality and for surface water quality as per CPCB guidelines on Inland Surface Water (IS: 2296-1982).	Before and after Construction	Contractor
b.	Ambient Air Quality Monitoring	• Ambient air quality will be monitored at different locations in accordance with National Ambient Air Quality (NAAQ) Standards 2009.	Before and after Construction	Contractor
c.	Ambient Noise Level Monitoring	• The measurement for monitoring the noise levels to be carried out at the work sites / dredging area/and near dumping areas in accordance to the Ambient Noise Standards formulated by CPCB. Noise shall be recorded using digitized noise monitoring instrument. The equivalent Noise Level will be recorded for comparison with prescribed limit and baseline data.	Before Construction and during Construction	Contractor
2	Maintenance of labor camps	• Contractor will follow all relevant provisions of the Factories Act, 1948 and the Building and the other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 for construction and maintenance of labor camp). • The contractor will maintain necessary living accommodation and ancillary facilities in functional and hygienic manner and as approved by the Engineer. • All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking,	During construction	Contractor

		cooking and washing. Adequate health care is to be provided for the work force. The layout of the construction camp and details of the facilities provided will be prepared and will be according to GIIP and World Bank guidelines. • Awareness about HIV/AIDS will be provided, grievance Redressal mechanism for the camps.		
3	Planning of temporary traffic arrangements	The activities are limited to the project sites and right of way. In case of any need in the site, necessary permissions for temporary diversion will be obtained. Signings and safety measures including flagmen are provided at the site.	During construction	Contractor
4	Barricading site	The activities would be restricted to project sites and right of way for alignment. Barricading with adequate marking, flags, reflectors etc. will be provided along the alignment for safety of restricted traffic movement and pedestrians.	During construction	Contractor
5	Pollution from Construction Wastes	All waste arising from the project is to be disposed of in the manner in consultation with CMWSSB Engineer. The contractor will avoid the generation of hazardous and non-hazardous waste materials. Where waste generation cannot be avoided, the contractor will reduce the generation of waste and recover and reuse waste in a manner that is safe for human health and environment.	During Construction	Contractor
6	Informatory signs and Hoardings	The contractor will provide, erect and maintain informatory/ safety signs hoardings written in English and local language, wherever required or as suggested by the Engineer	During Construction	Contractor
7	First Aid	The contractor will arrange for: • A readily available first aid unit including an adequate supply of sterilized dressing materials and appliances as per the Factories	During Construction	Contractor

		Rules in every work zone. • Availability of suitable transport at all times to take injured or sick person(s) to the nearest hospital. Emergency number will be displayed.		
8	Chance finds	Construction contractors to follow these measures in conducting any excavation work • All fossils, coins, articles of value of antiquity, structures and other remains or things of geological or archaeological interest discovered on the site shall be the property of the Government and shall be dealt with as per provisions of the relevant legislation. • The contractor will take reasonable precautions to prevent his work men or any other persons from removing and damaging any such article or thing. He will, immediately upon discovery thereof and before removal, acquaints the Engineer of such discovery and carry out the instructions for dealing with the same. • Stop work immediately to allow further investigation if any finds are suspected; • Create awareness among the workers, supervisors and engineers about the chance finds during excavation work • The Engineer will inform State Archaeological Department if a find is suspected, and seek direction from ASI prior to recommencing the work.	During Construction	Contractor
9	Flora and chance found Fauna	• Any fauna/ flora (aquatic or terrestrial) species or signs of their past presence such as scats observed in the project area during work will be reported to the Environment Management team and on-call field specialist should conduct field monitoring in the case of unusual or for	Throughout the project especially in water body	Contractor

		important chance finds; • The Contractor shall take reasonable precaution to prevent his workmen or any other persons from removing and damaging any flora (plant/vegetation) and fauna (animal) including fishing in any water body and hunting of any animal. If any animal is found near the construction site at any point of time, the contractor shall immediately upon discovery thereof acquaint in the Environmental Specialist and carry out his instructions for dealing with the same.		
10	Waste Disposal	• The contractor will provide garbage bins in the camps and ensure that these are regularly emptied and disposed of in a hygienic manner as per the Comprehensive Solid Waste Management Plan approved by the Engineer. • Unless otherwise arranged by local sanitary authority, arrangements for disposal of night soils (human excreta) suitably approved by the local medical health or municipal authorities or as directed by Engineer will have to be provided by the contractor. • Adequate sanitary, drainage, toilets with septic tanks, refuse collection and disposal facilities shall be provided for the construction workers.	During Construction	Contractor
11	Clearing of project site	• Contractor to prepare site restoration plans, the plan is to be implemented by the contractor prior to demobilization. On completion of the works, the left-over construction materials will be removed stored and removed by the contractor from project site for reuse/ proper disposal. • On completion of the works, all temporary structures will be cleared away, all rubbish cleared, excreta or other disposal pits or trenches filled in and effectively sealed off and the site will be left clean and	After completion of Construction	Contractor

		tidy, at the contractor's expenses, to the entire satisfaction of the engineer.		
12	Pollution from Fuel and Lubricants	• The contractor will ensure that all construction vehicle parking location, fuel / lubricants storage sites, vehicle, machinery and equipment maintenance and re fuelling sites will be located at least 500m from rivers and irrigation canal / ponds. • All location and layout plans of such sites will be submitted by the Contractor prior to their establishment and will be approved by the Engineer • Contractor will ensure that all vehicle / machinery and equipment operation, maintenance and re fuelling will be carried out in such a fashion that spillage of fuels and lubricants does not contaminate the ground. • Contractor will arrange for collection, storing and disposal of oily wastes to the pre-identified disposal sites (list to be submitted to Engineer) and approved by the Engineer. All spills and collected petroleum products will be disposed of in accordance with MoEF and state PCB guidelines.	During Construction	Contractor
13	Safety Aspects	• Adequate precautions will be taken to prevent the accidents and from the machineries. All machines used will conform to the relevant Indian standards Code and will be regularly inspected by the CMWSSB. • If loose soil is met with, shoring /strutting structures will be provided to give temporary support to the sides of the trench. • Protective footwear and protective goggles to all workers employed on mixing of materials like cement, concrete etc.	During construction	Contractor

		• Welder's protective eye-shields will be provided to workers' who are engaged in welding works. • Earplugs/ear muffs will be provided to workers exposed to loud noise, and workers working in crushing, compaction, or concrete mixing operation • The contractor will supply all necessary safety appliances (PPE) such as safety goggles, helmets, safety belts, ear plugs, life jackets, mask etc. to the labors working in creek and to the staffs. • The contractor will comply with all the precautions as required for ensuring the safety of the workmen as per the International Labor Organization (ILO) Convention No.62 as far as those are applicable to this contract. • The contractor will make sure that during the construction work all relevant provisions of the Factories Act, 1948 and the Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996 and adhered to. • The contractor will not employ any person below the age of 18 years for any work and no woman will be employed on the work of painting with products containing lead in any form. • Work shall follow the recommendation of Geo Technical investigation report while carrying out the work in the Creek. • Safety measure around pillars/piles of existing bridge (32m away) to protect them from any adverse impact due to the operation of dredger will be ensured during the work time. • Rescue facilities, including sufficient stretcher(s), portable resuscitation equipment and first aid facilities, should be provided		

		and kept readily accessible for emergency use for labors working in creek. • Absolute safety measures like High top boots will be provided to the workers to avoid any snake bites while working in Creek • Contractor will practice work rotation system among the workers to reduce health impacts related to prolonged exposure to noise or water (as work is in Creek). • The State and National Guidelines on COVID 19 pandemic will be strictly followed during the working hours and in the labour camp.		
14	Accessibility to sites /traffic	• Adequate road facilities have been provided in project site for movement of vehicle and unloading of materials without disturbing of existing features and activities. • The Contractor shall take all necessary measures for the safety of traffic during construction and provide erect and maintain such barricades, including signs, markings, flags, lights and flagmen as proposed in the Traffic Control Plan. • The fishermen should be informed well in advance in local language regarding the two stage construction process and makes them aware that there is no access / movement restriction during both phases. • The information regarding the dates of works will be displayed in the project site and will announce through notice in local newspapers in local language.	Construction Phase	Contractor and CMWS&SB

15	Environmental Monitoring	The water, air, soil, noise quality and biological environment will be monitored in pre-construction and Construction phase as detailed in Table 6.2.	Pre-construction & Construction	CMWS&SB & Contractor.
16	Storage of construction material	Site for storage of construction materials to be identified in consultation with Engineer in charge, without affecting the nearby water bodies, traffic and other common utilities.	During construction	Contractor
17.	Risk from electrical equipment	The Contractor shall take all required precautions to prevent danger from electrical equipment and ensure that – No material shall be so stacked or placed as to cause danger or inconvenience to any person or the public. All necessary fencing and lights shall be provided to protect the public in construction zones. All machines to be used in the construction shall conform to the relevant Indian Standards (IS) codes, shall be free from patent defect, shall be kept in good working order, shall be regularly inspected and properly maintained as per IS provision	During Construction	Contractor
18	Water Pollution From Construction Wastes	• The Contractor shall take all precautionary measures to prevent the wastewater generated during construction from entering into streams, water bodies or the irrigation system. • All waste arising from the project is to be disposed of in the manner that is acceptable by the Engineer.	During construction	Contractor and CMWSSB
19	Dredging materials from laying of conveying main	• Dredging material will be stored away from the water body and dredging material backfilled in the trench within 20 days. • Dredging material will be stored in the PWD site identified nearby water body without affecting the Mangroves and it will be covered by	During construction	Contractor and CMWSSB

		tarpaulin for avoid dust emission. • Wherever dredging materials are more likely to generate the airborne particles during operations, nominal wetting by water could be practiced to ensure compliance to ambient air quality standards. • The placement of dredged material on the temporary storage site may include the generation of sediment-laden runoff. So sedimentation pond type structure will be developed to ensure sediment-free water is released from these structures		
20	Dredging activity	• Cutter -Suction dredger must be selected to minimize re-suspension of sediments • Timing of dredging (March to September) and disposal must be considered at most favorable points in the tidal cycle to limit extent of effects. • Silt curtains can be used where practicable • The timing of the dredge must be considered to avoid sensitive species of benthic communities in the maintained channels and allow these species to vacate the area. • Use excavation tools /dredger heads appropriate to minimize the turbidity. • Minimize overflow by e.g. recirculation of overflow water. • Avoid the use of agitation dredgers which introduce large amounts of suspended sediments into the water column where this may lead to problems with oxygen depletion or contamination. Use Cutter - Suction Dredger as it is suitable for dredging in wide range of sediments. • Dredging activity will be carried out outside the migratory period	During construction	Contractor and CMWSSB

		(November to February).		
21	Solid Waste	To ensure the minimum impact on marine water quality, the following measures will be followed by the contractor during the construction time: • No garbage would be disposed to the Creek. • The solid waste like packing materials, paper plastics, tins, glass etc. generated during the Construction time will be segregated and stores it on-board facility (appropriate containers) and transported back to the shore where they will be recycled or disposed in the land based disposal facility (land fill). • If any plastic, scrap metal and other non-combustibles should be segregated and sent to authorize recyclers. • Waste management registers will be maintained along with photographic evidence.	Throughout the Construction phase	Contractor
22	Risk force measure	• Contractor shall take all reasonable precautions to prevent danger to the workers and public from fire, flood etc. resulting due to construction activities. • Contractor shall make required arrangements so that in case of any mishap all necessary steps can be taken for prompt first aid treatment. • Construction Safety Plan prepared by the Contractor shall identify necessary actions in the event of an emergency	Throughout the Construction phase	Contractor
23	Sediment Quality/Characteristics analysis	• For checking the characteristics of sediment, for choosing the suitable site for the storage. • Heavy metal parameters will be compared with US EPA standard on sediment quality	Prior to dredging activity	Contractor and CMWSSB

24	Safety measures in Creek	• All PPEs (Hand gloves, life buoy and life jacket) will be in good condition. • Ensure that the area is properly barricaded to avoid unauthorized entry of vessel/boat. • Divers should have previous experience of similar jobs and certified by recommended medical specialist only. • Under medication divers are not allowed to take diving operations. • Boat will be kept operational condition during pulling of pipeline. • Concrete blocks will be fitted with suitable anti-friction strip to avoid sliding. • Transfer of personnel only when secure and under supervision. • Hands to be free from any luggage during transfer from barge to boat. • Long working hours shall be controlled and where ever possible all diving task should be finished in the day hours. • Rescue/evacuation teams (including first aiders) of suitable capacity will be organized to deal with emergency situations. • The occurrence of an emergency situation will be informed immediately to the rescue team for immediate launching of appropriate rescue procedure. • Emergency situations will be reported immediately to the public emergency authorities, i.e. Fire Services Department and/or Police, Ambulance for immediate assistance. These personnel will be alerted well before start of works. • Sufficient rescue/evacuation boat(s) will be provided and kept ready for immediate use in case of emergency.	During Construction	Contractor

		• Emergency procedures, including rescue/evacuation procedures, would be formulated and reviewed regularly in the safety plan for, but not limited to, adverse weather, fire, injuries of workers, etc. • An emergency contact list (internal and external) will be displayed on board. • Basic facilities such as toilet, drinking water, electricity, health, eye shower, first aid facility and safety gadgets, personal protective equipments (Safety Glasses, Splash-proof Goggles, Gloves, Hearing Protection, Safety Shoes or Boots and Respirators/ underwater breathing apparatus) will be provided. • To prevent drowning personal flotation devices (PFD) for work activities on or near water shall be provided. PFDs must be worn with all straps, zippers, and ties fastened. Tuck in any loose strap ends to avoid getting hung-up. • Provide a floating ring buoy close to the work areas. • checklist for safety will be prepared and safety be ensured every day during work • Training for special work conditions will be provided for workers.		
25	Unforeseen Impacts	Unforeseen impacts encountered during implementation will be addressed in accordance with the principles of ESMF.	During construction	Contractor and CMWSSB
26	Compliance to EMP measures	Contractor shall ensure that all the measures identified in the updated ESIA report for pipe laying across Ennore Creek will be complied.	During Construction	Contractor

27	Closure activities	• On completion of the works, the left-over construction materials will be removed stored and removed by the contractor from project site for reuse/ proper disposal. On completion of the works, all temporary structures will be cleared away, all rubbish cleared, excreta or other disposal pits or trenches filled in and effectively sealed off and the site will be left clean and tidy.	After Construction	Contractor and CMWSSB
Operation Phase				
28	Environmental Monitoring	The water, and marine study will be monitored periodically. Detailed monitoring record will be maintained. Periodical report will be send to the Engineer. The frequency and parameters for Environmental Monitoring detail is given in Table 6.3 of the updated ESIA report.	During Operation	CMWSSB /Contractor.
29	Flora and fauna	Studies of flora and fauna to ensure the creek features are returned to normal after the construction.	After Construction activity	CMWSSB /Contractor
30	Operation& Maintenance	• CMWSSB/Contractor shall ensure display of Emergency number in the Creek during O & M. • Any major damage occurs to the pipe, the pipe will be returned back to the supplier and if only minor damage is there in the pipe, it will be disposed to Treatment, Storage and Disposal Facility (TSDF) approved by TNPCB and in consultation with engineer concerned. • Proper Safety measures should ensure for the pumping of water to the industries. • Sign-boards will be placed at both edges and at points along the pipe alignment to demarcate this and to prevent impacts due to other dredgers, boats etc., during operation phase as well.	Operation & Maintenance	Contractor

6.3 Environmental Monitoring Plan

Environmental Monitoring Plan of construction and operation phase is given in **Table 6.2 & 6.3.**

Table 6.2Environmental Monitoring Plan for Pre-Construction & Construction Phase

Attributes	Parameters	Frequency	Location	Responsible Agency
Pre-Construction & Construction Phase				
Air Quality	PM_{10}, $PM_{2.5}$, SO_2, NOx, CO and Pb (standards as per CPCB)	Pre-Construction (once) and during Construction (monthly)	Project site (Ennore Creek) and storage area of dredged material.	Contractor through approved monitoring agencies
Water Quality	Drinking water standards as per IS 10500:2012.	Pre-Construction (once) and during Construction (fortnightly)	Project site (atleast 4 locations in the Ennore Creek)and storage area of dredged material.	Contractor through approved monitoring agencies
Noise Level	Noise level on dB (A) scale noise levels on dB (A) scale (as per MoEF Noise Rulers, 2000)	Pre-Construction (once) and during Construction (fortnightly)	Project site (At least 4 locations in and around the Ennore Creek)	Contractor through approved monitoring agencies
Vibration	Vibrational intensity in terms of peak ground particle velocity (PPV) in mm/s	Pre-Construction (once) and during Construction (fortnightly)	Project site (At least 2 locations near the project work area.)	Contractor through approved agencies
Soil Quality	Monitoring of Pb, SAR and Oil & Grease (standards as per TNPCB)	Pre-Construction and During Construction (once)	Project site (Ennore Creek) and storage area of dredged material.	Contractor through approved monitoring agencies
Health	All relevant parameters including HIV	Regular check-ups are conducted for period of	---	Contractor

		3 months.		
Marine water quality	Marine water, sediment, Phytoplankton and Zooplankton	Pre-Construction and During Construction (once)	Project site (Ennore Creek) (10 locations)	Contractor through approved monitoring agencies.
Environmental Monitoring of the Storage Area	Air, Water, Soil, Avifauna	Pre storage and Post Storage	Storage Area	Contractor

Table 6.3- Environmental Monitoring Plan Operation Phase

Attributes	Parameters	Frequency	Location	Responsible Agency
Operation Phase				
Water Quality	Drinking water Standards as per IS 10500:2012.	Seasonal Sampling	Project site (Ennore Creek)	Implementing Agency
Noise Level	Noise level on dB (A) scale noise levels on dB (A) scale (as per MoEF Noise Rulers, 2000)	Seasonal Sampling (Pre-monsoon and Post-monsoon)	Project site (Ennore Creek)	Implementing agency
Soil quality	Monitoring of Pb, SAR and Oil & Grease	Seasonal Sampling	Project site (Ennore Creek)	Implementing Agency
Marine water quality	Marine water, sediment, Phytoplankton and Zooplankton	During any maintenance activity	Project site (Ennore Creek)	Contractor through approved monitoring agencies

Table 6.4 -Provision for EMP Implementation

S.N	Description	Remarks
1	Barriers and acoustic measures for generators	These items identified in the EMP will be included in the agreement with the Contractor for additional work.
2	Informatory Signs and Hoardings	
3	Pollution control measures like water spraying for dust suppression during laying of conveying main.	
4	Barricading at construction site of Conveying main by way of providing GI sheets on both sides of trenches.	
5	Environmental Monitoring during pre-construction and construction	
6	Sanitary facilities/ mobile toilets in the labor camp	
7	Solid waste Collection Bin & dredging material storage facilities (tarpaulin etc.)	
8	Safety measures for works in Creek	
9	Storing and backfilling of dredged material	Included as part of the BOQ item for laying of pipes.
10	Environmental Monitoring in the Ennore Creek (during Operation).	CMWSSB

6.4 Disaster Management Plan

The preparation of the Disaster Management Plan (DMP) is based on holistic in approach, recognizing that environmental risks arise from the complex interaction of environmental hazards and socioeconomic vulnerability.

An important element of mitigation is emergency planning i.e. recognizing that accidents are possible, identifying the types of accidents which may occur, assessing the consequences of such accidents and deciding on the emergency procedures, both on-site and off-site, that would need to be implemented in the event of specific type of emergency.

Emergency planning is just one aspect of safety and cannot be considered in isolation. In particular, it is not a substitute for maintaining good standards while laying the pipeline below ground level in Ennore Creek. Before starting to prepare the plan, the necessary basic standards and safety precautions are administered.

Emergency plans are likely to be separate for on-site and off-site, but they must be consistent with each other i.e. they must be related to the same assessed emergency conditions. The on-site plan is called Disaster Management Plan (DMP) and the off-site plan is called Emergency Preparedness Plan (EPP).

6.4.1 Objectives

The overall objectives of an emergency plan are:

- Prevention of disasters and their impact on families, infrastructure and environment
- Providing fast, coordinated, effective and appropriate responses to disasters and complex emergencies
- Minimizing the effects will include rescue, first-aid, evacuation, rehabilitation and giving information promptly to people living nearby.
- Ensuring timely recovery from disasters and complex emergencies, and leaving communities and families in a better position to withstand future hazards.
- First aid kit should be available boat/pontoon and onshore.
- Proper communication systems shall be followed to avoid unwanted entangle of divers while pushing the string in the water.

6.4.2 Identification of Hazard

This stage is crucial for both on-site and off-site emergency planning and requires to systematically identifying the potential emergencies at the site. These could range from small events, which can be dealt without outside help to the largest event conceived in the site to have a plan. Experience has shown that for every occasion that the full potential of an accident is realized, there are many occasions when some less severe event occurs or when a developing incident is mitigated before reaching full potential.

This project involves construction of under creek pipeline and other surface structures having large diameters and length up to several kilometers. Some of possible reasons of disaster is as under:

- Natural calamities such as Flood, Tsunami, Erosion, Landslides and Earthquake may affect any part of pipeline, which needs to be taken care by proper seismic and geological studies during designing
- Possible failure of a pipeline and the sudden release of stored water becomes a potential menace to nearby population and fauna of the creek; and
- Emergencies resulting from improper handling of construction equipment and manmade errors.
- Failure of diving Equipment
- Person entangled underneath the pipe.
- Electrocution due to improper electrical layout and mobile electrical machines and power tools.

➢ Considering examples in the past and historical record states that the area is least prone to Tsunami, Earthquake and Landslides.

6.4.3 Assessment of Hazards

The assessment of potential incidents should include:

- The worst events considered
- Likely other failure cases
- The relative likelihood of occurrence of events and
- The consequences of each event.

Emergency Preparedness Plan

- Seismic factor has been considered in the design of pipe line. In case of any emergencies, early warning message will be sent through radio communication to all nearby residents as well as through public address system.
- Display of Emergency number in the operation site for addressing any emergency situation.
- Appropriate medical services and effective rescue operations will be provided on war footing to limit post incident casualties as also to combat epidemics and evacuate the marooned / trapped individuals to safer places.
- Proper steps will be taken to salvage the properties damaged from the debris and to protect the personal properties of the affected population.

- Suitable steps on war footing need to be adopted to restore all the essential services like water supply, telecommunication, transportation, etc.
- Water quality monitoring mechanisms of creek will have to be set up to prevent outbreak of epidemics.
- Damage to road access due to land subsidence (secondary effects) should be immediately repaired and debris cleared with the help of local bodies.
- All diving equipment are checked by Diver before commencing the dive and regular inspection by diving supervisor.
- Skilled workers should be enrolled/deployed such critical tasks (in Creek).
- Ensure that the area is properly barricaded to avoid unauthorized entry of vessel/boat.
- Pontoon in-charge should continuously monitor under water clearance to avoid grounding and pontoon dent.
- During the onset of rain/thunder showers work to be stopped and moved away to sheltered area.
- Life jacket and buoy should be on board and distinctly visible.
- Regular follow-up of weather reports while installation of string in the water.
- In case of accidents, arrangement should be made with the local police, transport and taluk administration for extending support with the necessary mechanical devices like cranes, gas cutters, etc. required for rescue operation as well as for clearing of the accident site.

6.4.5 Community Involvement and Awareness

The nearest settlements and it is necessary to appraise the local communities about the activities involved in the Construction of the project. The following information would be listed in the project site:

- Providing general information on the nature and extent of off-site affects in the event of unforeseen circumstances.
- Details of the safety measures to be adopted in tackling the hazards in the event of any disaster.

- Education and periodic re-education of local communities by the CMWSSB in cooperation with the local government authority. Involving the community members in emergency preparedness and disaster management.
- Record keeping.

6.4.6 Recommendations for the Implementation of the Off-site Emergency Plan.

- Protection measures against water-related disasters should be multi-layered, connecting structural and non-structural measures. Aiming attention at preparedness, mitigation and adaptation strategies is less costly in environmental, social, and economic terms than focusing on emergency response on an event-by-event basis.
- Disaster risk reduction and adaption are two effective ways of reducing risks posed by natural hazards.
- Proactive measures to reduce vulnerability of communities at risk from natural disaster are "low or no-regret" investments because they can yield benefits even in the absence of catastrophic events.
- The emergency control center will be the focal point to co-ordinate emergency activities. The emergency control center would be equipped with an adequate number of equipment mentioned under heading 'Emergency Control Centre'.
- A summarized version of action procedures detailing the "Role of Essential Staff in Major Emergency" would be issued in a flip chart like booklet form to all concerned persons (officers and supervisors) at the berths and also to senior officers of the civic administration.

6.5 Emergency Response Plan

An Emergency Response Plan (ERP) to use in the O/M stage is prepared for some identified emergency events that may potentially affect the construction stage and project area. These events are: flooding, traffic accidents (road and rail), spill/leak of materials in land & water, civil disturbance/riot, terrorist event/threat. The objective of the plan is to facilitate a rapid and effective emergency response and recovery; provide assistance to emergency and security services; implement an effective evacuation plan if required, and communicates vital information to all relevant persons involved in the transport emergency (both internal personnel and external agencies) with a minimum of delay. The plan contains sufficient detail to enable those involved in the response to effectively carry out their duties.

6.5.1 Purpose of the Plan

This ERP is intended to provide information, strategies and procedures relating to all aspects of emergency management during operation, which comprise:

a. Prevention of emergencies,

b. Preparation for emergencies.

c. Response to an emergency. and

d. Recovery following an emergency.

Table 6.5 Emergency and Response

Emergency Event	Probability	Response/Action	Evacuation Plan
Flood	less	• Approach road and closure of nearby bridge if any. • Inspections of nearby infrastructure for damage after flood waters have subsided.	In the case of a major flood, the concerned authority would lead a major evacuation of the affected settlement communities.
Traffic Accidents	less	Temporary Closure of Affected Area.	In the case of accidents and other road emergencies, the affected lane will be temporarily shut-down and vehicles will be directed through unaffected lanes
Spill/Leak of Materials in Land & Water	Low	• Containment of leak/spill • Alerting and evacuation of surrounding populations (if required)	• Alert the fisherman and other population. • Vehicles are

		• Clean-up once emergency has been mitigated	rerouted.
Civil Disturbance /Riot	Low	Security Check Points	Nearby roads will be closed for temporarily.
Outbreak of any contagious disease	Low	Containment of the area. Isolation of the affected individual.	Barricading/ Isolation of affected area & closure of main roads to the affected area.

6.6 Covid-19 pandemic related risks and mitigation measures.

COVID-19 pandemic spreads through respiratory droplets when an infected person coughs or sneezes. This happens most directly when someone is in close contact with an infected person (within 2 meters/6 feet). It may also occur by touching infected surfaces.

Precautions / Standard Operating Procedures (SOP's) to be followed in the Project site

Civil works projects requires the assembly of a workforce, together with suppliers and supporting functions and services, and may lead to congregations of large numbers of people. So it is important to address Covid-2019 related risk and its mitigation measures should be practiced in the labour Camp/ Work site as the spread of disease is high while delivering works.

1. Safe work practices like thermal screening of the workers / employees before entering to the work place should be strictly followed in the construction site.
2. Only medically fit workers will be deployed at site and medical assistance will be arranged for unfit workers '
3. Placing Wash your hands' signs (and other preventative cues for workers) everywhere.
4. Hand washing stations should be set up at key places throughout site, including at entrances/exits to work areas, at accommodation, and at waste stations etc.
5. Ensure medical facilities are stocked with adequate supplies of medical PPE, as a minimum:

- ✓ Gowns, aprons

- ✓ Medical masks and some respirators (N95)
- ✓ Gloves
- ✓ Eye protections (goggles or face screens).

6. Those who are cleaning the project site will be provided with PPE (gloves, masks) and disinfectant (alcohol based hand rub).
7. Workers accommodation will be in good state for keeping clean and hygienic, and for cleaning to minimize spread of infection.
8. Wherever possible try to ensure social distancing and practice rotation in labor force. (Team A out and team B in).
9. The workers coming from outside shall observe home-quarantine for at least 14 days as per the guidelines issued by Ministry of health and family Welfare (MoHFW
10. If any of the workers or project team involved in the activity develops symptoms of pandemic should immediately go for quarantine and remain in isolation until they have been asymptomatic for 14 days.
11. Display and communicate the contact details of Govt. hospitals /camps or primary health centers nearby handling COVID-19 cases and Govt. helpline numbers
12. Contractor will strictly follow the State and National Guidelines on Covid-2019 at workplaces and at labor Camp.

6.7 Occupational Health and Safety Plan

CMWSSB is committed to maintaining a healthy and safe place of work for all its employees, as well as taking all reasonable steps to ensure that the public and the environment (which may be affected by its work) are exposed to the lowest practicable level of risk. It is also committed to the safe, efficient and cost effective use of marine vessels, equipment for the activities in the Creek. Safe work practices shall be developed to provide the control of hazards during the operation and maintenance. The detailed Site Specific Occupational Health and Safety Plan (OHSP) is enclosed as **Annexure X.**

6.8 Conclusion

The Disaster Management Plan is prepared in conjunction with and taking into consideration all technical reviews and suggestions as per acceptable norms and hence, will meet with any eventuality. The CMWSSB shall work in coordination with the relevant government authority to implement the plan in case of an emergency. The CMWSSB shall have the responsibility for carrying out remedial works after such an emergency in consultation with concerned government authority

7 SOCIAL IMPACT ASSESSMENT REPORT

7.1 Project Brief

The proposed project is laying of HDPE water pipeline below the Ennore Creek bed using Modular Cutter Suction Dredger. The pipe line proposed to lay in Ennore Creek is of total length 850m.

The project is implemented under Tamil Nadu Sustainable Urban Development Project (TNSUDP) with an estimated total project cost of Rs.392.61 Crores and estimated project cost for laying of conveying main across Ennore Creek is Rs.35 crores.

7.2 Project Components

This sub-project involves the following project components

- Total length of the Conveying main is 28.5 km. as per CRZ clearance (practically 25.350 km length)
- The product water pipe line proposed in Ennore Creek is of 850m.
- At either side of the Creek, 800mm dia DI pipeline and at Creek area 80mm Inner dia HDPE pipe of 50mm thickness.
- The depth of laying of conveying main is 6 m and width at top & bottom is 35m and 4m respectively.

7.3 Laying of Pipe Line in Ennore Creek

a) Storage of Construction Material and Dredging Material

The construction Material HDPE pipe, joints and CC Anchor etc. will be stored nearer to the project. The Construction/dredged material is stored in the area owned by PWD, hence prior permission will be sought from PWD for storage of construction material. The dredged (excavated) material will be stored in areas nearby project site without affecting the water bodies and nearby mangroves (located 40-50 m away from the project site). The storage area (20000 sq.mtr) selected and its location co-ordinates are given in the **Table 7.1**. Dredged material will be spread in a manner that material/ sediment mobilization is minimal in the specified area. The stored excavated material will be used for the backfilling of the dredged trench after the laying of pipeline.

