Project No: AESPL/INF-E/19-20/EIA/002

Draft Environmental Impact Assessment Report

Establishment of Fishing Harbor for Providing Fish landing Facilities to Fishermen at Versova Taluka Andheri, District Mumbai Suburban

Baseline Monitoring: Winter (Dec 2019-Feb2020)

by

Maharashtra Fisheries Development Corporation Ltd.,
Government of Maharashtra Undertaking

September - 2022

Environmental Consultant: Aditya Environmental Services Pvt. Ltd., Mumbai
QCI- NABET Accredited EIA Consultant
www.aespl.co.in

NABET/EIA/1922/SA 0129

Declaration by Experts contributing to the EIA report 'Establishment of Fishing Harbour at Versova, Taluka Andheri, District Mumbai Suburban' by Maharashtra Fisheries Development Corporation ltd., Government of Maharashtra.

I, hereby, certify that I was a part of the EIA Team in the following capacity that developed the above EIA.

EIA Coordinator:

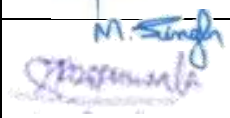
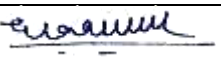
Name: N. K. Shendye

Signature & Date: 22nd August 2022

Period of involvement: since 13th September 2019

Contact information: 022-242127500 E**-mail:** contact@aespl.co.in

Functional Area Experts:

S.N.	Functional Areas	Name of the Expert/s	Involvement (Period& Task**)	Signature & Date
1	AP*	Rajiv Aundhe	since Sept 2019	
2	WP*	Snehal Jadhav	since Sept 2019	
3	SHW*	Rajiv Aundhe	since Sept 2019	
4	SE*	Mamta Singh Assisted by Sawak Tarapurwala	since November 2019	
5	EB*	Dhan B. Thapa	since Sept 2019	
6	HG*	--	--	--
7	GEO*	--	--	--
8	AQ*	Kavita Takale	May 2020 till Dec. 2020	
9	NV*	--	--	
10	LU*	Bela Pharate	since May 2020	
11	RH*	P. K. Sarode	Sept 2019 to Dec 2020	
12	SC*	--	--	--

NOTE:
(*) Full forms of abbreviations given on Next Page
(**) Tasks for each Functional Area Expert given on Next Page

Environmental Baseline monitoring and analysis for this project was carried out by in-house, environmental analytical laboratory.

Declaration by the Head of the Accredited Consultant Organization

I, Rajiv V. Aundhe, hereby, confirm that the above-mentioned experts prepared the EIA report '**Establishment of Fishing Harbour at Versova, Taluka Andheri, District Mumbai Suburban' by Maharashtra Fisheries Development Corporation ltd., Government of Maharashtra.** I also confirm that I shall be fully accountable for any mis-leading information mentioned in this statement.

Name: Rajiv V. Aundhe

Designation: Director

Name of the EIA Consultant Organization: Aditya Environmental Service Pvt. Ltd.

NABET Certificate No. & Issue Date: NABET/ EIA/1922/ SA 0129 dated 17th May 2020

Sr. No.	Functional Area Code	Complete Name of the Functional Areas	Tasks
1	AP	Air Pollution Prevention, Monitoring & Control	Assessing baseline ambient air quality, stack emission, possible impacts and control measures
2	WP	Water Pollution Prevention, Control & Prediction of Impacts	Assessing baseline surface/ ground water quality, possible impacts and control measures
3	SHW	Solid Waste and Hazardous Waste Management	Assessing solid/hazardous waste generation, treatment and disposal
4	SE	Socio-Economics	Assessing baseline Socioeconomic, demographic situation, impacts and CSR plan/ measures for upliftment
5	EB	Ecology and Biodiversity	Assessing baseline biodiversity situation in study area, impacts and Biodiversity management plans
6	HG	Hydrology, ground Water & Water Conservation	Assessing baseline hydrogeological situation in study area, impacts and management plans
7	GEO	Geology	Assessing baseline geological situation in study area, impacts and management plans
8	AQ	Meteorology, Air Quality Modeling & Prediction	Assessing nature and scale of impacts on ambient air quality through modelling and management plans
9	NV	Noise/ Vibration	Assessing baseline ambient noise quality, possible sources, impacts and control measures
10	LU	Land Use	Assessing baseline Land use Land cover possible impacts and control measures
11	RH	Risk Assessment & Hazard Management	Assessing safety measures taken up by proponent modelling to assess scale of impacts, disaster management and control measures
12	SC	Soil Conservation	Assessing soil quality, scale of impacts and suggest management and control measures

TO WHOMSOEVER IT MAY CONCERN

This is to confirm that we have checked the EIA report prepared by M/s Aditya Environmental Services Pvt Ltd for our proposed project of "Establishment of Fishing Harbor at Versova, Taluka Andheri, District Mumbai Suburban". We also confirm that the data/ information related to our process and project is correct as per our understanding of the process/ project at the moment.

Managing Director

Maharashtra Fisheries Development Corporation ltd.,

Government of Maharashtra Undertaking

Date: 21st Sept 2022

Place: Mumbai

TO WHOMSOEVER IT MAY CONCERN

This is to confirm that we have understood the Environmental Management Plan prepared as a part the EIA report prepared by M/s Aditya Environmental Services Pvt Ltd for our proposed project 'Establishment of Fishing Harbour at Versova, Taluka Andheri, District Mumbai Suburban'. We also confirm that Environmental Management Plan included as a part of EIA report, will be made part of Concessionaire Agreement/ other relevant documents

Managing Director

Maharashtra Fisheries Development Corporation ltd.,

Government of Maharashtra Undertaking

Date: 22nd August 2022

Place: Mumbai

TO WHOMSOEVER IT MAY CONCERN

This is to confirm that the EIA/ EMP for the project "Establishment of Fishing Harbor at Versova, Taluka Andheri, District Mumbai Suburban" by Commissioner of Fisheries, Government of Maharashtra of has been prepared by me in the capacity of EIA Coordinator. We confirm that the EIA report prepared is based on factual data and all due diligence has been followed in preparing the same.

Date: 22nd August 2022

Place: Mumbai

For Aditya Environmental Services Pvt. Ltd

N. K Shendye

EIA Coordinator

ADITYA ENVIRONMENTAL SERVICES PVT. LTD. MUMBAI

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Explanation of Terms Used

Abbreviation	Full form
ToR	Term of Reference
AAQ	Ambient Air Quality
MoEFCC	Ministry of Environment, Forest & Climate Change
MPCB	Maharashtra Pollution Control Board
CPCB	Central Pollution Control Board
CRIDF	Rural Infrastructure Development Fund
CGWA	Central Ground Water Authority
EIA	Environment Impact Assessment
EMP	Environment Management Plan
EMC	Environment Management Cell
PM	Particulate Matter
BDL	Below Detectable Limit
O&M	Operation and Maintenance
NOC	No Objection Certificate
NABARD	National Urban Infrastructure Development
EC	Environment Clearance
LULC	Land Use Land Cover
MTPD	Metric Ton Per Day
MTA	Metric Ton Per Annum
MPEDA	Marine Produce Exports Development Authority
MFDC	Maharashtra Fisheries Development Corporation Ltd.
CMD	Cubic Meter Per Day
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
AAQ	Ambient Air Quality
NAAQS	National Ambient Air Quality Standard
FDP	Fish Drying Platform
NMS	Net Mending Shed
CRZ	Coastal Regulation Zone
DoF	Maharashtra Fisheries Development Corporation ltd.
GoM	Government of Maharashtra
MSL	Mean Sea Level
w.r.t.	With Respect To
MMB	Maharashtra Maritime Board
CICEF	Central Institute for Coastal Engineering for Fisheries
Upgradation of facility	Refers to addition/ modification of component to existing facility (fishing harbour as a whole) in order to cope-up with need/ ease in operation/ save time/ optimum utilisation of resources
Distance	Distances mentioned in this report (unless specified) are measured between two nearest points and expressed as Approximate Shortest Aerial Distance

1 INTRODUCTION

1.1 Introduction

Maharashtra State has seven coastal districts viz Palghar, Thane, Mumbai Suburban, Mumbai City, Raigad, Ratnagiri and Sindhudurg. The State has about 173 fish landing centres and 2 fishing harbour (at Mirkarwada, Ratnagiri & Sassoon dock, Mumbai) along its 720Km long coastline. However, the number of fishing harbours available as of now is very few as compared to its long coastline. Fishing is a major business in every coastal district. Fish production of the state is stagnant around 4.50 lakhs metric tons/year. Marine export in the year 2017-18 in terms of quantity was 180820 tonnes and in terms of value it is Rs 490681 lakhs. In order to boost the fish production as well as marine export and to meet the international standards of EEC, MPEDA etc., it is earnestly essential to develop infrastructure facilities such as fishing harbours.

Versova is placed at mouth of the Malad creek in Andheri Tehsil of Mumbai Suburban district bordering the Arabian sea. Versova is a fishing village with about 5,592 fishermen population. Fishing is a traditional activity of fishermen for last many decades in this region.

Government of Maharashtra had accorded Administrative Approval to develop fishing harbour, vide Government Resolution number MATSY A VI - 1119/CR-48/ ADF-14, Mantralaya, Mumbai dated 10th July 2019. The work of "Establishment of Fishing Harbour at Versova, Taluka Andheri, District Mumbai Suburban" is administratively approved for Rs. 336.70 Crore.

1.2 Purpose of Environmental Impact Assessment (EIA) Report

The purpose of this Environmental Impact Assessment report is to investigate & assess the principal environmental concerns associated with activities such as, construction of Creation of boat basin, 2 Breakwaters, series of Quays, with necessary infrastructure (such as Fish Auction hall, Net Mending Shed, Dormitory, Resting shed, Cold Storage, Public Utility stores, Radio communication tower, Restaurant, Admin building, vehicle & boat parking), Ship repair yards and associated storages, Guard House approach roads and Utilities (power supply, water supply, sewage treatment, fuel dispensing for fishing boats)

1.3 Identification of Project & Project Proponent

Introduction of Maharashtra Fisheries Development Corporation ltd. (MFDC)

Maharashtra Fisheries Development Corporation (MFDC) has been established under the Companies Act, 1956, (A Govt. of Maharashtra Undertaking) for systematic development of Fisheries on commercial basis. The Corporation receives financial assistance in the form of share capital and grants from the State Government. The State Government has entrusted all commercial and promotional Fisheries activities to this Corporation.

Aims and Objectives of MFDC

- To promote, develop & scientifically exploit the marine as well as inland fishery resources and procure fish and other products.
- To acquire, maintain and operate fishing vessels, nets, hooks and other gear to raise overall production of fish within the state of Maharashtra and also from the seas far and near.
- To sell and export fish, fresh, frozen processed or dry and other aquatic products either produced by the company or acquired or purchased from other agencies on wholesale or retail or agency or by any other methods, either in this state or any other state in India.

1.4 Location of the Project & Need of project

1.4.1 Existing Facilities at The Site

Existing facilities at Versova landing centre consists of broken wharf, net mending shed, unpaved, open fish drying area, engineering workshop, fuel station and open space. Following images depicts of existing facilities at Versova.

Figure 1.1: General View of Site

1.4.2 Location of the Project

The project (development of fishing harbour) is located on eastern bank of Malad creek, village Versova, Taluka Andheri, Dist. Mumbai Suburban. Nearest railway station is Andheri which is about 4.6 km, towards E w.r.t. site. The site is adjacent to J P road also known as Bunder Road. Figure below shows taluka map with location of village Versova.

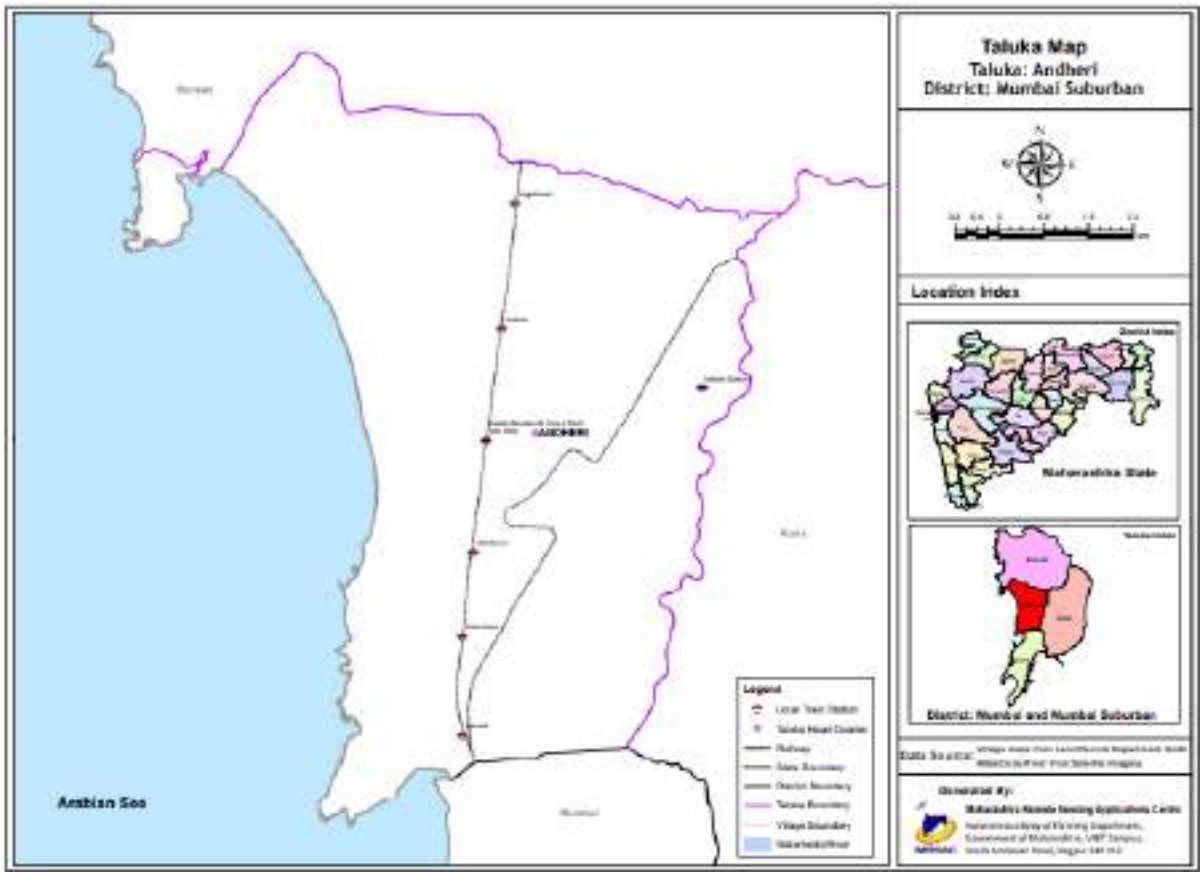


Figure 1.2: Andheri Taluka Map Showing Location of village Versova

1.4.3 Importance of the Project to the Country, Region

Maharashtra Fisheries Development Corporation ltd. is government of Maharashtra undertaking created to provide facilities and with an objective to enhance total fish production in Maharashtra. MFDC through its various schemes, always works for upliftment of fisher folks.