Table 7. 1- Land requirement details for storage of Construction/ dredged Material

Pt.	Description	Area In sq. mtr.	Location coordinates	
			Latitude	Longitude
A	Primary Launching Pad	500	13°13'55.29"N	80°19'4.27"E
B	Temporary Pipe Storage	500	13°13'58.86"N	80°19'4.86"E
C	Dredged Soil Temporary Storage	20000	13°14'0.52"N	80°19'3.42"E
D	Alternate Fabrication & Launching Yard	7000	13°14'51.39"N	80°18'48.77"E
E	Block Casting & Storage Yard	3000	13°17'59.95"N	80°13'8.50"E

Table 7. 2Land Ownership of the roads for the Proposed TTRO Conveying main

S.No	Location	Size of Main (mm)	Start Chainage	Final Chainage	Length (m)	Land ownership	Remarks
1	Inside Kodungaiyur					CMWSSB's Own Land	No Social Impact
	Disposal line	800	0	1528	1528		
2	MFL & CPCL, TT Plant Road	800	1528	3379	1851	MFL & CPCL	No Social Impact
3	B'Canal Crossing	800	3379	3425	46	PWD	No Social Impact
4	IOCL Road	800	3425	3570	145	Corporation of Chennai	No Social Impact
5	Highways Crossing Manali Road	800	3570	3615	45	National Highway	No Social Impact
6	PWD 'B'Canal Road	800	3615	4425	810	PWD	No Social Impact
7	Railway Crossing	800	4425	4566	141	Southern Railway	No Social Impact
8	PWD 'B' Canal road	800	4566	6187	1621	Govt. of India	No Social Impact
9	Highways Crossing Basin Bridge - Manali Road	800	6187	6264	77	State Highway (Gov. of TN)	No Social Impact

10	PWD 'B' Canal Road	800	6264	12658	6394	Govt. of India	No Social Impact
11	Kathivakkam Highroad	800	12658	12778	120	State Highway (Gov. of TN)	No Social Impact
12	Railway Subway	800	12778	12843	65	Southern Railways	No Social Impact
13	Kathivakkam Highroad	800	12843	13193	350	State Highway (Gov. of TN)	No Social Impact
14	Ennore Creek (under water)	800	13193	14043	850	PWD	No Social Impact
15	Highways Road(Upto NCTPS)/ Beach – Ennore Port Road	800	14043	15850	1807	State Highway (Gov. of TN)	No Social Impact
	Total (800mm)				**15850**		
16	Old Ennore port road (NCTPS to EnnoreKamarajar port	600	15850	18225	2375	NCTPS	No Social Impact
17	L&T Port Road	600	18225	22850	4625	State Highway (Gov. of TN)	No Social Impact
	Total (600mm)				**7000**		
18	Highways Road Basin Bridge - Manali Road	300	0	2500	**2500**	State Highway (Gov. of TN)	No Social Impact

Permission for laying conveying main in the right of way of the existing roads in National High ways and railway crossing near CPCL and PWD road, IWAI and CRZ clearance have been obtained from the concern authorities. Approvals for laying the conveying main along the IWAI, Public Works Department, Government of Tamil Nadu, are enclosed in **Annexure III.**

b) Land Use for laying of Pipe Line: Laying of conveying main (850m) across Ennore Creek is owned by PWD, Government of Tamil Nadu. Private Land Acquisition / resettlement are not involved in this project. The Social Categorization of Projects, the number of Project Affected People (PAPs) in this project is nil, hence this project is categorized under S-3 category as per ESMF. A detail of the social/environmental categorization of the project is given in the **Chapter 1**.

7.4 Status of the Work

The transmission main of 800mm dia DI pile has been completed up to the Kathivakkam High School at Kathivakkam High road. The balance length of DI pipe upto the end of existing compound wall will be laid between the compound wall and the road at a depth of 1.50m from the GL. At Creek portion the depth of the HDPE pipe at starting will be 1.50m and will be gradually increased up to 6.0m depth at the middle of the creek. Then the depth will be gradually reduced to 1.50m at the end of the creek portion.

The alignment of the proposed HDPE will be 32.00m away from the existing piers of the Creek Flyover. Jointing of DI pipes the with the proposed 800mm dia ID HDPE pipe at both ends will be done after completing the work of Crossing Ennore Creek by dredging method.

7.5 Impact of Traffic Congestion

The conveying main will be laid across Ennore Creek (850 m). Ennore fly over road is the onlyroad that affects some traffic congestion during peak hoursas it is the main road connecting the Kattukupam Main Road and Athipattu Main Road & Port Access Road. The laying of pipe line across Ennore Creek creates some disturbance in the free movement of vehicles in and around the fly over bridge. People may suffer some inconvenience during the peak hours of the day.

Mitigation Measures of Traffic Congestion

- Traffic must be re-routed to facilitate ease of movement.
- Proper signage should provide detailed information on the dates and duration of road closures and which detours will be available, ideally well in advance of actual construction so residents can plan accordingly.

- Strategic placement of traffic police at critical intersections will also facilitate better flow of traffic and Necessary Barricades, Sign Board will be erected for the pedestrians and motorists.
- The traffic control plans will contain details of temporary diversion, details of arrangement for construction under traffic arrangement after cessation of work each day, SIGNAGES, safety measures for transport of construction materials and arrangement of flagmen.
- The school nearer to the site is located 800 m from the project location. Thus during construction, the flow of traffic to the school will not be affected as there may be some traffic congestion in some nearby areas. The construction work will be completed as quickly as possible.

Figure 7. 1Site Connectivity

7.6 Impact on an Old Building (Salt building) and Adjacent Structures

- The Old building is located in 140 m distance at Eastern side of the project site. The Archeological Survey of India, Chennai Circle is nowhere mentioned this old building as an archeological building or monuments.

7.7 Impact on Fishing Activity

During construction activity, the fishing activity and boat movement will affect temporarily.

7.7.1 Mitigation Measures

- The entire Laying of conveying main activity is planned to be carried out in two stages. In the first stage, 50 percentage of the total length to be dredged i.e. 425m will be done.
- Then the laying of the conveying main in the dredged trench and simultaneous backfilling of the dredged area will be complete in the whole stretch.
- In the second stage, the remaining 425m will be dredged for the laying of conveying main.
- As the Laying of conveying main is a two stage process, during first phase of construction, the boat can access second phase area, and during second phase, the vessels will get access through the first phase area. Hence during construction time, movement of boat will not be affected.
- During the laying of conveying main, fishes will be shifted from the project site to a safe zone due to the disturbances developed from the equipment handling. This is the temporary impact and after completion of work all fishes will come back to the project site.

7.8 Other Impacts

- The clearing of bushes and weeds will be necessary from the either side of the creek bed.
- The dust generation during earthen work will be suppressed by the water spraying.
- If any other negative temporary impact occurs, that will be attended immediately.
- During construction phase, adequate air release valves will be installed for the release of air, and scour valves will be installed in the pumping main to avoid any bursting.

7.9 Social Impacts

Social impacts due to implementation of the proposed project are assessed and the same are given below:

1. There is no loss of land and assets.
2. There is no loss of shelter or Homestead.
3. There is no loss of income or means of livelihood.
4. There is no loss of access to productive resources, shelter and residences
5. Construction of shelter camp does not require any land acquisition, as the same will be established within the plant premises, if required.
6. The identified and proposed location has no human settlement or any agricultural activity. Hence, proposed establishment of project does not require any displacement of human settlement.
7. Also, the proposed site (Ennore Creek) is uninhabited and without any social or reserve forests cover. Hence, there is no requirement for Resettlement and Rehabilitation (R&R) plans.
8. The cultural and religious activities of the people around the project site will never be intervened by any of the activities of the project, rather they will get support through employment (both direct & indirect), and sponsorship for continual up gradation of their socio-economic development.
9. The health of the workers will be continuously monitored by an exclusive Health Surveillance Plan (HSP) implemented by the CMWSSB. Requisite account of Emergency Management Plans, on-site and as well for off-site, will be prepared and kept under surveillance by CMWSSB administration, to meet any situations of emergency due to fire or any accident.

Based on the above analysis, the project (laying of conveying main) falls under the Social category of S3 as per ESMF.

7.10 Unidentified Impacts

Any unidentified social impact during construction phase of the conveying main will be mitigated as per the ESMF Social Safeguards Policy and compensated as per the Entitlement matrix.

Social Impacts and Measures

Possible Impacts	Mitigation Measures
• Due to Influx of Labour • Health and Safety of the population involved in project activities. • Impact on public movement during construction	• Unskilled labor will be preferentially recruited from the Local Residents. • Development of a code of conduct for camp workers, camp rules and disciplinary procedures. • All dredging materials to be suitably covered - to prevent dust generation by wind action. • Restriction of working hours - to minimize the noise impact on local residents. • In order to avoid unauthorized entry and to ensure safety for public movement, the necessary sign boards will be erected at appropriate places. • A strict speed limit will be enforced for the vehicles entering the site using unmade tracks.

7.9.2 Implementation Monitoring

- The project engineer will issue a Readiness Certificate which contains the details of the site to the contractor.
- After the project execution, the CMWSSB will submit monthly progress report to TNUIFSL regarding social impacts.
- CRZ& Inland Waterways Authority of India (IWAI) clearance conditions will be abided by the proponent during laying of TTRO water distribution pipeline across Ennore Creek. Some specific conditions to be followed are mentioned below and clearance copy is attached as **Annexure I.**

1. It shall be ensured that there are no blockages and free flow of water is ensured in the Canal/creek during the process of laying of pipelines except during extreme events in the creek such as storm surge
2. Along Buckingham Canal & across Ennore Creek for a length of 850m, laid under water at a depth of 4m (pipe bottom), from existing bed level to a maximum depth of 3.75m.

- Social Screening Form is attached as **Annexure V.**

7.9.3 Grievance Mechanism

1. The CMWSSB have Grievance Redressal mechanisms to address the grievance related to the employees of the project.
2. A grievance redressal committee (GRC) already setup for the project and the members are as follows (Preferably one of them as women)
   a. Superintending Engineer (Projects -CMWSSB)
   b. Executive Engineer (Projects- CMWSSB)
   c. A person who is publicly known in the local area (local Gram Panchayat person).
   d. A person from CMWSSB who is not directly involved in the implementation of the project.

The complaints will be acknowledged to the complainant. Efforts will be made by CMWSSB to ensure closure of complaint within a period of 30 days from the date of its receipt. If not satisfied with the resolution provided by GRC, the complaints shall be handled at higher level i.e., Chief engineer of CMWSSB.CMWSSB shall submit monthly reports on the status of compliance with the ESMF requirements to TNUIFSL.

7.9.4 Grievance Redressal Committee (GRC)

The GRC shall

- Convene meetings of the committee as necessary at such place or places in the Project Implementation Agency as he considers appropriate; and
- Conduct the proceedings in an informal manner as he considers appropriate with the object to bring an amicable settlement between the parties.

Step by step approach will be followed for redressing grievances. First, the aggrieved Project Affected Person to approach the GRC in the first stage and the grievance committee will look into the grievances and resolve the issues. The proceedings of GRC will be documented.

If not satisfied with the resolution provided by GRC, then the complainants can appeal to higher level.

8 PUBLIC CONSULTATION

PUBLIC CONSULTATION – ENNORE

Proceedings of the Public Hearing/Stake Holders Meeting conducted on 11/01/2020 at St. Joseph Church, Ennore in connection with the Laying of Conveying Main across Ennore Creek for the Distribution of TTRO Water to various industries in and around Ennore Area.

Information on Public Consultation is given adequately to the Public by means of notice, personal contact, etc. As per the World Bank policy on access to information and disclosure, the proposed project attracts Public Hearing. The Public Hearing was arranged by the Chennai Metropolitan Water Supply & Sewerage Board (CMWSSB).The concerned persons having plausible take in environment aspects were requested to attend the meeting. Wide canvassing has been made by issuing notices door to door and keeping displays. The minutes of public consultation are as follows. The following were present during public meeting.

1. Mr. A.Malaichamy(Superintending Engineer, CMWSSB)
2. Mr. A. Radhakrishnan (Executive Engineer, CMWSSB)
3. Mrs. S.T Vani Priyadharsini(AEE,CMWSSB)
4. Mr. P.Babu Krishnan (DGM, BGR Energy Systems Limited)
5. Mr. K. Suresh Kumar(DGM, pipeline, BGR Energy Systems Limited)

The proposed project is laying of 800mm ID HDPE pipeline of 50mm thickness and length of 850 m across the Ennore Creek using dredging technology. The depth will be 6.0m from existing bed level. In order to explain the current status of the project to the beneficiary public, a joint meeting has been held at St. Joseph Church, Ennore on 11.01.2020 by 11:30am. Senior officials of CMWSSB facilitated the consultative meeting which was attended by almost 30numbers of people.

At the beginning Superintending Engineer, CMWSSB, welcomed the gathering and explained the salient features of the proposal. The importance of the project and need for distributing treated water to various industries nearer to Ennore Creek were mentioned in detail. The Engineer has also explained the successful execution of the similar projects and being maintained under different technologies. He further gave technical explanations about the Project to public with salient details such as existing Treatment Plant, TTRO plant Treatment System, Conveyance main details in Ennore Creek, and quality of Pipe (HDPE) used etc. The stake holders /beneficiaries were asked to offer their views on the proposed project.

The major queries and discussions of the meetings are as follows:

S.N	Query	Reply
1	M.Anandan, Citizen of Kattukuppam: Asked for the total length, width and depth of the laying of pipe line in Ennore creek	The Superintending Engineer, CMWSSB replied: The total length of the laying of pipeline is 850m, width 4 m and depth is 6 m from existing bed level.
2	M.Devadoss, Citizen of Kattukuppam: What type of pipe proposed to be used in Ennore creek for conveying of treated water?	The Superintending Engineer, CMWSSB explained: The High Density Poly Ethylene (HDPE) Pipe will be used for the conveying the main in Ennore creek.
3	G.Kumar,Citizen of Thazhankuppam: If any damageoccurinlaying of conveying main in Ennore Creek, will it create any impact?	The Superintending Engineer, CMWSSB explained: As the pipe is to be laid for conveying tertiary treated water from Kodungaiyur TTRO plant to the industries at Ennore such as NCTPS, NCTP, etc,, even if any leakage there will not be any adverse impact on the river / canal.
4	L.C RajiNattukuppam, Citizen of Thazhankuppam: What is the life span of HDPE pipe?	The Superintending Engineer, CMWSSB explained: The life span of High Density Poly Ethylene (HDPE) Pipe is 30 years.
5	D.Srinuvasan, Citizen of Ennore: Why cannot construct the pipe carrying bridge instead of laying of conveying main in the river bed?	The Superintending Engineer, CMWSSB explained: PWD had not given permission for constructing pipe carrying bridge for conveying the pipeline; they suggested some alternative method for conveying the pipe line. Hence, CMWSSB has decided to lay pipeline below bed level without affecting the ship movements.
6	M.Natesan, Citizen of Ennore: What are the clearances required for the proposed project and obtained from concern department?	The Superintending Engineer, CMWSSB explained: CRZ clearance, PWD and IWAI No Objection Certificates (NOC) were obtained from concerned department.

7	G.Kumar, Citizen of Thazhankuppam: Minimum period required for completion of laying of conveying main in Ennore Creek?	The Superintending Engineer, CMWSSB explained: The completion period of laying of conveying main in Ennore Creek is 2 Months.
8	S.Muthu, Citizen of Ennore: How to do the fishing activity and boat movement during construction period?	The Superintending Engineer, CMWSSB explained: The entire laying of conveying main activity is planned to be carried out in two stages. In the first stage, 50 percentage of the total length will be dredged i.e. 425m.Then the laying of the conveying main in the dredged trench and simultaneous backfilling of the dredged area will be complete in the whole stretch. In the second stage, the remaining 425m will be dredged for the laying of conveying main. Hence proposed activity will not create any impact on fishing activity.
9	M.Natesan, Citizen of Ennore: What type of technology will be adopted for laying of conveying main in Ennore Creek.?	The SuperintendingEngineer,CMWSSB explained: The float n Sink and Lay-Barge both methodologies will be used for laying pipe line (850 m) in Ennore Creek.
10	B. AnserBasha Citizen of Kattukuppam: During heavy flood, water level and high tide is high, in that situation, will conveying main rise to the top of the water level and will it create any damage to the pipe line?	The Superintending Engineer, CMWSSB explained: CC Anchor Blocks will be provided to prevent rising of the pipeline when it is fully empty and for facing any adverse condition likes flood.
11	L.C Raji, Citizen of Nattukuppam: The fisher man nearer to the Ennore Creek already facing some skin related diseases during fishing activity in Ennore Creek, as the water body is completely polluted due to the surrounding industries, if any leakage occurs in pipe line, will it added up any problem to the fisher folks / fishing activity?	The Superintending Engineer, CMWSSB explained: As this is the tertiary treated water, any leakage will not create any adverse impact to human and water body. The treated water coming out from the plant is safe for using in the industries as it meets the acceptable limits of CPCB standards. The treated water quality is like TDS<70, Hardness<5,TSS, BOD, COD -(BDL)
12	D. Srinuvasan, Citizen of Ennore: How to handle the sludge generated during laying of conveying main?	The Superintending Engineer, CMWSSB explained: The dredged (excavated) material will be stored in nearby low lying areas in the project site without affecting the water bodies and nearby mangroves.

		The stored excavated material will be used for the backfilling of the dredged trench after the laying of pipeline.

Mr. Mr. A. Malaichamy (Superintending Engineer, CMWSSB) concluded the meeting by thanking all the participants who have attended the meeting.

Mr. Malaichamy
Superintending Engineer
CMWSSB

9 IMPLEMENTATION OF THE PROPOSED PROJECT AND INSTITUTIONAL ARRANGEMENTS AT CMWSSB

9.1 Introduction

The proposed project is laying of HDPE water pipeline of 800mm ID below the Ennore Creek bed using Modular Cutter Suction Dredger to a total length 850m .This project will be implemented on DBOT basis by CMWSSB under the scheme of Tamil Nadu Sustainable Urban Development Project (TNUSDP) at an estimating cost of Rs. 392.61 Crores and laying of conveying main cost Rs. 35 crores.

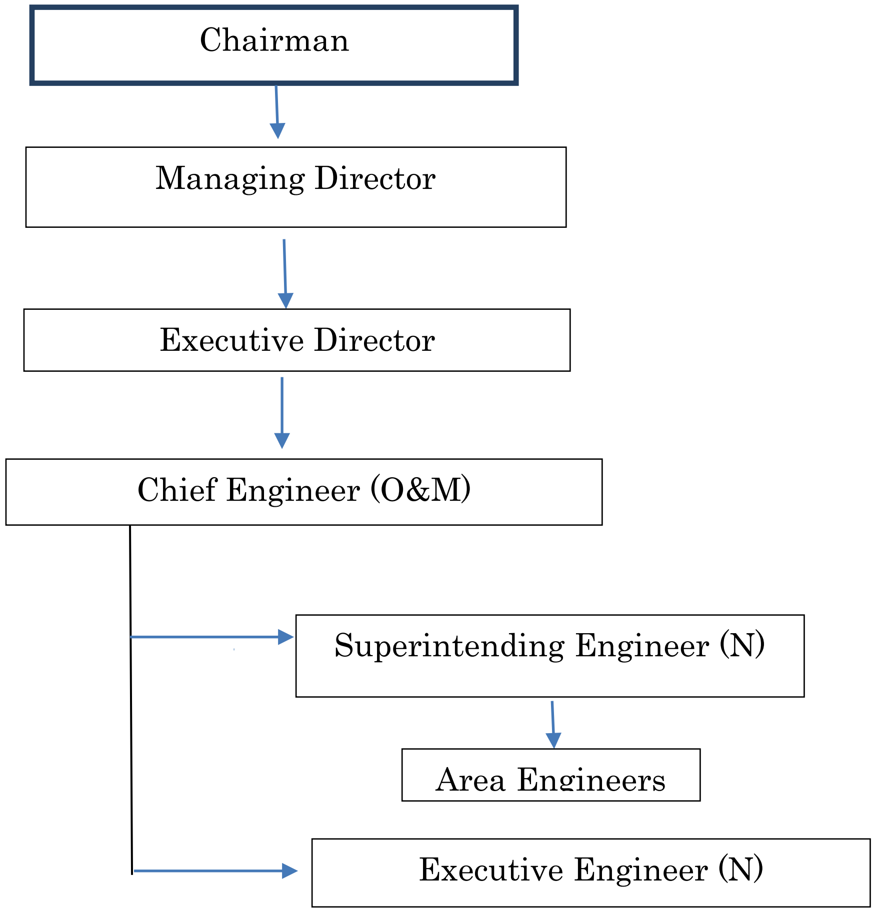
The project is proposed to be implemented by DBOT contractor. The environmental management measures identified for contractor will be included in the bid document for ensuring implementation of the environmental safeguards. The DBOT contractor shall develop and prepare specific EMP in line with the management measures identified in the ESIA report. The same shall be submitted to CMWSSB for approval prior to construction or along with designs.

Implementation of the management measures by the contractor shall be ensured by CMWSSB and report on ESMF compliance shall be submitted to TNUIFSL periodically. The implemented management measures will be taken up by the CMWSSB & DBOT contractor upon completion of construction activities.

9.2 Organization Structure

The CMWSSB has the ultimate responsibility for implementing the provisions of the ESMP. This role includes ongoing management of environmental impacts, measuring environmental performance through inspections/audits and monitoring. The contractor performance as well as development of mechanisms for dealing with HSE is an integral part of the environmental management. Contractors are responsible for implementation and adherence to all mitigation measures outlined in the ESMP.

CMWSSB is responsible for the safeguard implementation and monitoring of the proposed laying of HDPE pipeline across Ennore Creek. CMWSSB organization Chart is described below.



9.3 Stakeholder Engagement, Consultation, Analysis and Disclosure

A stakeholder is defined as a person, group, or organization that has direct or indirect stake in the project/ organization because it can affect or be affected by the project/ organization's actions, objectives, and policies. Stakeholders are categorized in terms of degree of interest, influence and control they have over the project. This includes the process of identifying and engaging relevant stake holders as a part of ESIA study. If there a risks or adverse impacts from a project, consultation must be inclusive and culturally appropriate and provide stakeholders with opportunities to express their views. In line with current guidance from the IFC, consultation should ensure "free, prior and informed consultation of the affected communities.

9.3.1 Stakeholder Identification

Identification of stakeholders and their engagement through appropriate medium in the decision-making process can help in prioritizing, analyzing and addressing issues; and create management systems and strategies to address their concerns/ expectation.

During the scoping stage a preliminary list of project stakeholders were identified using international guidance and considered the following groups:

- National, regional and local government
- Local community and local leaders (like Panchayat members, political party representatives etc.)
- Community members including vulnerable sub-groups such as women, youth and elderly;
- National and local environmental and social non-government organizations (NGO's).

9.3.2 Key stakeholders Group for the project and their Profile

Concerned Central Government Ministries and Department

Following mentioned Ministries and Department at central level are important for the project from the perspective of obtaining necessary approval, permits etc. related to environment & social issues of the proposed project.

- Ministry of Environment, Forests & Climate Change, Government of India;
- Central Pollution Control Board
- Inland waterways Authority of India

Concerned State Government Ministries and Department

Following mentioned state level government offices, might have influence over different stages of the project, especially in the realm of Environment & Social issues of the proposed project.

- Tamil Nadu State Pollution Control Board;
- Public Work Department (PWD);
- Labour Department.

Community likely to be affected by project

This includes the fishermen and other local peoples surrounding the Ennore creek who may be impacted by the project activities. However, impact to the fishing is temporary during the construction time and fishermen should be informed well in advance in local language regarding the two stage construction process and makes them aware that there is no access / movement restriction during both phases. The information regarding the dates of works will be displayed in the project site and will announce through notice in local newspapers in local language.

Local community representatives, political leaders.

This category of stakeholders will typically include local leaders such as Gram panchayat members, local leaders associated with active political parties in the region, any other individual or group having potential to influence community opinion and ability to mobilize locals.

Local Media

Local media is one of the important communication platform between project and stakeholders. Local media, especially print media do play important role in shaping perception of local community regarding project activities

Institutional stakeholders

Industries situated in the Manali – Ennore corridor, Manali-Minjur Corridor of the North Chennai are the key institutional stakeholders of the proposed project. Major industries located after Ennore Creek are North Chennai Thermal Power Station, Tamil Nadu Energy Company Ltd, and L&T Ship Building. Local peoples surrounding the Creek are also beneficiaries/stakeholders of the proposed project, the water (RO water) from the desalination plant located at Minjur will be used for augmenting water supply to the nearby areas.

9.3.3 Stakeholder Engagement during ESIA process

ABC Technolabs of India private limited engaged with respective stakeholders at various stages of this ESIA study in order to obtain necessary data and/or feedback, relevant for the study. The key stakeholder groups consulted during screening and scoping of ESIA study were;

- Project Proponent (CMWSSB)
- Government Department (MOEF & CC for CRZ clearance; Inland waterways authority of India, PWD)
- Local Community.

9.4 Environmental Management Plan

The proposed project will be implemented on D.B.O.T basis by the CMWSSB; hence the contractor will form his own Environmental Management Cell which includes experts in marine ecologists, hydrologists, structural engineer and emergency specialist. However, CMWSSB will ensure for the compliance of the EMP.

9.4.1 Grievance Mechanism

Grievance Mechanism

1. The CMWSSB have Grievance Redressal mechanisms to address the grievance related to the employees of the project.
2. A grievance redressal committee (GRC) already setup for the project and the members are as follows (Preferably one of them as women)
   a. Superintending Engineer (Projects -CMWSSB)
   b. Executive Engineer (Projects- CMWSSB)
   c. A person who is publicly known in the local area (local Gram Panchayat person).
   d. A person from CMWSSB who is not directly involved in the implementation of the project.

The complaints will be acknowledged to the complainant. Efforts will be made by CMWSSB to ensure closure of complaint within a period of 45 days from the date of its receipt. If not satisfied with the resolution provided by GRC, the complaints shall be handled at higher level i.e. Chief Engineer of CMWSSB.

CMWSSB shall submit monthly reports on the status of compliance with the ECSMF requirements to TNUIFSL.

9.4.2 Grievance Redressal Committee (GRC)

The GRC shall

- Convene meetings of the committee as necessary at such place or places in the Project Implementation Agency as he considers appropriate; and
- Conduct the proceedings in an informal manner as he considers appropriate with the object to bring an amicable settlement between the parties.

Step by step approach will be followed for redressing grievances. First, the aggrieved Project Affected Person to approach the GRC in the first stage and the grievance committee will look into the grievances and resolve the issues. The proceedings of GRC will be documented. If not satisfied with the resolution provided by GRC, then the complainants can appeal to higher level.

10. PROJECT BENEFITS

10.1 Project Scenario

The main source of water supply to the Chennai city is from surface water sources such as Poondi, Cholavaram and Red hills reservoirs and also from ground water sources from Araniar and Koratalaiyar basin. Chennai city does not have any perennial source of water. The water supply has been augmented by Krishna Water Supply Scheme with supply from the State of Andhra Pradesh and by Chennai Water Supply Augmentation Project with supply from Veeranam Tank.

A desalination plant of capacity 100 MLD is commissioned near Kaatupalli village, Minjur. Another 100 MLD capacity desalination plant is commissioned at Nemmili at the Southern outskirts of Chennai.

Preliminary Assessment on Suitability of Treated water usage by Industries

The secondary treated effluent of about 63.5 MLD is treated by TTRO plant, 45 MLD of treated water will be send to the industries. The balance 18.5 MLD treated effluent is being let into the Buckingham canal.

As the demand for TTRO water is now assessed from the industries in North Chennai by M/s ITCOT Consultancy and services, it is proposed to construct a TTRO Plant of capacity 45 MLD at Kodungaiyur to supply the TTRO water to meet their demands.

The study results are positive and on the basis of occupancy level and maturity of industrial parks and compound annual growth rate envisaged, the water demands for 2014 – 15 & 2019 – 20 is projected at 45 MLD & 60.0 MLD respectively.

Based on the study an overwhelming 70 – 92 % of the units have evinced interest in buying TTRO water from M/s CMWSSB.

10.2 Project Benefits & Future Scenario

The proposed project aims at treating the secondary treated water suitable for industrial use. Some of the major project benefits are given below:

- Industrial consumers will be supplied with treated water with good quality. So far the industrial consumers are depending on the fresh water from lake and ground water.

- Reuse of water helps to save the fresh water dependency to the other natural sources.
- Reduction of fresh water consumption by industries and more fresh water shall be made available for potable use in the city.
- The project will also be able to meet the industries increasing fresh water demands in future. Meeting the growing needs of industries for fresh water supply by the water supply authorities would also be difficult since the fresh water requirement of the city also increases in time.
- Employment generation in terms of skilled and unskilled man power due to plant construction and operation.
- The successful completion of project enables diversion of 45 MLD of drinking water to the public use and it will be a relief to the Chennai City facing shortage of water supply on every summer season.
- The availability of water is sustainable irrespective of the season throughout the year.

11 DISCLOSURE OF CONSULTANT

This chapter presents the details of the environmental consultants engaged, their background and the brief description of the key personnel involved in the project

11.1 INTRODUCTION

ABC Techno Labs India Private Limited is an ISO 9001, ISO 14001 & OHSAS 18001 Certified Company & leading Environmental Engineering & Consultancy Company. ABC is the first firm to be accredited by NABET (National Accreditation Board for Education and Training), Quality Council of India, as an ESIA Consultant. ABC is equipped with in-house, spacious laboratory, accredited by NABL (National Accreditation Board for Testing & Calibration Laboratories), Department of Science & Technology, Government of India. Copy of the NABET accreditation is given in the last page.

Since establishment our focus is on sustainable development of Industry and Environment based on sound engineering practices, innovation, quality, R&D and most important is satisfying customers need. The company has successfully completed more than 100's projects of variety of industries, in the field of pollution control. We are also dealing in the projects of waste minimization and cleaner production technology. Our team of technocrats and scientists are well experienced to deal with the Designing, Manufacturing, Fabrication, Installation and Commissioning of Effluent/Wastewater Treatment Plants, Sewage Treatment Plants, Combined Treatment Plants.

We are having a well experienced team of Scientists & Engineers who are looking after our well-equipped analytical laboratory with a facility including analysis of physical, chemical and biological parameters as per the requirements of the State Pollution Control Board and our clients.

Quality Policy

- Providing high quality consultancy services
- Time bound completion of projects and submission of reports
- Employing competent engineers and scientists
- Implementing the best available technology
- Maintaining a good quality products and public relation practice
- Continually improving the effectiveness of Quality Management

Services Offered

A. Environmental Services

- Environmental Impact Assessment (EIA)
- Environmental Management Plan (EMP)
- Social Impact Assessment (SIA)
- Environmental Baseline data collection for Air, Meteorology, Noise, Water, Soil, Ecology, Socio-Economic and Demography etc;
- Environmental Monitoring
- Socio Economic Studies
- Resettlement & Rehabilitation Plan
- Ecological & Human Health Risk Assessment Studies
- Ecological Impact Assessment
- Environmental Management Framework
- Solid Waste Management
- Hazardous Waste Management
- Internship & Training

B. Multi-lab Division

- Chemical Testing
- Environmental Testing
- Microbiological Testing
- Food Testing
- Metallurgical Testing
- Mechanical Test
- Chemical Testing

C. Turnkey Projects

- Water Treatment Plants
- Sewage Treatment Plant
- Recycling & Water Conservation Systems
- Zero Discharge System
- Operation & Maintenance of Water & Waste Water Plants
- Water & Waste Water Treatment Chemicals
- Pilot Plant studies
- Feasibility studies & preparation of budgetary estimates

Sectors We Serve

- Mining of Minerals including Opencast/Underground mining
- Thermal Power Plants

- Mineral Beneficiation including Pelletisation
- Metallurgical Industries (Ferrous & Non Ferrous)
- Chlor-alkali Industry
- Textile- cotton & Man-made fibre
- Coke Oven Plants/ Waste Heat Recovery
- Synthetic Organic Chemical Industries
- Sugar, Distilleries and Cogeneration
- Integrated Paint Industries
- Common Municipal Solid waste Management facility
- Industrial Estates/ Parks/Complexes/Special Economic Zones
- Common Effluent Treatment Plants
- Building & Construction Projects,
- Townships & Area Development Projects

Study Team

The multidisciplinary team included expertise in Environmental& Social Impact Assessment, Air pollution & Control measures, Noise Control measures, Ecology and bio-diversity, Land use, Geology, Environmental Chemistry and Socio-Economic planner.