Versova and nearby landing centres have annual production of 45335 Tons. having 411 trawlers, 395 Bagnet, 40 no of Gill net, (i.e., total 846 mechanized boats) and 79 traditional fishing crafts with 5,592 fisherman population (Ref: Techno-Economic Feasibility Report, June 2019 by CICEF). Versova is one of the important fish landing Centres in Mumbai region. The activities at the centre have been hampered by, lack of proper infrastructure to dock fishing vessels, facilities for maintenance and repair of boats, fuelling/ bunkering, sufficient space for auction, net mending etc. due to which fishermen are not able to utilise full potential of the site. Further, they have to manage space and time for dispersal of their catch and face lot of hardships to perform post harvesting activities.

This project aims to resolve these issues by development of fishing harbour with creation of Basin, 2 Breakwaters, series of Quays, with necessary infrastructure (such as Fish Auction hall, Net Mending Shed, Dormitory, Resting shed, Ice factory, Cold Storage, Public Utility stores, Radio communication tower, Restaurant, Admin building, vehicle & boat parking), Ship repair yards and associated storages, Guard House approach roads and Utilities (power supply, water supply, sewage treatment, fuel dispensing for fishing boats)

1.4.4 Regulatory Framework

Maharashtra Fisheries Development Corporation ltd., GoM is involved in helping fishermen communities to take benefit of various government schemes, provide infrastructure facilities, invent new techniques and implements to enable fish production, fish catch, better landing facilities, improved storage facilities/ shelf life, spreading awareness/ alerts regarding climatic conditions etc.

This fishing harbour projects to handle about 41,060 tons fish catch annually. This capacity brings this project under 7e, category B of Environmental Impact Assessment Notification 14th September 2006 with subsequent amendments and requires prior Environmental Clearance. Similarly; foreshore infrastructure facilities are covered in CRZ notifications dated 06th January 2011 and require prior CRZ clearance.

1.4.5 Scope of the EIA Study

The scope of work has been prepared based on guidelines issued by MoEFCC, standard ToR and additional ToR approved by SEIAA, Maharashtra for conducting EIA studies. The scope covers following details:

- Assessment of environmental features of existing facilities and evaluation of existing pollution control measures
- Assessment of environmental features of proposed development, it's location w.r.t. CRZ (based on approved CZMP) and conformity to permissible activities
- Establishment of present status of land, air, noise, water, biological and socioeconomic and cultural components of the environment. This study also includes marine water & sediment
- Identification of likely impacts due to fishing harbour on environmental components during the construction, commissioning, operation and decommissioning phases.
- Study of existing operations/ activities at site
- Assimilation of collected and generated data during the course of EIA studies

Delineation of an Environmental Management Plan (EMP) outlining measures to be implemented by Maharashtra Fisheries Development Corporation ltd. for mitigation of adverse impacts.

1.5 Methodology of EIA

Any development project is likely to impact surrounding environment. The nature and magnitude of impact on different components of the environment will depend on the nature and size of project as well as location aspects of the project site and steps taken for mitigating the environmental impact. The final net impact due to the proposed project on environmental components can be evaluated through Environmental Impact Assessment (EIA) studies within the study area prior to its implementation. The results of EIA Studies form the basis for preparation of a viable Environmental Management Plan (EMP).

The EIA Studies can be broadly divided in to three phases.

- **1st PHASE:** The first phase involves identification of significant environmental components and assessing their baseline (Pre-project or existing) status within the study area.
- **2nd PHASE:** The second phase involves identification of impacts on various identified significant environmental parameters due to proposed project. Data regarding the proposed construction activities, design capacity of the individual units, water consumption, solid/ hazardous waste, sewage/ effluent generation, characteristics of disposal medium and topography of the study area is also taken into consideration to evaluate project related environmental features.
- **3rd PHASE:** The third phase covers the evaluation of final impacts and delineation of an Environmental Management Plan to mitigate adverse impacts on the quality of surrounding environment.

For the purpose of assessing the impacts, a study area of 10 km radius from project site was identified for the EIA study as per EIA Notification and was studied in winter (Dec 2019 – Feb 2020).

The EIA involves detailed investigation to assess impacts on different environmental components. The base line studies were carried out and the predictions made on the basis of the above are presented in the EIA report. The various facets of the work carried out are briefly reported below.

1.5.1 Baseline Environmental Studies

These include study of environmental conditions in winter 2019-2020 (i.e., Dec 2019 & Jan- Feb 2020), close to site as well as in study area (radial distance of 10 km from site). Details of various components covered therein are as below:

1.5.1.1 Land Environment

Preliminary information pertaining to topography of study area, location aspects of site, land-use pattern, development pattern and landscape features within study area was collected through toposheets (OSM maps), Google Imagery, available geographical and road maps of study area. Land Use Land Cover map was prepared based on satellite imagery and finalized by undertaking ground truthing using GPS. Soil and marine sediment characteristics were also established by collecting data at site and study area.

1.5.1.2 Air Environment

Preliminary information regarding topography of study area and possible air pollution sources were collected through reconnaissance survey and review of available data and literature. Based on the information, PM_{10} and PM $_{2.5}$, Sulphur dioxide (SO_2), Oxides of Nitrogen (NO_X), CO (Carbon Monoxide), emissions were identified as major project related primary air pollutants, mainly due to construction activity. Baseline status of these parameters in ambient air was assessed at Versova and data presented in the report. Meteorological data on wind speed, wind direction, temperature and relative humidity were sourced from climatological tables (IMD) and other internet sources.

1.5.1.3 Noise Environment

Noise level data was collected near site to identify existing baseline status.

1.5.1.4 Water Environment

Reconnaissance studies included identification of available water resources (ground/ surface) in the study area. Primary data collection and analysis of marine & ground/ surface water was carried out to assess its quality as baseline study.

1.5.1.5 Biological Environment

Study includes identification of species of flora and fauna by making visits at various locations in study area. Information was also collected from secondary sources like Forest department, published literature.

1.5.1.6 Socio Economic Environment

Studies included collection of information about population in study area, income profile of people, standard of living and literacy rate of the population staying in study area from authorized sources like Census 2011, data from Primary Health Centres in vicinity. Primary survey was conducted in fishing villages attached to Versova fishing harbour to understand status of health, education, needs and aspirations of populace.

1.5.2 Impact Assessment Matrix

From a study of the nature of activities during construction phase & after completion & knowledge of existing baseline/ background levels of various environmental parameters viz. Air/ Water/Noise level/sediment/Population density in/ around the site, the nature & severity of impact on environment was estimated.

Impact Matrix was prepared delineating activities v/s tangible impacts. Environmental Management Plan was prepared for the project to reduce negative impacts of the project.

1.5.3 Environmental Management Plan

based on identified impacts, Environmental Management Plan is prepared to ensure minimum impact on environment during phases of fishing harbour.

1.6 Regulatory Scoping & Its Compliance

Terms of Reference are issued by SEAC-I, Maharashtra during meeting no. 182 dated 14th March 2020, agenda no.6 and same are approved by SEIAA in 198th meeting dated 27th May 2020 (**Annexure I** ToR letter) for this project and its compliance are presented.

Table 1.1: ToR Compliance

Sr. No.	Conditions as per Standard TOR	Compliance
1.	Reasons for selecting the site with details of alternate sites examined/rejected/selected on merit with comparative statement and reason/basis for selection. The examination should justify site suitability in terms of environmental angle, resources sustainability associated with selected site as compared to rejected sites. The analysis should include parameters considered along with weightage criteria for short-listing selected site.	Details given in chapter 5, section no. 5.1
2.	Details of the land use break-up for the proposed project. Details of land use around 10 km radius of the project site. Examine and submit detail of land use around 10 km radius of the project site and map of the project area and 10 km area from boundary of the proposed/existing project area, delineating project areas notified under the wildlife (Protection) Act, 1972/critically polluted areas as identified by the CPCB from time to time/notified eco-sensitive areas/interstate boundaries and international boundaries. Analysis should be made based on latest satellite imagery for land use with raw images	Details are given in Chapter 3 LULC section (3.1.3) Eco-sensitivity details are given in Chapter 3 point no 3.1 (Table 3.1)
3.	Submit the present land use and permission required for any conversion such as forest, agriculture etc. land acquisition status, rehabilitation of communities/ villages and present status of such activities	Present land use is fish landing centre and beach. The proposal is for development of Fishing Harbour. No land use conversion is required.
4.	Examine and submit the water bodies including the seasonal ones within the corridor of impacts along with their status, volumetric capacity, quality likely impacts on them due to the project	The proposal pertains to development of fishing harbour at Versova, Mumbai with highly urbanized surroundings (no seasonal waterbodies present). Malad creek and the Arabian sea are two waterbodies present within corridor of impact, details of water quality are given in Chapter 3, section no. 3.7. Likely impacts due to project are discussed in Chapter no. 4, section no. 4.3.4 and 4.5.4.
5.	Submit a copy of the contour plan with slopes, drainage pattern of the site and surrounding area	Details are given in Chapter 3 fig. 3.9, 3.10 and Annexure IV.

Sr. No.	Conditions as per Standard TOR	Compliance
6.	Submit the details of terrain, level with respect to MSL, filling required, source of filling materials and transportation details etc.	Terrain Details are given in Chapter 3, fig. 3.5, 3.6, 3.7 and 3.8. Filling details are given in chapter no.2, section no. 2.6.6.2 and 2.6.7.1.
7.	Examine road/rail connectivity to the project site and impact on the existing traffic network due to the proposed project/activities. A detailed traffic and transportation study should be made for existing and projected passenger and cargo traffic	Details of road/ rail connectivity to the project site are given in chapter no. 2, section no. 2.3. Impact pertains to traffic and traffic-transportation study are given in chapter no. 4, section no. 4.3.1 and 4.3.2.
8.	Submit details regarding R&R involved in the project	The land is owned by Government of Maharashtra, R& R is not applicable
9.	Submit a copy of layout superimposed on the HTL/LTL map demarcated by an authorized agency on 1:4000 scale along with the recommendation of the SCZMA	Copy of layout superimposed on the HTL/LTL map demarcated by Institute of Remote Sensing IRS Anna university, Chennai, on 1:4000 scale is presented in Chapter no. 2, section no. 2.3, fig 2.5.
10.	Submit the status of shoreline change at the project site	Details of shoreline change are given in Chapter no.3, section 3.7.1.6.
11.	Details of the layout plan including details of channel, breakwaters, dredging, disposal and reclamation.	Details are given in Chapter 2, section no. 2.3, fig. no. 2.4.
12.	Details of handling of each cargo, storage, transport along with spillage control, dust preventive measures. In case of coal, mineral cargo, details of storage and closed conveyance, dust suppression and prevention filters	The proposal pertains to development of fishing harbour. No cargo handling is involved. Details of fish catch/ handling are given in Chapter no. 2, section no. 2.6.
13.	Submit the details of fishing activity and likely impacts on the fishing activity due to the project. Specific study on effects of construction activity and pile driving on marine life	Details of fishing activities are given in chapter no. 3, section no. 3.7.5 and impacts are given in chapter 4, section no. 4.3.6 and 4.5.5.
14.	Details of oil spill contingency plan	kindly refer chapter no. 7, section no. 7.10.
15.	Details of bathymetry study	Kindly refer chapter no. 3, section no. 3.7.1.
16.	Details of ship tranquillity study	Kindly refer chapter no. 2, section no. 2.6.4.1.
17.	Examine the details of water requirement, impact on competitive user, treatment details, use of treated wastewater.	Kindly refer chapter no. 2, section no. 2.9.1.
18.	Details of rainwater harvesting and utilization of rainwater	Project being in coastal area, no rainwater harvesting is proposed.
19.	Examine details of Solid waste generation treatment and its disposal	Kindly refer chapter no. 2, section no. 2.10 and 2.11.
20.	Details of desalination plant and the study for outfall and intake	Desalination plant is not proposed in the proposal.
21.	Examine baseline environmental quality along with projected incremental load due to the proposed project/activities	Details of environmental baseline quality are given in Chapter 3 in various sections