S.NO	NAME	ROLE
1.	Mr. Shankar N Gajbhiye	EIA Coordinator - Overall coordination of EIA study, report preparation, review and validation
2.	Dr. R. K. Jayaseelan	FAE –Water Pollution, Hydrology
3.	Mr. PVRS. Surendra	SIA Team Coedinator
4.	Dr. Muthiah Mariappan	FAE - Solid & Hazardous Waste Management, Air Pollution
5.	Jada Srinivasa Rao	FAE –Land Use
6.	Mrs. Vijayalakshmi	FAE –Noise and Vibration, Air Quality
7.	Mr.AbhikSaha	FAE –Ecology and Biodiversity
8.	Mr. R. Rajendran	FAE – Noise, Solid & Hazardous Waste Management
9.	Mr. Sushil mesram	FAE- Socio Economy
10.	Mr. Rajendran	FAE- Soil and Conservation
11.	Mr. Rajaganapathy. J	Sr.Project Engineer - Preparation and Documentation/ FAE Water Pollution Control & SHW
12.	Mrs. Seena Mithra. S	Junior Project Engineer- EIA, Preparation and Documentation / FAA
13.	Mr. Robson Chinnadurai	Senior Chemist - Environmental Monitoring

14.	Mr. Venkateshwaralu	Team Member - Environmental Monitoring
15.	Mr. Thavanesan	Field Technician

ANNEXURE I

1. CRZ Clearance obtained from MoEF & CC

2. Amendment in CRZ Clearance obtained from MoEF&CC

F.No. 11-23/2016-IA-III
Government of India
Ministry of Environment, Forest and Climafe Change

Indira Paryavaran Bhawan,
Jor Bagh Road,
New Delhi - 110003
Date: 26.10.2018

To,

The Superintending Engineer (WWT&R)
Chennai Metropolitan Water Supply and Sewerage Board,
No.1, Pumping Station Road, Chintradripet
Chennai-600002, Tamil Nadu

Sub: ***Amendment in CRZ Clearance accorded for Laying of Conveying Main along Buckingham Canal and Across Ennore Creek for supply of 45 MLD of RO Permeate to Industries and Discharge of Rejects of 18.5 MLD into Buckingham Canal in CRZ area at Kodungaiyur, Fort-Tondairpet, Chennai, Tamil Nadu - reg.***

Sir,

This refers to your letter no. CMWSSB/S.E. (WWT&R)/STP (North)/KOD-45MLDTTRO/039/CRZ/2015-16, dated 03.05.2018 requesting therein amendment of CRZ clearance accorded on 05.09.2017 for Laying of Conveying Main along Buckingham Canal and Across Ennore Creek for supply of 45 MLD of RO Permeate to Industries and Discharge of Rejects of 18.5 MLD into Buckingham Canal in CRZ area at Kodungaiyur, Fort-Tondairpet, Chennai, Tamil Nadu.

2. In this regard, it is to inform that your request was reconsidered by the Expert Appraisal Committee (EAC)- Infrastructure Development, Coastal Regulation Zone, Building/Construction and Miscellaneous Projects viz. EAC (CRZ), in its 198th meeting held on 17.09.2018. In acceptance of the recommendation of the EAC (CRZ) the Competent Authority in this Ministry, has considered your request and it is hereby informed that the following amendment shall be made in this Ministry's letter of even no. dated 05.09.2017 as follows:

Under para no. 2, (v) the details of proposed conveying pipeline shall be now read as follows:

S.N	Length of pipeline (m)	CRZ category	Location
1	300	CRZ-I	Inter tidal zone
2	10945	CRZ-II	In CMDA area
3	7000	CRZ-III	Outside CMDA area
4	850	CRZ-IV	Water area (beneath the water bed) in Ennore creek
5	9405	NIL	Non CRZ Area

OFFICE OF THE S.E. ENGG. (STP) NORTH
02 NOV 2018
No. 2424
C.M.W.S.S.B CHENNAI

4. All other terms and conditions mentioned in this Ministry's letter of even number, dated 05.09.2017, shall remain unaltered.

This issues with the approval of the Competent Authority.

Yours faithfully,

(W. Bharat Singh
Director/ Sc 'F'

Copy to:

1. The Secretary, Environment & Forests Department, Govt of Tamil Nadu, Saint George Port, Chennai.
2. The Chairman, Central Pollution Control Board, Parivesh Bhavan, CBD- cum-Office Complex, East Arjun Nagar, Delhi - 110032.
3. The Chairman, Tamil Nadu State Pollution Control Board, 76, Mount Salai, Guindly, Chennai – 600032.
4. The Member Secretary, Tamil Nadu Coastal Zone Management Authority, Department of Environment and Forests, Government of Tamil Nadu, First Panaqal Building, Saidapet, Chennai 600015.
5. The APCCF (C), MoEF&CC, RO, 1st Floor, Handloom Export Promotion Council, 34, Cathedral Garden Road, Nungambakkam, Chennai-600034.
6. Guard File.
7. Monitoring File

(**W. Bharat Singh**)
Director/ Sc 'F'

OFFICE OF THE EXE. ENGR/STP(N)
11 SEP 2017
No. 1861
C.M.W.S.S.B. CHENNAI

Office of the Superintending Engineer (W.W.T.&R)
Date: 11/9/17
No: 1485
CMWSS Board, Chennai-600 002

F.No. 11-23/2016-IA-III
Government of India
Ministry of Environment, Forest and Climate Change

Indira Paryavaran Bhawan,
Jor Bagh Road, New Delhi - 110003
Dated: 05.09.2017

To,

The Superintending Engineer (WWT & R)
Chennai Metro Water Supply and Sewerage Board
No.1, Pumping Station Road, Chintadripet
Chennai-600 002, Tamil Nadu

PEI | AEE (C2+C3)
11/9/17
EE(STP(N))

Sub: CRZ Clearance for "Laying of Conveying Main along Buckingham Canal and across Ennore Creek for supply of 45 MLD of RO permeate to Industries and Discharge of Rejects of 18.5 MLD into Buckingham Canal in CRZ area at Kodungaiyur, Fort-Tondairpet, Chennai, Tamil Nadu - reg.

Sir,

This has reference to your proposal No. IA/TN/MIS/55851/2016, received in this Ministry for CRZ Clearance in accordance with the provisions of the Coastal Regulation Zone (CRZ) Notification, 2011 issued under the Environment (Protection) Act, 1986.

2. The proposal for Laying of Conveying Main along Buckingham Canal and across Ennore Creek for supply of 45 MLD of RO permeate to Industries and Discharge of Rejects of 18.5 MLD into Buckingham Canal in CRZ area at Kodungaiyur, Chennai, Tamil Nadu was earlier considered in the 162nd meeting of the Expert Appraisal Committee (EAC) - Infrastructure Development, Coastal Regulation Zone, Building / Construction and Miscellaneous projects held on 29th August, 2016. The proposal was re-considered again in 173rd meeting held during July 24, 2017, wherein the EAC has recommended the proposal for CRZ Clearance. The details of the project, as per the documents submitted and as informed during the aforesaid meetings of the EAC are noted as under:

i) The project involves construction of 45 MLD capacity Tertiary Treatment Reverse Osmosis Sewage Treatment Plant (TTRO Plant) at Kodungaiyur and laying of conveying mains along the Buckingham Canal and across the Ennore Creek.
ii) Total area of TTRO plant will be 28,340 sq.m. The TTRO plant is located in the Institutional zone, outside CRZ.
iii) Conveying mains will traverse 28.5 km of pipelines supplying treated water from TTRO plant to the industries, power plants and iinstitutions located at Manali- Minjur, Manali- Ennore Corridor in North Chennai. The TTRO site is located at a distance of 1.5 km from Tondiarpet High Road.

EE/TTRO for n/a 11/9/17

iv) The conveying mains have varying diameter viz. 800 mm diameter pipeline for a length of 19 km; 600 mm diameter pipeline for a length of 7 km; and 300 mm diameter pipeline for a length of 2.5 Km respectively.

v) The details of proposed conveying pipeline are as follows:

S. No.	Length of pipeline (m)	Pipeline under CRZ	Location
1	300	CRZ I	Inter tidal zone
2	10945	CRZ II	In CMDA area
3	7000	CRZ III	Outside CMDA area
4	850	CRZ IV	Water area at Ennore creek
5	9405	NIL	Non CRZ Area

vi) The proposed conveying main will be laid below ground level; hence there is no disturbance to the existing overhead electric lines.

vii) Tamil Nadu Coastal Management Authority (TNCZMA) has recommended the project vide their letter No.3736/EC.3/2016-2 dated 23rd May, 2016 and letter No. 81/EC.3/2017-1 dated 09.01.2017.

viii) Demarcation of High Tide Line/Low Tide Line was done by Institute of Remote Sensing, Anna University, Chennai.

ix) Hazardous wastes shall be sent to Tamil Nadu Pollution Control Board approved recyclers.

x) Green belt of 4300 sq.m is proposed to be developed around the TTRO plant.

xi) Municipal solid waste generated disposal facility: The sludge disposed from TTRO plant will be utilized as manure for agriculture and horticulture.

xii) Waste water generation, treatment and disposal: 63 MLD of Secondary Treated sewage will be taken for the proposed TTRO Plant at Kodungaiyur to produce 45 MLD of TTRO water which will be supplied to the industries and the balance 18 MLD will be rejects from the TTRO Plant. These rejects after blending with secondary treated sewage to meet the TNPCB standards will be discharged into the Buckingham Canal.

xiii) Drinking water earlier supplied to the industries will now be made available for public use.

xiv) There is no Forest land involved.

xv) Investment/Cost of the project: Rs. 255 Crores.

xvi) RWH: Rainwater Harvesting is proposed.

xvii) Energy efficient pumps will be used for energy saving.

xviii) Power requirement and source: 4270 kW will be sourced from Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO). DG set of 750 KVA will be used as backup power in case of power failure

xix) National Park/ Wild Life Sanctuary in 10 km radius area: Nil within 10 km radius.

xx) Reduction of fresh water consumption by industries and more fresh water shall be made available for potable use in the city.

xxi) Employment: About 100 persons will be employed during peak period and an average of 50 persons in normal period.

3. Based on the information submitted as at para no. 2 above and others and presentation made before the EAC (Infrastructure Development, Coastal Regulation Zone, Building / Construction and Miscellaneous projects) in its 173rd meeting held on July 24, 2017, and in acceptance of the recommendation of the EAC, the Ministry of Environment, Forest and Climate Change hereby accords CRZ Clearance to the above project viz *'Laying of Conveying Main along Buckingham Canal and across Ennore Creek for supply of 45 MLD of RO permeate to Industries and Discharge of Rejects of 18.5 MLD into Buckingham Canal in CRZ area at Kodungaiyur, Fort-Tondairpet, Chennai, Tamil Nadu,* subject to the following specific and general conditions as under:

PART A - SPECIFIC CONDITIONS:

(i) All conditions/recommendations stipulated by the Tamil Nadu Coastal Zone Management Authority (TNCZMA) vide its letter no. No.3736/EC.3/2016-2 dated 23.05.2016 and letter No. 81/EC.3/2017-1 dated 09.01.2017 shall strictly be complied with.

(ii) A 2% of the cost of the project shall be apportioned for marine and coastal biodiversity protection and conservation measures, to be spent by the project proponent towards fulfilling its Corporate Environmental Responsibility (CER) during the currency of the project. Proper record and account of measures taken should be maintained and should also be submitted to the CZMA every six months.

(iii) It shall be ensured that system for detecting leakages along the pipeline shall be installed and regularly monitored through an independent agency. In case of any such eventualities, the project proponent shall immediately stop disposal through the said pipeline and take the corrective measures. The results of monitoring shall be regularly submitted to the PCB and the regional office of Ministry.

(iv) The project proponent shall ensure that any adverse potential impacts due to the proposed activity on the marine/creek environment during construction and operational phases on the marine environment/Buckingham Canal is managed through a robust marine environment management plan (MEMP) and implemented in letter and spirit.

(v) As committed the project proponent shall ensure that only treated sewage water from the TTRO plant is supplied to the industries and the drinking water being supplied to the industries shall be made available for public consumption once the TTRO plant is in operation.

(vi) It shall be ensured that there are no blockages and free flow of water is maintained in the Canal/creek during the process of laying of pipelines.

(vii) 'Consent to Establish' shall be obtained from State Pollution Control Board under the Air (Prevention and Control of Pollution) Act, 1981 and the Water (Prevention and Control of Pollution) Act, 1974, as may be applicable.

(viii) The construction in CRZ areas shall be done strictly in accordance with the provisions of CRZ Notification, 2011 and as amended from time to time.

(ix) There shall be regular monitoring of the results of standard parameters of the waste effluent discharged from TTRO plant, under intimation to the TNPCB.

(x) The project proponent shall ensure that no ground water is extracted within CRZ areas without prior approval of the Central Ground Water Authority.

(xi) Soil and ground water samples in and around the TTRO plant shall be tested regularly to ascertain that there is no threat to ground water quality by leaching of heavy metals and other toxic contaminants.

PART B - GENERAL CONDITIONS:

(i) A copy of the clearance letter shall be uploaded on the websites of the Company/Proponent and concerned State Pollution Control Board. The Clearance letter shall also be displayed at the Regional Office, District Industries centre and Collector's Office/ Tehsildar's office for 30 days.

(ii) The funds earmarked for environmental protection measures shall be kept in separate account and shall not be diverted for other purpose. Year-wise expenditure shall be reported to this Ministry and its concerned Regional Office.

(iii) Adequate provision for infrastructure facilities including water supply, fuel and sanitation must be ensured for construction workers during the construction phase of the project to avoid any damage to the environment.

(iv) A six-monthly monitoring report shall need to be submitted by the project proponent to the concerned regional Office of this Ministry regarding the implementation of the stipulated conditions.

(v) The Ministry of Environment, Forest & Climate Change or any other competent authority may stipulate any additional conditions or modify the existing ones, if necessary in the interest of environment and the same shall be complied with.

(vi) Concealing factual data or submission of false/fabricated data and failure to comply with any of the conditions mentioned above may result in withdrawal of this clearance and attract action under the provisions of Environment (Protection) Act, 1986.

(vii) The above stipulations would be enforced among others under the provisions of the Water (Prevention and Control of Pollution) Act, 1974, the Air

(Prevention and control of Pollution) Act, 1981, the Environment (Protection) Act, 1986, the Public Liability (Insurance) Act, 1991, the EIA Notification, 2006 and the CRZ Notification, 2011.

(viii) Full co-operation shall be extended to the officials from the Regional Office of MoEF&CC, during monitoring of implementation of environmental safeguards stipulated. It shall be ensured that documents/data sought pertinent is made available to the monitoring team. A complete set of all the documents submitted to MoEF&CC shall be forwarded to the concerned Regional Office of MoEF&CC.

(ix) In the case of any change(s) in the scope of the project, the project would require a fresh appraisal by this Ministry.

(x) The Ministry reserves the right to add additional safeguard measures subsequently, if considered necessary, and to take action to ensure effective implementation of the suggested safeguard measures in a time bound and satisfactory manner, including revoking of the environment clearance under the provisions of the Environmental (Protection) Act, 1986, for non compliance.

(xi) All other statutory clearances such as the approvals for storage of diesel from Chief Controller of Explosives, Fire Department, Civil Aviation Department, Forest Conservation Act, 1980 and Wildlife (Protection) Act, 1972 etc. shall be obtained, as applicable by project proponent from the respective competent authorities.

(xii) The project proponent should advertise in at least two local Newspapers widely circulated in the region, one of which shall be in the vernacular language informing that the project has been accorded CRZ Clearance and copies of clearance letters are available with the State Pollution Control Board (SPCB) and may also be seen on the website of the Ministry of Environment, Forest and Climate Change at http://www.envfor.nic.in. The advertisement should be made within Seven days from the date of receipt of the Clearance letter and a copy of the same should be forwarded to the concerned Regional Office of this Ministry.

4. This Clearance is subject to final order of the Hon'ble Supreme Court of India in the matter of Goa Foundation Vs Union of India in Writ Petition (Civil) No.460 of 2004 as may be applicable to this project.

5. Any appeal against this clearance shall lie with the National Green Tribunal, if preferred, within a period of 30 days as prescribed under Section 16 of the National Green Tribunal Act, 2010.

6. A copy of the clearance letter shall be sent by the proponent to concerned Panchayat, Zilla Parisad/Municipal Corporation, Urban Local Body and the Local

NGO, if any, from whom suggestions/ representations, if any, were received while processing the proposal.

7. The proponent shall upload the status of compliance of the stipulated conditions, including results of monitored data on their website and shall update the same periodically. It shall simultaneously be sent to the Regional Office of MoEF&CC, the respective Zonal Office of CPCB and the SPCB.

8. The environmental statement for each financial year ending 31st March in Form-V as is mandated to be submitted by the project proponent to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, shall also be put on the website of the company along with the status of compliance of clearance conditions and shall also be sent to the respective Regional Office of the Ministry by e-mail.

(Arvind Nautiyal)
Director

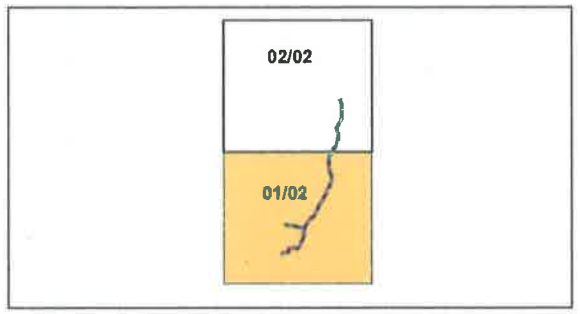
Copy to:

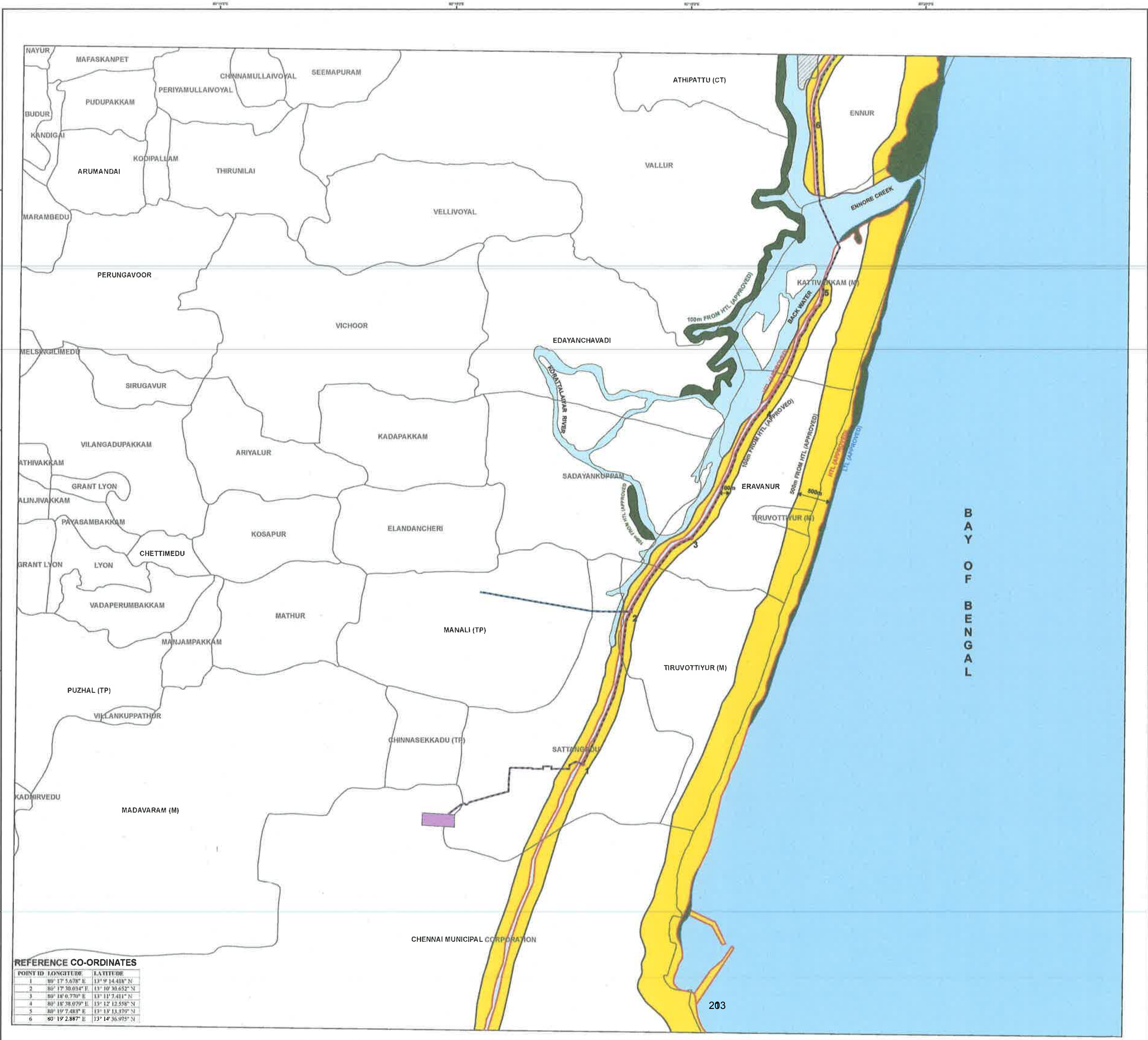
1. The Secretary, Environment & Forests Department, Govt of Tamil Nadu, Saint Geroge Port, Chennai.
2. The Chairman, Central Pollution Control Board, Parivesh Bhavan, CBD- cum-Office Complex, East Arjun Nagar, Delhi - 110032.
3. The Chairman, Tamil Nadu, Environment and Forests (EC.3) Department, Secretariat, Chennai-9.
4. The Chairman, Tamil Nadu State Pollution Control Board, 76, Mount Salai, Guindly, Chennai – 600032.
5. The APCCF (C), MoEF&CC, RO, 1st Floor, Handloom Export Promotion Council, 34, Cathedral Garden Road, Nungambakkam, Chennai-34.
6. Guard File.
7. Monitoring File.

(Arvind Nautiyal)
Director

ANNEXURE – II
CRZ Map

SHEET No. 01/02





REFERENCE CO-ORDINATES

POINT ID	LONGITUDE	LATITUDE
1	80° 17' 5.678" E	13° 9' 14.418" N
2	80° 17' 30.034" E	13° 10' 30.652" N
3	80° 18' 0.770" E	13° 11' 7.411" N
4	80° 18' 38.079" E	13° 12' 12.558" N
5	80° 19' 7.483" E	13° 13' 13.379" N
6	80° 19' 2.887" E	13° 14' 36.975" N

LEGEND

SOURCE : EXISTING APPROVED CMP (www.environemtn.tn.nic.in/iczmp)

- LOW TIDE LINE (LTL)
- HIGH TIDE LINE (HTL) FOR SEA/RIVER/CREEK/CANAL
- 200m FROM HIGH TIDE LINE
- 500m/100m FROM HIGH TIDE LINE
- SALTPAN
- CRZ I (LOW WATER LINE TO HIGH WATER LINE / INTER TIDAL/ SENSITIVE AREA)
- CRZ II
- CRZ III
- SEA
- WATERBODIES (RIVER/CREEK/CANAL)

SOURCE :CADASTRAL MAPS

- VILLAGE BOUNDARY

SOURCE :CLIENT

- PROPOSED 300MM DI PIPE (2300m)
- PROPOSED 600mm DI PIPE (7000m)
- PROPOSED 800mm DI PIPE (19000m)
- TTRO PLANT BOUNDARY

SCALE : 1:25,000

0 500 1,000 2,000 M

REF NO. AU/IRS/KS/414 - 2017 Dated 21.07.2017

PREPARED BY

INSTITUTE OF REMOTE SENSING
ANNA UNIVERSITY
CHENNAI - 600 025

FOR

THE EXECUTIVE ENGINEER
CMWSSB, STP / NORTH
KALIAMMAN KOIL STREET
KOYAMBEDU, CHENNAI

PREPARED BY	
VERIFIED BY	K.
APPROVED BY	Prof. S.S. Ramakrishnan, B.E(Hons), M.Tech.,Ph.D., Director, Institute of Remote Sensing, Anna University, Chennai-600 025.

DEMARCATION OF HIGH TIDE LINE / LOW TIDE LINE FOR THE PROPOSED CONVEYING PIPELINE FROM KODUNGAIYUR (TTRO PLANT), CHENNAI DISTRICT TO L&T PORT, ENNORE, TAMILNADU

INDEX MAP

PROPOSED 300mm DI PIPE (2300m)

Classification	Length in Metres
HTL TO 100m	288.87m
Waterbodies	41.27m
Non - CRZ	1959.11m

PROPOSED 600mm DI PIPE (7000m)

Classification	Length in Metres
HTL TO 100m	8517.48m

PROPOSED 800mm DI PIPE (19000m)

Classification	Length in Metres
HTL TO 100m	10886.98m
Waterbodies	804.43m
Non - CRZ	2459.04m

PREPARED BY

INSTITUTE OF REMOTE SENSING
ANNA UNIVERSITY
CHENNAI - 600 025

FOR

THE EXECUTIVE ENGINEER
STP / NORTH
KALIAMMAN KOIL STREET
KOYAMBEDU, CHENNAI

PREPARED BY	
VERIFIED BY	K.
APPROVED BY	28/11/12 Prof. S.S. Ramakrishnan, B.E(Hons), M.Tech.,Ph.D., Director Institute of Remote Sensing, Anna University, Chennai-600 025.

ANNEXURE – III

NOC'S

भारतीय अन्तर्देशीय जलमार्ग प्राधिकरण
(पोत परिवहन मंत्रालय, भारत सरकार)
मुख्यालय : ए–13, सैक्टर–1, नौएडा–201 301, (उ० प्र०)

INLAND WATERWAYS AUTHORITY OF INDIA

(Ministry of Shipping, Govt. of India)
Head Office : A-13, Sector-1, Noida-201 301 (U.P.)
Website : www.iwai.gov.in | www.iwai.nic.in

Tel. : +91-120-2544036, 2543972, 2527667, 2448101 Fax : +91-120-2544009, 2544041, 2543973, 2521764

File No. IWAI/NOC/PIPELINE/CMWS&SB/2018 Dated 12.06.2018

S.E.-W.W.T&R

To

The Chief Engineer-O&M (II)
Chennai Metropolitan Water Supply and Sewerage Board
No-1 Pumping Station Road
Chinthadripet, Chennai-02

26/6/18
C.E. O&M-II

CE (O & M)-II OFFICE
2778
26 JUN 2018
CMWSS BOARD

Sub: Issue of NOC for laying of TTRO Water Pipeline by CMWSSB along Buckingham Canal & crossing of Ennore Creek – In consideration to classification of Buckingham Canal Waterways as NW 4 & Class 3 by IWAI - Reg.

Ref: 1. Your Letter No. CMWSSB/EE(STP/N)/TTRO/KOD/039/RC/IWAI/2018, dated 05.06.2018

Sir,

With reference to above cited subject & reference letter, no objection of IWAI is here by conveyed, for laying of TTRO Water pipe line in the below mentioned areas:

1. At Ennore, along the Buckingham Canal from NCTPS Gate to L & T Shipping Yard for a length of 7000 m.
2. At Ennore, along the Buckingham Canal from Ennore Creek to NCTPS Main Gate for a length of 1900 m.
3. Along Buckingham Canal & across Ennore Creek for a length of 850 m, laid under water at a depth of 4 m (pipe bottom), from existing bed level of maximum depth of 3.75 m.

You are requested to inform the undersigned at the time of commencement of the proposed construction in stage wise / periodically so that the same can be monitored to ensure the required clearances.

It is also requested that the proposed construction be carried out as per Annex- I & II of IWAI's Office Memorandum dated 27.08.2007.

This is issued with the approval of the Chairperson, IWAI.

Office of the Superintending Engineer(W.W.T.&R)
Date: 26/6/18
No: 2147
CMWSS Board, Chennai-600 002

EE(STP/N)
26/6/18
SE(WWT&R)

Yours faithfully

(S.V.K. Reddy)
Chief Engineer-I

Encl: Annex-I & II

Copy to: Director, IWAI Vijaywada for information please

Date: 21/8/17
No: 1341

PUBLIC WORKS DEPARTMENT

From	To
Er. K. Elangovan., B.E, Executive Engineer, PWD, WRD, Araniyar Basin Division, Chepauk, Chennai – 5.	**The Superintending Engineer,** Palar Basin Circle, PWD, WRD, Chepauk, Chennai-5.

Letter No. DB / JDO.4 / F.414 / CMWSSB / 2017/ Dated: 10.08.2017

Sir,

Sub: CMWSSB – STP (N) – Re-use of sewage for industrial purposes in North Chennai by establishing a Tertiary Treatment Reverse Osmosis plant at Kodungaiyur STP – Proposed pipeline alignment –Permission to construct pipe carrying bridge and to lay pipeline – Road cut estimate – Alternate proposal requested -- Reg.

Ref: The Superintending Engineer (WWT&R), CMWSSB, No.1, Pumping Station, Chintadripet, Chennai – 600 002, Letter No. CMWSSB / EE (STP / N) / TTRO / Kod / 2015 Dated: 30.11.2016.

-*-*-*-*-*-

With reference to the Superintending Engineer (WWT&R), CMWSSB, Chennai–2 letter cited, it is kindly informwed that, the Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB) have proposed to set up a 45 MLD Tertiary Treated Reverse Osmosis plant at Kodungaiyur STP to supply water to industries at Manali & Minjur and requested for necessary permission to lay the pipe line in the Buckingham Canal at Basin – Manali Road. The proposal consists of the following:

1. To construct pipe carrying bridge across the North Buckingham Canal near Manali Express Highway Bridge for a length of 30m as per sketch furnished by the CMWSSB.
2. Laying 800mm dia DI pipeline along the service road adjacent to North Buckingham Canal up to Kathivakkam High Road for a length of 8445m.
3. To construct pipe carrying bridge across Ennore Creek for a length of 850m.

The CMWSSB has requested permission to lay pipeline and pipe carrying bridge and necessary estimates for Road cutting & restoration charges in the above stretches. The proposed alignment was jointly inspected with the Executive Engineer, CMWSSB on 19.7.2017 and following are the observations:

The proposed pipe is of 800mm DI dia to be laid along the PWD limit along the eastern bank North Buckingham Canal abutting the Jeep track toe for a length of 8445 metres [From Thiruvottiyur-Manali Road (LS 8560m) to Kathivakkam Main road (LS 17300m)]. The Pipeline is to be laid below the existing ground level to a minimum depth of 2.00 metre. Except some minor changes, the alignment is considered feasible. (Reach – II).

The proposed crossing across Buckingham canal for 30 metres shall be permitted upstream of Manali Express Highway Bridge (LS. 11062m) Reach – I.

OFFICE OF THE EXE. ENGR/STP
21 AUG 2017
No. 1623
C.M.W.S.S.B. CHENNAI

EE/TTRO
AE
21/8

The CMWSSB has proposed 800mm dia pipe for a length of 850 metres in an elevated manner on pier support along the Ennore Creek (Reach – III) adjoining the existing Highway Bridge which is not permitted due to the following reasons:

The Highway Bridge is aligned across the Ennore Creek with piers erected on the water spread. Subsequently, TANGEDCO has started executing elevated Coal conveyor belt with pier support along the Ennore Creek from NCTPS to ETPS. Hence, if CMWSSB is permitted to lay elevated pipes near the Bridge area, there will be a gross reduction in the water spread area of Ennore Creek due to congestion caused by erection of piles, pile caps and ultimately generates turbulence at the time of flood around this zone. Hence, it not only affects the hydraulic parameters, but the ecosystem and the livelihood of the surrounding hamlets as well.

Besides, the National Green Tribunal (Southern Zone) has constituted an Expert committee to study and submit a comprehensive report regarding the pollution of Buckingham canal and the adjoining Backwaters of Ennore Creek due to discharge of fly ash by the NCTPS, effect on Flora and Fauna, transformation of natural landscape, hydrology, land use, pollution of water bodies, etc., in Application No.198 of 2016.

Under the above circumstances, the proposed alignment along Ennore Creek by the CMWSSB has been ruled out. Hence the CMWSSB shall be directed to explore and submit an alternate proposal in compliance with the above parameters. Accordingly, the present proposal is returned herewith.

Sd/-
Executive Engineer, PWD., WRD.,
Araniyar Basin Division,
Chepauk, Chennai – 5.

Copy to the Superintending Engineer (WWT&R), CMWSSB, No.1, Pumping Station, Chintadripet, Chennai – 600 002 for favour of information and further necessary action.

Copy to the Assistant Executive Engineer, PWD., WRD., Adayar Basin Division, Chepauk, Chennai – 5 for taking necessary followup action.