Sr. No.	Conditions as per Standard TOR	Compliance
22.	The air quality monitoring should be carried out according to the notification issued on 16th November, 2009	Complied, air quality monitoring was carried out according to the notification issued on 16th November 2009. Details are given in 3.3.3.
23.	Examine separately the details for construction and operation phases both for Environmental Management Plan and Environmental Monitoring Plan with cost and parameters	Details are given in chapter 6 and 10
24.	Submit details of a comprehensive Risk Assessment and Disaster Management Plan including emergency evacuation during natural and man-made disasters	Details are given in Chapter no. 7 Risk assessment in section no. 7.2 Disaster Management Plan in section no. 7.3.
25.	Submit details of the trees to be cut including their species and whether it also involves any protected or endangered species. Measures taken to reduce the number of the trees to be removed should be explained in detail. Submit the details of compensatory plantation. Explore the possibilities of relocating the existing trees	The project is to be developed on the Versova There is no vegetation on site.
26.	Examine the details of afforestation measures indicating land and financial outlay. Landscape plan, green belts and open spaces may be described. A thick green belt should be planned all around the nearest settlement to mitigate noise and vibrations. The identification of species/ plants should be made based on the botanical studies	Kindly refer chapter no.4, section no. 4.3.5.
27.	The Public Hearing should be conducted for the project in accordance with provisions of Environmental Impact Assessment Notification, 2006 and the issues raised by the public should be addressed in the Environmental Management Plan. The Public Hearing should be conducted based on the ToR letter issued by the Ministry and not on the basis of Minutes of the Meeting available on the website	This draft EIA report is submitted to conduct public hearing
28.	A detailed draft EIA/EMP report should be prepared in accordance with the above additional ToR and should be submitted to the Ministry in accordance with the Notification	Draft EIA/EMP report is prepared adhering to ToR approved.
29.	Details of litigation pending against the project, if any, with direction /order passed by any Court of Law against the Project should be given	None
30.	The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out	Kindly refer chapter no. 6, section no. 6.3.

Sr. No.	Conditions as per Standard TOR	Compliance
31.	Any further clarification on carrying out the above studies including anticipated impacts due to the project and mitigative measure, project proponent can refer to the model ToR available on Ministry website "http://moef.nic.in/Manual/Port and harbour"	--
Additional ToR CONDITIONS		
1.	PP to submit copy of CRZ clearance	Application for CRZ clearance is made to MCZMA on 30th Sept 2020.
2.	PP to submit detailed layout of the area of proposed facilities to be developed on site along with area statement, details of green belt and contour levels	Kindly refer chapter no. 2, section no. 2.3.
3.	PP to include design details of ETP and STP proposed in the project in the EIA report	Kindly refer chapter no. 2, section no. 2.9.1.1.
4.	PP to include details of hazardous and non-hazardous solid/ liquid waste including domestic solid waste like fish peeling, washing etc. that will be generated on site along with its scientific storage, treatment and disposal mechanism in the EIA/EMP report	Kindly refer chapter no. 2, section no. 2.10 and 2.11.
5.	PP to include impact of proposed construction activity on marine biodiversity along with proposed mitigation measures in the EIA/EMP report	Details are given in Chapter 4, section no. 4.3.5
6.	PP to submit point wise compliance of the conditions stipulated in the OM issued by MoEF&CC dated 04th January 2019	Noted
7.	PP to ensure uniformity in the information submitted in EC application, presentation and EIA/EMP report	Noted

2 PROJECT DESCRIPTION

2.1 Type of Project

The proposal pertains to development of fishing harbour in village Versova. The existing landing facility is a part of recognized fish landing centre and is owned by GoM. This project involves creation of Basin, 2 Breakwaters, series of Quays, with necessary infrastructure (such as Fish Auction hall, Net Mending Shed, Dormitory, Resting shed, Ice plant, Cold Storage, Public Utility stores, Radio communication tower, Restaurant, Admin building, vehicle & boat parking), Ship repair yards and associated storages, Guard House approach roads and Utilities (power supply, water supply, sewage treatment, fuel dispensing for fishing boats) Details of each component are given in subsequent paragraphs in this chapter.

2.2 Need for the Project

The project would contribute substantially to increase the fish and crustacean supplies to domestic markets. The average annual total landings of fish and crustaceans from the year of stabilization of the project (Year 2) would amount to 41,060tonne valued at Rs.25,142 lakhs, at the boat side prices. The project would directly benefit 8640 persons (including 6140 fishermen and about 2500 persons in shore-based establishments, distribution and marketing of fish and crustacean products.), large indirect benefits that would accrue as a result of developmental efforts.

Presently, there is no proper berthing facility and systematic arrangement for performing post harvesting activities at Versova fish landing centre. Thus, fishermen are not able to utilise full potential of site as landing centre. Further, they have to manage space and time for dispersal of their catch and face lot of hardships to perform post harvesting activities. This also involves risk of catch getting perished or left with less time to dispersal for market.

Socio-economic survey conducted also reveals need for infrastructure development at site. A request letter from fishermen society in Versova reads the same. These letters are available for references vide **Annexure II.**

The project will enable fishermen to enter the harbour and dock their vessels at berths provided for unloading fish catch, it makes the operation irrespective of tide, easier, faster and secured. The project's overall objective of utilizing maximum capacity of fish production per year and save time, money and efforts of fishermen which will in turn improve economy of the community.

2.3 Location Details

Versova village is situated in Andheri Taluka of Mumbai Suburban district of Maharashtra State. Versova situated 4.6 km from Andheri railway station and has all the infrastructure

facilities like good approach road, power, water supply, sewerage system, post office, telephone, medical, educational, banking facilities etc.

Project site and entire 10km study area is covered in Open Series Map (OSM published by Survey of India) No E43A16 the same is depicted below; Site Layout map showing proposed facilities is enclosed overleaf.

Reference coordinates of site are as follows:

Figure 2.1 Location of project site on Google Earth Imagery

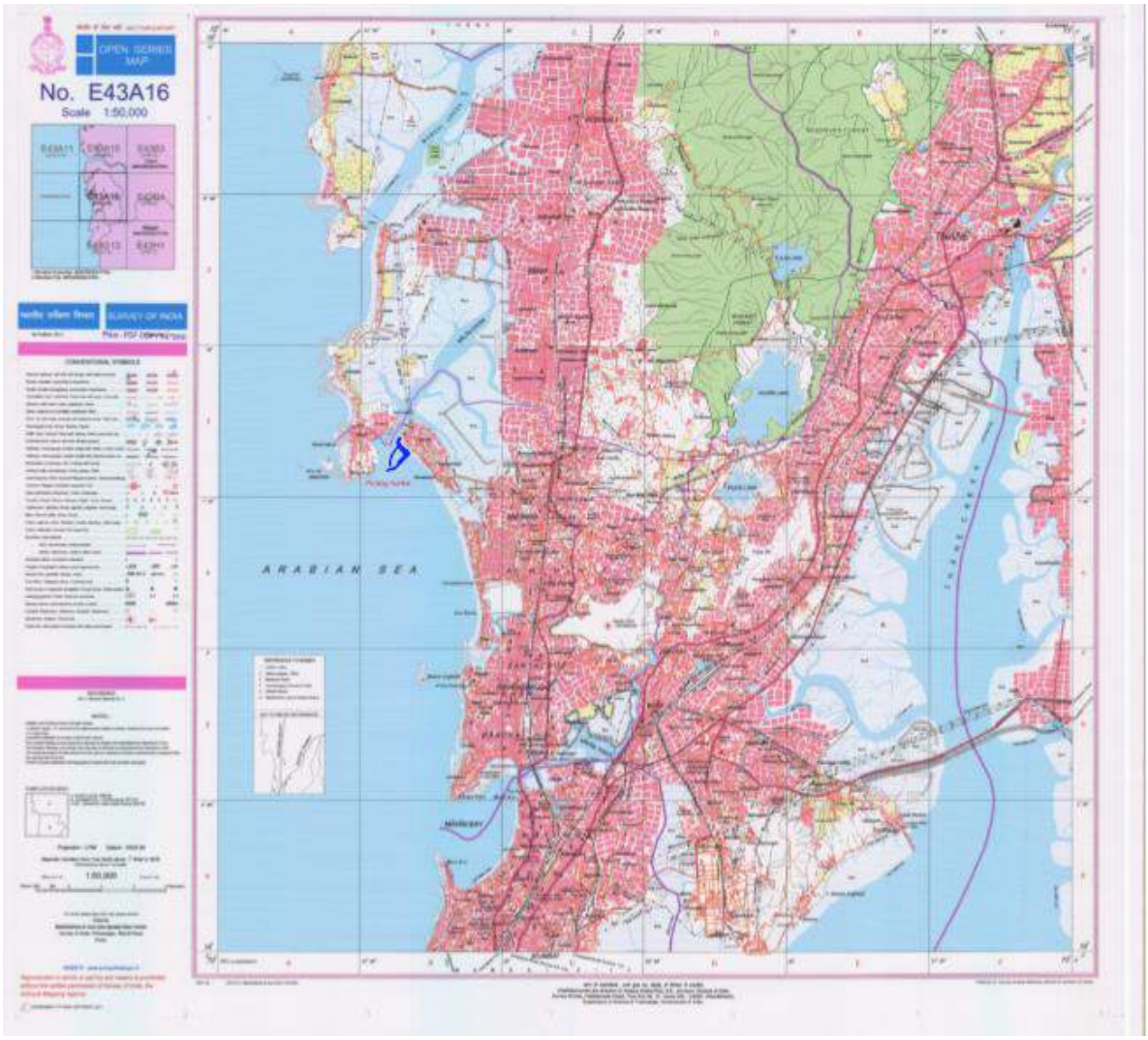


Figure 2.2: Open Series Map showing Site

Figure 2.3: Site and Surrounding Area

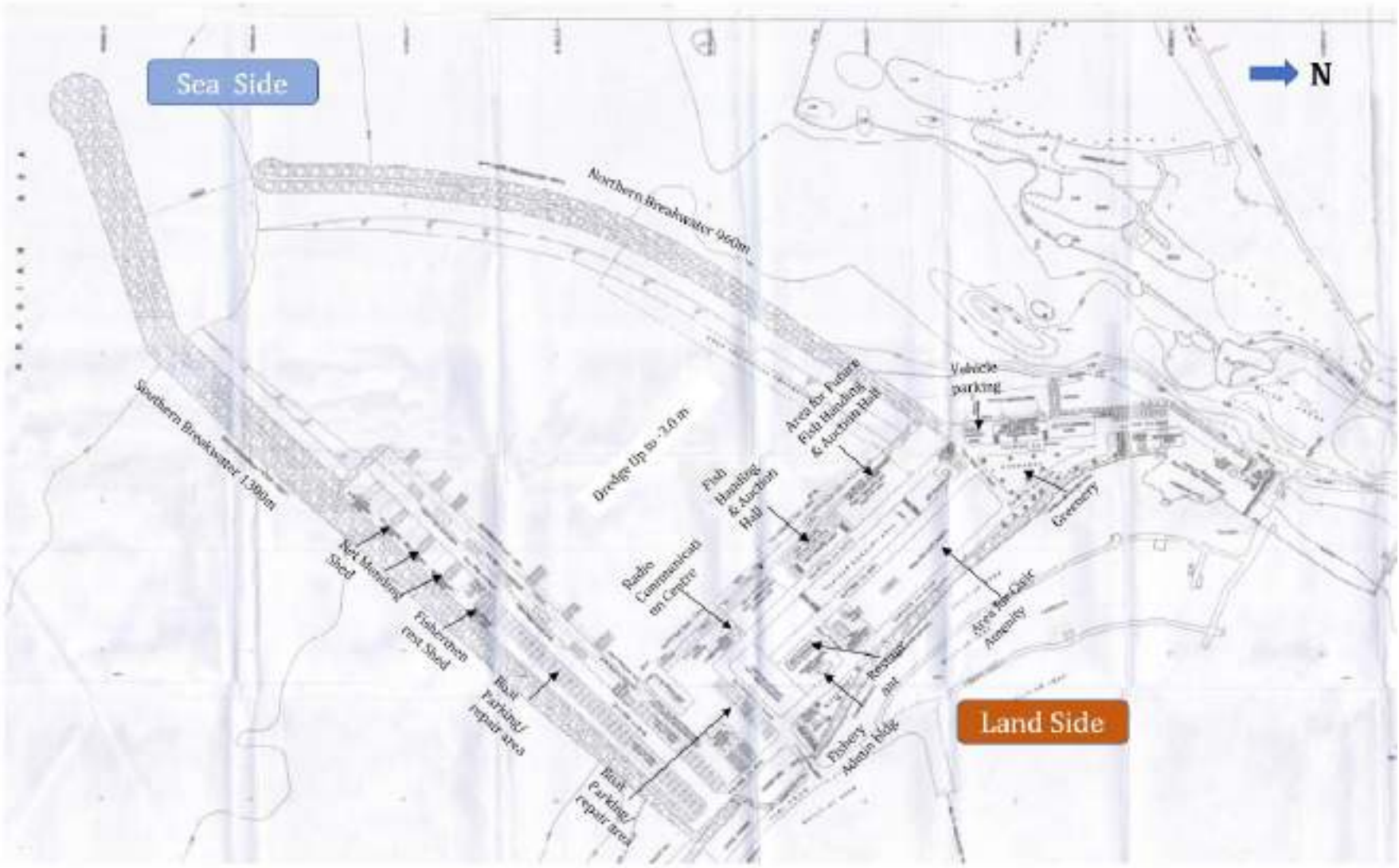


Figure 2.4: Proposed Site Layout at Versova

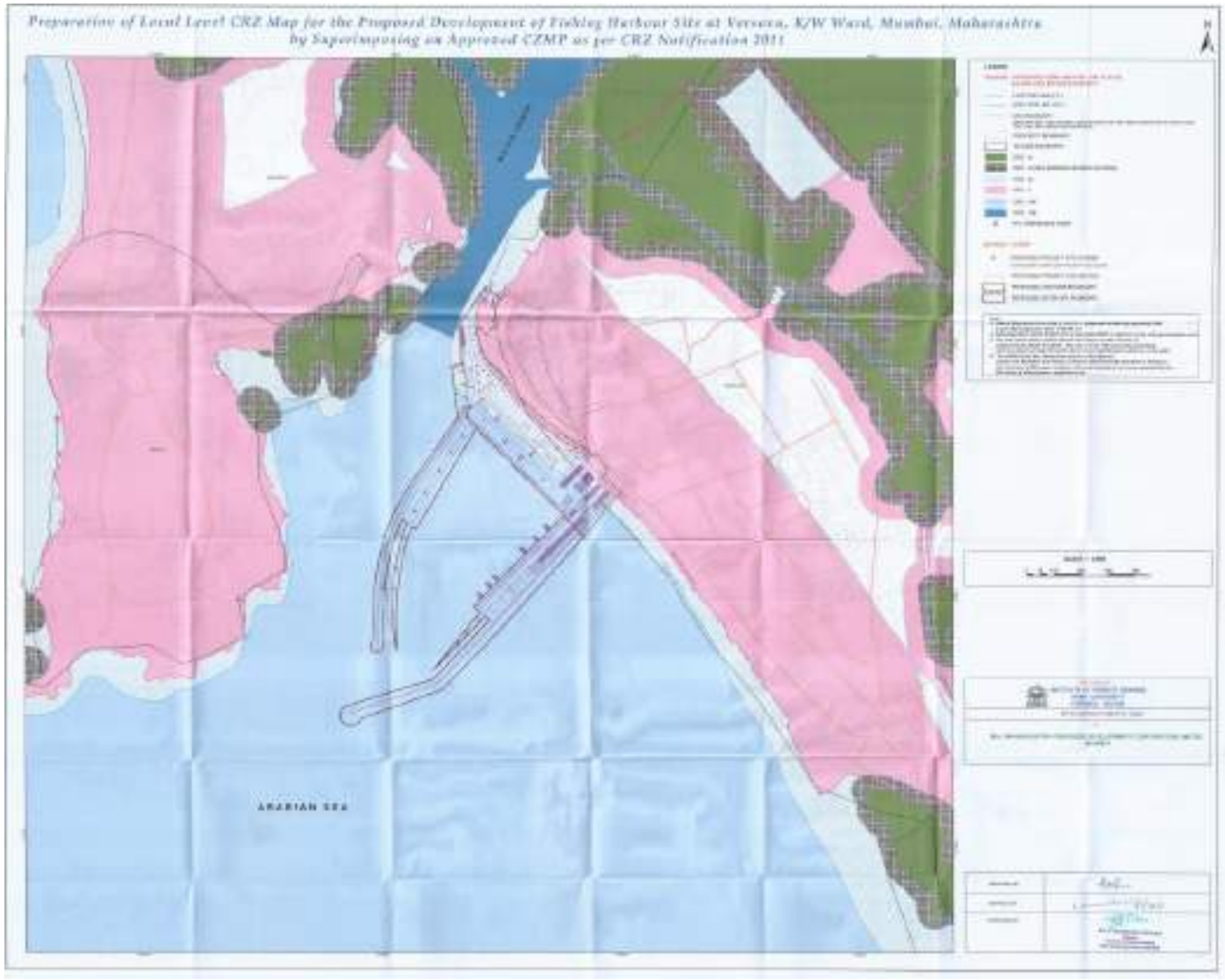


Figure 2.5 Location of Site on CRZ Map by IRS (1:4000)

Project activities are superimposed on approved CZMP by Institute of Remote Sensing IRS, Anna university, Chennai, enlarged map of 1:4000 scale and 1:25000 scale is enclosed vide **Annexure III**.

According to the above referred map, all project activities are located in CRZ IB, CRZ IVA, & CRZ II.

2.4 Size/ Magnitude of Project

The project is spread over area of 32.8 Ha. This involves reclaimed land 19.19Ha. Removal of substratum (approximately 5,29,548 cum) will be used for reclamation purposes within site.

Sr. No.	Proposed Facility	Length (m)	Width (m)	Area (m^2)	No. of Units	Excavation
1.	Dredging activity	1200	30	6000	--	6000 m^3
2.	Construction of auction hall					
3.	Construction of dormitory	215	10	2150	1	2275 m^3
4.	Construction of Radiocommunication Tower	45	10	450	1	
5.	Construction of rest shelter	25	15	375	1	427 m^3
6.	Construction of net mending sheds	10	7	70	1	
7.	Construction of toilet blocks	6.5	8.5	55.25	1	38 m^3
8.	Solar Street Light	--	--	--	60	--
9.	Guide Pole	--	--	--	6	--

2.4.1 Capital Investment

The total capital expenditure for development of fishing harbour including Construction of Two breakwaters, creation of basin, and other foreshore facilities for fishermen will include construction material, transport, labour, equipment and machinery, shore establishment, predevelopment expenditure, design consultancy charges, approval consultancy charges, statutory fees, administrative and other charges is estimated to be Rs. 336.70 Crores, as shown in table below:

2.5 Proposed Schedule for Approval & Implementation

The forward path of environmental and CRZ clearance for the proposed infrastructure facilities is as below:

- Environmental CRZ clearance 10-12 months
- Construction phase (24 months)

  Conceptual bar chart is provided in table below:

Table 2.1 Conceptual bar chart for proposed project completion

Sr. No.	Details of Work	Estimated period – 24 Months											
		2	4	6	8	10	12	14	16	18	20	22	24
1	removal of substratum and reclamation work												
2	Harbour under construction												
3	Building of shore-based facilities												

2.6 Planning, Designing of Harbour

Details of proposed activities, designing considerations, criteria to decide magnitude of Versova fishing harbour are given below:

The proposed fishery harbour at Versova fish landing centre has to cater to the needs of four different types of fishing vessels viz.,11m Bag Net/ Gill Net crafts, 11m trawlers, 17m trawlers and 14 m trawlers. It is, therefore, important to know the vessel characteristics of these boats. The vessel characteristics are the overall length, beam and draft of the vessel in loaded condition. The information gathered on the draft of the fishing vessels vis å-vis the Overall Length (OAL) and beam of the vessels operating at the harbour are shown in the table below.

Table 2.2 Fishing Vessel Characteristics

Overall Length of Vessels (m)	Max. Draft in Loaded Condition (m)	Beam (m)
11BN/GN	1.20	1.5
11	1.20	3.0
14	1.80	5.0
17	2.20	6.0

2.6.1 Design Fishing Fleet Size

The fishery statistics furnished by, the Maharashtra Fisheries Department reveal that there are about 846 mechanised fishing vessels comprising 411 trawlers 395 bag net and 40 gill net belong to Versova fishery, zone which has a total of three fishery centres i.e., Versova, Madh and Patwadi. Presently the trawlers and bag netter/gill netter currently undertaking fishing operations from Malad creek do not have fish landing and berthing facilities.

In order to arrive at the fleet size for which the proposed fishery harbour is to be designed. the Director. CICEF held discussions with the Commissioner of Fisheries. Govt. of Maharashtra. As a result of the correspondence and discussions taking into consideration various fishery aspects, it was agreed that the fishery harbour at Versova shall be designed for a fishing fleet of 170 numbers of 11 m-290 numbers of 14 m. 40 numbers of 17 m trawlers and 400 numbers of 11 m bag netter/gill netter (BN/GN).

2.6.2 Chart Datum of Fishery Harbour

Chart Datum fixed for a fishery harbour is one such useful reference level with which the water depths in the fishery harbour basin can be found out for the safe navigation and operation of fishing boats. All levels in the topographic and hydrographical map of the

site refer to the chart datum which is 6.748m below BOM cut on eastern stone wall and north of entrance door to port office approx. 0.5m above floor level. Sounding datum is transferred from Apollo Bunder to Versova by Maharashtra Maritime Board, Mumbai.

In addition to this, CICEF survey team has established a temporary benchmark BOM engraved on the corner of windowsill at North-east corner of Versova Macchimar Vividh Karyakari Sahakari Society. The TBM value is +6.40m above chart datum.

Table 2.3 Designed Data

Overall length of vessel	No. of vessels	Average landing per boat /trip (kg)	No. of days in a fishing season	No. of fishing days in year	Rest days	Duration of each trip (days)	No. of fishing trips
11m BN/GN	400	330	270	150	120	1	150
11m Trawler	170	200	270	200	70	1	200
14m Trawler	290	3000	270	180	90	9	20
17m Trawler	40	7000	270	180	90	15	12

2.6.3 Planning of Fishery Harbour Facilities

Presently, fishermen are unloading fish catch on the open shores and exiting quays of Versova fish landing centre. After conducting the detailed engineering investigations viz., topographic, hydrographic and subsoil surveys at site and after deciding the design fleet size, the CICEF had prepared fishery harbour layouts for the proposed development of fishery harbour. The Ministry of Agriculture has sanctioned the project by giving administrative approval for the finalised cost of Rs.336.70 Crores.

The CICEF while finalising the fishery harbour layout in consultation with the Fisheries Department of Maharashtra has ensured that the proposed fishery harbour will caters to all existing fishery activities during fishing and non-fishing season at Versova fish landing centre. For the planning of harbour layout, the flow of fishing boats normally taking place during fishing season is surmised below:

- The fishing boats arrive in the fishery harbour after their fishing voyage of specified duration.
- First, they go over to fish landing quay to unload the fish catch. After the fish is unloaded in plastic crates, it is taken to the fish handling and auction hall. There it is washed, sorted, weighed and displayed in boxes for auctioning. Then it is packed with ice in the fish packing sections and dispatched to the local fish markets for further fish processing. Some quantities of wet fish may go for chilled store, freezing, canning etc., while the trash fish is taken for making fish meal, fish manure or else to be used in other allied fish industries.
- Then, the boats move on to the idle-berthing quay for idle-berthing or to repair quay for minor boat repair/engine repair till the next fishing trip.

- Before departing the harbour on their next fishing trip, the fishing boats take fuel, ice, fresh water and food provisions from the outfitting quay.

  Keeping in mind the topographic and hydrographic features of the site, the waterside and landside facilities are planned in a systematic manner following the modular concept. The facilities connected with fish landing, outfitting, idle-berthing, repair and public utility modules are grouped together so as to avoid cross-traffic of fishing vessels on water side and movement of men and vehicular traffic on land side.

  Both waterside and landside facilities planned and designed are to supplement and complement each other in their functions and are in tune with the international standards for the hygienic fish handling and sanitation. In the fish landing module Fish handling and auction hall. fish loading area. parking area are provided. The outfitting quay is placed next to the landing quay with supply facilities like ice. fuel and fresh water delivery points. The idle-berthing jetties are placed close to the shore facilities like fishing gear sheds. fishermen's rest sheds. Net mending sheds etc. Repair quay is provided next to the idle-berthing jetties. In the Repair quay module RC sloping hard. boat repair shop, boat repair/parking yard are provided. Adequate harbour basin area for the vessels is provided adjacent to quays so that the safe manoeuvring of vessels approaching and leaving the berths is possible. Apart from this, the fishery harbour layout provides for the following landside facilities:

- Administrative office navigation aids and radio-communication centre. restaurant. fish merchant's dormitory public toilet blocks, security / guard house. electric substation. overhead tank for storing fresh water, facilities for storing and distribution of fuel and freshwater on the outfitting quay side, boat repair shop, fishermen gear sheds, net mending shed, and fishermen rest shed.

The entire fishery harbour complex accommodating the landside facilities is spread over in area of 19.27 ha out of which reclaimed area will be of 19.19 hectares. The harbour basin area provided for the safe berthing and manoeuvring of fishing vessels is of 13.53 hectares.

The fishery harbour layout incorporating the above waterside and landside facilities is shown in figure 2.4, design aspects of these facilities are elaborated below.

2.6.4 Waterside Facilities

2.6.4.1 Breakwater

Commissioner of Fisheries. Government of Maharashtra requested CWPRS to conduct the desk and wave flume studies for the proposed Fishery harbour at Versova. Accordingly, the Mathematical model studies for wave tranquillity and tidal hydrodynamics /siltation were carried out at CWPRS. The scope of the studies is as below

1. Mathematical model studies for assessment of wave tranquillity
2. Mathematical model studies for tidal hydrodynamics and sedimentation

3. Desk and wave flume studies for design of cross-sections of breakwaters
4. The marginal splashing permitted during High water levels

Details of Ship tranquillity study is given in **Annexure V** – CWPRS report

2.6.4.2 Harbour Basin

The maximum draft for the fully laden vessel of 17 m OAL is around 2.2m. Since, sufficient depths are not available during the low water springs it is proposed to create the basin up to -3 m so as to facilitate the fishery harbour to be used as an all-weather harbour. The basin area enclosed by northern and southern breakwaters is 32.8 Hectors

2.6.5 Construction of Quays

The top level of the fish landing quay- should be such that it should facilitate easy unloading of fish baskets/ boxes by manual labour during mean high water of springs and there should be no overtopping of the quay during highest astronomical tide. Keeping in view the requirement of 17 m trawler and the tide levels prevailing during spring and highest Astronomical tide level surmised at site the crest level of the fish landing and other quays like outfitting, idle-berthing and repair are placed at R.L.5.5 m with a clear freeboard of'1.40 m during MHWS (+4.1 m). In addition. a low, level quay is provided to facilitate unloading of fish catch by vessels arriving during low waters springs with top of deck slab at R.L +3.0m

2.6.6 Other Structures Proposed

2.6.6.1 RC Sloping Hard

RC sloping hard is required for hauling of boats on to land for repair/dry stacking etc. Separate RC sloping hard for MFVs and traditional boats are proposed. RC sloping hard for MFVs of 30 m width inside basin and that for traditional boats of 20 m width on the Malad creek side are proposed to haul up vessels requiring regular maintenance and necessary repairs to hull. engines etc. The slope of-ramp is 1V:8H. Sufficient space is provided behind the sloping hard for boat building, boat parking and repair of vessels.

2.6.6.2 Reclamation bund

The Reclamation bund is proposed on the creek side and inside the basin to protect the reclamation material. The slope of the finished bund is 1:1.5 on both sides. The height of the bund is same as reclamation height. Reclamation of land is necessary for providing the land-based facilities. The length of the bund on creek side is 500 m and inside the harbour basin reclamation bund of length 100 m is proposed on the western side of berthing quay.

2.6.6.3 Navigation Aids

Navigational aids are required for safe navigation of fishing vessels during both night and day times. They are needed to demark the harbour entrance channel, rocky outcrops in the vicinity of the harbour and also lor visibility during night times also. as fishers go or come back from fishing operations without any time schedule. Vessel operators may wish to go for fishing either during daytime or night hours depending on the fishing grounds

and knowledge of shoals While smaller boats of a day's fishing trip would try to do fishing in near shore waters, the bigger boats of multiple day voyages may go farther deep in the sea, and will be in touch with the shore station.

At present there is a light house near the port office on the west side of Malad creek and two concrete pillars on rocky outcrops in the creek. Other than this, there are no navigation aids in the harbour area. For the entrance channel to be visible during night, marker/lighted buoys need to be installed to demarcate the shallow patches/rocky outcrops around the fishery harbour waters for ensuring safe navigation of fishing vessels. Therefore, Provision is made for the navigation aids' However, the specific requirement and details need to be worked out at the time of actual Project implementation.

2.6.7 Landside Facilities

2.6.7.1 Land Reclamation

Correlation of tide levels at site with that of Mumbai Port and Bandra during spring high waters have revealed that the highest high water at site could reach a maximum level of +5.18 m. As such, the average reclamation level is proposed at +5.5 m to prevent the harbour area from inundation during highest tide levels/astronomical tides. The average ground level is RL -2 m on the southern breakwater side and it is RL +3.0 m on beach landing side. Based on this level, the quantum of land reclamation is of the order of 8,81,385 cum. Although creation of the harbour basin to a level of -3 m is considered in the fishery harbour proposal, the excavated quantity would be only of the order of 5,29,548 cum. The remaining quantities of earth required for land reclamation to the extent of 3,51,837 cum in the harbour complex has to be accomplished with suitable borrowed earth from outside for locating the shore-based facilities in an area of 19.27 hectare.

Slope of finished reclamation on waterside for boat parking/ repair yard and the fish landing, outfitting, repair and idle-berthing quays is proposed to be protected by 50cm thick revetment of stones weighing 50 to 100kg laid in two layers over a layer of 30cm thick well-graded stones weighing up to 10kg. A slope of 1V: 1.5H is suggested for the revetment.

2.6.7.2 Auction Hall

The proposed fish handling and auction hall is covered from all sides by brick walls with doors to provide security. The floor of the building would be provided with durable, strong, semi-polished. chemical resistant, water-tight, non-skid white kota/cudappa stone appropriate for industrial use. Inside wall surfaces are cladded with ceramic tiles up to the lintel height. Instead of Kota/cudappa stone, non-skid epoxy coated granite flooring may also be most desirable.

The fish handling and auction hall is divided into number of bays along the length to make it suitable to carry out pre-processing activities including fish auctioning. This would enable to move the unloaded fish from several boats at a time to fish bays without exposing fish to sun heat, dust, dirt and other contaminants. The fish workers would

encounter with fish sorting tables to sort fish by grade, weight and species-wise standing on either side of the table. Next to fish sorting tables, fish display platforms with weighing scales are arranged so that fish boxes displaying species. size and source could be readied for fish auction to take place without wasting time.

Thereafter, fish packing space are provided in the same line adjoining fish loading area to move fish catch in a linear fashion right from the quay face to fish loading area undergoing all the pre-processing activities. In this way, criss-cross movement of fish transfer from one place to other is avoided. All the fish washing tanks, sorting tables, fish display platforms and fish packing tables would be topped with ceramic tiles.

Quantum of water required in fish handling and auction hall for cleaning fish, floor cleaning and fish box washing would be manifold compared to fresh water required for personal use. Therefore, instead of fresh water, clean and bacteria-free sweater would be used in all the fish cleaning/floor washing operations.

Together with seawater supply system, Separate freshwater lines will be laid for this purpose. The seawater and freshwater supply lines would be colour-coded to distinguish between the two supply lines. Pipes and pipe fittings including valves would be of UV stabilized PVC/HDPE pipes and fittings to avoid marine corrosion.

11m MFVs, 170 number with 1 day trip, average landings of 200 kg

No. of vessels operating/ day	=0.9 x 170	=153 nos
No. of arrivals in a day during peak hour	=0.4 x 153	= 61.2 say 61 nos
Average landing/ boat in Peak hour	=1.2 x 200	= 240 kg
Total landing from 15 boats	=61 x 240	= 14640 kg

14m MFVs, 290 numbers with 9 days trip, average landings of 3000 kg

No. of boats operating/ day	= 0.9 x 290/9	= 29 nos
No. of arrivals in a day during peak hour	= 1.2x 29/6	= 5.8 say 6
Average landing/ boat	=3000 kg	
Peak landing/ boat	= 1.2 x 3000	= 3600 kg
Total landing from 7 boats	= 6 x 3600	= 21600 kg

17m Trawlers, 40 numbers, 15 days trip, average landings of 7000 kg

No. of boats operating/ day	= 0.9 x 40/15	= 2.4 say 3
No. of arrivals in a day during peak hour	= 1.2 x 3/6	= 0.6 say 1 no
Average landing/ boat	=7000 kg	
Peak landing/ boat	= 1.2 x 7000	= 8400 kg
Total landing from 54 boats	= 1 x 8400	= 8400 kg

Total Quantity of Fish Catch Landed During Peak Hour (Tonnes)

A	11 m Trawlers (1 day's fishing trip)	14.64
B	16 m Trawlers (9days fishing trip)	21.60
C	17 m Trawlers (15days fishing trip)	8.40
Total		44.64

It is assumed that 75% of the fresh fish landed at the fishery harbour is likely to be taken into the fish handling and auction hall and remaining 25% will be trash fish meat for fish drying. fish meal etc.

Total fresh fish coming into the auction hall = 44.64 x 0.75 = 33.48 tonne/hour

Since, the fish auctioning process for each batch may take about 1.5 to 2 hours, fish catch landed during 2 hours (i.e., 33.48 x 2 = 66.96 tonne say 67 tonne) is considered for the computation of plinth area of fish auction hall. The size of each fish box is 0.60 m x 0.40 m x 0.30 m. Each fish display area of 4.6 m x2.6 m will hold at least 6.24 tonne of fish when arranged in 13 rows and 4 columns of fish boxes in three levels with a net weight of each fish box taken as 40 kg

Number of bays required = 67/6.24 = 10.74 say 11 bays

Total length of fish auction hall required = 12 x 5 + 10 + 10 +80 m

Provide Fish Auction Hall of area 80.51 m x 18.06 m = 1454 sqm

Fish auction hall area for Beach landing vessels

11 m BN/GN of 1 day, fishing trip with average fish landings of 330 kg - 400 nos.

The number of boats operating per day = 0.9 × 400 = 360 nos.

Number of arrivals in a day during peak hour = 0.4 × 360 = 144 nos.

Average fish landing per boat = 330 kg

Peak fish landing per boat = 1.2 × 330 = 396kg

Total landing from 144 boats = 144 × 396 = 57,024 kg; Say 57 tonnes

It is assumed that 50% of the fresh fish landed at the beach landing is likely to be taken into the fish handling and auction hall and remaining 50% will be trash fish meat for fish drying, fish meal, etc.

Total fresh fish coming in to the auction hall = 57.0 x 0.5:28.50 tonne/hour

Since, the fish auctioning process for each batch may take about 1.5 to 2 hours, fish catch landed during 2 hours (i.e., 28.5 x 2 =57 tonne) is considered for the computation of plinth area of lish auction hall. The size of each fish box is 0.60 m x 0.40 m x 0.30 m. Each fish display area of 4.6 m x 2.6 m will hold at least 6.24 tonne of fish when arranged in 13 rows and 4 columns of fish boxes in three levels with a net weight of each fish box taken as 40 kg.

Number of bays required = 57/ 6.24 = 9.13 say 9 bays
Total length of fish auction required = 10 x 5 + 10 + 10 = 70 m
Provide Fish Auction Hall of area 70.51 mx 10.23m =721.32 sqm

Fish will be displayed on the platforms of 4.6 m x2.6 m area in boxes for buyers to know about the fish species grade, weight and who supplied it. There, the auction field staff could assess the quality and quantity of fish being sold in auction and keep track of the quantum of fish landings. Each auction process with fish coming in batches is expected to last at least for 1.5 to 2 hours during which time ail the pre-processing operations like washing, sorting, weighing, auctioning and fish packing with ice including loading of fish in the waiting refrigerated vans could be completed. Fish transported from the fishery harbour complex is only in the form of fresh fish as further fish processing for export is done elsewhere in the fish processing Plants.

After each batch of fish is handled and auctioned, cleaning and disinfecting of floors, walls and fish boxes would be done with chlorinated seawater by wall mounted or hand pulled high-pressure cleaners for effective cleaning as well as water saving measures. Thus,

clean fish boxes/crates could be made available to the fish sellers at a nominal cost and stored back into box storerooms at the end of each auction hall. After auction, buyers would collect their purchases and head to the fish packing area for ice packing in plastic crates.

The floor finish level within the building would be higher by 0.45 m above the quay surface for better drainage. The fish handling and auction hall would have sewerage and drainage arrangements for washed water from fish washing tanks, floors and sewage from toilets. All the drainage and sewage lines from the fish handling auction hall would be connected to the underground sewage system. Within the building internal drains would run lengthwise and breadthwise to collect washed water and prevent floor becoming wet and slippery. Since the drains are likely to be frequently blocked by fish wastes. The drains provided are of open type but covered with galvanized steel metal grids/gratings or perforated concrete slabs so that the top covering can be easily removed and replaced during inspection and cleaning operations. These internal drains would be provided with suitable water-sealed chambers at the junctions to prevent drains clogging from fish waste/offal and foul smell emanating from the drains.

Necessity for chilled storage facilities for the excess fish catch not sold on a particular day's auction might arise during the operation of fish handling and auction hall. For this reason, the building provides for insulated rooms for overnight storage of ice fish. A separate room is provided to install DG set to he used during power breakdown to provide continuous power supply. Change room is provided to be utilised by the up keepers of the fish auction hall to change their dresses.

Within the fish handling and auction hall, adequate windows and ventilators would be provided to allow for natural light and ventilation in addition to exhaust fans fixed at the lintel height below the false ceiling. Windows and ventilators would be adequately screened with nylon/aluminium nets curtains and doors provided with mechanical air curtains to prevent the ingress of insects like flies. mosquitoes and birds. In addition to general lighting of the building, the fish display-fish packing management room and other areas needing care would be well lit by providing special anti-glare type hanging lights of adequate luminosity with shadow covers. This would help to conduct fish handling. icing and auctioning operations even during night hours.

The front and back of fish handling and auction hall on the fish landing quayside and fish loading areas would be well lit with high mast lights. Since the fish unloading operations could take place during day as well as night hours the building is provided with a centralized uninterrupted electric supply in the form of standby- diesel gen-set for lighting the building and surrounding areas, besides normal electric power supply.

2.6.7.3 Fish Loading Area

Behind the fish handling and auction hall and adjacent to fish packing rooms. fish loading areas with sunshade are provided to enable vehicles including the refrigerated vans to approach the fish auction hall from behind for transportation of auctioned fish to consuming markets. The extent of concrete surface in fish loading area with sunshade structure is 3230 sq.m. The fish loading area is of concrete surface for the entire length of fish handling and auction hall to withstand the vehicle loads and spillage of water. The surface of the fish loading areas would be given suitable slope towards drains to avoid forming wet, slippery conditions at the fish loading place.