11/8/17
Executive Engineer, PWD., WRD.,
Araniyar Basin Division,
Chepauk, Chennai – 5.

11/8

AEE (C3)
21/8/17
EE(STP) N

Annexure IV

Bathymetry Study

BATHYMETRY SURVEY ACROSS THE ENNORE CREEK CHENNAI

For

FLOWLINE SYSYTEM PVT. LTD.
NEW PANVEL, MUMBAI

AUGUST 2019

Prepared by

SAGARIKA INSTRUMENTS & TECHNOLOGY
CHENNAI

SAGARIKA INSTRUMENTS & TECHNOLOGY
CHENNAI

Project Title	Bathymetry survey across the Ennore creek, Chennai.
Client Name	Flowline system Pvt.Ltd, New Panvel, Mumbai.
Project Location	Ennore, Chennai.

Abstract

Flowline System Pvt Ltd (FSPL), New Panvel, Mumbai, is planning to lay the pipeline across the Ennore creek. In this connection FSPL asked Sagarika Instruments and Technology (SIT), Chennai, to carry out the bathymetry survey in the proposed pipeline route. Accordingly, the surveys were conducted from 22.7.2019 to 25.7.2019

This report presents the methodology, survey techniques, tidal correction and the results of bathymetry surveys.

Type of Report	:	Final
No. of Pages	:	13
No. of Tables	:	Nil
No. of Figures	:	6
Date of Submission	:	9th August 2019

CONTENTS

LIST OF FIGURES

1. INTRODUCTION

Flowline System Pvt Ltd (FSPL), New Panvel, Mumbai, is planning to lay the underground pipeline across the Ennore creek. In this connection FSPL asked Sagarika Instruments and Technology (SIT)., Chennai, to carry out the bathymetry survey in the proposed pipeline route.

Accordingly, the bathymetry surveys were conducted from 22.7.2019 to 25.7.2019. This report represents the methodology, survey techniques, tidal correction and the results of bathymetry survey.

The satellite imagery of the survey area is shown in Figure 1.

All calendar dates are referred in Indian style as dd.mm.yy. (eg. 22.07.19 for 22nd July 19) and the time is referred to Indian Standard Time in 24-hour clock, eg. 3 P.M. is written as 1500 hrs. SI units are followed for fundamental and derived units. The depths are referred with respect to Chart Datum. The UTM coordinates are indicated in WGS 84 spheroid - Zone 44N.

2. SCOPE

i) *to carry out bathymetry survey in the proposed pipeline route area,*

ii) *to prepare the chart and submit the report.*

3. METHODOLGY

3.1. Reference spheroid

World Geodetic System (WGS84) spheroid – Zone 44 was followed for entire surveys and for the presentation in the report.

3.2. Horizontal control

Reference station: The DGPS Beacon Transmitter operated at "*PULICAT*" by Department of Lighthouse and Navigation is taken as reference station. The transmitting frequency of this reference Beacon transmitter is 319 kHz.

Mobile station: The horizontal positioning of the mobile unit was carried out using **HemisphereR100** Series DGPS Beacon Receiver. It combines high-performance GPS reception with a DGPS-capable receiver in a light weight, durable housing and comes with a separate antenna. It gives the horizontal position to an accuracy of close to 1 m.

The GPS receiver also contains technology enabling *WAAS/EGNOS*, *Omni STAR* or *Beacon* real time differential capabilities. When used with a Real- time Kinematic (RTK) Base station, the GPS receiver provides RTK positioning for high-accuracy, centimeter-level applications. A standard GPS receiver provides the following features: •10 Hz (10 positions per second) output rate •12 GPS (C/A-code L1, C/A code L2 (for the Omni STAR XP/HP and RTK models)) tracking channels, code carrier channels •Sub meter differential accuracy (RMS), assuming at least five satellites and a PDOP (Position Dilution of Precision) of less than four (when used with Satellite Based Augmentation Systems (SBAS) correction).

The system configuration is enabled with:

- LED display and keypad

- Outputs a 1 PPS (pulse per second) strobe signal on both ports. This signal enables an external instrument to synchronize its internal time with a time derived from the very accurate GPS system time
- SBAS such as WAAS (Wide Area Augmentation System) differential correction 1
- Beacon differential correction
- Omni STAR VBS capability
- Omni STAR XP/HP capability in the XP/HP and RTK models
- RTK positioning capability, In the RTK model only
- EVEREST™ multipath rejection technology
- Two connectors that support both CAN 2.0B and RS-232:
- – CAN: J1939 and NMEA 2000 messages
- – RS-232:
- NMEA-0183 output: GGA, GLL, GRS, GST, GSA, GSV, MSS, RMC, VTG, ZDA (the default NMEA messages are GGA, GSA, VTG, and RMC).

3.3. Vertical Control

BM: The bench mark is located at top level of the pedestrian's path of bridge entrance and opposite to Police booth at Attipattu-Ennore road junction. The static survey was carried on the BM by Leica RTK GNSS. The static data on vertical elevation were recorded continuously for a period of 10 hours at 1.0 s interval. The observed data were processed in Leica Geo Office software. Then the arrived Reference Level is (+) 3.360 m MSL.

Details of Benchmark

Description	Geographical Coordinates (WGS 84)		UTM Coordinates (Zone – 44)		Reference Level w.r.t. MSL (m)
	Latitude, N	Longitude, E	X (m)	Y (m)	
BM	13°13'33.09"	80°19'15.50"	426430.9	1462212.6	(+) 3.36 m

3.4. Tides

The tide measurement was carried out in the survey region using Aanderaa Seaguard Water Level Recorder (WLR). The data were recorded at 10 minute interval. The mooring configuration of Tide measurements is shown in Fig. 2. The details of measurement locations are given below:

Details of Tide Measurements

Location	Geographical Coordinates (WGS 84)		UTM Coordinates (Zone – 44)		Measurement period	
	Latitude, N	Longitude, E	X (m)	Y (m)	From	To
Ennore Creek	13°13'03.50"	80°19'11.17"	0426301.1	1462379.0	22.07.19	25.07.19

Deployment of tide recorder

Methodology

Aanderaa Seaguard Water Level Recorder: The Aanderaa Seaguard Water Level Recorder is manufactured by Aanderaa Data Instruments, Norway. It is a high precision recording instrument for measuring the variation of water level in the sea. The Pressure Sensor 4647 is a compact, yet intelligent sensor designed to be used in this measuring systems. The sensor is based on a silicon piezo-resistive bridge sample and temperature compensated by an advanced Digital Signal Processor. The tide measurement is an average of the hydrostatic pressure measured over a time period of 10 seconds to 8 minutes (Optional). The recoding interval is selected between 2 seconds and 2 Hrs. The output parameters are Tide pressure, Tide level, Pressure and Temperature. Tide levels are preliminary, internally calculated estimates, based on fixed, selectable values of atmospheric pressure. Tide pressure is an average of hydrostatic pressure over the integration time. The data are stored on SD card/DSU. The instrument is housed in a pressure case that is closed by two C-clamps. All external and internal parts are fastened to the top end plate so that the whole instrument can be removed from the pressure case as one unit. In addition to carrying the combined handle and protection ring, the acoustic transducer and sensor inlet, the top end plate is furnished with a watertight receptacle. This terminal permits remote triggering and real-time reading of data by connecting cable.

Technical Specifications:

Top-End Plate	:	Multiparameter platform
Recording system	:	Data Storage on SD card/DSU
Storage Capacity	:	≤ 4GB
Battery	:	2 batteries inside the instrument
	:	Alkaline 3988 9V, 15Ah (nominal 12.5Ah; 20W down to 6V at 4°C) or Lithium 4002: 7V, 30Ah
Supply voltage	:	6 to 14VDC
	:	Parallel 2 Alkaline battery (each 9.0 VDC)
Operating temperature	:	-5 – +40˚C (23 – 104˚F)
Deployment depth	:	Up to 300 m depending on sensor
Dimensions	:	OD: 139mm; H: 356mm
Weight in air	:	6.3kg
Weight in water	:	1.8kg
Materials	:	PET, Titanium, Stainless Steel 316, Epoxy
Pressure	:	4647B Range: 0 – 700kPa (101 psia) 60 m depth
	:	Resolution: 0.0001% FSO
	:	Accuracy: ±0.04% FSO
	:	Pressure connection: Swagelok™ 1/8 inch
	:	Inlet port (reference): top of the pressure port
	:	Pressure parameters: Pressure in kPa, Pressure raw data in LSB
Temperature	:	Range: 0 – 36°C (32 – 96.8˚F)
		Resolution: 0.001°C (0.0018°F)
		Accuracy: ±0.4°C (0.72°F)
		Response Time (63%): < 2 min

	:	Temperature parameters: Temperature in °C, Temperature raw data in LSB
Tide	:	Integration time: 10s - 8 minutes
	:	Tide parameters: Tide pressure in kPa,
	:	Tide level in meter

3.5. Bathymetry survey

Area of survey

The survey boundary coordinates were given by client, which is covering an area of approximately 800 m along the bridge and 110 m width. The survey was covered 5 m line spacing and tie up lines was covered in 100 m line spacing. The details of survey area coordinates are given below:

Details of survey boundaries

Location	Geographical Coordinates (WGS 84)		UTM Coordinates (Zone – 44)	
	Latitude, N	Longitude, E	X (m)	Y (m)
Point A	13°13'33.6"	80°19'13.2"	0426362	1462229
Point B	13°13'30.8"	80°19'12.1"	0426328	1462144
Point C	13°13'56.6"	80°19'03.4"	0426068	1462935
Point D	13°13'55.8"	80°19'00.4"	0425977	1462912

The transact lines were planned perpendicular to the creek banks. The planned survey lines are shown in Fig. 3.

Methodology

The survey boat "***FV PANDIAN***" was used for the survey. The Echosounder transducer was mounted on the star board side of the vessel by positioning it at 0.50 m below the sea surface. The DGPS receiver antenna was mounted on the mast vertically in line with the transducer, so that it represents the exact coordinates of the location where the depth is simultaneously measured by the transducer.

CEEDUCER PRO ECHOSOUNDER: This survey echosounder is manufactured by Bruttour International, Australia. It is a dual frequency echosounder with standard transducer having the frequencies of 200 kHz and 30 kHz. It measures the depth ranging between 0 - 500 m with the accuracy of 0.01 m and a resolution of 0.01 m. It has a built in 12 channel GPS receiver with an integrated Beacon receiver. It is a dual channel Beacon receiver for collection of reference station data in both, automatic and manual mode. The system provides horizontal accuracy close to ± 1 m. It has the capability of giving position with WGS84 standard datum and 1 user defined datum. It has an antenna with 20 m long cable. The system works on 9 - 18 VDC or on 220 VAC. The unit has two RS232 ports. It is equipped with internal data logger which can store 40 hours survey data. It also has large LCD display in the front panel. There is a provision for auto scale change, external DGPS input and heave compensation input. It has NMEA output which can be connected to onboard PC and integrated with Hydrographic Software. The touch setting in the front panel enables to mark draught, tide input, time, date, scale shift, calibration gauge, alarm filter and fix interval.

Hydrographic Survey Software: HYPACK survey software was used for data collection and processing. It is integrated, first generation hydrographic survey software developed by Coastal Oceanographical INC., USA. It works in MS Windows operating environment. The HYPACK's design program allows importing background map in CAD's DFX or Microsoft's DGN format. It enables to quickly create planned survey lines, plotting sheets and bottom coverage grids in a graphical environment. It gives the flexibility to support multiple navigational systems (GPS, range/range, range/ azimuth), echo sounders (single and dual frequency, multiple transducers and multibeam), magnetometers, ROV-tracking systems, telemetry tide systems and many other devices. It contains the post processing module to analyze and prepare the chart. The survey tracks were planned using this software for accurate manoeuvring of the vessel and to keep the accuracy of the track. The post processing of the survey data and preparation of map were carried out using this software.

Data recording: The Echosounder and Beacon DGPS receiver were interfaced through HYPACK software with onboard PC. The entire system was supported by AC Power Generator installed onboard. The position and depth were recorded along the pre planned transect at 500 millisecond intervals continuously.

Tidal corrections: The necessary tidal corrections were applied for the collected bathymetry data based on the measured tides at site.

Preparation of Map: The bathymetry chart of the survey region is prepared in required scale. The map was presented in UTM co-ordinates (Universal Transverse Mercator) and also supplemented by geographical co-ordinates (latitudes and longitudes in degrees, minutes and seconds). The datum in WGS 84 is used for preparing the maps. The preparation of map is carried out using post processing hydrographic software HYPACK MAX on the required scale.

4. RESULTS

4.1. Tides

The variation of design tide levels with respect to Chart Datum (CD) for Chennai is given in Indian Tide Tables - 2019, published by Surveyor General of India is given below:

Tide	Level w.r.t. CD
Mean High Water Spring	1.15 m
Mean High Water Neap	0.84 m
Mean Sea Level	*0.65 m*
Mean Low Water Neap	0.43 m
Mean Low Water Spring	0.09 m

The variations of measured tides w.r.t. MSL are presented in Fig. 4.

4.2. Bathymetry Survey

The bathymetry map is prepared in WGS84 spheroid with UTM coordinates and supplemented with geographical coordinates indicating the latitude and longitude. The bathymetry map prepared in 1:1000 scale and depths are presented in 5 m x 5 m grid spacing is shown in Fig. 5. The Fig. 5 shows the map prepared with reference to Mean Sea Level. And the Fig. 6 shows the map prepared with reference to Chart Datum.

The bathymetry chart shows the southern side of survey area is very shallow and it has an elevation of about 0.2 m MSL, which sets dried up during low tide. A mud patch is noticed along the mid part of survey area. The depth varies between 0.5 m and 3.5 m MSL in the entire survey area.

During the survey period scattered concrete debris were noticed near the bridge pillars and it is visible during low tide. Due to the scattered debris the proposed pipeline should be placed minimum 10 m away from the existing bridge pillars. The tentative pipeline route is marked in Fig. 5. & Fig. 6.

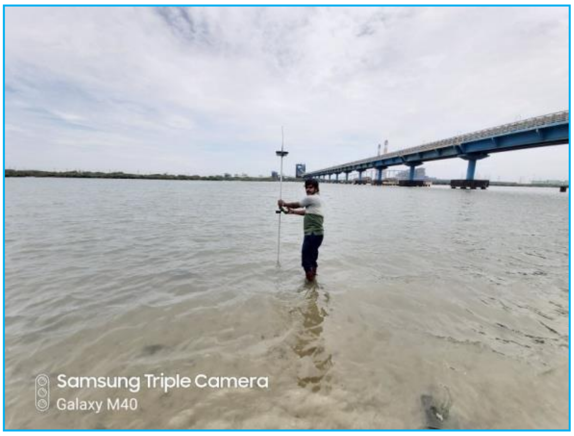
GALLERY

Installation of tide gauge

Installation of Tranducer

On board data collection

RTK base station setup



RTK Survey

TBM

Client inspection

Mud pacth during low tide

ANNEXURE – V

Social Screening Form

SOCIAL SCREENING FORM

Name of the Borrower : Chennai Metropolitan Water supply and Sewerage Board

Project location : Ennore Creek

Project : Conveying Main along Buckingham Canal and Across Ennore Creek for supply of 45 MLD of RO Permeate to Industries and Discharge of Rejects of 18.5 MLD.

Land Use, Resettlement, and/or Land Acquisition				
S.N	**Components**	**Yes**	**No**	**Details**
1	Does the project involve acquisition of private land?		No	
2	Alienation of any type of Government land including that owned by Urban Local Body?		No	
3	Clearance of encroachment from Government/ Urban Local body Land?		No	Not applicable
4	Clearance of squatters/hawkers from Government/ Urban Local Body Land?			Not applicable
5	Number of structures, both authorized and/or unauthorized to be acquired/ cleared/		No	
6	Number of household to be displaced?			Not applicable
7	Details of village common properties to be alienated Pasture Land (acres) Cremation/ burial ground and others specify?			Not applicable
8	Describe existing land uses on and around the project area (e.g., community facilities, agriculture, tourism, private property)?	Yes		The proposed activity will be carried out in Ennore Creek (850 m). The industrial area is located north west and north east side from Ennore Creek. The surrounding people are doing the fishing activity in Ennore creek and Bay of Bengal.
9	Will the project result in construction workers or other people moving into or having access to the area (for a long time		No	

	period and in large numbers compared to permanent residents)?			
10	Are financial compensation measures expected to be needed?		No	
Loss of Crops, Fruit Trees, Household Infrastructure and livelihood				
S.N	**Components**	**Yes**	**No**	**Details**
11	Will the project result in the permanent or temporary loss of the following?		No	
11.1	Crops?		No	
11.2	Fruit trees / coconut palms? Specify with numbers		No	
11.3	Petty Shops/ Kiosks		No	
11.4	Vegetable/Fish/Meat vending		No	
11.5	Cycle repair shop		No	
11.6	Garage		No	
11.7	Tea stalls		No	
11.8	Grazing		No	
11.9	Loss of access to forest produce (NTFP)		No	
11.10	Any others - specify		No	
Welfare, Employment, and Gender				
S.N	**Components**	**Yes**	**No**	**Details**
12	Is the project likely to provide local employment opportunities, including employment opportunities for women?	Yes		Local area people will be considered for employment in construction of laying of conveying main in creek and TTRO plant.
13	Is the project being planned with sufficient attention to local poverty alleviation objectives?		No	
14	Is the project being designed with sufficient local participation (including the participation of women) in the planning, design, and implementation process?	Yes		The local people suggestion will be consider for proposed project.
Historical, Archaeological, or Cultural Heritage Sites				
S.N	**Components**	**Yes**	**No**	**Details**
Based on available sources, consultation with local authorities, local knowledge and/or observations, could the project alter:				

15	Historical heritage site(s) or require excavation near the same?		No	The old building (100-150 years) is located 140 m from the project site. That building is not listed in Archaeological place by department of Archelogy.
16	Archaeological heritage site(s) or require excavation near the same?		No	
17	Cultural heritage site(s) or require excavation near the same?		No	
18	Graves, or sacred locations or require excavations near the same?		No	
	Tribal Population/Indigenous People			
19	Does this project involves acquisition of any land belonging to Scheduled Tribes?		No	
	Beneficiaries			
20	Population proposed to be benefitted by the proposed project	Yes		Local residents will get employment opportunities.
21	No. of Females proposed to be benefitted by the proposed project		No	
22	Vulnerable households /population to be benefitted		No	
23	No. of BPL Families to be benefitted		No	

Date: ___________

Signature and Name of the Borrower

Enclosures: Land details for the project sites, location, survey numbers, extent available and required, land use classification, current use of the site, land ownership, alienation/acquisition status, FMB extracts, as required along with a certificate giving availability of sites required for the project by the borrower.

ANNEXURE – IV

Environmental Screening Form

ENVIRONMENTAL SCREENING FORM

(To be prepared by the Borrowers for each project)

Name of the Borrower: CMWSSB

Project Location : Ennore Creek

Project : Construction of TTRO plant of capacity 45 MLD at Kodungaiyur and supply of TTRO water to industries and power plants located at Manali –Minjur and Manali –Ennore Corridor.

Project Components		
S.N	**Components**	**Details**
1	Brief description of the project proposal	CMWSSB has construct TTRO Plant of capacity 45 MLD at Kodungaiyur and supply treated water to industries, power plants and institutions located at Manali-Minjur Corridor, Manali-Ennore Corridor in North Chennai through conveying main of length 25.35 km.The laying of 850 m conveying main across Ennore Creek using dredging technology
2	Number of project sites and Project Components	Ennore Creek and dredging activity will be carried out the project. HDFC pipe will be used.
3	Details of Alignment and Component	The laying of conveying main length is 850 m, width top of the bed is 30-35 m and bottom is 4 m and depth is 6m, and require 50m for connecting the pipeline of each end.
4	Location of the Project Sites & Current Use (Provide Information for all sites involved in the project)	Ennore Creek

Biological Environment				
S.N	**Components**	**Yes**	**No**	**Details**
5	Is the project Adjacent to any of the following (Provide information for all sites and alignment of the project)			
i	Cultural Heritage site		✓	The old building (100-150 years) is located 140 m from the project site. That building is not listed in Archaeological place by department of Archelogy.
ii	Protected Area		✓	

iii	Wet Land/ Mangrove/ Estuarine Region		✓	
iv	Natural Forests		✓	
v	Other Sensitive Environmental Components as listed in ESMF		✓	
vi	Residences, Schools, Hospitals etc		✓	
vii	Drinking water source, upstream and downstream uses of rivers etc		✓	
viii	Low lying areas prone to flooding/ areas of Tidal Influence (CRZ)	✓		Buckingham Canal and Ennore Creek
6	Does the proposed project could cause the following			
i	Impact on Surrounding Environmental Conditions		✓	
ii	Degradation of land / eco-systems		✓	
iii	Loss or Impacts on Cultural/ heritage properties		✓	
iv	Water Resource problems		✓	
v	Pollution of Water bodies/ Ground water		✓	
vi	Cutting of Trees/ Loss of Vegetation		✓	
vii	Health & Safety Risks in the neighborhood		✓	
viii	Potential risk of habitat fragmentation due to the clearing activities? (eg. Hindrance to the local biodiversity like disturbing the migratory path of animals/ birds etc.)		✓	
Physical Environment				
S.N	**Components**	**Yes**	**No**	**Details**
7	Will the project affects the River flow pattern, stream pattern or any other irrigation		✓	

	canal?			
8	Water quantity? Estimated usage of water quantity for the project	✓		1 KLD required for during construction phase for domestic purpose
9	Estimated energy consumption for the project activities		✓	
10	Any other resources proposed to be utilized for project activity? (eg., ground water)		✓	
		Geology / Soils		
S.N	**Components**	**Yes**	**No**	**Details**
11	Does the project activity involve cutting and filling/ blasting etc..?	✓		Dredging activity will be involved for laying of conveying main.
12	Will the project cause physical changes in the project area (eg., changes to the topography) due to excavation, earthwork etc..?		✓	
13	Will the project involve any quarrying/ mining etc?		✓	
		Pollution		
	Components	**Yes**	**No**	**Details**
14	Will the project use or store dangerous substances (eg., large quantities of hazardous chemicals/ materials like Chlorine, Diesel, Petroleum products etc..?)		✓	
15	Will the project produce solid or liquid wastes/	✓		Dredging Material from During construction period
16	Will the project cause air pollution or increase in emission of pollutants?	✓		Dredging Material from During construction period
17	Will the project generate or increase noise?	✓		Noise will be generated during laying of conveying main.
18	Will the project generate water pollution (water bodies/ ground water)		✓	

19	Will the project cause construction Hazard to workers/ residents	✓		Personal protective equipments will be given to workers
20	Is there a potential for release of toxic gases or accident risks		✓	
Environmental Enhancement Measures				
	Components	**Yes**	**No**	**Details**
21	Has the project design considered the following?			
i	Is the project design considering energy conservation measures/ energy recovery options?		✓	
ii	Is the project considering waste minimization or waste reuse/ recycle options?	✓		Dredging material will be used for the back filling the trench.
iii	Has the project design considered RWH or any other environmental enhancement measure?		✓	
iv	Has the project design considered extreme events, drought, flood, natural disasters?	✓		Design has been made considering all extreme events
General				
23	Please indicate whether any other features of the project that could influence ambient environment		✓	
24	Has any consultation with the public or stakeholders been conducted?	✓		Public consultation has completed on 11.01.2020at St. Joseph Church, Ennore.

Date: _______________

____

Signature and Name of the Borrower

ANNEXURE VII

PUBLIC CONSULTATION

PUBLIC CONSULTATION – ENNORE

The major queries and discussions of the meetings are as follows:

S.N	Query	Reply
1	M.Anandan, Citizen of Kattukuppam: The total length, width and depth of the laying of pipe line in Ennore creek	The Superintending Engineer, CMWSSB explained: The total length of the laying of pipeline is 850m, width 4 m and depth is 6 m from existing bed level.
2	M.Devadoss, Citizen of Kattukuppam: What type of pipe will be used in Ennore creek for conveying of treated water?	The Superintending Engineer, CMWSSB explained: The High Density Poly Ethylene (HDPE) Pipe will be used for the conveying the main in Ennore creek.
3	G.Kumar, Citizen of Thazhankuppam: If any damageoccur inlaying of conveying main in Ennore Creek,it is create any impact?	The Superintending Engineer, CMWSSB explained: As the pipe is to be laid for conveying tertiary treated water fromKodungaiyur TTR Oplant to the industries at Ennore such as NCTPS, NCTP, etc,, even if any leakage there will not be any adverse impact on the river / canal.
4	L.C RajiNattukuppam, Citizen of Thazhankuppam: What is the life span of HDPE pipe?	The Superintending Engineer, CMWSSB explained: The life span of High Density Poly Ethylene (HDPE) Pipe is 30 years.
5	D.Srinuvasan, Citizen of Ennore: Why not construct the pipe carrying bridge instead of laying of conveying main in river bed.	The Superintending Engineer, CMWSSB explained: PWD had not given permission for constructing the pipe carrying bridge for conveying the pipeline; they suggested some alternative method for conveying the pipe line. Hence, CMWSSB has decided to laypipeline below bed level without affecting the ship movements.
6	M.Natesan, Citizen of Ennore: What are the clearances required for the proposed project and obtained from concern department?	The Superintending Engineer, CMWSSB explained: CRZ clearance, PWD and IWAI No Objection Certificates (NOC) were obtained from

		concerned department.
7	G.Kumar, Citizen of Thazhankuppam: Minimum period required for completion of laying of conveying main in Ennore Creek?	The Superintending Engineer, CMWSSB explained: The completion period of laying of conveying main in Ennore Creek is 2 Months.
8	S.Muthu, Citizen of Ennore: How to do the fishing activity and boat movement during construction period?	The Superintending Engineer, CMWSSB explained: The entire laying of conveying main activity is planned to be carried out in two stages. In the first stage, 50 percentage of the total length will be dredged i.e. 425m will be done. Then the laying of the conveying main in the dredged trench and simultaneous backfilling of the dredged area will be complete in the whole stretch. In the second stage, the remaining 425m will be dredged for the laying of conveying main. Hence proposed activity will not create any impact on fishing activity.
9	M.Natesan, Citizen of Ennore: What type of technology will be adopted for laying of conveying main in Ennore Creek.?	The Superintending Engineer,CMWSSB explained: The float n Sink and Lay-Barge both methodologies will be used for laying pipe line (850 m) in Ennore Creek.
10	B. AnserBasha Citizen of Kattukuppam: During heavy flood, water level and high tide is high, in that situation, will conveying main rise to the top of the water level and will it create any damage to the pipe line?	The Superintending Engineer, CMWSSB explained: CC Anchor Blocks will be provided to prevent rising of the pipeline when it is fully empty and for facing any adverse condition likes flood.
11	L.C Raji, Citizen of Nattukuppam: The fisher man nearer to the Ennore Creek already facing some skin related diseases during fishing activity in Ennore Creek, as the water body is completely polluted	The Superintending Engineer, CMWSSB explained: As this is the tertiary treated water, any leakage will not create any adverse impact to human and water body.

	due to the surrounding industries, if any leakage occurs in pipe line, will it added up any problem to the fisher folks / fishing activity?	
12	D. Srinuvasan, Citizen of Ennore: How to handle the sludge generated during laying of conveying main?	The Superintending Engineer, CMWSSB explained: The dredged (excavated) material will be stored in nearby low lying areas in the project site without affecting the water bodies and nearby mangroves. The stored excavated material will be used for the backfilling of the dredged trench after the laying of pipeline.

Mr. Mr. A. Malaichamy (Superintending Engineer, CMWSSB)concluded themeeting by thanking all the participants who have attended the meeting.

Mr. Maaichamy
Superintending Engineer
CMWSSB

சென்னை பெருநகர் குடிநீர் வழங்கல் மற்றும் கழிவு நீரகற்று வாரியம்

கொடுங்கையூரில் அமைக்கப்பட்டுள்ள 45 MLD உற்பத்தி திறன் கொண்ட எதிர்மறை சவ்வூடு பரவுதல் மூலமாக மூன்றாம் நிலை கழிவுநீர் சுத்திகரிப்பு நிலையத்தில் இருந்து சுத்திகரிக்கப்பட்ட நீர் எண்ணூர் சிற்றோடை வழியே கொசஸ்தலையாா் ஆற்று நீரின் 6.00 மீட்டர் ஆழத்தில் குழாய் அமைத்து எண்ணூர் தொழிற்சாலைகளுக்கு எடுத்து செல்வதற்காக

பொதுமக்கள் கருத்து கேட்பு கூட்டம்

நாள் : 11/01/2020
இடம் : **எண்ணூர்**

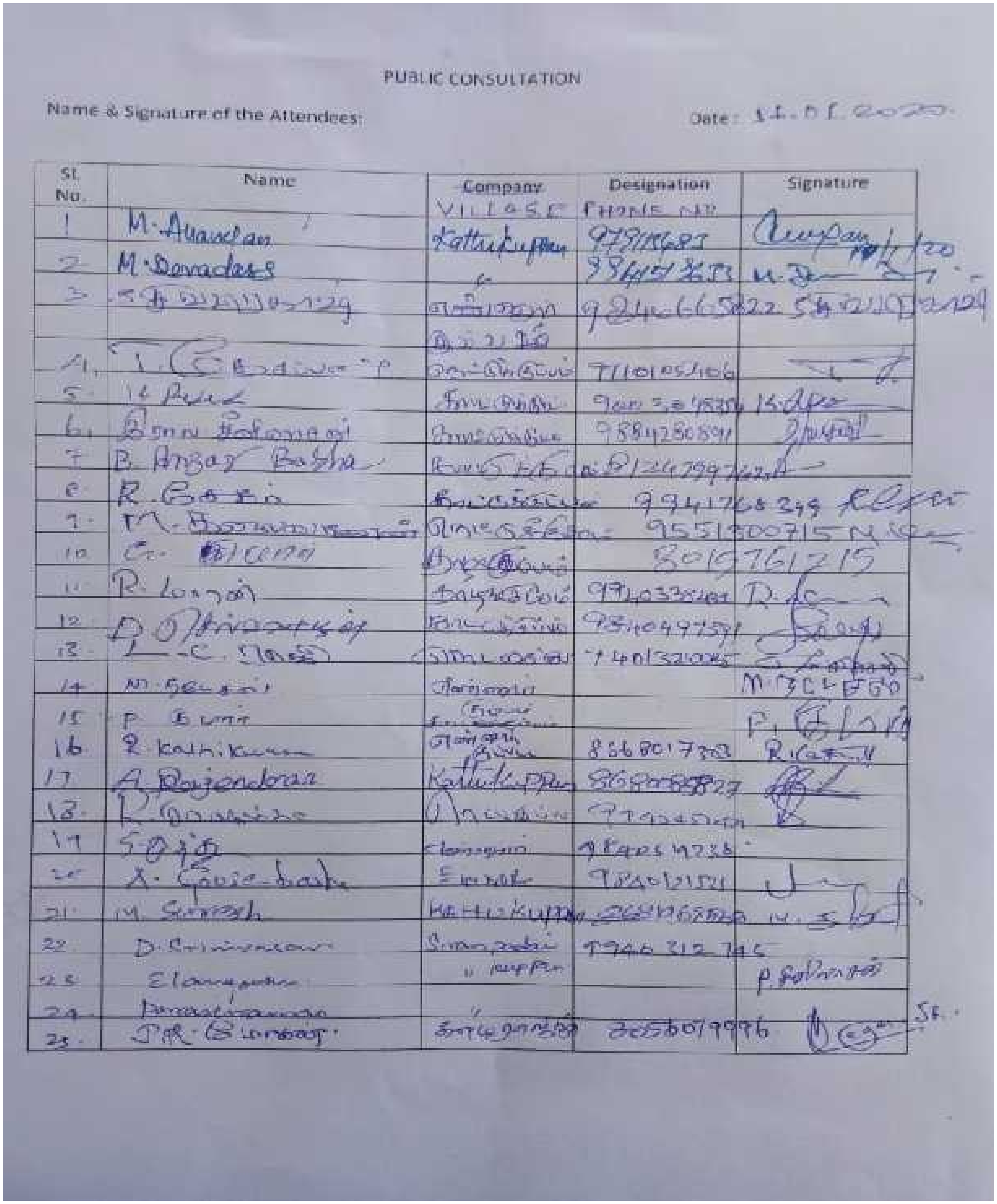
இத்திட்டம் பற்றிய விளக்க கூட்டத்தை தொடர்ந்து பொதுமக்கள் கருத்து மற்றும் ஆலோசனை கேட்பு கூட்டம் எண்ணூர் வியாபாரிகள் சங்கம் திருமண மாளிகையில் நடைபெற உள்ளதால் பொதுமக்கள் அனைவரும் கலந்துகொண்டு தங்களின் கருத்து மற்றும் ஆலோசனைகளை வழங்குமாறு கேட்டுக்கொள்கிறோம்.