2.6.7.4 Fishery Administrative office

Fishery administrative office is necessary for management and maintenance of harbour facilities. for regulating activities relating to fishery industry such as fish handling and auction hall- fish prices and the movement of fishing vessels in and out of the harbour. Fishery Administrative Officer along with his supporting staff is expected to work from this office to look after the day-to-day activities. As such the proposed fishery harbour complex provides for a fishery administrative office having a plinth area of 186 sq.m

2.6.7.5 Fishermen's Gear sheds

Between the rest days of the fishing voyages and during non-fishing season some fishing vessel operators for security reasons may, prefer to keep their fishing gear in the fish gear sheds instead of keeping in the fishing vessels. As such. fishing gear storage cabins with locking arrangements are required to be provided in a fishery harbour. For this purpose, a limited number of fishing gear storage sheds (proposed in four blocks each having 12 cabins with a plinth area of 161.30 sq.m and two sheds for future expansion) for 48 fishing vessel operators are proposed in the fishery harbour complex as shown in Drg.No.MH-l5/06. The four blocks have a total plinth area of 645.2 sq.m. The basis for arriving at the plinth area of the gear storage sheds is that each fishing boat operator would need 10 sq.m. of floor space for storing gears and tackles. For this reason, each cabin provided is of 3.75 m X 3 m in floor area with additional racks provided for storing petty items like paints, lubricants, hooks, floats etc.
These four blocks are located central to idle-berthing quay so that the fishing boat operators need not have to carry the heavy gears and tackles for a long distance and can keep the fishing gear in safe custody in the gear sheds under lock. In addition to the above there is provision for one more fishermen's gear shed to be constructed in future

2.6.7.6 Net mending Shed

Fishing nets would become wet and damaged to some extent after each trip. As such, a top covered net mending shed with open on all four sides is required for the fishermen to repair their damaged nets sitting under the sunshade. Therefore, four net mending sheds of total plinth area of 1042.4 sq.m are provided in the fishery harbour complex. Each net mending shed is of 10.23 m wide and 25.23 m long with a plinth area of 260.60 sq.m in addition to open land space of over 1,000 sq.m on either side of the net mending shed 1br spreading and drying of nets. -These net mending sheds are aligned longitudinally more or less in the east-west direction so that the fishermen sitting under the open net mending shed are not exposed to direct sunlight and are located behind the idle-berthing quay.

2.6.7.7 Boat repair shop

Separate boat repair shops are provided for MFVs and FRP boats of 148.7 and 103.67 sq.m plinth area respectively for attending to electrical/electronic/mechanical repairs, checking up of lubricants and cooling system of the engines of fishing vessels in addition to boat building activities.

2.6.7.8 Restaurant

Restaurant is required for those working in the fishery harbour premises and visitors to have refreshment and food. As such a restaurant of 150.50 sq.m plinth area is provided in the public utility module of the fishery harbour complex near administrative office building. The proposed restaurant has kitchen. store service in addition to terrace and lawn space and other provision for public conveniences like waiter's room, wash basins, water closet/urinals etc.

2.6.7.9 Fishermen rest sheds

The fishermen need rest after they, come from each fishing trip, unloading. auctioning process etc. Fishermen job is hard and fatiguing and they have to leave at night or early morning hours for fishing when the conditions for fishing voyages are favourable. They, are also required to keep watch on their boats lying on tire quayside. There would also be homeless fishermen who have temporarily migrated from other fishery centres and made their fishing base from Versova fishery harbour during the peak fishing season. Therefore, rest sheds for fishermen are needed for resting/recreation purposes. As such, four fishermen rest sheds of each 268.83 sq.m plinth area.

2.6.7.10 Dormitory

Dormitory facility would be needed for the fish merchants, traders operating from the fishery harbour and for those visiting harbour on regular business trips. Lodging and boarding facilities would be desirable right at the fishery harbour project site so that the business community is able to coordinate their activities from within the fisher, harbour complex. As such a fish merchant's dormitory of 333.33 sq.m. plinth area is provided within the fishery harbour complex.

The building provides single/double rooms and dormitory hall to accommodate more persons. Further dining facilities, reception, waiting lounge. kitchen. store for food provisions. dish wash bathing toilet facilities etc. are added to the dormitory. Since the dormitory would be built on a framed column structure, more floors can be added later.

2.6.7.11 Public toilet blocks

From the sanitation point of view, and essentially for maintaining a cleaner fishery harbour, adequate lavatories, urinals and bathing facilities need to be provided near places where people tend to concentrate in large numbers. For this purpose, two public toilet blocks each with a plinth area of 70.00 sq.m are proposed, one each near civic amenity site and tire other near beach landing facility.

2.6.7.12 Radio Communication Tower

A radio-communication tower is very much required in a fishery harbour to coordinate the shore-to-ship and ship-to-shore communication between the fishing vessels, to keep watch and regulate fishing vessel movements within the fishery harbour complex to disseminate information to fishermen relating to exact fishing grounds. movement of fish shoals, navigation hazards etc., and to guide/extend necessary assistance to the fishing boats making distress calls from for off sea.

Radio-communication tower is proposed near the outfitting quay module which is central to the quays on the waterside. The radio-communication tower of a total built up area of 125.38 sqm in ground would be equipped with skilled technicians. VHF instruments and

other equipment to provide round-the clock service and two-way communication to fishing boat operators. The radio-communication tower would make necessary arrangements for display of signals, flags and lamps to provide useful weather information and cyclone warming services to fishermen community and caution them not to venture into the sea during rough weather conditions. In addition, the radio-communication tower would also he used to monitor the weather parameters and thus act as a local meteorological observatory station whose results and findings could be used by fishery harbour authorities and other user departments.

2.6.7.13 Security/Guard house and compound wall

Security/guard house is need to check the entry and exit of vehicles and visitors in the fishery harbour complex. It also serves to ensure that the vehicles carrying fish loads and other fish products leave the harbour premises atter paying the toll tax/fee. Guard house proposed is of 30.5 sq.m plinth area. Further, the proposed fishery harbour complex is to be secured from intruders and squatters. As such, it is proposed to provide a compound wall of 1175 m on the landside to provide security for the fishery harbour complex.

The compound wall is of 230 mm thick brick masonry wall in CM 1:6 with 150 mm thick concrete coping at top. Over the compound wall barbed wire fence is provided

2.6.7.14 Approach road and internal roads

The fishery harbour site is situated adjacent to Versova - Andheri Road. Within the fishery harbour complex, the internal roads of sufficient width to cater to two-lane traffic are proposed. These roads are proposed to be of cement concrete. The roads demarcate the limit of utility buildings and areas. The road widths shown in the harbour layout drawing include the pedestrian path over the covered storm drains and vehicular traffic lanes. The length of concrete road proposed is 2909 m.

2.6.7.15 Parking area for vehicles

Traders and consumers visit the fishery harbour daily on their vehicles like trucks, vans. auto rickshaws, scooters, bi-cycles, tricycles etc., for buying collecting and transporting fish and fish products to nearby fish markets and consuming centres. ln addition there will be vehicles connected with the fishery industry bringing ice and other commodities. Therefore, adequate vehicle parking area in the form of paved surface is provided behind the proposed fish auction hall. The area earmarked for vehicle parking behind the proposed fish auction halls in the form of paved surface of 12,250 Sqm.

2.6.7.16 Boat Parking/Repair Yard

During non-fishing season, some of the migratory fishing vessels from Versova fishery, harbour may like to return to their original base whereas the native fishing boats will be parked in the fishery, harbour complex. During this period the fishing boats need to be pulled on to shore for regular maintenance and repairs to hull engine etc. For the above purposes, open land space of 18,580 sq.m is provided for parking and repair of boats. The extent of land provided is sufficient for orderly parking of at least 77 boats belonging to Versova out of the total MFVs of 500 numbers. The boat parking/repair yards have manoeuvring lanes of WBM roads of adequate width for transportation of boats. Thus,

the transfer of fishing vessels from water to land to their designated plots in the yard through RC sloping hard and vice-versa is made easy. Further, the individual boat parking/repairing plots have enough land space on all the four sides for conveniently attending to boat repair/parking.

2.6.7.17 Ice Plant

It is the present practice of-the trawlers performing 1, 9- and 15-days fishing trip to carry at least 150 kg,2 tons and 4 tons of ice per trip respectively. At this rate, the fishing boats would need about 100 tons of ice per day. The demand for ice could further increase if the fish catch improves after the construction of fishery harbour. As such. the proposed fishery harbour provides for a plot of 4600 sq.m. The provision made is only for the land as the investment for ice plant-cum-chilled storage is later expected to come up from the private entrepreneurs.

2.6.7.18 Drainage and Sewerage System

The storm and surface water from road surface would be collected in the storm water drains proposed along both sides of roads. The sewage water from the fish handling and auction hall and other shore-based infrastructures of the entire fishery harbour complex need pre-treatment before disposal. As such it would be necessary to have separate drainage and sewage systems for both storm water and sewage. Effluent collected from the fish handling and auction hall at the end of the sewers would be given secondary treatment in a specially built effluent treatment facility, to be set up at one corner of the fishery harbour complex and the output of the treatment plant after treatment to tolerable limits will be discharged into the sea water.
The wastewater treatment plant would include fully covered RC tanks for collecting effluent water taking into account hydraulic gradient, site elevation, screening, grit removal, settling tank, desludging tank, filtering through up-flow filter bed device and finally disinfect the overflowing effluent in chlorine dozing tank or by UV radiation before letting the same through outfall to exiting sewer line in the nearby area. The wastewater treatment plant would be designed to be aesthetically attractive and visually compatible with the surrounding area and land uses.

Provision for the drainage and sewage system including the roadside dustbins, septic tanks, soak pits, manholes, sewage treatment plant, storm water drains etc., within the fishery harbour is made on lump sum basis and the actual details are to be worked out at the time of project implementation.

2.6.7.19 Electric Power and Lighting System

During peak fishing season the fishery harbour is expected to be operative round the clock. Hence, fish landing, outfitting, idle-berthing jetties and repair quays need to be well lit for easy access by the fishermen and fishing boats. Walkways and approaches to the fish landing. outfitting. idle-berthing jetties and repair quays need to be lighted for safety, and security reasons. Power plug points need to be provided at the idle-berthing jetties for plug-in service so that the vessels can draw from main electricity supply, while idle-berthing in order to save their battery power. Three-phase electric power supply is required for ice plants. refrigeration equipment etc. in addition. electric power is required for street lighting. illuminating vehicle parking areas, fish auction hall and other

individual buildings etc. Provision is made for the electric power supply, general lighting and 11 KVA electric substation within the fishery harbour complex.

To tide over emergency situation like General Electric power shutdowns/breakdowns, the important buildings like fish handling and auction hall, ice plant, fishery administrative office and freshwater and seawater pumping stations would be supplied with power by standby diesel gen-sets.

2.6.7.20 Civic Amenities

Fishermen require many items such as fish nets. baskets. sinkers. buoys anchors. ropes. automobile/machinery parts/products etc., for their fishing vessels and gear. The fishermen also need to carry food provisions before going on a fishing trip. Therefore, marine supply and provision stores are required to be set up in the fishery harbour complex. It is also necessary for the mechanised fishing vessels to possess onboard electronic equipment such as fish finder, echo sounder. Walkie-talkies, radio. electronic position finder etc. When these services are available within the fishery harbour complex, fishing vessel operators can avoid going in search of such services to other places/cities. Apart from the above services, the proposed fishery harbour needs civic amenities such as food courts/ outlets, tea/coffee and soft drink dispensers, post and telegraph facilities including telephone. fax and e-mail and internet cafes medical stores and health services, financial institutions such as banks preferably with automated teller machines (ATMs). institutions extending credit/insurance services etc. Since large number of people congregate in a fishery harbour during peak fishing season police outpost may be necessary to maintain law and order and to thwart any untoward incidents effectively. To meet the above demands, tire proposed fishery harbour provides for civic amenity site of 13.410 sq.m area in public utility module for setting up the above-mentioned services in the fishery, harbour complex.

The provision made is only for the land as the investment for actual civic amenity facilities/shops is expected to come up from the user groups like private entrepreneurs, governmental and non-governmental agencies. In addition to vendor shops, the civic amenity site would have open spaces for greeneries, vehicle parking area etc.

2.6.7.21 Greeneries, Gardens/ Parks and Landscaping

In order to enhance the aesthetics and beauty of- the surrounding environment- the proposed fishery harbour provides for open land spaces in the harbour complex are for landscaping. Greeneries cultivated inside the fishery harbour complex also act as a lung space within the periphery of the harbour complex and the presence of green foliage would purify, the air, increase the oxygen level and refresh the atmosphere. This will help to a great extent in maintaining pollution levels well within the permissible limits of environmental norms. Entrance to the fishery harbour complex near main gate will also be given suitable facelift and landscaping to welcome the visitors to a well maintained and cleaner fishery harbour. Monitory provision for development and maintenance of green belt will be made.

2.7 Environmental Aspects in Project Activities

Environmental aspects envisaged are as below,

- Proposed activity is located partly in intertidal and partly in subtidal region.

- Construction material will have to be brought to the site through road which may result in traffic congestion in construction phase.
- Construction activity will require use of trucks/ tippers, Poclain, Cranes etc.
- Excavation activity will result in spoils which will also result in benthic loss.
- Entire activity will result in temporary increase in turbidity which will affect the marine ecosystem.
- Dredging activity will be carried out by 'Trailing Suction' technique by trained experienced agency. This method provides control over loose sediment as it gets pumped immediately into the system.

2.8 Construction Material, Other Requirements & Sourcing

The material required is mainly civil construction material and it is proposed to obtain it from market of nearby areas. Sourcing locations and distances are indicated below:

Table 2.4: Construction Material & Source Locations

Sr. No.	Name of Material	Source	Distance (km)
1.	Cement	Andheri	7
2.	Steel	Andheri	7
3.	Bricks	Oshiwara	5
4.	Metal (below 40mm)	Oshiwara	5
5.	Sand	Andheri	7
6.	NP3 class RCC Pipe	Andheri	7

2.9 Utilities Required During Construction Phase

Various utilities/Equipment required and respective fuel consumption for construction purpose is given in following table:

Table 2.5: Utilities, Equipment, Fuel Consumption

Machinery	Number	Fuel (Diesel) Required
Poclain (0.90cum)	2	20 Lit./ hrs.
JCB (0.60cum)	2	12 Lit./ hrs.
Truck/Tipper (14 cum))	5	2 Lit./km
Concrete Mixer (0.60cum)	2	5 Lit./hrs.
Needle Vibrator	5	2.5 Lit./hrs.
Crane (25T)	1	14 lit/hrs.
Diesel Generator (125kv)	1	15 lit/hrs.
Water tanker (10000 Lit)	1	2 lit/km
Poclain (CK 300)	1	18 Lit./ hrs.
Spud pontoon	1	--

2.9.1 Water Requirement

Fresh water supply during operation of fishery harbour must be adequate to meet the requirements of fishing vessels to carry on their fishing trips, for manufacture of ice, and domestic use. The water used by vessels, fish industries, domestic purposes and ice making must be potable, whereas for washing and cleaning of fish in auction hall, seawater could be used provided it is unpolluted and bacteria-free.

Drinking water will be supplied by MCGM. Potable water will be supplied to vessels at outfitting quays. Daily freshwater requirement for the entire fishery harbour is as follows:

I. **Fresh water supply**

A. Fishing Vessels

Water requirement for 11m trawler vessels conducting 1day fishing trip at 100 litres/boat/day 153 x 100 = 15,300 lit.

Water requirement for 11m, GN/BN vessels conducting 1day fishing trip at 50 litres/boat/day 360 X 50 = 18,000 lit.

Water requirement for 14 m&17 m trawler vessels conducting 9- & 15-days fishing trip at 250 litres/boat/day (35X9X250)+(4X15X250) =93,750 lit

Total = 1,27,050 lit.

B. Ice Plant

Considering 2 days reserve ice capacity, 20,000 litres x 2 days = 40,000 lit.

C. For fishermen and fishery industry people working within the fishery harbour complex

5,000 Nos. × 15 litres/day = 75,000 lit.

D. For future fish processing industries to be located within the fishery harbour complex

Fresh water requirement in the fish processing industries will be nearly 2 to 3 times the fish to be handled in these plants. Since tire exact capacity of these industries is not known at present. freshwater requirement is tentatively taken as 50,000 litres

Total daily freshwater requirement (A+B+C+D) = 2,92,050 litres say 3,00,000 litres

The proposed fishery harbour complex has provision for an overhead water tank capacity of 100 K-litres. Similar to sea water distribution system a separate pumping station with freshwater distribution system is provided in the fishery harbour. Fresh water would be pumped 3 times daily from the ground water sumps and stored in the overhead tank. Uninterrupted power supply to pump freshwater from the sumps is ensured through electric power failing which diesel gen-set would supply, the required power to pump water from the sump at any time.

Bulk supply of freshwater to fishing boats at outfitting quay it provided by extending water pipes to the quay face and making available required number of freshwater outlets.

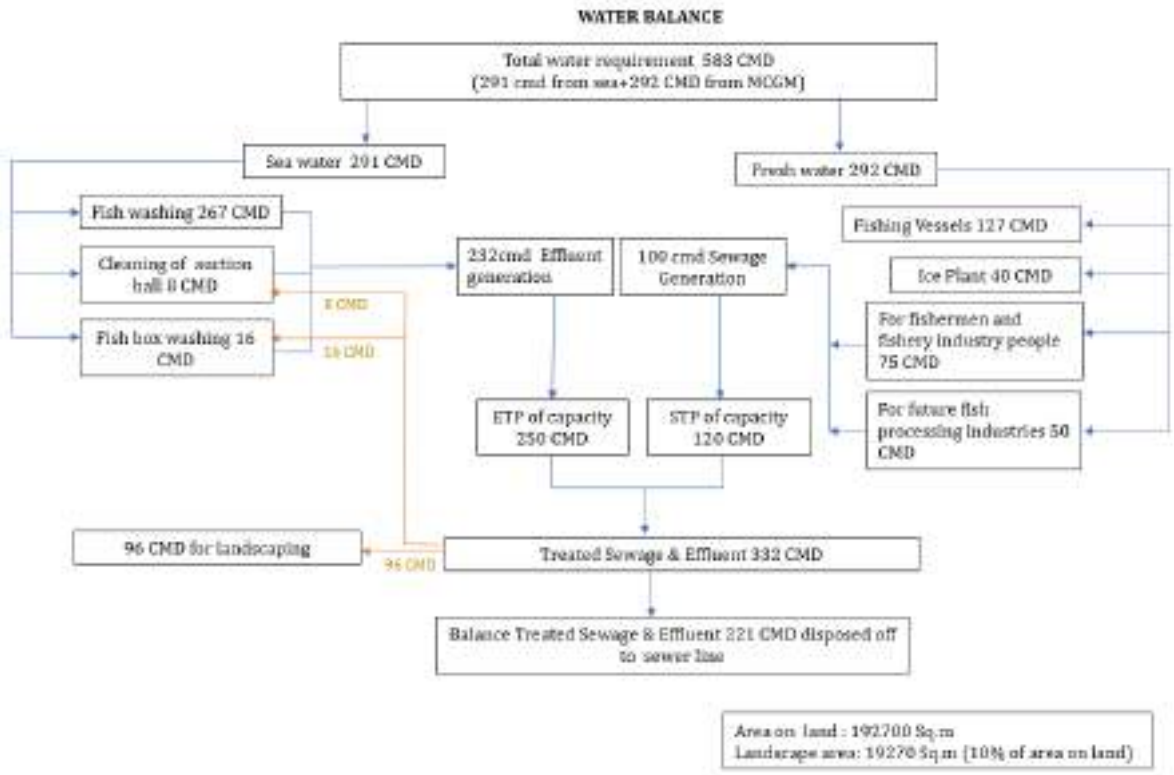
II. **Sea water supply**

Quantum of water required in fish handling and auction hall for cleaning fresh fish, floor cleaning and fish box washing would be manifold compared to water required for

personal use. Therefore, clean and bacteria-free seawater could be used for, cleaning of fish, floor cleaning and lish box washing to save freshwater. Therefore, clean and bacteria free seawater drawn from the shallow tube wells is proposed as an alternative. The daily requirement of seawater in the fishery harbour is computed as below:

1. Fish washing
   Taken at 1 litre/kg of fish handled in auction hall in peak season per day = 1,67,000 lit.
2. Cleaning of fish auction hall premises
   Taken at 5 litres/sq.m of floor area/day (considering 50% less for high pressure cleaning systems = 7712 lit.
3. Fish box washing
   Taken at 10 litres/box/day (considering 50% less for high pressure cleaning system)
   = 16,200 lit.
   Total = 2,67,600 + 7712 + 16, 200 = 2,91,512 lit. Say 3,00,000 lit.

III. Water Balance:



Total Water consumption shall be 583 CMD for the above-mentioned activities. The sewage and effluent generation will be 100 and 232 cmd respectively. The sewage will be treated in STP of capacity 120 cmd and effluent will be treated in ETP of capacity 250 CMD. The major impacts shall occur due to sewage discharge without proper treatment. The treated water as per required standard will be used for green belt

development/flushing/cleaning of fish handling and auction hall premises/fish box washing.

2.9.1.1 Description of Sewage Treatment Plant

The sewage generated (Total capacity: 120 m^3/day) from entire harbour complex will be collected by gravity sewers leading to the sewage collection pit of STP.

Sewage treatment plant unit Sequence:

Screening – Oil & grease trap – Equalization Tank – Bio Reactor – Secondary Settling tank – Disinfection System – Sand Filtration – Carbon Filter.

A. Sewage Collection Pit

The sewage generated from various locations in complex will be collected in sewage collection pits. This pit will be provided with sewage transfer pump to transport sewage from Sewage collection pit to STP screen chamber.

B. Screen Chamber

Raw sewage from the source will be received into the screen chamber by pumping. Screen provided will remove all floating and large size suspended matter coming from various locations like fish auction hall, box washing area etc. The screen will be periodically cleaned to remove trapped solids. The screen will be disposed of along with sludge of STP.

C. Oil and Grease Skimmer

The overflow from the bar screen chamber after screening enters into the oil and grease chamber. Belt type oil skimmer will be provided to remove the oil and grease content present in the sewage before biological treatment as it may cause problem for biological treatment. The highly oleophilic endless belt rotates touching the sewage. Belt comes into contact with the oil floating on the surface of the liquid and picks up the oil. The belt carries the oil on its surface to the top end of the machine where a set of scrapers remove the oil from the belt surface and deposits into a collection tray from where it is drained by means of gravity into slop oil tank. Further it will be disposed of along with STP sludge.

D. Equalization Tank

The sewage from Oil & Grease skimmer will be collected into an equalization tank.

Equalization tank will have 8 – 10 hrs retention time at average flow rate. The sewages are homogenized in equalization tank by having provision of coarse bubble aeration grid at the bottom of the equalization tank.

This tank acts as a buffer tank to take care of organic and hydraulic shock loads during plant operation. The equalised sewage from this tank will be fed to biological tank for further treatment. Biological tank feed pump (BTFP) will be provided to transport sewage from equalization tank to Biological System.

E. Biological System

Biological System consists of biological tank for removal of organic matter (BOD, COD) & Secondary clarifier. These units will be placed inside a single MSEP tank. Each of these components as described below.

a. Biological (MBBR) Tank

This tank will be filled with floating bio media of cylindrical shaped polyethylene carrier elements for biological growth. In this process biomass will be in the attached as well as in suspended form. Therefore, more surface area will be available for bacteria to grow on, thereby maintaining and retaining maximum possible bacterial population in a limited volume. As a result, volume required for biological tank in this process is less than biological tank of conventional process.

The sewage will enter at the top of the MBBR tank. Air is introduced at the bottom of the tank through fine bubble diffusers. Bio media will be in suspension because of the turbulence created by the air. The bacteria required for the oxidation of the organic matter is attached to the media and some part is suspended in the tank. After oxidation, the bacteria grow in number and need to be separated from the MBBR tank liquor. Hence biologically treated effluent then gravitates into the Secondary clarifier through overflow weir. Wire mesh will be attached with overflow weir to trap and retain plastic media into MBBR tank.

b. Secondary Settling Clarifier

The effluent from Bio reactor contains some amount of MLSS & suspended solids which need to be removed before tertiary treatment of the effluent. This purpose will be served by the Secondary settling clarifier. The Secondary settling clarifier has plates inclined at 55°C which act as settling surface. The overall settling area of the Secondary clarifier is greater than that of a conventional clarifier of similar size. Thus, efficient removal is achieved in a smaller footprint. The clarifier system helps in clarification and separation of the bacteria (sludge) and clear overflow flows into chlorine contact tank.

c. Chlorine Contact Tank

In chlorine contact tank, Sodium hypo Chlorite (NaOCl) will be added for disinfecting the mixture of treated sewage & trade effluent. Baffle plates will be provided in chlorine contact tank to make better chlorine contact.

F. Tertiary Treatment

The chlorinated treated effluent will be pumped & further treated in MGF followed by ACF to meet the other consent parameter.

1) Multi-Grade Filter (MGF)

This unit will be used for removal of total suspended solid content in treated sewage. It consists of vertical centrifugal FRP vessel with filter media consisting of

pebbles, gravel and fine sand. The accessories installed in vessel consists of frontal piping with valves, instrumentation etc. to achieve the desired filtered water quality. The filters will be backwashed intermittently for removal of suspended solids trapped over a period

of plant operation. Filter backwash will be carried out for a period of maximum 10-15 minutes. MGF backwash flow rate will be achieved by using both (working & standby) filter feed pump at a time. Accordingly, filter feed / backwash pump of suitable capacity along with blowers will be provided.

2) Activated Carbon Filter (ACF)

This unit will be used for removal of traces of colour, odour, free chlorine, COD and total suspended solid content in treated sewage. It consists of vertical centrifugal FRP vessel with filter media and activated carbon. The accessories installed in vessel consists of frontal piping with valves, instrumentation etc. The filters will be backwashed intermittently for removal of suspended solids layer developed on top media layer over a period of plant operation.

3) STP Treated Water Disposal

The treated sewage from this tank will be pumped for green belt development and/or flushing purpose cleaning of fish auction hall, cleaning of fish boxes etc. using STP treated water transfer pumps. There will be no discharge of treated sewage into marine area. Excess treated water will be disposed of into existing sewer line.

2.9.2 Work Shift and Manpower

The work execution will be influenced by the tidal condition. The time available for actual work execution is low. Manpower required for proper execution of this project is depicted in below table.

Table 2.6 Project based manpower and work-shifts.