இப்படிக்கு

சென்னை குடிநீர் வாரியம்

Public Hearing Canvassing photos are given below:

A statement showing list of participants present during the public hearing is given below:



PUBLIC CONSULTATION

Name & Signature of the Attendees: Date: 11.01.2020.

Sl. No.	Name	~~Company~~ VILLAGE	Designation PHONE NO	Signature
1	M. Aravindan	Kattukuppam	9791168283	[illegible] 11/1/20
2	M. Devadoss	"	9841518573	M. [illegible]
3	[illegible]	[illegible]	9840665822	[illegible]
4	[illegible]	[illegible]	7710105406	[illegible]
5	K. [illegible]	[illegible]	9003049354	K. [illegible]
6	[illegible]	[illegible]	9884280891	[illegible]
7	B. Anzar Basha	[illegible]	8124799722	[illegible]
8	R. [illegible]	[illegible]	9941768349	[illegible]
9	M. [illegible]	[illegible]	9551300715	M. [illegible]
10	G. [illegible]	[illegible]	8015761215	
11	R. [illegible]	[illegible]	9940338401	R. [illegible]
12	D. [illegible]	[illegible]	9840497591	[illegible]
13	L. C. [illegible]	[illegible]	7401320085	[illegible]
14	M. [illegible]	[illegible]		M. [illegible]
15	P. [illegible]	[illegible]		P. [illegible]
16	R. Kathikumar	[illegible]	8668017783	R. [illegible]
17	A. Rajendran	Kattukuppam	[illegible]827	[illegible]
18	R. [illegible]	[illegible]	[illegible]	[illegible]
19	S. [illegible]	[illegible]	9840514738	
20	A. Gopinath	[illegible]	9840121521	[illegible]
21	M. Suresh	Kattukuppam	[illegible]	M. [illegible]
22	D. Srinivasan	[illegible]	9940312745	
23	Elangovan	" [illegible]		P. [illegible]
24	[illegible]	"		
25	[illegible]	[illegible]	2056019996	[illegible]

ANNEXURE VIII

Labour law

workers.

(i) Equal Remuneration Act 1976: The Act provides for payment of equal wages for work of equal nature to male and female workers and for not making discrimination against Female employees in the matters of transfers, training and promotions etc.

(j) Payment of Bonus Act 1965: The Act is applicable to all establishments employing 20 or more employees. Some of the State Governments have reduced this requirement from 20 to 10. The Act provides for payments of annual bonus subject to a minimum of 8.33% of the wages drawn in the relevant year. It applies to skilled or unskilled manual, supervisory, managerial, administrative, technical or clerical work for hire or reward to employees who draw a salary of Rs. 10,000/- per month or less. To be eligible for bonus, the employee should have worked in the establishment for not less than 30 working days in the relevant year. The Act does not apply to certain establishments.

(k) Industrial Disputes Act 1947: The Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations, a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.

(l) Trade Unions Act 1926: The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities.

(m) Child Labour (Prohibition & Regulation) Act 1986: The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in the Building and Construction Industry.

(n) Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979: The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, traveling expenses from home upto the establishment and back, etc.

(o) The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996 and the Building and Other Construction Workers Welfare Cess Act, 1996 (BOCWW Cess Act): All the establishments who carry on any building or other construction work and employ 10 or more workers are covered under these Acts. All such establishments are required to pay cess at the rate not exceeding 2% of the cost of construction as may be notified by the Government. The Employer of the establishment is required to

SALIENT FEATURES OF SOME MAJOR LABOUR LAWS

APPLICABLE TO ESTABLISHMENTS ENGAGED IN CIVIL CONSTRUCTION WORK

(a) Employees Compensation Act 1923: The Act provides for compensation in case of injury, disease or death arising out of and during the course of employment.

(b) Payment of Gratuity Act 1972: gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years' service or more or on death at the rate of 15 days wages for every completed year of service. The Act is applicable to all establishments employing 10 or more employees.

(c) Employees P.F. and Miscellaneous Provision Act 1952 (*since amended*): The Act provides for monthly contribution by the employer plus workers @ 10% or 8.33%. The benefits payable under the Act are:

(i) Pension or family pension on retirement or death, as the case may be.

(ii) Deposit linked insurance on the death in harness of the worker.

(iii) Payment of P.F. accumulation on retirement/death etc.

(d) Maternity Benefit Act 1961: The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc.

(e) Sexual Harassment of Women at the Workplace (Prevention, Prohibition and Redressal) Act, 2013: This Act defines sexual harassment in the workplace, provides for an enquiry procedure in case of complaints and mandates the setting up of an Internal Complaints Committee or a Local Complaints Committee

(f) Contract Labour (Regulation & Abolition) Act 1970: The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by law. The Principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour.

(g) Minimum Wages Act 1948: The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employments.

(h) Payment of Wages Act 1936: It lays down the mode, manner and by what date the wages are to be paid, what deductions can be made from the wages of the provide safety measures at the building or construction work and other welfare measures, such as Canteens, First – Aid facilities, Ambulance, Housing accommodations for workers near the work place etc. The Employer to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by the Government.

(p) Factories Act 1948: the Act lays down the procedure for approval of plans before setting up a factory engaged in manufacturing processes, health and safety provisions, welfare provisions, working hours, annual earned leave and rendering information regarding accidents or dangerous occurrences to designated authorities. It is applicable to premises employing 10 persons or more with aid of power or 20 or more persons without the aid of power.

(q) Weekly Holidays Act -1942

(r) Bonded Labour System (Abolition) Act, 1976: The Act provides for the abolition of bonded labour system with a view to preventing the economic and physical exploitation of weaker sections of society. Bonded labour covers all forms of forced labour, including that arising out of a loan, debt or advance.

(s) Employer's Liability Act, 1938: This Act protects workmen who bring suits for damages against employers in case of injuries endured in the course of employment. Such injuries could be on account of negligence on the part of the employer or persons employed by them in maintenance of all machinery, equipment etc. in healthy and sound condition.

(t) Employees State Insurance Act 1948: The Act provides for certain benefits to insured employees and their families in case of sickness, maternity and disablement arising out of an employment injury. The Act applies to all employees in factories (as defined) or establishments which may be so notified by the appropriate Government. The Act provides for the setting up of an Employees' State Insurance Fund, which is to be administered by the Employees State Insurance Corporation. Contributions to the Fund are paid by the employer and the employee at rates as prescribed by the Central Government. The Act also provides for benefits to dependents of insured persons in case of death as a result of an employment injury.

(u) The Personal Injuries (Compensation Insurance) Act, 1963: This Act provides for the employer's liability and responsibility to pay compensation to employees where workmen sustain personal injuries in the course of employment.

(v) Industrial Employment (Standing Order) Act 1946: It is applicable to all establishments employing 100 or more workmen (employment size reduced by some of the States and Central Government to 50). The Act provides for laying down rules governing the conditions of employment by the Employer on matters provided in the Act and get the same certified by the designated Authority.

ANNEXURE IX

Geotechnical test report

GEO MARINE
THE SPIRIT OF ENGINEERING

flowline
SYSTEMS PVT. LTD.
Underwater Pipeline Solutions

GEO MARINE CONSULTANTS (P) LTD.,
11, 2nd Main Road, Kannappa Nagar Ext,
Kottivakkam, Chennai – 600 041.
Ph. No. 044 - 24481485 & 24480305.
drcvp@geomarineindia.com

PROJECT

PROPOSED PIPELINE LAYING BELOW THE CREEK BED AT BACKWATER CANAL AT ENNORE, CHENNAI

CLIENT

FLOW LINE SYSTEMS PVT LTD,
129C, VEL AMRUTHA TOWER,
15/7 NALLANNA MUDALI STREET,
ROYAPETTAH, CHENNAI – 600 114.

TITLE

FACTUAL GEOTECHNICAL INVESTIGATION REPORT

REPORT NO.: GT- 2024

(WORK ORDER NO. FSPL/19-20/STV/13)

DATE	REVISON	DESCRIPTION		AUTHORISED SIGNATORY
14/11/2019	-	SUBMISSION OF GEOTECHNICAL REPORT	SIGN	
			DATE	14/11/2019
			DESIGNATION	MANAGING DIRECTOR
			NAME	DR. C.V.PRASAD

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CHAPTER-1

INTRODUCTION

1.0 Project Information Matrix

Nature of project : Proposed laying of pipe line

Project Owner : **FLOW LINE SYSTEMS PVT LTD.,**

Project Location : Backwater Creek, Ennore

Job Code : GT-2024

1.1 Scope Of Work

1.1.1 Field Work

- ❖ Conducting four soil investigation bore holes of 150 mm diameter up to 10 m depth below the creek bed level.
- ❖ Conducting Standard Penetration Test (SPT) within the borehole at every 1.0m depth interval up to borehole termination depth
- ❖ Collection of SPT soil samples
- ❖ Collection of water samples if groundwater table met within the investigation depth

1.1.2 Laboratory Work

- ❖ Natural Moisture Content
- ❖ Atterberg limits
- ❖ Grain Size Analysis
- ❖ Chemical Analysis test on soil and water samples to give pH, Chlorides and Sulphates

1.2 Structure of the Report

- ❖ Contents
- ❖ Introduction
- ❖ Investigation Methodology & Test Results
- ❖ Sub-Surface Stratification
- ❖ Guidelines & Recommendations
- ❖ Annexure

CHAPTER-2

INVESTIGATION METHODOLOGY & TEST RESULTS

2.0 Preamble:

Four soil investigation boreholes were put as per the planning of the engineer in-charge and these locations are shown in Fig.2.0.The equipment used and the methodology adopted to carry out the fieldwork is described below.

2.1 Methodology of Field Work:

2.1.1 Equipment Used and Method of Drilling:

All the boreholes were sunk by conventional rotary drilling rigs. For borehole Methodology followed for boring conformed to IS: 1892 -2000. Boring was progressed by the cutting action of rotating bit with water circulation and stabilizing the side of the boreholes by using casing pipes/bentonite slurry up to required depth to prevent collapse of sidewall. Boring was continued by normal boring process using MS soil cutter in soil. However Tungsten Carbide (TC) bit drilling was resorted to drill in highly weathered rock stratum where the normal boring process became slow. Diamond Core (DC) bit drilling was adopted in moderately weathered rock formations where penetration using TC bit was became slow.

2.1.2 Standard Penetration Tests:

This is a field test to determine “Penetration Resistance of Stratum at the Test Depth”. This has been conducted in the boreholes generally up to refusal depth using procedures described in IS: 2131- 2002. In this test, split spoon sampler (50.8 mm OD and 35 mm ID) has replaced driving bit. Sampler is then driven by dropping 63.5 kg hammer on top of driving collar with free fall of 75 cm. The length of sampler is 60 cm.

The tests were conducted at the depth intervals indicated in Chapter-1 (Sec.1.1.1).

2.1.3 Collection of Soil Samples:

2.1.3.1 Disturbed Samples:

The SPT-samples collected were used as disturbed soil samples. These samples were used for visual and physical identification and for conducting laboratory classification tests as per I.S.1498-1970.

2.1.4 Collection of Ground Water Samples:

One representative water sample from each borehole was collected after 24 hours of completing the borehole if water table met within the investigated depth.

Note on Groundwater Table Record:

- ❖ Groundwater table observation in geotechnical report is predominantly to arrive at foundation design criteria and shall not be construed as design guidelines for the design of dewatering systems
- ❖ The groundwater level indicated in the bore logs is specific to the duration of investigation and intensity of the monsoon rains during the time of investigation. Hence, the level shall be taken as guidelines only to plan the investigation for the dewatering system

- No foundation excavation or basement excavations if anticipated within the groundwater table zone shall be carried out without implementing groundwater lowering schemes

2.2 Laboratory testing:

2.2.1 On Coarse Grained Soil

On the representative samples, sieve analysis tests were conducted to arrive at grain size distribution. These tests were conducted as per I.S.2720 (part 4)-1985 and the results are presented in Table - 2.1 to 2.4. The graphical representation of grainsize distribution curve for the representative samples in each bore is presented in Fig. 2.6 to 2.8.

2.2.2 On Fine Grained Soil

On the SPT sample index property tests were conducted to estimate consistency. These test results are presented in Table - 2.1 to 2.4. The graphical representation of hydrometer analyses curve for the representative samples in each bore is presented in Fig. 2.9 to 2.16

2.2.3 Chemical Analysis Tests

On representative soil samples chemical analysis tests were conducted to estimate pH, Chloride and Sulphates and these results are presented in Table - 2.5.

2.3 Summary:

The locations of the field investigation boreholes are shown in site plan given in Fig.2.0. The average sub soil profiles encountered at each location along with their classification and engineering properties are presented in Figs.2.1 to 2.4. Further, the cross sectional variation of the sub surface profile through different bore holes is presented in Figs.2.5.

FIGURE 2.0 PLAN SHOWING THE BOREHOLE INVESTIGATION LOCATIONS

GEOMARINE THE SPIRIT OF ENGINEERING	SITE INVESTIGATION RECORD					BORE HOLE No.	BH-01
						PAGE No.	1
PROJECT NAME	PROPOSED CONSTRUCTION OF UNDERGROUND PIPELINE					DIA OF BORE HOLE	150mm ✓ / NX
LOCATION	Creek Location, Ennore	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	18/10/2019
STRUCTURE	Underground Pipe Line	DRILLING METHOD	Rotary	CO-ORDINATES	N 1462729.86	BORE END DATE	18/10/2019
JOB CODE	GT-2024	FLUSHING MEDIUM	Bentonite		E 426087.40	TOTAL DRILL DAYS	1

Depth below E.G.L. (m)	Drilling progress per metre: Date	Time Hr.	Time Min.	Type of Drill Bit (SC / TCB / DB)	Core Details: Total Core Recovery %	Core Details: R.Q.D %	SPT Details Blows/cm. 0-15	15-30	30-45	SPT 'N' Value	Sample Details: Depth	No.	Type	RL (m)	Layer Data: Legend	No	Depth	Geotechnical Description
1	18/10/2019						Penetration With Self Weight			0	1.00	-	-	-1.0				
		15 To 15	5 To 6	SC	-	-												
2							0	0	1	1	2.00 ↓ 2.45	1	SS	-2.0		L1	2.0	Brownish Grey,Wet,Very Soft,**Recent Sediment** (predominantly clay & silt particles with shells at times)
		15 To 15	13 To 14	SC	-	-												
3							-	-	-	-	3.00	2	UDS	-3.0				
		15 To 15	27 To 28	SC	-	-												
4							0	1	0	1	4.00 ↓ 4.45	3	SS	-4.0				
		15 To 15	48 To 49	SC	-	-												
5							1	1	1	2	5.00 ↓ 5.45	4	SS	-5.0				
		16 To 16	02 To 03	SC	-	-												
6							0	1	1	2	6.00 ↓ 6.45	5	SS	-6.0				
		16 To 16	18 To 19	SC	-	-												
7							-	-	-	-	7.00	6	UDS	-7.0				
		16 To 16	43 To 44	SC	-	-												
8							5	7	6	13	8.00 ↓ 8.45	7	SS	-8.0		L2	8.0	Grey to Black,Moist,Very Soft to Soft, **Silty CLAY (CH)** Clays of High Plasticity
		17 To 17	13 To 15	SC	-	-												
9							4	7	8	15	9.00 ↓ 9.45	8	SS	-9.0		L3	9.0	Grey,Moist,Poorly Graded,Fine to Medium Grains,Medium Dense, **Silty SAND (SM)**
		17 To 17	34 To 35	SC	-	-												
10							6	8	11	19	10.00 ↓ 10.45	9	SS	-10.0		L4	10.5	Grey to Brownish Grey,Moist,Poorly Graded,Fine to Medium Grains, Medium Dense, **Clayey Silty SAND (SC)**

CS - Core Sample	DS - Disturbed Sample	LOGGED	V. Aravindhan	PROJECT SITE DETAILS		REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	18/10/2019	REF. BED LEVEL (m)	0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Anitha Kondusamy	WATER DEPTH (m)	2.00	
WS - Wash Sample	DB - Diamond Bit	DATE	22/10/2019	CASING DEPTH (m)	4.5	

BOREHOLE TERMINATED AT 10 M DEPTH BELOW E.G.L

FIG.2.1 SUB SOIL PROFILE AT BH-01 LOCATION

GEOMARINE
THE SPIRIT OF ENGINEERING

SITE INVESTIGATION RECORD

BORE HOLE No.	**BH-02**				
PAGE No.	1				
PROJECT NAME	PROPOSED CONSTRUCTION OF UNDERGROUND PIPELINE			DIA OF BORE HOLE	150mm ✓ / NX
LOCATION	Creek Location, Ennore	MACHINE No.	CR-01	CHAINAGE (m)	-
BORE START DATE	19/10/2019				
STRUCTURE	Underground Pipe Line	DRILLING METHOD	Rotary	CO-ORDINATES	N 1462580.30
BORE END DATE	19/10/2019				
JOB CODE	GT-2024	FLUSHING MEDIUM	Bentonite	CO-ORDINATES	E 426182.10
TOTAL DRILL DAYS	1				

Depth below E.G.L. (m)	Date	Drilling progress per metre – Time (Hr.)	Time (Min.)	Type of Drill Bit (SC / TCB / DB)	Total Core Recovery %	R.Q.D %	SPT Blows/cm. 0-15	15-30	30-45	SPT 'N' Value	Sample Depth	No.	Type	RL (m)
	19/10/2019	10 To 10	12 To 13	SC	-	-								
1							Penetration With Self Weight			**0**	1.00	-	-	-1.0
		10 To 10	20 To 21	SC	-	-								
2							-	-	-	**-**	2.00	1	UDS	-2.0
		10 To 10	32 To 33	SC	-	-								
3							0	1	1	**2**	3.00 – 3.45	2	SS	-3.0
		10 To 10	48 To 49	SC	-	-								
4							1	2	2	**4**	4.00 – 4.45	3	SS	-4.0
		10 To 10	58 To 59	SC	-	-								
5							-	-	-	**-**	5.00	4	UDS	-5.0
		11 To 11	12 To 13	SC	-	-								
6							0	1	1	**2**	6.00 – 6.45	5	SS	-6.0
		11 To 11	33 To 34	SC	-	-								
7							1	1	1	**2**	7.00 – 7.45	6	SS	-7.0
		11 To 11	57 To 58	SC	-	-								
8							2	4	6	**10**	8.00 – 8.45	7	SS	-8.0
		12 To 12	19 To 20	SC	-	-								
9							4	6	8	**14**	9.00 – 9.45	8	SS	-9.0
		12 To 12	39 To 41	SC	-	-								
10							6	11	12	**23**	10.00 – 10.45	9	SS	-10.0

Layer Data

No	Depth	Geotechnical Description
L1	1.7	Brownish Grey,Wet,Very Soft,**Recent Sediment** (predominantly clay & silt particles with shells at times)
L2	3.0	Pale to Medium Grey,Wet,Very Soft, **Silty CLAY (CH)** Clays of High Plasticity
L3	4.0	Grey,Moist,Wet,Very Soft, **Silty CLAY (CL) With Sand Mixture** Lean Clay of Low Plasticity
L4	5.0	Grey,Moist,Poorly Graded,Fine to Medium Grains,Very Loose, **Silty SAND (SM)**
L5	6.0	Grey,Moist,Very Soft, **Silty CLAY (CH)** Clays of High Plasticity
L6	8.0	Grey,Moist,Very Soft, **Silty CLAY (CI) With Sand Lenses** Lean Clay of Medium Plasticity
L7	9.0	Grey,Moist,Poorly Graded,Predt. Medium Grains,Loose, **Silty SAND (SM)**
L8	10.5	Grey,Moist,Poorly Graded,Predt. Medium Grains,Medium Dense, **Silty SAND (SM)**

CS - Core Sample	DS - Disturbed Sample	LOGGED	V. Aravindhan	PROJECT SITE DETAILS		REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	19/10/2019	REF. BED LEVEL (m)	0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Anitha Kondusamy	WATER DEPTH (m)	2.20	
WS - Wash Sample	DB - Diamond Bit	DATE	22/10/2019	CASING DEPTH (m)	4.5	

BOREHOLE TERMINATED AT 10 M DEPTH BELOW E.G.L

FIG.2.2 SUB SOIL PROFILE AT BH-02 LOCATION

GEOMARINE THE SPIRIT OF ENGINEERING	SITE INVESTIGATION RECORD					BORE HOLE No.	BH-03
						PAGE No.	1
PROJECT NAME	PROPOSED CONSTRUCTION OF UNDERGROUND PIPELINE					DIA OF BORE HOLE	150mm ✓ / NX
LOCATION	Creek Location, Ennore	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	19/10/2019
STRUCTURE	Underground Pipe Line	DRILLING METHOD	Rotary	CO-ORDINATES	N 1462314.56	BORE END DATE	19/10/2019
JOB CODE	GT-2024	FLUSHING MEDIUM	Bentonite		E 426295.75	TOTAL DRILL DAYS	1

Depth below E.G.L. (m)	Drilling progress per metre: Date	Time Hr.	Time Min.	Type of Drill Bit (SC / TCB / DB)	Core Details: Total Core Recovery %	R.Q.D %	SPT Blows/cm. 0-15	15-30	30-45	SPT 'N' Value	Sample Details: Depth	No.	Type	RL (m)	Layer Data: No	Depth	Geotechnical Description
1	19/10/2019						Penetration With Self Weight			0	1.00	1	SS	-1.0			
		13 To 13	57 To 58	SC	-	-									L1	1.8	Brownish Grey,Wet,Very Soft,**Recent Sediment** (predominantly clay & silt particles with shells at times)
2							1	0	0	0	2.00 – 2.45	2	SS	-2.0			
		14 To 14	09 To 10	SC	-	-											
3							-	-	-	-	3.00	3	UDS	-3.0			
		14 To 14	23 To 24	SC	-	-											
4							0	1	1	2	4.00 – 4.45	4	SS	-4.0			
		14 To 14	39 To 40	SC	-	-											
5							1	1	2	3	5.00 – 5.45	5	SS	-5.0			
		14 To 14	58 To 59	SC	-	-											
6							-	-	-	-	6.00	6	UDS	-6.0			
		15 To 15	15 To 16	SC	-	-									L2	7.0	Gey to Black,Moist,Very Soft to Soft, **Silty CLAY (CH) With Sea Shells at times** Clays of High Plasticity
7							1	2	3	5	7.00 – 7.45	7	SS	-7.0			
		15 To 15	42 To 43	SC	-	-									L3	8.0	Grey,Moist,Poorly Graded,Fine to Medium Grains,Loose, **Silty SAND (SM)**
8							2	4	3	7	8.00 – 8.45	8	SS	-8.0			
		15 To 16	59 To 01	SC	-	-											
9							3	4	7	11	9.00 – 9.45	9	SS	-9.0			
		16 To 16	29 To 30	SC	-	-									L4	10.0	Grey to Black,Moist,Medium Stiff to Stiff, **Silty CLAY (CH)** Clays of High Plasticity
10							4	8	12	20	10.00 – 10.45	10	SS	-10.0	L5	10.5	Grey to Black,Moist,Very Stiff, **Silty CLAY (CH)**

CS - Core Sample	DS - Disturbed Sample	LOGGED	V. Aravindhan	PROJECT SITE DETAILS		REMARKS	
SS - Split Spoon Sample	SC - Soil Cutter	DATE	19/10/2019	REF. BED LEVEL (m)	0.00		
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Anitha Kondusamy	WATER DEPTH (m)	2.50		
WS - Wash Sample	DB - Diamond Bit	DATE	22/10/2019	CASING DEPTH (m)	4.5		

BOREHOLE TERMINATED AT 10 M DEPTH BELOW E.G.L

FIG.2.3 SUB SOIL PROFILE AT BH-03 LOCATION

GEOMARINE
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SITE INVESTIGATION RECORD

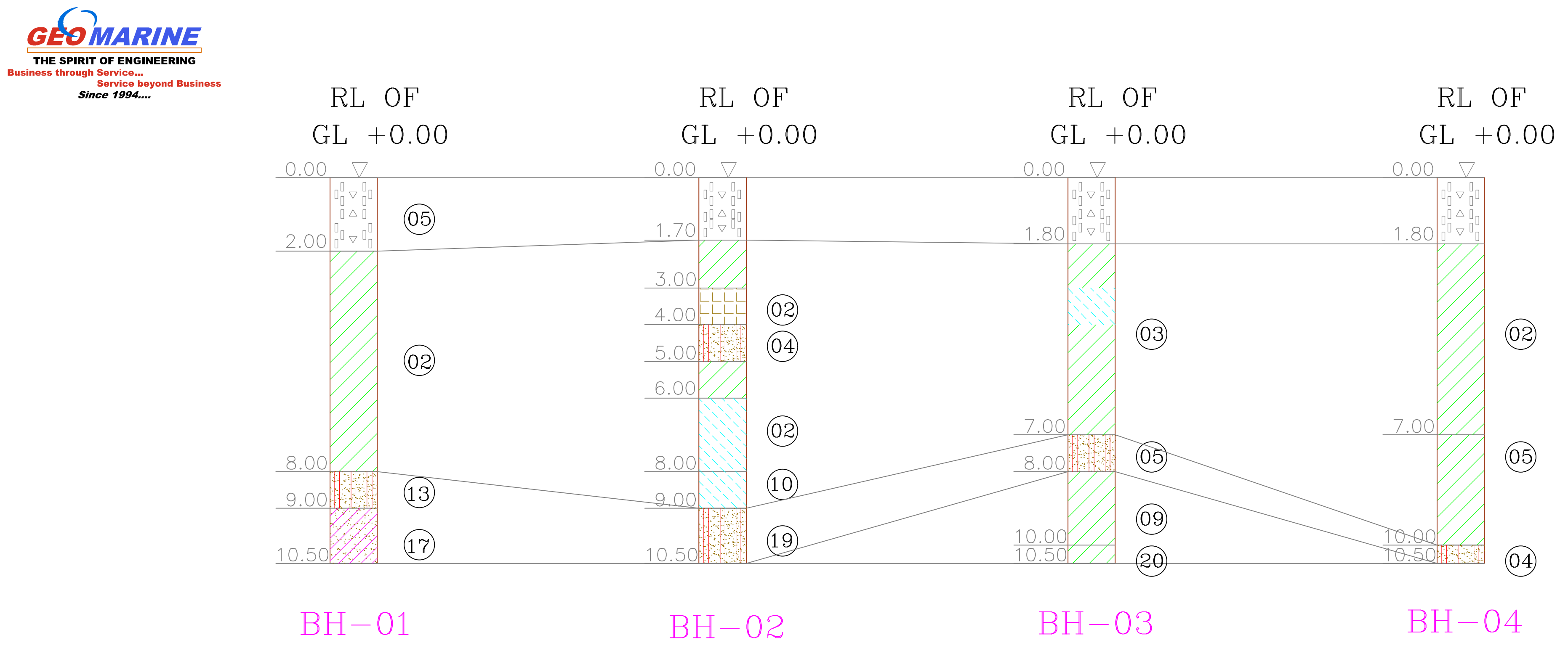
BORE HOLE No.	BH-04						
PAGE No.	1						
PROJECT NAME	PROPOSED CONSTRUCTION OF UNDERGROUND PIPELINE					DIA OF BORE HOLE	150mm ✓ / NX
LOCATION	Creek Location, Ennore	MACHINE No.	CR-01	CHAINAGE (m)	-	BORE START DATE	20/10/2019
STRUCTURE	Underground Pipe Line	DRILLING METHOD	Rotary	CO-ORDINATES	N 1462465.25	BORE END DATE	20/10/2019
JOB CODE	GT-2024	FLUSHING MEDIUM	Bentonite		E 426238.97	TOTAL DRILL DAYS	1

Depth below E.G.L. (m)	Drilling progress per metre: Date	Time Hr.	Time Min.	Type of Drill Bit (SC / TCB / DB)	Core Details: Total Core Recovery %	R.Q.D %	SPT Details: Blows/cm. 0-15	15-30	30-45	SPT 'N' Value	Sample Details: Depth	No.	Type	RL (m)	Layer Data: Legend	No	Depth	Geotechnical Description
1	20/10/2019	10 To 10	27 To 28	SC	-	-	Penetration With Self Weight			0	1.00	-	-	-1.0		L1	1.8	Brownish Grey,Wet,Very Soft,**Recent Sediment** (predominantly clay & silt particles with shells at times)
2		10 To 10	36 To 37	SC	-	-	0	0	0	0	2.00 – 2.45	1	SS	-2.0				
3		10 To 10	42 To 43	SC	-	-	-	-	-	-	3.00	2	UDS	-3.0				
4		10 To 10	54 To 55	SC	-	-	0	0	1	1	4.00 – 4.45	3	SS	-4.0				Gey to Black,Moist,Very Soft to Soft, **Silty CLAY (CH)** Clays of High Plasticity
5		11 To 11	14 To 15	SC	-	-	1	2	1	3	5.00 – 5.45	4	SS	-5.0				
6		11 To 11	35 To 36	SC	-	-	-	-	-	-	6.00	5	UDS	-6.0		L2	7.0	
7		11 To 11	53 To 54	SC	-	-	1	2	3	5	7.00 – 7.45	6	SS	-7.0				
8		12 To 12	19 To 20	SC	-	-	2	2	3	5	8.00 – 8.45	7	SS	-8.0				Gey to Black,Moist,Medium Stiff, **Silty CLAY (CH)** Clays of High Plasticity
9		12 To 12	51 To 52	SC	-	-	2	2	4	6	9.00 – 9.45	8	SS	-9.0		L3	10.0	
10							4	1	3	4	10.00 – 10.45	-	*SS	-10.0		L4	10.5	Sample Failed (Interpreted as Fine Sand)

CS - Core Sample	DS - Disturbed Sample	LOGGED	V. Aravindhan	PROJECT SITE DETAILS	REMARKS
SS - Split Spoon Sample	SC - Soil Cutter	DATE	20/10/2019	REF. BED LEVEL (m) 0.00	
UDS- Undisturbed Sample	TCB - Tungsten Carbide Bit	CHECKED	Anitha Kondusamy	WATER DEPTH (m) 2.30	
WS - Wash Sample	DB - Diamond Bit	DATE	22/10/2019	CASING DEPTH (m) 4.5	

BOREHOLE TERMINATED AT 10 M DEPTH BELOW E.G.L

FIG.2.4 SUB SOIL PROFILE AT BH-04 LOCATION



LEGEND

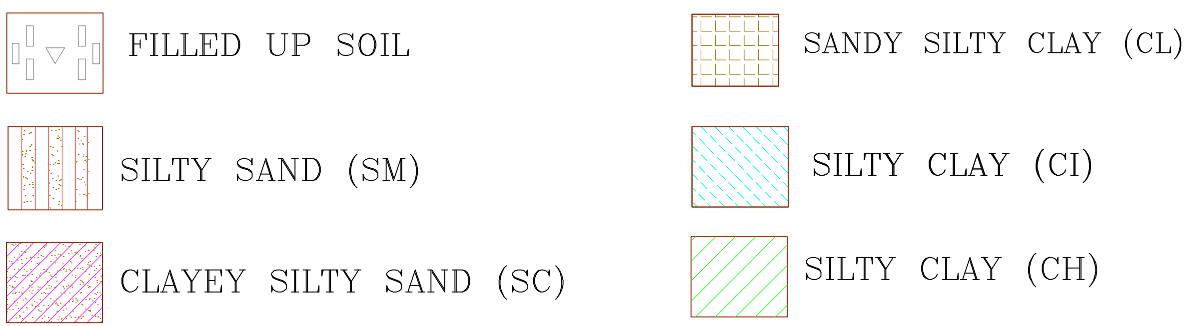


FIG.No.2.5 CROSS SECTIONAL VARIATION OF SUB SOIL PROFILE THROUGH BH-01 TO 04

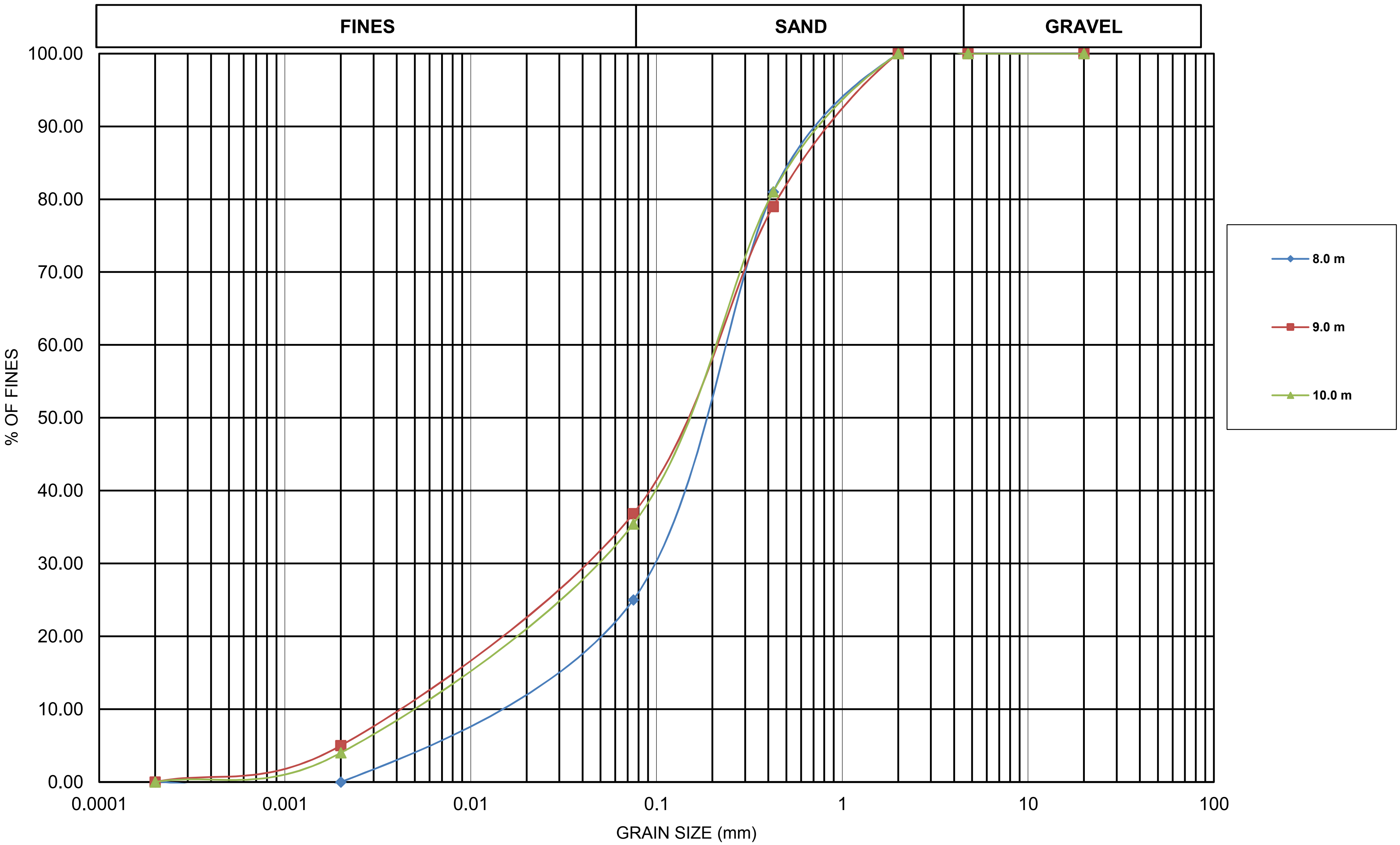


Fig. 2.6 GRAIN SIZE DISTRIBUTION CURVE - BH-01

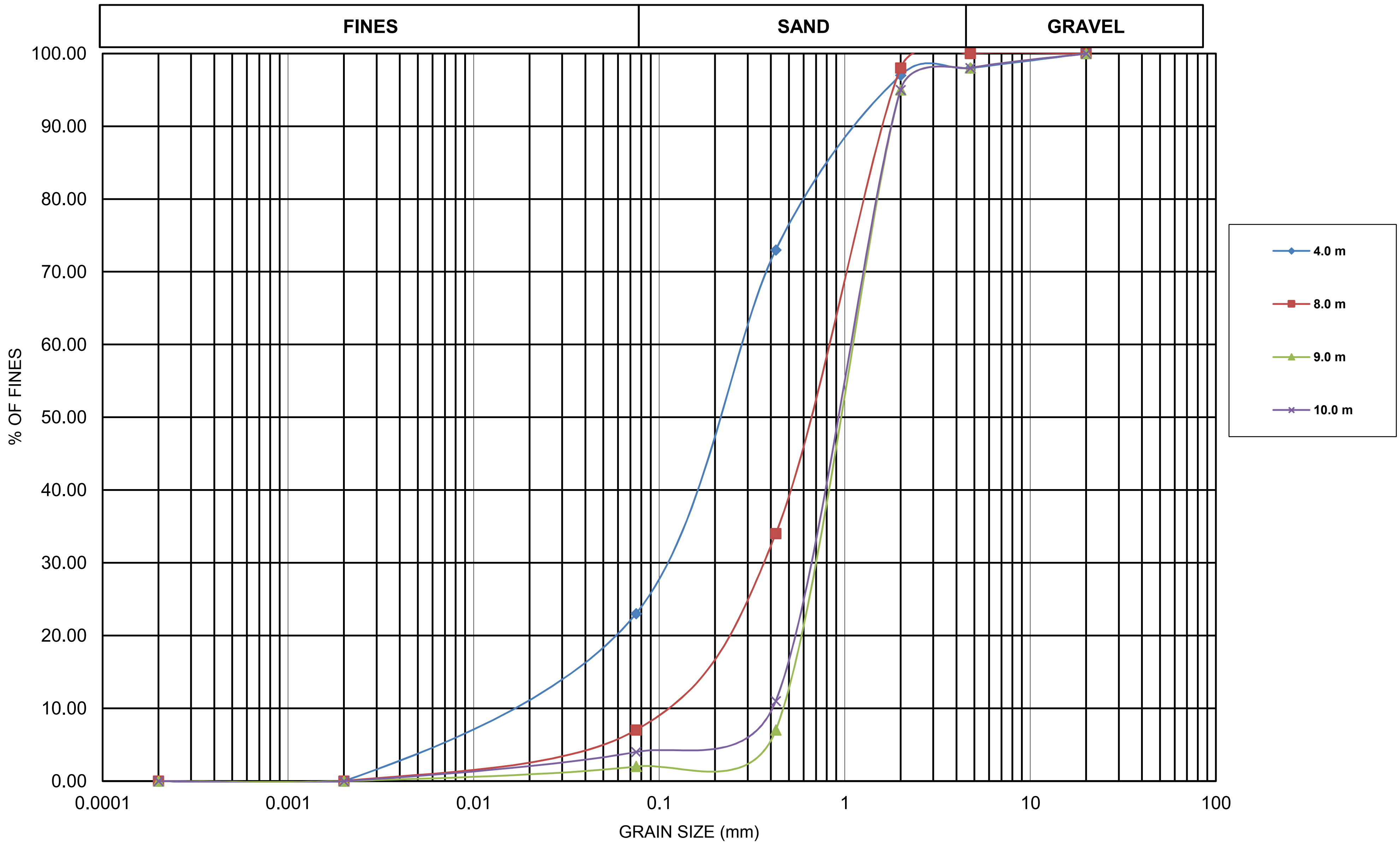


Fig. 2.7 GRAIN SIZE DISTRIBUTION CURVE - BH-02

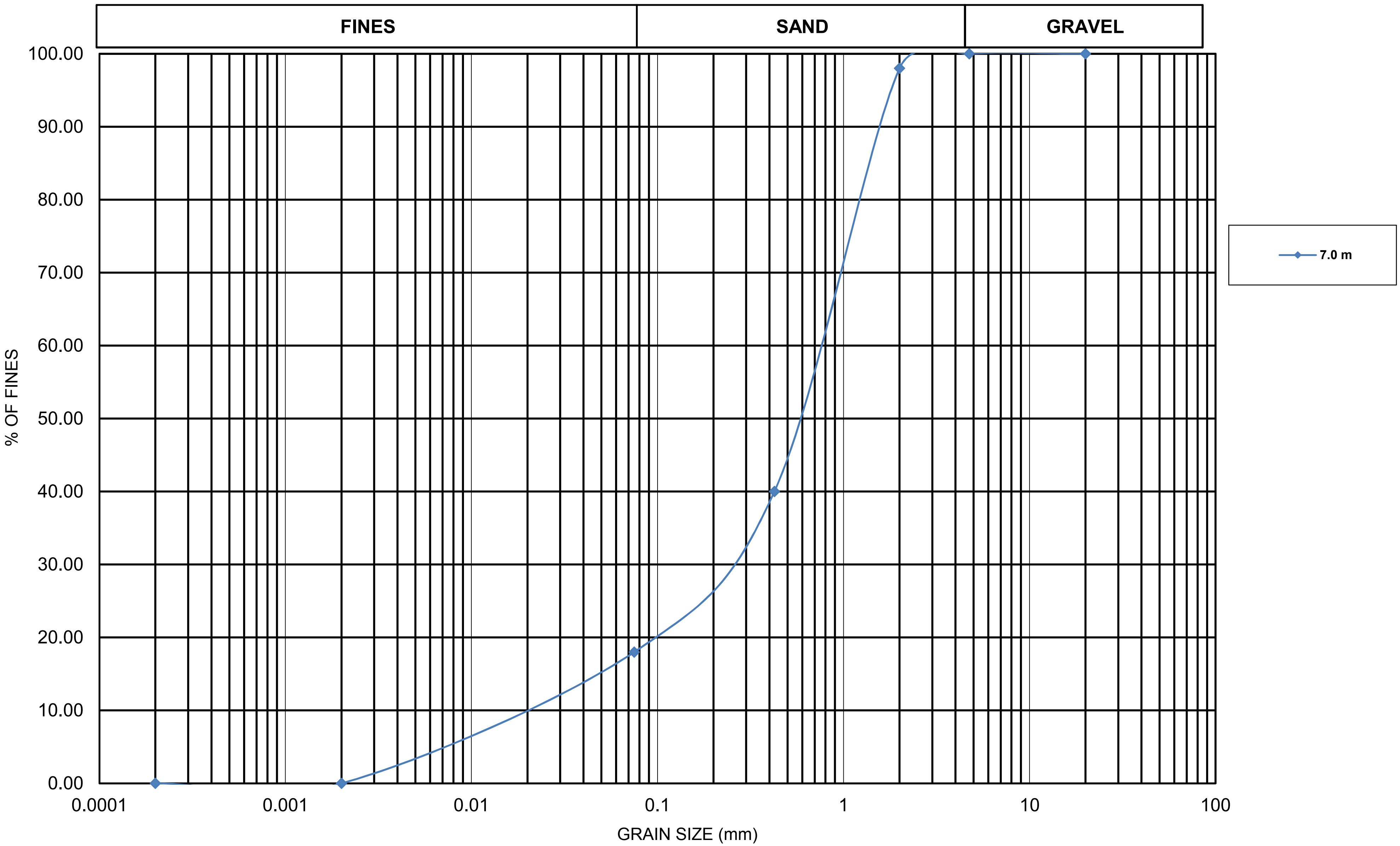


Fig. 2.8 GRAIN SIZE DISTRIBUTION CURVE - BH-03

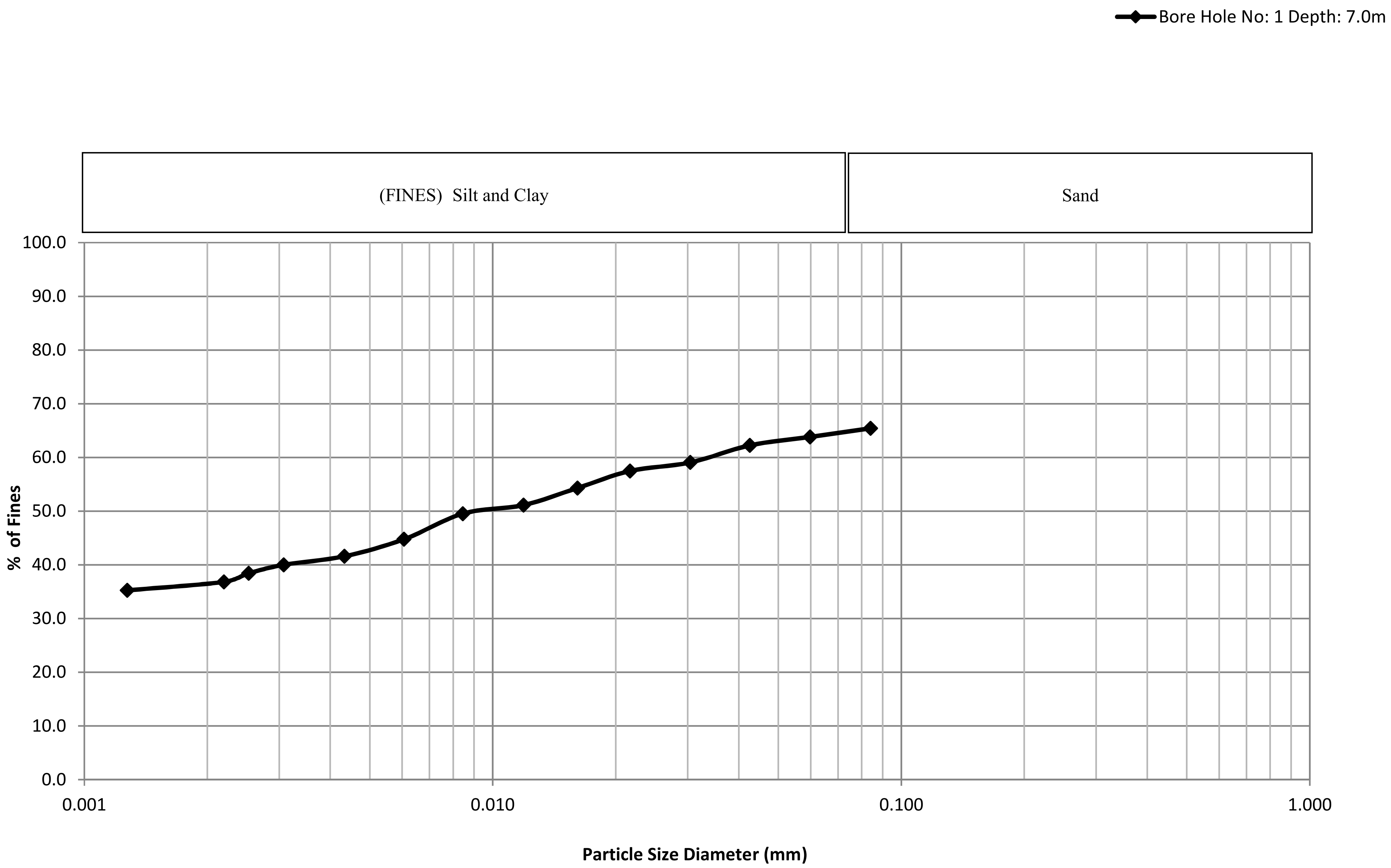


Fig 2.9 Hydrometer Analysis Master Curve

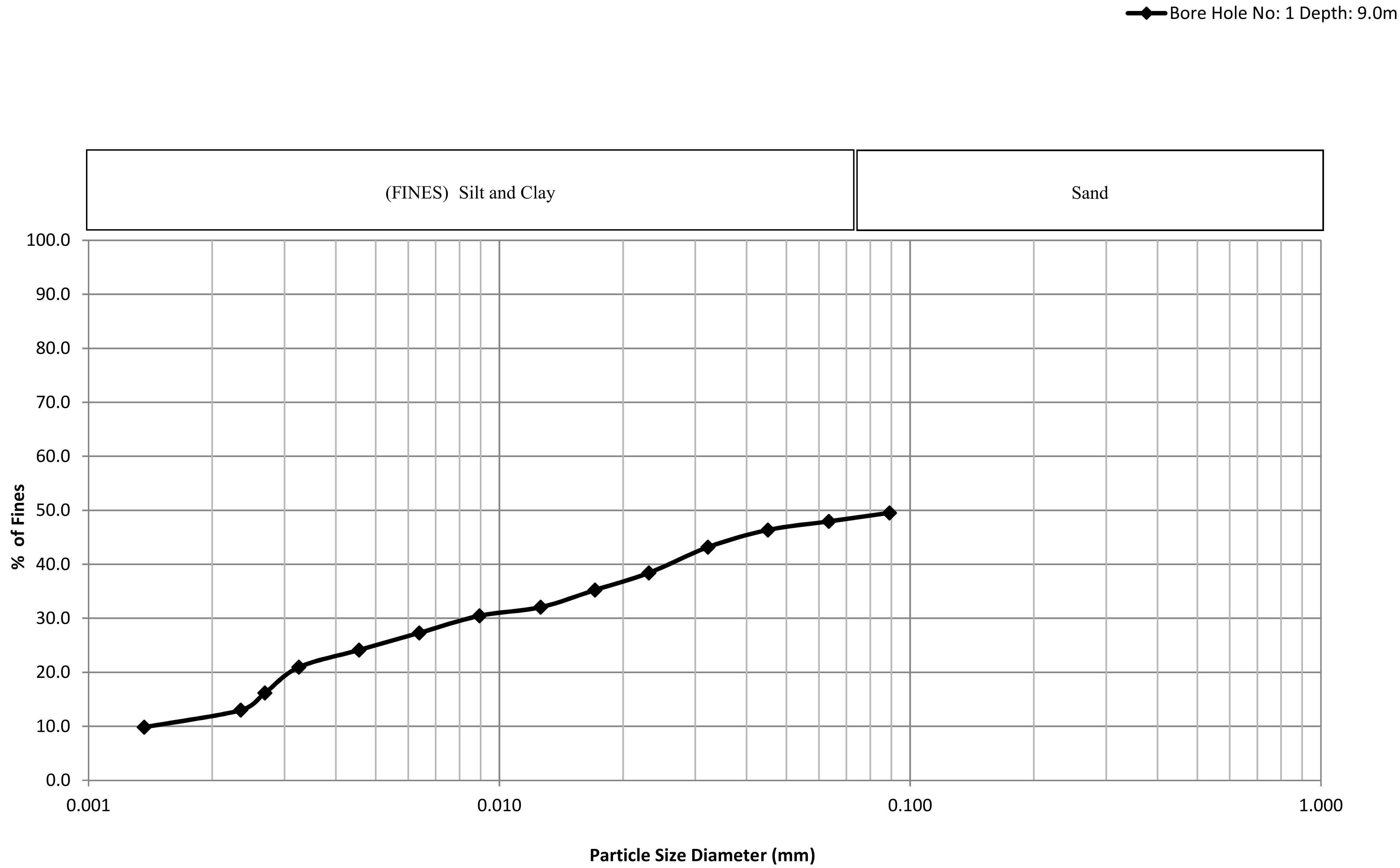


Fig 2.10 Hydrometer Analysis Master Curve

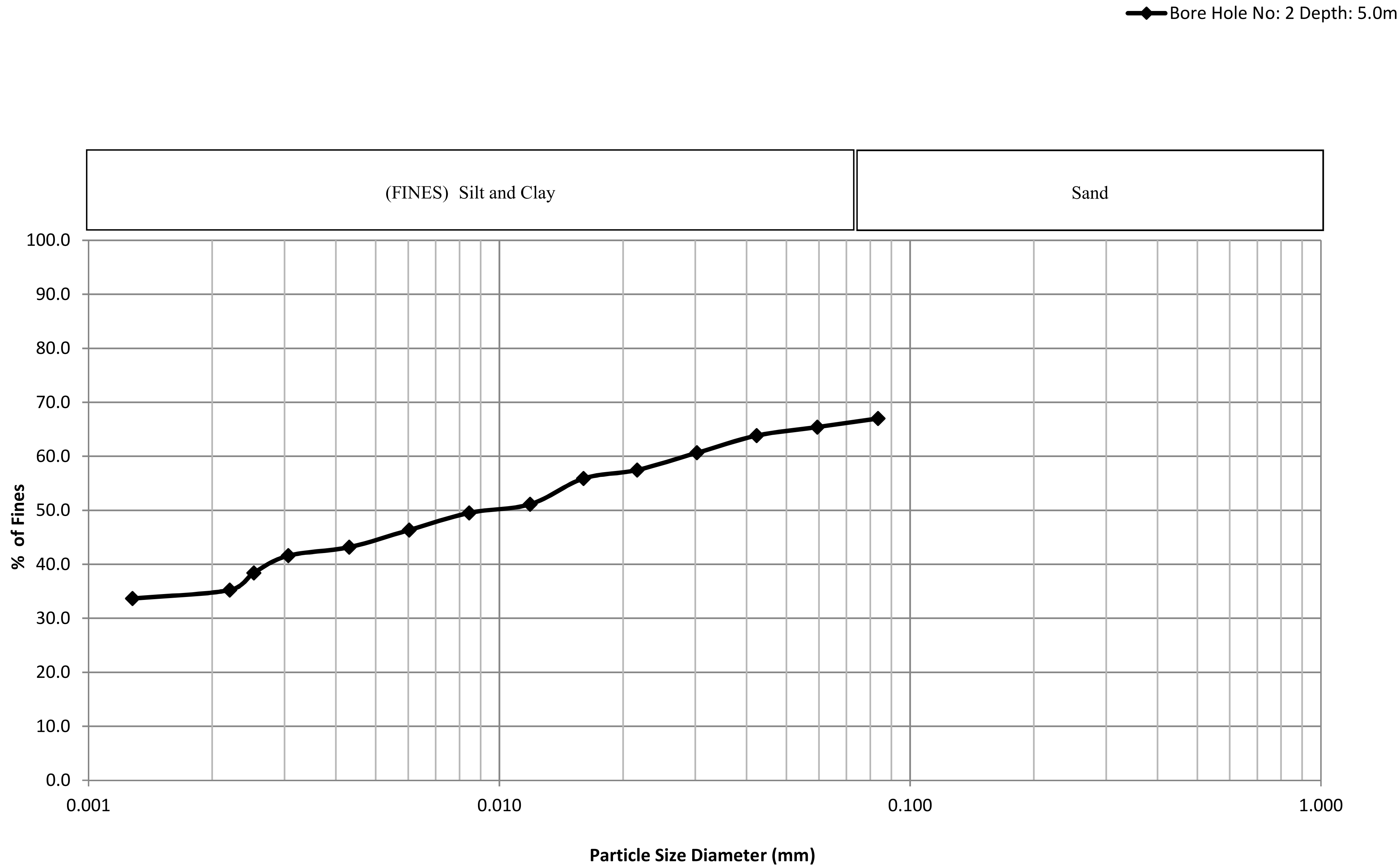


Fig 2.11 Hydrometer Analysis Master Curve

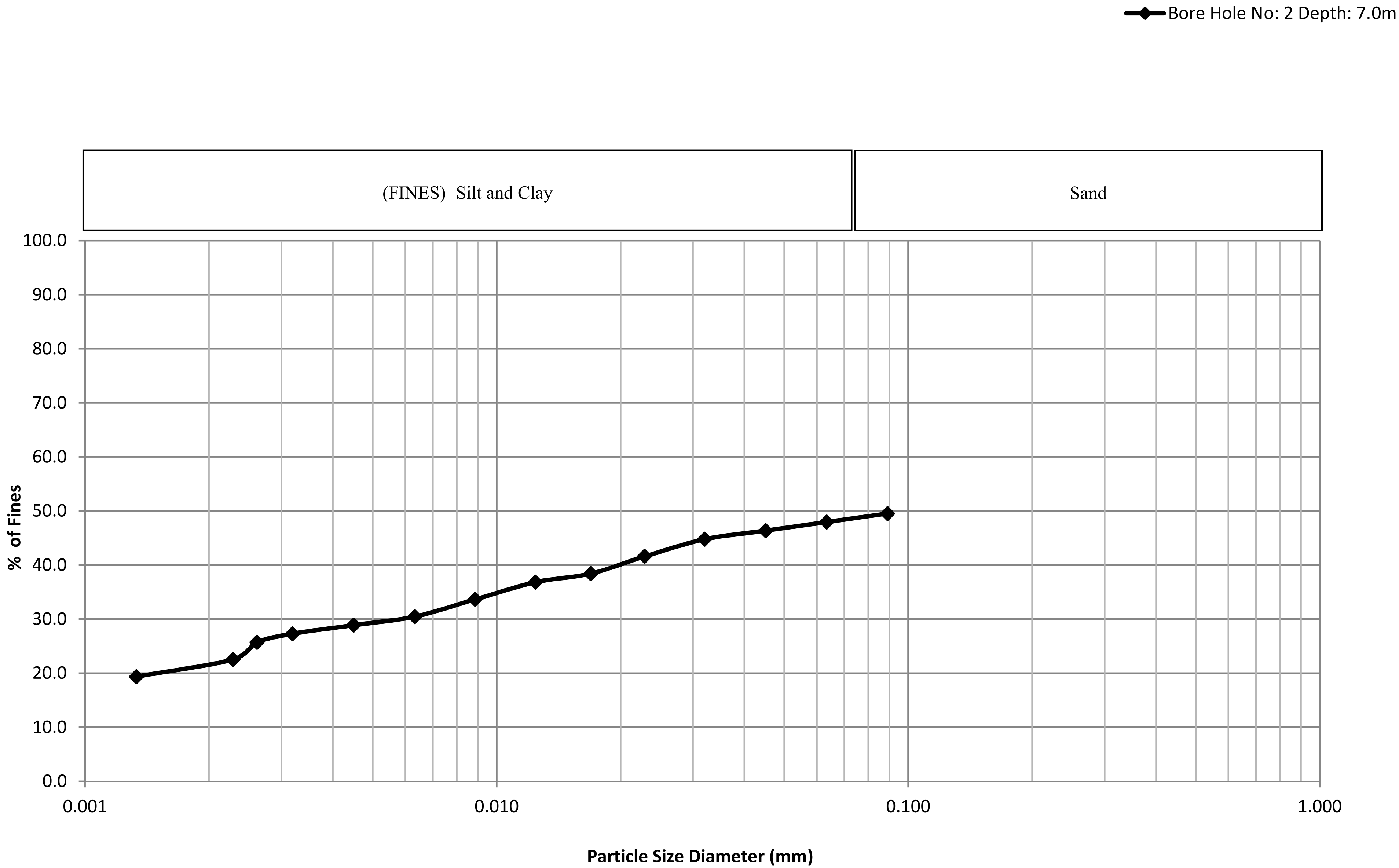


Fig 2.12 Hydrometer Analysis Master Curve

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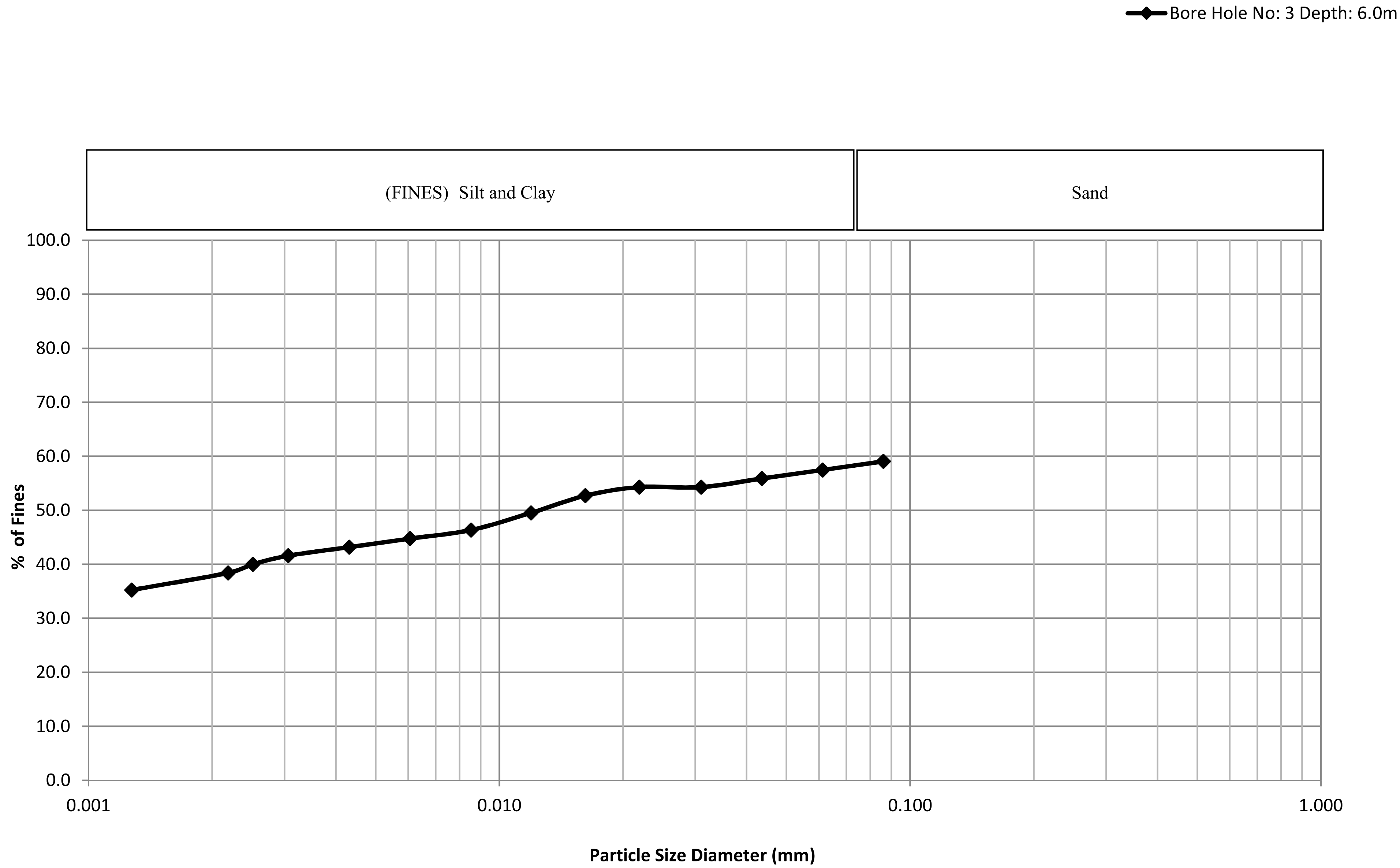

Fig 2.13 Hydrometer Analysis Master Curve

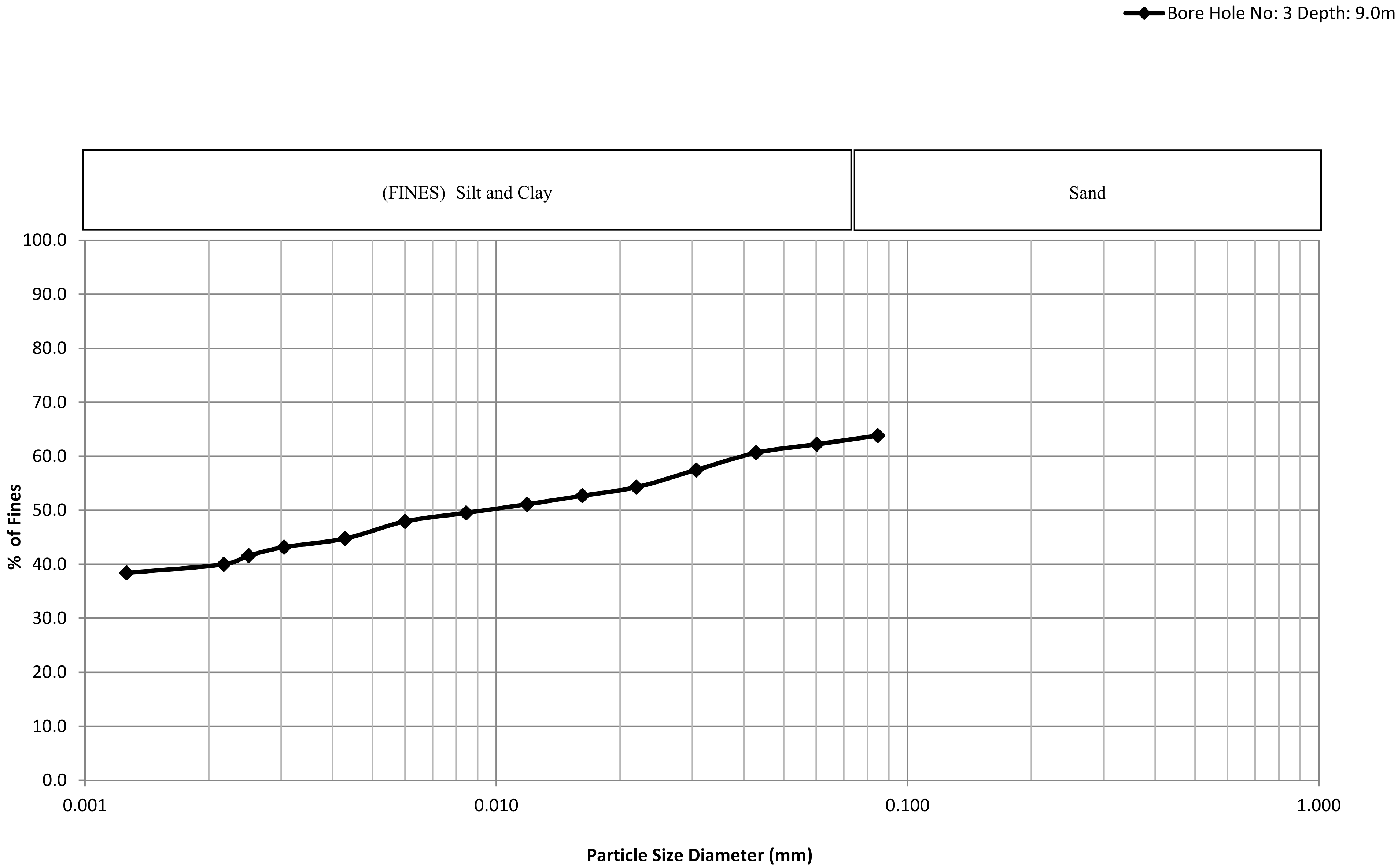

Fig 2.14 Hydrometer Analysis Master Curve

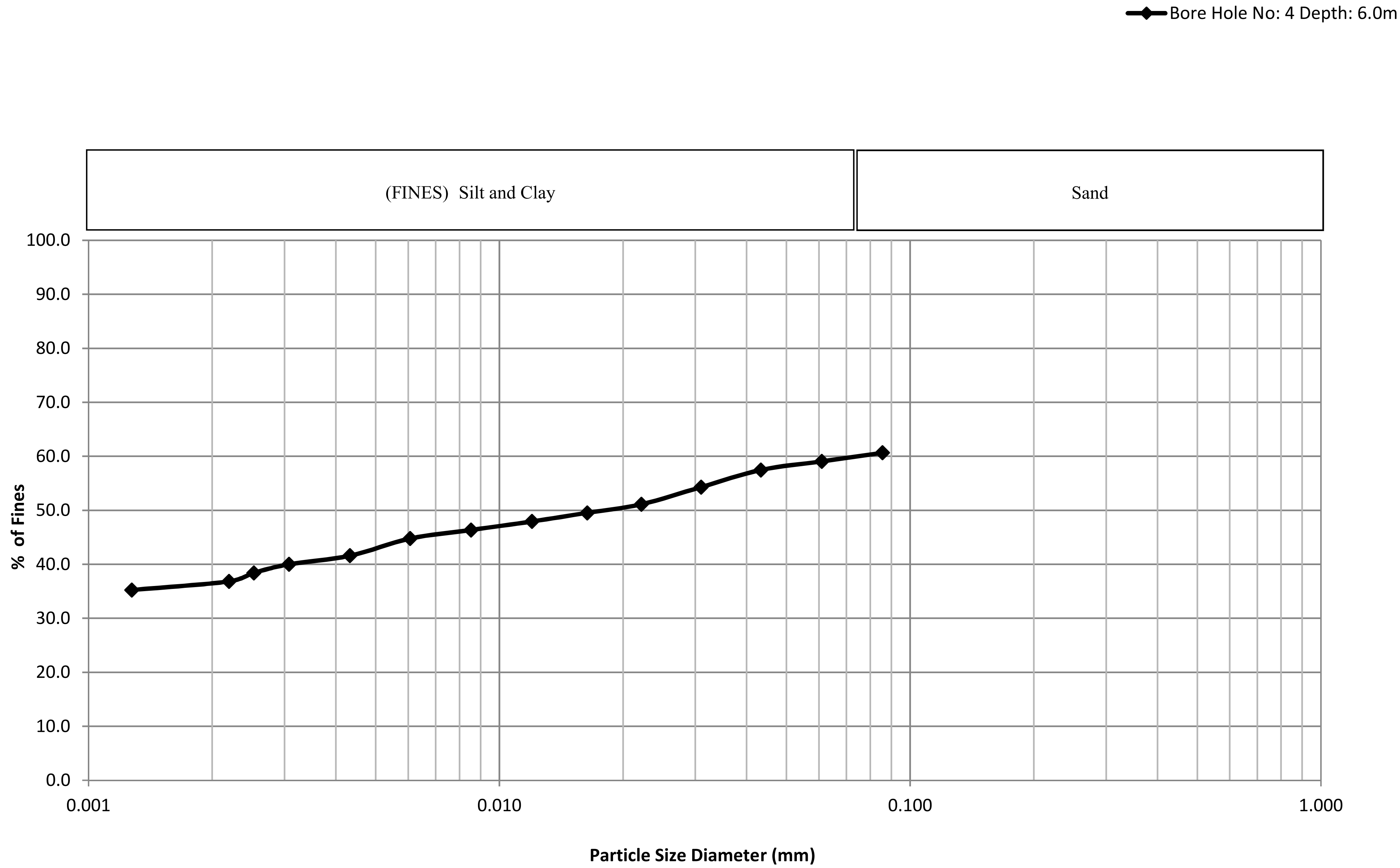

Fig 2.15 Hydrometer Analysis Master Curve

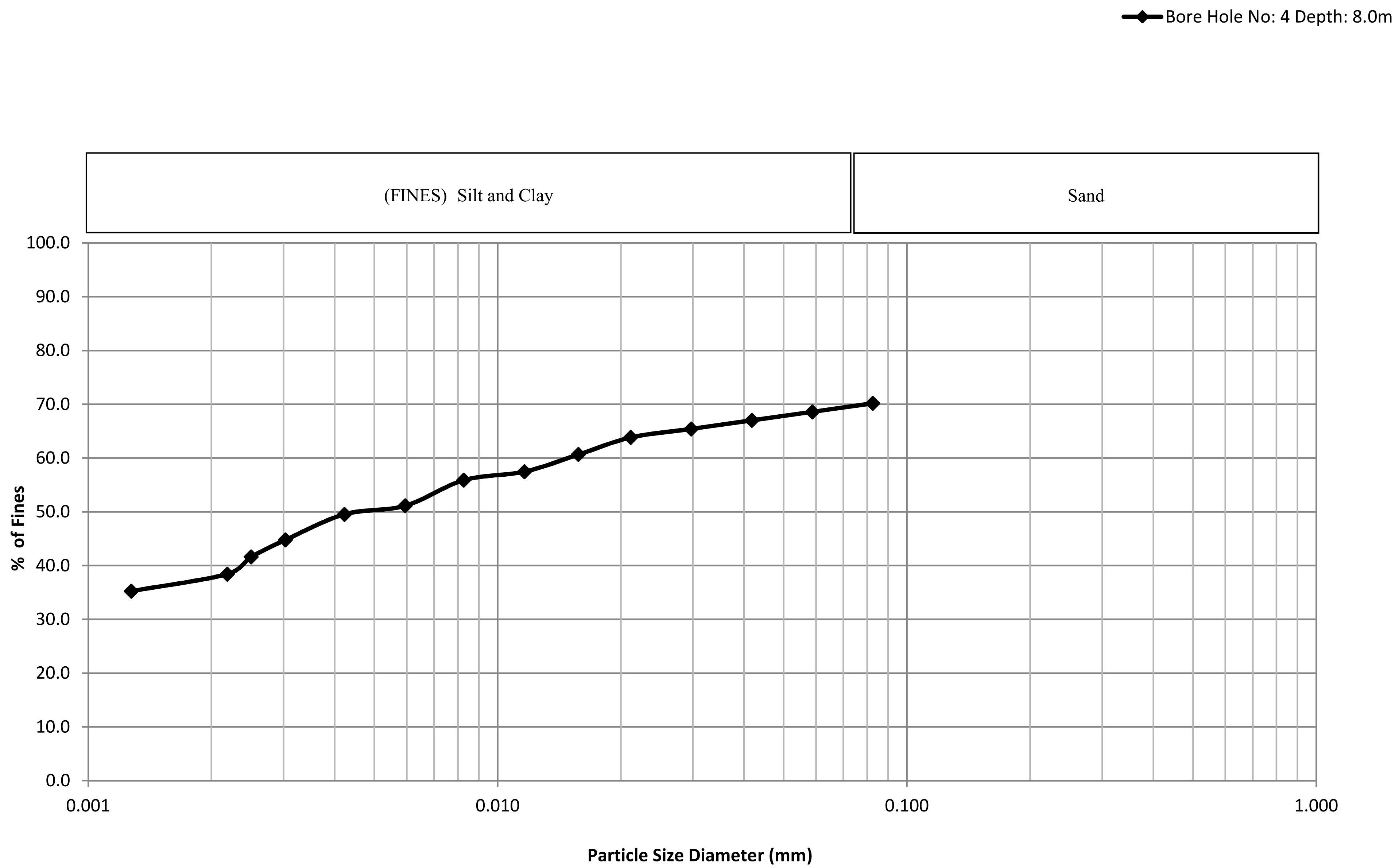

Fig 2.16 Hydrometer Analysis Master Curve

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TABLE-2.1 LABORATORY CLASSIFICATION OF SOIL SAMPLES FROM BH-01

Depth of Sample below E.G.L. (m)	SPT-Value	Type of Sample	Sub Soil Classification																								
			Fine Grained (FG)											Coarse Grained (CG)													
			N.M.C(%)	L.L (%)	P.L (%)	I_P	Ic	Shrinkage (cm^3)	D.F.S (%)	Consistancy	Position With Respect to A-Aline	IS:Notation	Bulk Density (kN/m^3)	Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	D_{10} (mm)	D_{30}(mm)	D_{60} (mm)	$C_U=D_{60}/D_{10}$	$C_c=D_{30}^2/(D_{10}xD_{60})$	Relative Density	IS-Notation	
																										Gravel	Sand
2.00	1	SS	65	53	25	28	-0.40	12	42	Very Soft	Above	CH	-	-	-	-	-	67	33	-	-	-	-	-	FG>50%	FG>50%	FG>50%
3.0	-	UDS	63	59	28	31	-0.13	12	45	Very Soft	Above	CH	14.1	-	-	-	-	64	36	-	-	-	-	-	FG>50%	FG>50%	FG>50%
5.0	2	SS	58	65	32	33	0.21	11	39	Very Soft	Above	CH	-	-	-	-	-	62	38	-	-	-	-	-	FG>50%	FG>50%	FG>50%
7.0	-	UDS	52	67	32	35	0.43	10	58	Very Soft	Above	CH	14.6	-	-	-	-	62	38	-	-	-	-	-	FG>50%	FG>50%	FG>50%
8.0	13	SS	-	-	-	-	-	-	-	CG>50%	-	-	-	0	0	19	56	25	0	-	-	-	-	-	M.Dense	<50%	SM
9.0	15	SS	18	30	17	13	0.89	18	20	CG>50%	Above	-	-	0	0	21	39	35	5	-	-	-	-	-	M.Dense	<50%	SC
10.0	19	SS	16	29	17	12	1.07	17	25	CG>50%	Above	-	-	0	0	19	43	34	4	-	-	-	-	-	M.Dense	<50%	SC

FG = Fine Grained; PL = Plastic Limit; FS = Differential Free Swell Index; NMC= Nature Moisture Content; Ic = (LL-NMC)/Ip; LL = Liquid Limit
CG = Coarse Grained; Ip = Plasticity Index; C_U = Uniformity Coefficient; C_C = Coefficient of Curvature; SL = Shrinkage Limit

TABLE-2.2 LABORATORY CLASSIFICATION OF SOIL SAMPLES FROM BH-02

Depth of Sample below E.G.L. (m)	SPT-Value	Type of Sample	Sub Soil Classification																							
			Fine Grained (FG)										Bulk Density (kN/m^3)	Coarse Grained (CG)												
			N.M.C(%)	L.L (%)	P.L (%)	I_P	Ic	Shrinkage (cm^3)	D.F.S (%)	Consistancy	Position With Respect to A-Aline	IS:Notation		Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	D_{10} (mm)	D_{30}(mm)	D_{60} (mm)	$C_U=D_{60}/D_{10}$	$C_c=D_{30}^2/(D_{10}xD_{60})$	Relative Density	IS-Notation	
																										Gravel	Sand
2.0	-	UDS	90	58	30	28	-1.14	13	33	Very Soft	Above	CH	14.2	-	-	-	-	65	35	-	-	-	-	-	FG>50%	FG>50%	FG>50%
3.0	2	SS	94	32	15	17	-3.77	16	-5	Very Soft	Above	CL	-	-	-	-	-	80	20	-	-	-	-	-	FG>50%	FG>50%	FG>50%
4.0	4	SS	-	-	-	-	-	-	-	CG>50%	-	-	-	2	1	24	50	23	0	-	-	-	-	-	V.Loose	<50%	SM
5.0	-	UDS	49	58	30	28	0.30	11	55	Very Soft	Above	CH	14.8	-	-	-	-	65	35	-	-	-	-	-	FG>50%	FG>50%	FG>50%
6.0	2	SS	36	36	19	17	0.03	16	14	Very Soft	Above	CI	-	-	-	-	-	78	22	-	-	-	-	-	FG>50%	FG>50%	FG>50%
7.0	2	SS	51	39	20	19	-0.66	14	9	Very Soft	Above	CI	-	-	-	-	-	77	23	-	-	-	-	-	FG>50%	FG>50%	FG>50%
8.0	10	SS	-	-	-	-	-	-	-	CG>50%	-	-	-	0	2	64	27	7	0	-	-	-	-	-	Loose	<50%	SP-SM
9.0	14	SS	-	-	-	-	-	-	-	CG>50%	-	-	-	2	3	88	5	2	0	-	-	-	-	-	M.Dense	<50%	SP
10.0	23	SS	-	-	-	-	-	-	-	CG>50%	-	-	-	2	3	84	7	4	0	-	-	-	-	-	M.Dense	<50%	SP

FG = Fine Grained; PL = Plastic Limit; FS = Differential Free Swell Index; NMC= Nature Moisture Content; Ic = (LL-NMC)/Ip; LL = Liquid Limit

CG = Coarse Grained; Ip = Plasticity Index; C_U = Uniformity Coefficient; C_C = Coefficient of Curvature; SL = Shrinkage Limit

TABLE-2.3 LABORATORY CLASSIFICATION OF SOIL SAMPLES FROM BH-03

Depth of Sample below E.G.L. (m)	SPT-Value	Type of Sample	Sub Soil Classification																							
			Fine Grained (FG)										Bulk Density (kN/m^3)	Coarse Grained (CG)												
			N.M.C(%)	L.L (%)	P.L (%)	I_P	Ic	Shrinkage (cm^3)	D.F.S (%)	Consistancy	Position With Respect to A-Aline	IS:Notation		Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	D_{10} (mm)	D_{30}(mm)	D_{60} (mm)	C_U=D_{60}/D_{10}	C_c=D_{30}^2/(D_{10}xD_{60})	Relative Density	IS-Notation Gravel	IS-Notation Sand
2.0	0	SS	55	59	28	31	0.13	11	39	Very Soft	Above	CH	-	-	-	-	-	67	33	-	-	-	-	-	FG>50%	FG>50%	FG>50%
3.0	-	UDS	48	44	20	24	-0.14	13	32	Very Soft	Above	CI	14.2	-	-	-	-	75	25	-	-	-	-	-	FG>50%	FG>50%	FG>50%
4.0	2	SS	56	52	27	25	-0.15	12	36	Very Soft	Above	CH	-	-	-	-	-	70	30	-	-	-	-	-	FG>50%	FG>50%	FG>50%
5.0	3	SS	56	67	32	35	0.32	10	50	Soft	Above	CH	-	-	-	-	-	64	36	-	-	-	-	-	FG>50%	FG>50%	FG>50%
6.0	-	UDS	62	71	31	40	0.23	10	73	Soft	Above	CH	14.9	-	-	-	-	62	38	-	-	-	-	-	FG>50%	FG>50%	FG>50%
7.0	5	SS	-	-	-	-	-	-	-	CG>50%	-	-	-	0	2	58	22	18	0	-	-	-	-	-	Loose	<50%	SM
8.0	7	SS	43	69	29	40	0.65	10	37	M.Stiff	Above	CH	-	-	-	-	-	62	38	-	-	-	-	-	FG>50%	FG>50%	FG>50%
9.0	11	SS	42	75	32	43	0.77	10	45	Stiff	Above	CH	-	-	-	-	-	60	40	-	-	-	-	-	FG>50%	FG>50%	FG>50%
10.0	20	SS	29	63	31	32	1.06	10	57	V.Stiff	Above	CH		-	-	-	-	62	38	-	-	-	-	-	FG>50%	FG>50%	FG>50%

FG = Fine Grained   PL = Plastic Limit   FS = Differential Free Swell Index   NMC= Nature Moisture Content   Ic = (LL-NMC)/Ip   LL = Liquid Limit

CG = Coarse Grained   Ip = Plasticity Index C_U = Uniformity Coefficient C_C = Coefficient of Curvature   SL = Shrinkage Limit

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TABLE-2.4 LABORATORY CLASSIFICATION OF SOIL SAMPLES FROM BH-04

Depth of Sample below E.G.L. (m)	SPT-Value	Type of Sample	Sub Soil Classification																							
			Fine Grained (FG)											Coarse Grained (CG)												
																									IS-Notation	
			N.M.C(%)	L.L (%)	P.L (%)	I_P	Ic	Shrinkage (cm^3)	D.F.S (%)	Consistancy	Position With Respect to A-Aline	IS:Notation	Bulk Density (kN/m^3)	Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	D_{10} (mm)	D_{30}(mm)	D_{60} (mm)	$C_U=D_{60}/D_{10}$	$C_c=D_{30}^2/(D_{10}xD_{60})$	Relative Density	Gravel	Sand
2.0	0	SS	78	51	25	26	-1.05	13	40	Very Soft	Above	CH	-	-	-	-	-	68	32	-	-	-	-	-	FG>50%	FG>50%	FG>50%
3.0	-	UDS	65	70	33	37	0.13	10	38	Very Soft	Above	CH	14.1	-	-	-	-	62	38	-	-	-	-	-	FG>50%	FG>50%	FG>50%
5.0	3	SS	61	73	34	39	0.32	9	46	Soft	Above	CH	-	-	-	-	-	60	40	-	-	-	-	-	FG>50%	FG>50%	FG>50%
6.0	-	UDS	55	63	31	32	0.26	11	29	Soft	Above	CH	14.7	-	-	-	-	63	37	-	-	-	-	-	FG>50%	FG>50%	FG>50%
7.0	5	SS	44	58	30	28	0.50	11	42	M.Stiff	Above	CH	-	-	-	-	-	65	35	-	-	-	-	-	FG>50%	FG>50%	FG>50%
8.0	5	SS	44	68	32	36	0.67	11	17	M.Stiff	Above	CH	-	-	-	-	-	62	38	-	-	-	-	-	FG>50%	FG>50%	FG>50%
9.0	6	SS	49	66	32	34	0.51	10	61	M.Stiff	Above	CH	-	-	-	-	-	62	38	-	-	-	-	-	FG>50%	FG>50%	FG>50%

FG = Fine Grained; PL = Plastic Limit; FS = Differential Free Swell Index; NMC= Nature Moisture Content; Ic = (LL-NMC)/Ip; LL = Liquid Limit

CG = Coarse Grained; Ip = Plasticity Index; C_U = Uniformity Coefficient; C_C = Coefficient of Curvature; SL = Shrinkage Limit

Table-2.6 Results of Chemical Analysis					
		Soil (2:1)			
SL No.	**Bore HoleNo.**	**Depth of Sample (m)**	**pH**	**Chlorides (ppm)**	**Sulphates (ppm)**
1	BH-01	7.0	7.53	4537	>3000
2	BH-02	3.0	7.55	5230	>3000
3	BH-03	4.0	7.55	4750	>3000
4	BH-04	5.0	7.55	4585	>3000

CHAPTER-3

GEOLOGY&SUB-SURFACE STRATIFICATION

3.0 Preamble:

Geotechnical investigation carried out at a specific site provides location specific sub surface engineering characteristics. However, in major project sites, where the construction activities spread over a very large area, location specific sub surface strata characteristics are studied together with the geological mapping data. This is required to incorporate the impact of any documented macro-level geological characteristics of the region on the foundation design, irrespective of the location specific sub surface strata characteristics.

In view on the above, though it is beyond the scope of the present study to carry out macro-level geological investigation, the regional geology based on the published data is presented and discussed with respect to the foundation design.

3.1 Geology of Study Area (based on the published data)

Geologically, the present site is located in a coastal region with sub surface consisting of sedimentary deposits. The top sedimentary deposit is under laid by upper Gondwana system, particularly lower stage of Sriperumpudur. The formation mechanism of the sediments is chiefly due to transportation of surface water and marine deposition.

3.2 DESIGN SUB SOIL PROFILE: (from Foundation Engineering Application)

The sub soil characteristics obtained at the test location are further processed to arrive at the design soil parameters required for the design of sub structure using the following shear strength correlations with respect to the Standard Penetration Test Values of different layers.

- **For Coarse Grained Material, Ref. IS: 6403 to estimate Angle of Shearing Resistance (Reproduced and shown in Fig.A1).**
- **For Fine Grained Material, Ref. Terzaghi & Peck, 1948, to estimate Unconfined Compressive Strength (Reproduced and shown in Fig.A2)**

Based on the above, the average design soil characteristics are given below:

REFERENCE BORE HOLE-BH:					1	Ref R.L. of G.L. (m):			0.00		
Layer No.	Layer Thk. (m)			Type of Strata	Colour	Ave. Design SPT	Relative Density	Consistency	(γ) kN/m^3	Shear Parameters	
	Top. R.L.	Bot. R.L.	Thickness							(C_u) kPa	(ϕ) Deg.
1	2.00	8.00	6.00	Silty Clay	Grey	2	-	Very Soft	14	13	-
2	8.00	9.00	1.00	Silty Sand	Grey	13	Medium Dense	-	16.5	-	30.9
3	9.00	10.50	1.50	Clayey Silty Sand	Brownish Grey	17	Medium Dense	-	18	-	32.1

REFERENCE BORE HOLE-BH:					2	Ref R.L. of G.L. (m):			0.00		
Layer No.	Layer Thk. (m)			Type of Strata	Colour	Ave. Design SPT	Relative Density	Consistency	(γ) kN/m^3	Shear Parameters	
	Top. R.L.	Bot. R.L.	Thickness							(C_u) kPa	(ϕ) Deg.
1	1.70	4.00	2.30	Silty Clay	Grey	2	-	Very Soft	14	13	-
2	4.00	5.00	1.00	Silty Sand	Grey	4	Very Loose	-	13.5	-	20.22
3	5.00	8.00	3.00	Silty Clay	Grey	2	-	Very Soft	14	13	-
4	8.00	9.00	1.00	Silty Sand	Grey	10	Loose	-	15	-	30
5	9.00	10.50	1.50	Silty Sand	Grey	19	Medium Dense	-	18	-	32.7

REFERENCE BORE HOLE-BH:					3	Ref R.L. of G.L. (m):			0.00		
Layer No.	Layer Thk. (m)			Type of Strata	Colour	Ave. Design SPT	Relative Density	Consistency	(γ) kN/m^3	Shear Parameters	
	Top. R.L.	Bot. R.L.	Thickness							(C_u) kPa	(ϕ) Deg.
1	1.80	7.00	5.20	Silty Clay	Grey	2	-	Very Soft	14	13	-
2	7.00	8.00	1.00	Silty Sand	Grey	5	Loose	-	14	-	20.37
3	8.00	10.00	2.00	Silty Clay	Grey	9	-	Stiff	17	60	-
4	10.00	10.50	0.50	Silty Clay	Grey	20	-	Very Stiff	20	133	-

REFERENCE BORE HOLE-BH:					4	Ref R.L. of G.L. (m):			0.00		
Layer No.	Layer Thk. (m)			Type of Strata	Colour	Ave. Design SPT	Relative Density	Consistency	(γ) kN/m^3	Shear Parameters	
	Top. R.L.	Bot. R.L.	Thickness							(C_u) kPa	(ϕ) Deg.
1	1.80	7.00	5.20	Silty Clay	Grey	1	-	Very Soft	13.5	7	-
2	7.00	10.00	3.00	Silty Clay	Grey	5	-	Medium Stiff	15	33	-

CHAPTER-4

GUIDELINES FOR LAYING THE PIPELINE BELOW THE BED LEVEL OF ENNORE CREEK & RECOMMENDATION

4.0 Proposed work

The proposed work is laying a HDPE water pipeline below the Ennore creek bed

4.1 Preamble

In the present case, it is proposed to lay HDPE water pipe line with a minimum overburden of 3.0m below the recent sediment deposits of creek bed. Hence, considering the sub surface strata characteristics for laying the 900mm diameter pipeline the overall excavation depth required is 6.0m.

Taking into cognizance of sub surface strata, it is not physically possible to maintain definite trench cutting profile as the material is having flowing nature. Thus, the required excavation depth may only be considered before pipe line laying as the actual trench cross section profile cannot be estimated in these conditions.

4.2 Generalised Stratigraphy/Formation:

The present investigation location consists of broadly 4 layers of formation as given below

Layer-I 0.0m (bed level) - 1.8m	Recent sediment deposition (predominantly clay & silt)
Layer-II 1.8m to 7.0m	Very Soft to Soft, Silty Clay formation
Layer-III 7.0m to 10.0m	Medium Stiff, Silty Clay / Loose to Medium Dense, Sand
Layer-IV >10.0m	Very Stiff, Clay/ Medium Dense, Sand

4.3 Specific Recommendation:

- The deep dredging operation should not be carried out near the abutments of the existing bridge at both ends. Hence, sufficient precaution is to be taken to end the deep excavation (recommended as 6.0mts) well before approaching the abutment that is at a safe distance of about 15.0m to 20.0m from the abutments.
- The allowable safe bearing capacity at 6.0m depth is 60 kPa and typical computation is presented in Annexure.
- The additional pressure due to the laying of pipeline at 6.0m is less than 25 kPa which is much lesser than the pre-consolidation pressure of very soft clay, hence no creep settlement are takes place. In the present case, total settlement is estimated as per IS 8009 Part-I and found to be 40mm.

AUTHORISED SIGNATORY

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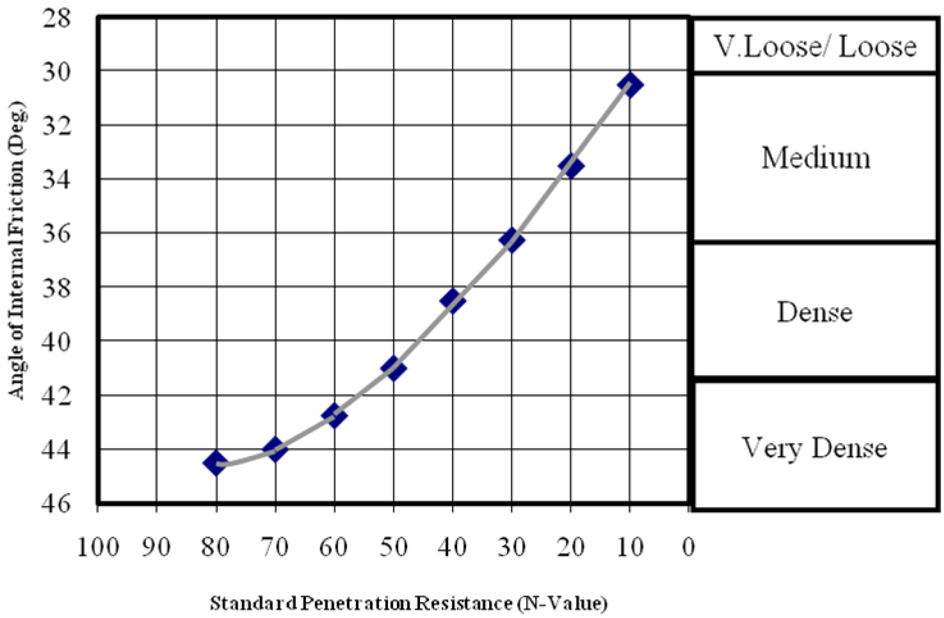


FIG. A1 Relation Ship between Angle of Internal Friction & N-value (Reproduced from IS:6403-1981)

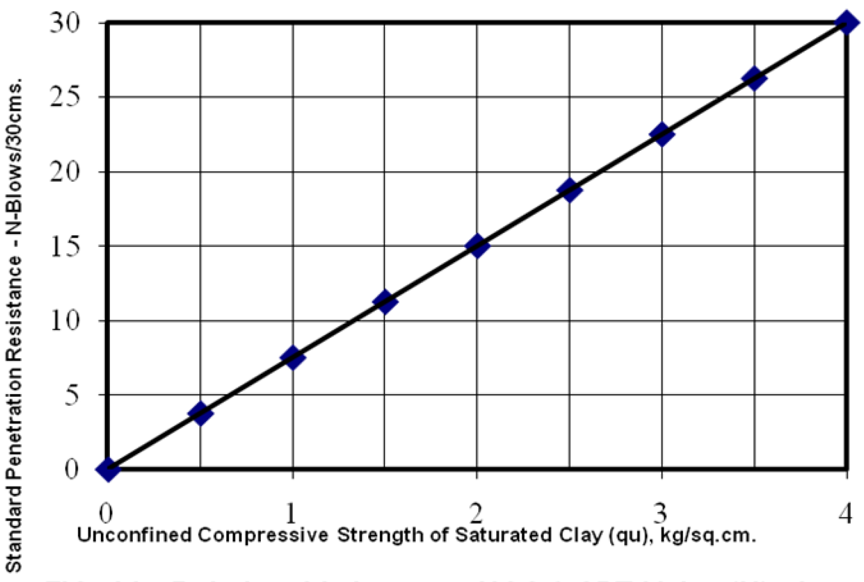


FIG. A2 : Relationship between UCC & SPT-Value (N) of Saturated Clay (AfterTerzhagi & Peck, 1948)

TYPICAL BEARING CAPACITY COMPUTATIONS FOR SHALLOW FOUNDATIONS

1.0 COMPUTATION OF BEARING CAPACITY AS PER IS:6403

1.1 Geometrical Data :

	BH-02
Shape of the Foundation	Strip
Depth of foundation below E.G.L"Df" (m)	6.00
Diameter of pipe "B" (m)	0.90
B/L	1.00
Inclination of Vertical Load with the Vertical (a)	0.00
Thickness of Fill (m)	0.00

1.2 Soil Data :

Type of Effective Bearing Strata :	Clay
Design SPT-value of the Bearing Strata :	2.00
Type of Shear Failure:	General
Undrained Shear Strength (Cu)	13.33

1.3 Design Parameters:

Bulk Density of Soil above the foundation depth (γ_{bulk})	14.0
Water Table Correction Factor (w')	0.50
Effective Overburden pressure at foundation level including the thickness of fill (q)	24.00
Bearing Capacity Factors:	
N_c =	5.14
N_q =	-
N_g =	-
Shape Factors:	
S_c =	1.00
S_q =	-
S_g =	-
Depth Factors :	
D_c =	2.33
D_q =	-
D_g =	-
Inclination Factor:	
I_c =	1.00
I_q =	-
I_g =	-

1.4 Ultimate Bearing Capacity (Qu) :

Qu=Cu*Nc*Sc*Dc*Ic	159.91	kPa

1.5 Safe Bearing Capacity (Qsafe) :

Factor of Safety (F.S.) :	2.50	
Qsafe :	64.0	kPa
Say Q_{safe}	**60**	**kPa**

2 Computation of Settlement as per IS:8009-Part I

2.1 Compression Parameters:

Average Natural Moisture content of soft clay (NMC)	55.0	
Specific gravity	2.66	
Average liquid limit of soft clay	65.0	
Average Compression Index (C_c)=0.009*Ave,Liquid Limit of 65)	0.495	
Average Initial Void Ration (e_o)=NMC*Sp.Gr. (2.66))	1.463	
Stress history factor (λ)	1.0	

2.2 Geometrical Data:

Depth of Top of Compressible clay layer from E.G.L. is (Z_1)	6.00	m
Detph fo Bot. of Compressible Clay layer from E.G.L. is (Z_2)	8.00	"
Thickness of compressible soft clay influenced by stress bulb (ΔH)	2.00	

2.3 Stress Computations:

Effective overburden pressue at the middel of the Compressible soft clay layer (P_0)	28.00	
B/Z1	0.15	
L/Z1	0.15	
B/Z2	0.11	
L/Z2	0.11	
Stress Reduction Factor (I_B)	0.17	
Additional stress due to the superstructure construction (Δp)=Q_{safe}*I_{B-ave})	10.20	kPa

2.4 Settlement Computations:

Consolidation Settlement (S_c=C_c*$\lambda*\Delta$H*log{(P_0+Δp)/P_0}/(1+e_0)	54.23	mm
Rigidity Factor	0.8	
Depth Factor (Ref. IS:8009-Part1-1976, Fig.12)	0.8	
Corrected Settlement(S_c)=	34.70	mm

3.0 Computation of Settlement for Maximum Pressure and Size of Footing: (as per IS:8009-Part-I-Ref. Eq.11) (Elastic Analysis)

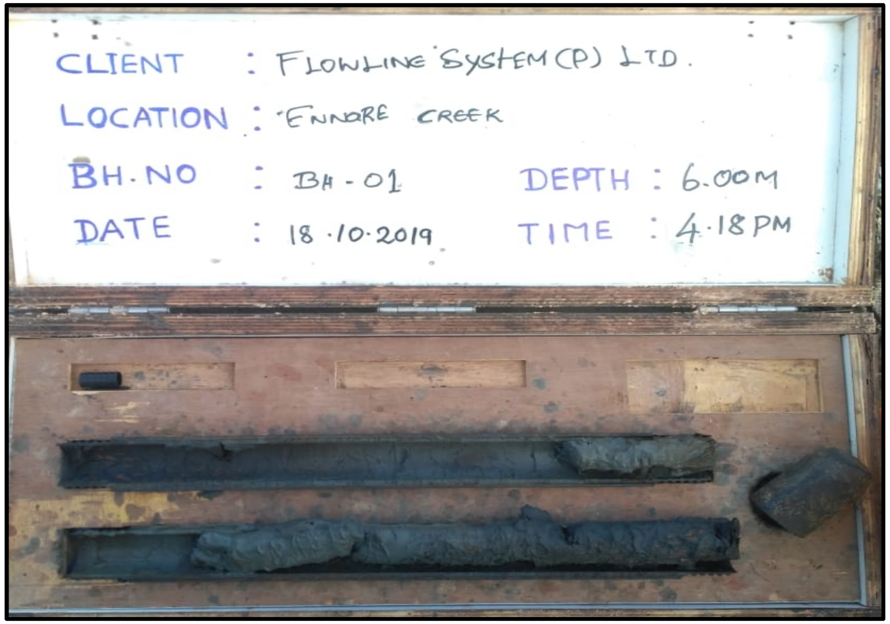
The immediate elastic settlement (S_e)=	qB(1-m^2)*I/E_s	
q= bearing pressure	60.00	
Poission's Ratio (μ)	0.50	
Modulus of Elasticity (E_s)(Ref. Joseph E Bowels,1996,page316,Table5.6, Japanese design standards)		
Modulus of Elasticity (E_s)	6666.67	
Breadth of strip foundation(m)	0.90	
Influence factor	0.95	
Rigidity Factor	0.80	
Elastic Settlement (S_e)	4.62	mm
Total Settlement (S_c+S_e)	39.32	mm


BH-01


BH-02


BH-03


BH-04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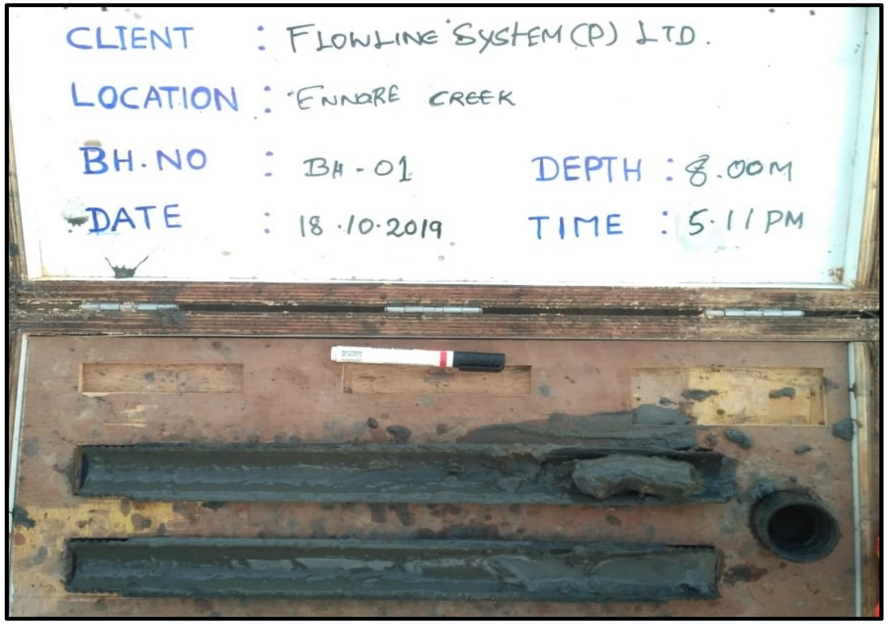
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DATE : 18.10.2019
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LOCATION : ENNORE CREEK
BH.NO : BH - 01
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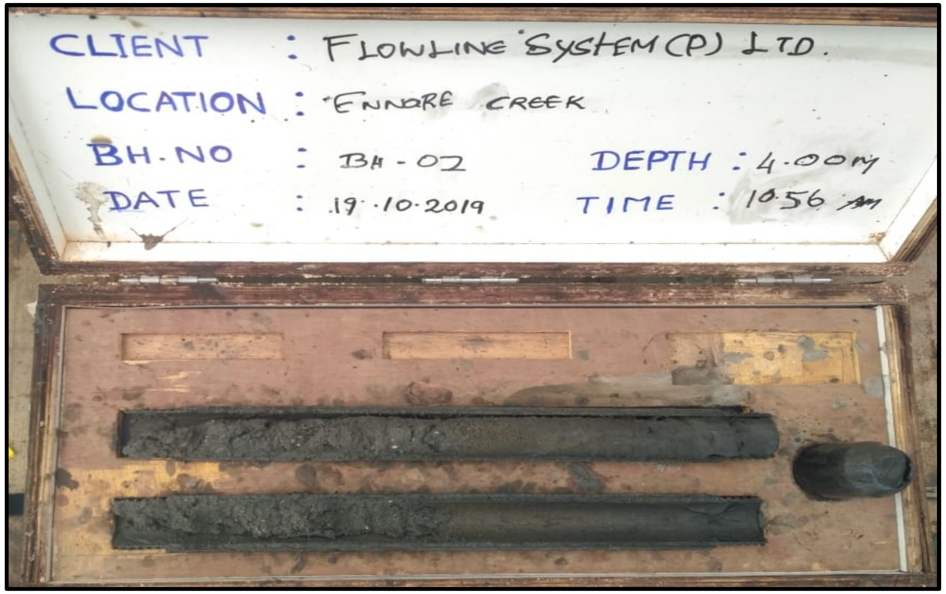
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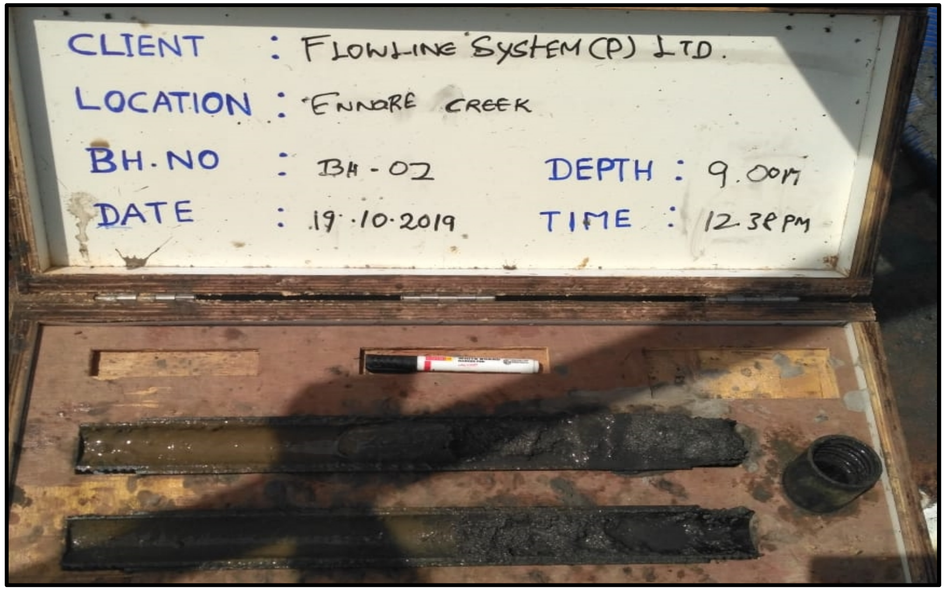
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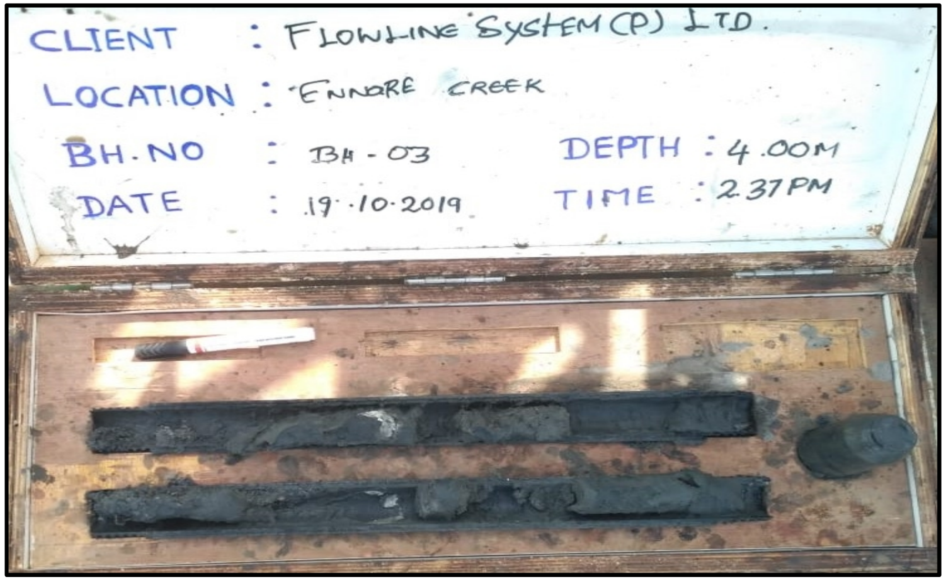
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LOCATION : ENNORE CREEK
BH. NO : BH - 03
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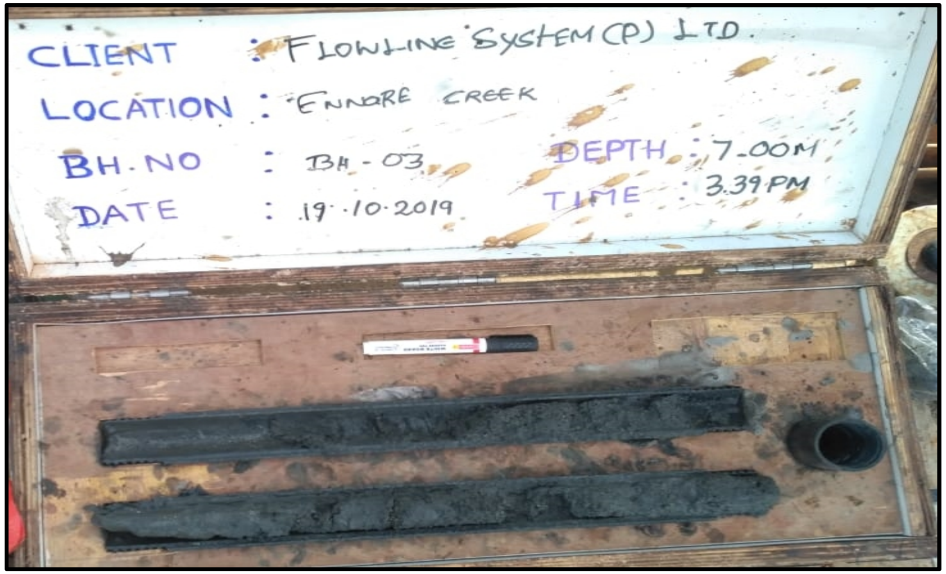
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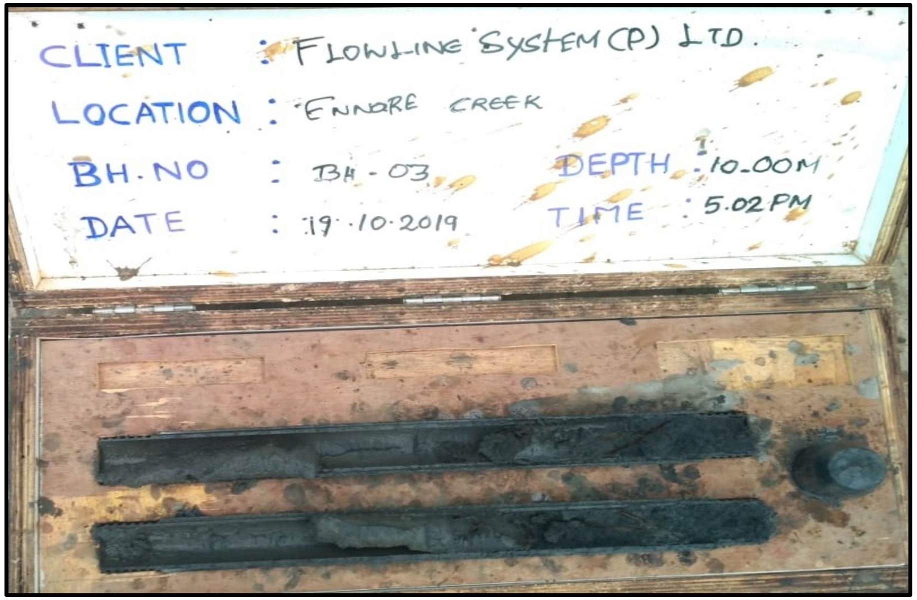
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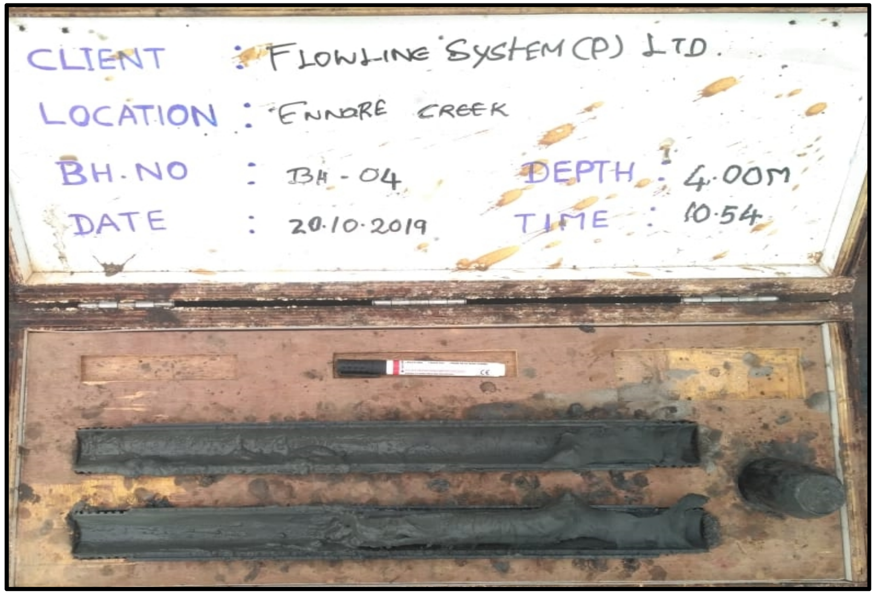
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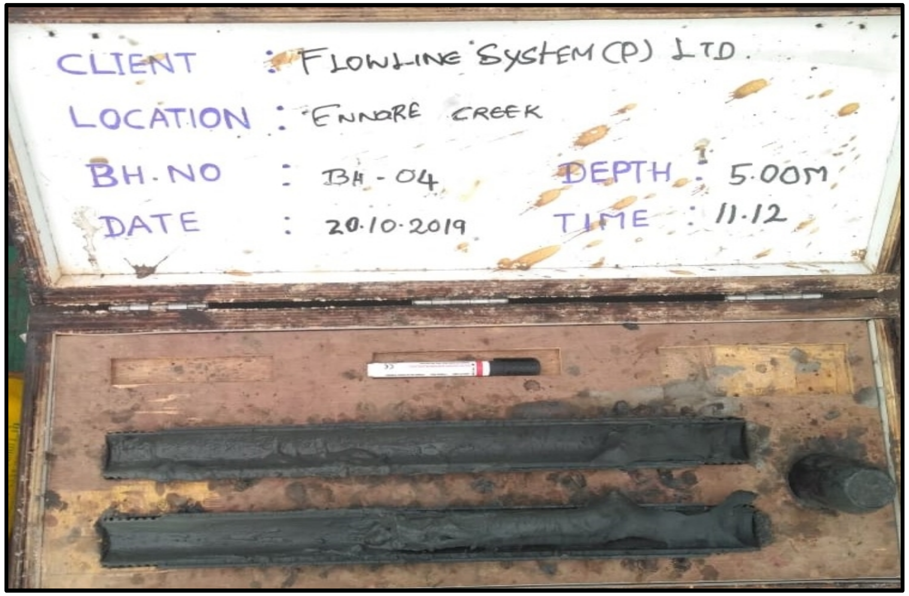
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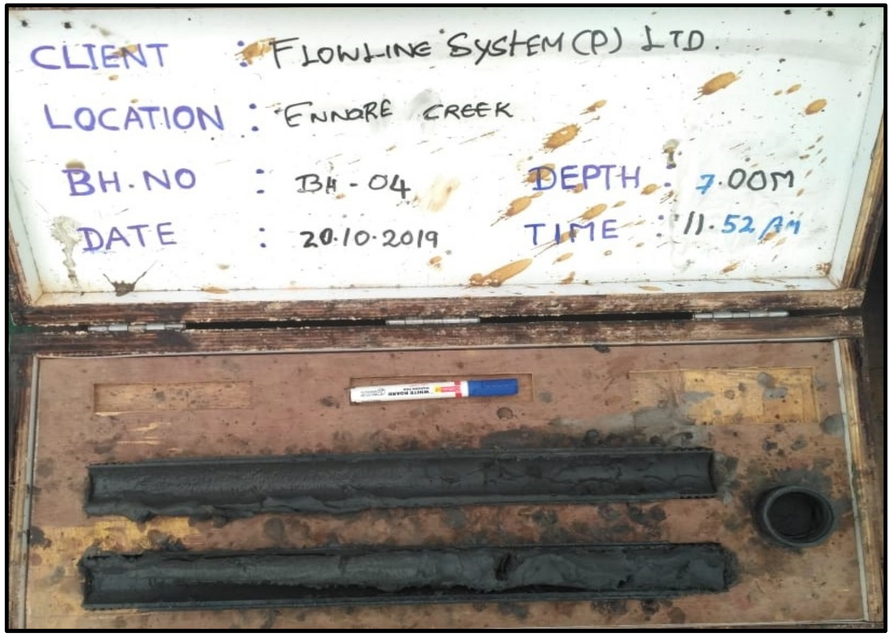
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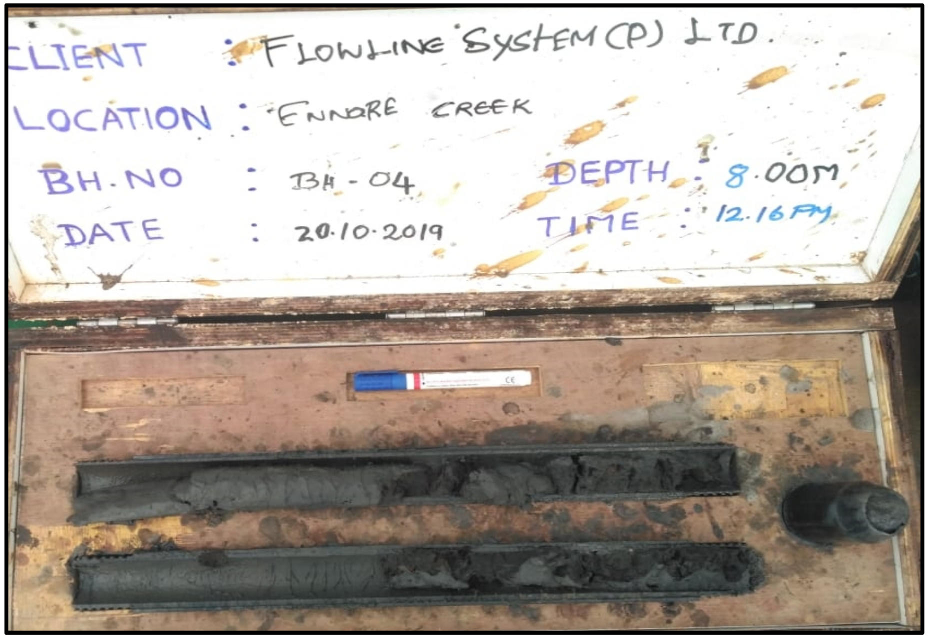
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CLIENT : FLOWLINE SYSTEM (P) LTD.
LOCATION : ENNORE CREEK
BH.NO : BH - 04
DEPTH : 9.00M
DATE : 20.10.2019
TIME : 12.48 PM

ANNEXURE X

Occupational Health and Safety Plan

Occupational Health and Safety Plan

INTRODUCTION:

CMWSSB is committed to maintaining a healthy and safe place of work for all its employees, as well as taking all reasonable steps to ensure that the public and the environment (which may be affected by its work) are exposed to the lowest practicable level of risk. The Contractor of CMWSSB will take steps to prevent accidents, injury and disease arising from, associated with, or occurring in the course of work by minimizing the cause of hazards as per CMWSSB's HSE policies and guidelines. The process includes:

- Identification of potential hazards to the workers;
- Provision of preventive and protective measures;
- Training for the workers who is going to work in the Ennore Creek.
- Documentation and reporting of occupational accidents, diseases and incidents ; and
- Emergency prevention, preparedness and response arrangements.

Effective management of health and safety risks helps to:

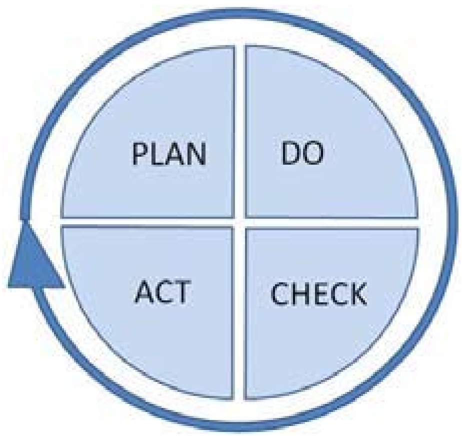
- Maximise the well-being and performance of its employees
- Stop people getting injured, ill or killed by their work
- Prevent reputation damage in the eyes of customers, suppliers, other stakeholders and the wider community
- Encourage better relationships with partnerships / contractors and ensure that
- the activities of contractors do not pose a health and safety risk for the Council
  or its employees / visitors / customers.
- Minimise the likelihood of prosecution and consequent penalties

SAFETY STANDARDS

The International Organization for Standardization (ISO), for instance, develops standards according to the principles of voluntary, industry-wide consensus. International Safety Management (ISM) Code also created guidelines. A few examples include:

- ISO 9001:2008 for the execution of quality assurance;
- ISO 14001:2004 for the execution of environmental protection;
- SCC and OHSAS 18001:2007 for the execution of occupational health and safety;

APPROACH TO MANAGING HEALTH & SAFETY RISKS



Plan, Do/Implementation, Check, Act (management review) approach achieves a balance between the systems and behavioral aspects of management. It also treats health and safety management as an integral part of good management generally, rather than as a stand-alone system.

<table>
<tr><th>S.No</th><th>Approach</th><th>Conventional Health and safety management</th><th>Process Safety</th></tr>
<tr><td>1</td><td>PLAN</td><td>Determine your Policy/Plan for implementation</td><td>Define and Communicate acceptable performance and resources needed</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">DO</td><td rowspan="2">Profile risks/organize for health and safety/implement your plan</td><td>Identify and assess risks/identify controls/Record and maintain job safety knowledge</td></tr>
<tr><td>Implement and manage control measures</td></tr>
<tr><td>3</td><td>CHECK</td><td>Measure performance (Monitor before events, investigate after events)</td><td rowspan="2">Measure and review performance/Learn from measurements and findings of investigations.</td></tr>
<tr><td>4</td><td>ACT</td><td>Review performance/Act on lessons learned.</td></tr>
</table>

To manage the health and safety risks it faces and to follow the Plan, Do, Check, Act model, CMWSSB takes the following approach:

Plan: Policy (include CMWSSB HSE policy, safety management arrangements and codes of practice.

Do:

Departmental Meetings –Health & Safety included as a standard agenda item for discussion at monthly meetings. Environmental performance will discussed during regular review meeting between CMWSSB representative and the contractor representative. A review of the performance of the contractor will be undertaken on the completion of the projectactivity.

Health & Safety Representatives: Volunteers have been established to act as contact points within their service areas on matters of health & safety. Regular H&S Rep meetings conducted with any resultant actions identified being taken forward by attendees to senior management where relevant.

Health & Safety Training:

The provision of internal and external Health & Safety Training. Specific health and safety training may also be arranged and undertaken by members of each service area.

Health & Safety information –An intranet Health & Safety page freely accessible for all levels of staff to view policies, procedures and guidance together with examples generic risk assessments. The intranet page is also used to communicate important health & safety information and updates on the subject together with upcoming training events.

CMWSSB Procedures and Codes of Practice:

Form part of the overall health and safety policy, providing safe systems of work for employees to follow and to adapt them to their service areas as appropriate.

Check

Monitoring of hazards: The Health & Safety Adviser from contractor side provides regular reports to enable Management Team to monitor the status and the types of the risk assessments within their site areas and to follow up with the appropriate management response where necessary.

Accident Investigations Where appropriate, accidents are investigated with findings and recommendations communicated to responsible managers for them to take action to prevent reoccurrence. Summaries of lost working time accidents are reporting to TNUFSIL and CMWSSB.

Annual Reporting on Corporate Health & Safety: Annual reports to be produced and to inform all staff of the work undertaken regular period and including results of surveys used to measure health and safety performance and accident statistics.

Prioritised audits – Health and Safety related audits conducted. Higher risk areas identified for examination by the H&S Adviser, reporting findings and recommendations to the relevant Service Area Manager and employees involved.

Act

Review of policies and procedures – Considerable review of the Health & Safety policy, corporate procedures and codes of practice with ongoing review taking place. Review is undertaken as a result of audits and outcomes of accident investigations.

Role of CMWSSB contractor:

CMWSSB's management is responsible for the performance of all its contractors and ensuring that all CMWSSB's commitments and policy requirements are translated into contractors' requirements and implemented to the full intent and extent of CMWSSB's commitment. Contractor is responsible for implementation and adherence to all the mitigation measures outlined in the ESMP

Potential hazards that may happen during the Construction Activity.

- Accidents may occur during the construction stage (dredging) due to the lack of knowledge on handling of new equipment's, workers functioning without proper personal protective equipment and without possessing first aid facilities at work sites.
- During dredging, workers are subject to physical, chemical and noise hazards due to work activities as vegetation clearing, laying of pipeline, and during the handling of machines. Workers are exposed to physical hazards from operating machineries and moving vehicles.
- Electrocution due to improper electrical layout and mobile electrical machines and power tools.
- Person entangled underneath the pipe.
- Psychological hazards or Environmental hazards like poor visibility/wind speed/physical hazards.
- Workers sustaining injury during dive/in-water trauma /unconscious/entangled/ under water equipment failure.

Prevention measures to be taken by the Contractor

- Skilled workers should be enrolled/deployed for working in the Creek for critical tasks.

- Update of circumstances and summary of job methodology. Dredging or disposal of dredged material outside of approved areas is a breach of approval conditions and shall be reported to the Superintendent and the concerned Engineer.
- PPE should wear always while working off shore works. (Life jackets and life buoy of sufficient quantities be made available in the store always). All PPEs will be maintained in good condition
- Floating pipes shall be properly anchored to prevent lateral movement while doing welding on the welding platform.
- Regular follow-up of weather reports while installation string in the water. Boat will be kept operational condition during pulling of pipeline.
- Rescue crew and Rescue boat should be available to tackle for any mishap.
- Emergency vehicle always available on shore if the injured/ill person to shift nearest hospital (primary health center situated in 2.5km) for further medical assistance.
- The Contractor should be required to furnish facilities and give assistance for the inspection as the Engineer may direct, to access the dredging area. Transportation should be provided for the dredging Inspector to and from a convenient shore-landing at the beginning and the end of each work period.
- For both the contractor and employer (particularly when operating in Creek) to keep accurate and contemporary records of hours worked, locations, quantities removed, delays incurred, and instructions received or given in order that performance can be accurately monitored.
- Periodical health check-up of the workers are to be arranged by the contactors to ensure good health.
- Adequate sanitary, drainage, toilets with septic tanks, refuse collection and disposal facilities shall be provided for the construction workers. The provision of a potable water supply, cooking fuel and toilet facilities shall be made as per the stipulated guidelines of the International Labor Organization (ILO) and World Bank EHSGs.

- The contractor will provide garbage bins in the camps and ensure that these are regularly emptied and disposed of in a hygienic manner as per the Comprehensive Solid Waste Management Plan. No Garbage will be disposed to the creek.
- Contractor will practice work rotation system among the workers to reduce health impacts related to prolonged exposure to Creek water. Maximum 40 workers shall be working at a given point of time in water body during the peak construction period. Standard PPE like life jackets, general safety ring buoy etc. shall be provided.
- The Contractor shall take all necessary measures for the safety of traffic (boats/vessels) during construction and provide, erect and maintain such barricades, including signs, marking, flags during dredging.
- The State and National Guidelines on COVID 19 pandemic will be strictly followed during the working hours and in the labor camp.
- CMWSSB/Contractor shall ensure display of Emergency number in the Creek during Operation & Maintenance. Suitable sign-boards shall be placed at both edges and at points along the pipe alignment to demarcate this and to prevent impacts due to other dredgers, boats etc., during operation phase as well.