Sr. No.	Type	Numbers
1	Operator	20
2	Supervisor	15
3	Mechanic	05
4	Electrician	02
5	Mazdoor	150
	Total	**192**

2.10 Solid & Hazardous Waste Generation

In construction phase, activities include piling, excavation, civil construction in marine area, erection of other support facilities like guide poles. Solar lights etc. In operation phase of project berthing, de-berthing of fishing vessels, unloading fish catch, replenish utility/ food/ water stock, boat repair and maintenance, fish processing including drying (only sun drying) etc. Solid waste generated during these processes will be separately collected. Designated dustbins at places will be made available. Segregated waste then stored at designated place with impervious flooring. Disposal will be done through existing municipal solid waste disposal facility. It is observed during site visit that, there is no designated place or defined disposal mechanism in place. hazardous waste will also be store at designated place with impervious flooring and disposed of through authorised vendor.

2.11 Waste generation, Treatment and Disposal

Construction Phase:

Solid waste generation and disposal from the construction will be as follows:

Table 2.7 Non- Hazardous waste generation & disposal

Sr. No.	Particulars	Quantity	Unit	Method of Disposal
1	Cement bags	96400	Nos	Sale to authorized dealers
2	Excavated material	~5,29,548	m^3	Will be used for reclamation activity

Operation Phase:

Solid waste generation and disposal from the operation will be as follows:

Table 2.8 non-Hazardous waste generation & disposal

Sr. No.	Particulars	Quantity in Kg/ Annum	Method of Disposal
1	Discarded fish by-catch	90670	Given it for manuring/ composting/ 'Fish Meal'
2	Iron scrap	360	Sale to scrap dealers
3	Wooden planks	2700	Reuse in Koliwada
4	Reinforced fibre panels	900	Reuse in Koliwada
5	Resin foam pieces (damaged fibre boats)	360	Reuse in Koliwada
6	Torn pieces of fishing nets	180	Sale to scrap dealers

2.11.1 Hazardous Waste Generation

Construction phase:

Hazardous waste generation and disposal from the construction will be as follows:

Table 2.9 Hazardous waste generation & disposal

No	Description	Category as per HW rules 2016	Total Quantity (per year)	Method of Disposal
1	Paint/ Antirust/ CPCC solution containers	33.1	50 nos.	Sale to scrap dealer

Operation Phase:

Hazardous waste generation and disposal from the operation will be as follows:

Table 2.10 Hazardous waste generation & disposal

No	Description	Category as per HW rules 2016	Total Quantity (per year)	Method of Disposal
1	Used oil from boats and DG sets	5.1	5 Ton	Sale to authorized recyclers

2	Used batteries	-	50 Nos.	Will be exchanged with the dealer on purchase of new batteries

3 DESCRIPTION OF THE ENVIRONMENT

Environmental baseline data of site and surrounding region prior to development of fishing harbour at Versova covering land, ambient air, water, noise, biological & socio-economic including marine environment in the study area was collected by undertaking primary surveys through field visits, sampling/ monitoring, laboratory analysis, questionnaire surveys and discussions with fishermen co-operative societies. Secondary data was collected from relevant agencies, such as Primary Health Centres, Forest Department and Directorate of Census Operations. The baseline data collected and generated, together with the relevant project activities will be considered for identifying likely impacts of the project on the environment. Subsequently, an appropriate environmental management plan (EMP) will be presented to enable the project proponent to run the project within acceptable level of environmental impact and meet the compliance of the regulatory criteria (MoEFCC's Guidelines). An Environmental Impact Statement (EIS) will be ultimately made to summarize the post project status of the environment, with the project proponent incorporating the suggested EMP measures.

MFDC is proposing to develop fishing harbour at existing fish landing centre at Versova. Baseline study of surrounding area was done by keeping in mind type & scale of upgradation, considering the MoEFCC Guidelines.

For the purpose of assessing the impacts, study area of 10km radius from project site was identified for the EIA. Concerns have also been accounted about possible impact of project on marine ecology.

3.1 Environmental Sensitivity

Environmental Sensitive features associated with the location of project are identified on the basis of reconnaissance visit, baseline survey and authentic secondary sources such as Archaeological Survey of India, Open Series Maps published by Survey of India, notifications issued by MoEFCC. Names of such sensitive features with approximate distances (within 15Km) from site boundary are presented in table below:

Table 3.1 Environmental Sensitivity

Sr. No.	Areas	Name/ Identity	Aerial distance (within 15 km.) Proposed project location boundary
1	Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value	Sanjay Gandhi National Park	~9.4 km to East.
		Thane Creek Flamingo Sanctuary	~14 km to South East
		Kondivate Caves	~7.5 km to East
		Jogeshwari Caves	~5.7 km to East
		Mandapeswar Caves	~12.82 km to North East
		Buddhist Caves, Kanheri	~13.2 km to North East
		Sion Fort	~ 12.4 km to South East
		Portuguese Church, Mandapeswar	~12.6 km to North East
		Madh Fort	~1.2 km towards SW

Sr. No.	Areas	Name/ Identity	Aerial distance (within 15 km.) Proposed project location boundary
2	Areas which are important or sensitive for ecological reasons - Wetlands, watercourses or other water bodies, coastal zone, biospheres, mountains, forests	Sanjay Gandhi National Park	~9.4 km to East.
		Thane Creek Flamingo Sanctuary	~ 14 km to South East
		Powai Lake	~11km towards East.
		Mangroves	~ 0.25 km towards West
3	Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration	Thane Creek Flamingo Sanctuary	~14 km towards SE
		Sanjay Gandhi National Park	~9.4 km towards East.
4	Inland, coastal, marine or underground waters	Versova Beach	Adjacent to project site
		Malad Creek	~0.5km towards North
5	State, National boundaries	-	--
6	Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas	Madh Ferry	~0.4 km towards North
7	Defense installations	INS Hamla	~ 5 km towards N
8	Densely populated or built-up area	Versova	Site located within western suburbs of Mumbai city ~0.15 km towards NE
		Andheri	~4.5 km towards East
9	Areas occupied by sensitive man-made land uses (hospitals, schools, places of worship, community facilities)	Andheri	Site within western suburbs of Mumbai city Number of schools, colleges, hospitals in vicinity of site
10	Areas containing important, high quality or scarce resources (ground water resources, surface resources, forestry, agriculture, fisheries, tourism, minerals)	Versova Beach/ Malad Creek	
11	Areas already subjected to pollution or environmental damage. (those where existing legal environmental standards are exceeded)	-	Chembur
12	Areas susceptible to natural hazard which could because the project to present environmental problems (earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions)	-	This area is generally not prone to any natural disasters. The area under study falls in Zone-III, according to the Indian Standard Seismic Zoning Map.

3.2 Land Environment

3.2.1 Local Setting

Village Versova, where the fishing harbour is to be located, falls in Andheri Taluka of Mumbai Suburban district. Site is well connected by road. Nearest railway station, Andheri is about 7 km, towards E w.r.t. site. Versova metro station about 2 km towards East side of the project site. Figures below shows the project site with 10km study area and proposed project activity with surrounding locality in Google imagery. Project site and entire 10km study area is covered in open series map (OSM published by Survey of India) no. E43A16 and the same is depicted in figure 2.4.

3.2.2 Regional Setting

Versova, originally named Vesave, was a small fishing village of the Kolis, situated to the north of the old Mumbai city. Versova is an important busy fishery centre in Mumbai district where both motorised and mechanised fishing vessels are operating. it is located about 7km from Andheri railway station within the limits of Mumbai metropolitan region in Andheri taluk of Mumbai district of Maharashtra state.

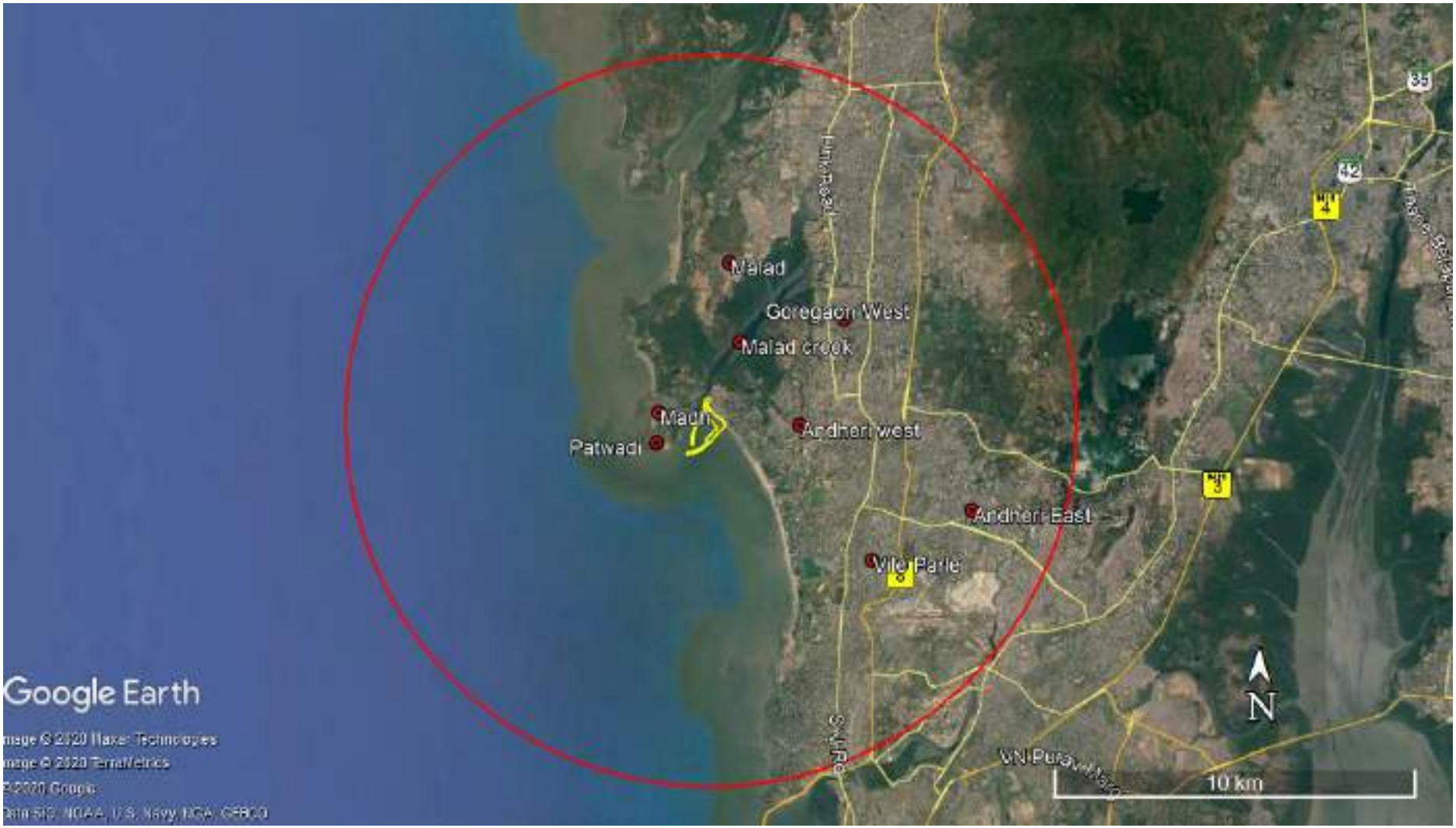


Figure 3.1: Google Earth Image showing site & 10Km surrounding area

Figure 3.2: Proposed Site at Versova & Vicinity

3.2.3 Land Use Pattern

Proposed development of fishing harbour will take place at Versova fish landing centre. The land use land cover in study area was assessed through satellite imagery and ground truthing. Available satellite imagery has been interpreted to indicate extent of various land use features.

3.2.3.1 Methodology

The satellite image procured from National Remote Sensing Centre (NRSC), Hyderabad was in raw format and few pre-processing procedures (georeferencing) were adopted to bring the image to the real-world coordinate system.

A buffer of 10 km is generated using ArcGIS 10.2.1 software from the centre point of the project site. This image is further used to study the land use/landcover of the project under consideration. Standard image interpretation elements like tone, texture, shape, size, association, shadow and pattern are useful to identify prominent LULC classes.

To achieve planimetric accuracy, the remote sensing scene was rectified with respect to SoI maps on 1:50,000 scales. The Ground Control Points (GCP) in the scene such as railroad intersections, corners of water reservoirs, canals etc. were identified on the image as well as on the reference map. Third order model was constructed and finally registration of image was carried out with nearest neighbourhood resampling taking map as reference and one map registration was achieved.

ERDAS IMAGINE 9.2 is used primarily to process geospatial raster data that allows preparing, displaying and enhancing digital images. It is possible to see features that would not normally be visible and to locate geo-positions of features that would otherwise be graphical with the help of ERDAS IMAGINE. This software is of particular importance in vegetation analysis or linear feature extraction from the image.

Then the subset of image is taken according to the boundary of the study area. The digital classification technique is used for the extraction of the land use/ landcover information from the imagery. Six different land use/ landcover classes have been identified in the area under study. The detailed report is available as **Annexure IV**

Table & Figure below shows reference coordinates of project site and LULC map showing study area. % Distribution of Land use land cover classes is shown in Figure overleaf.

Table 3.2: Reference Coordinates of Study Area

Study Area (Km^2)	Geographical location (centre co-ordinate of study area)	
314.15	Latitude	Longitude
	19°8’25.73” N	72°48’8.41”E

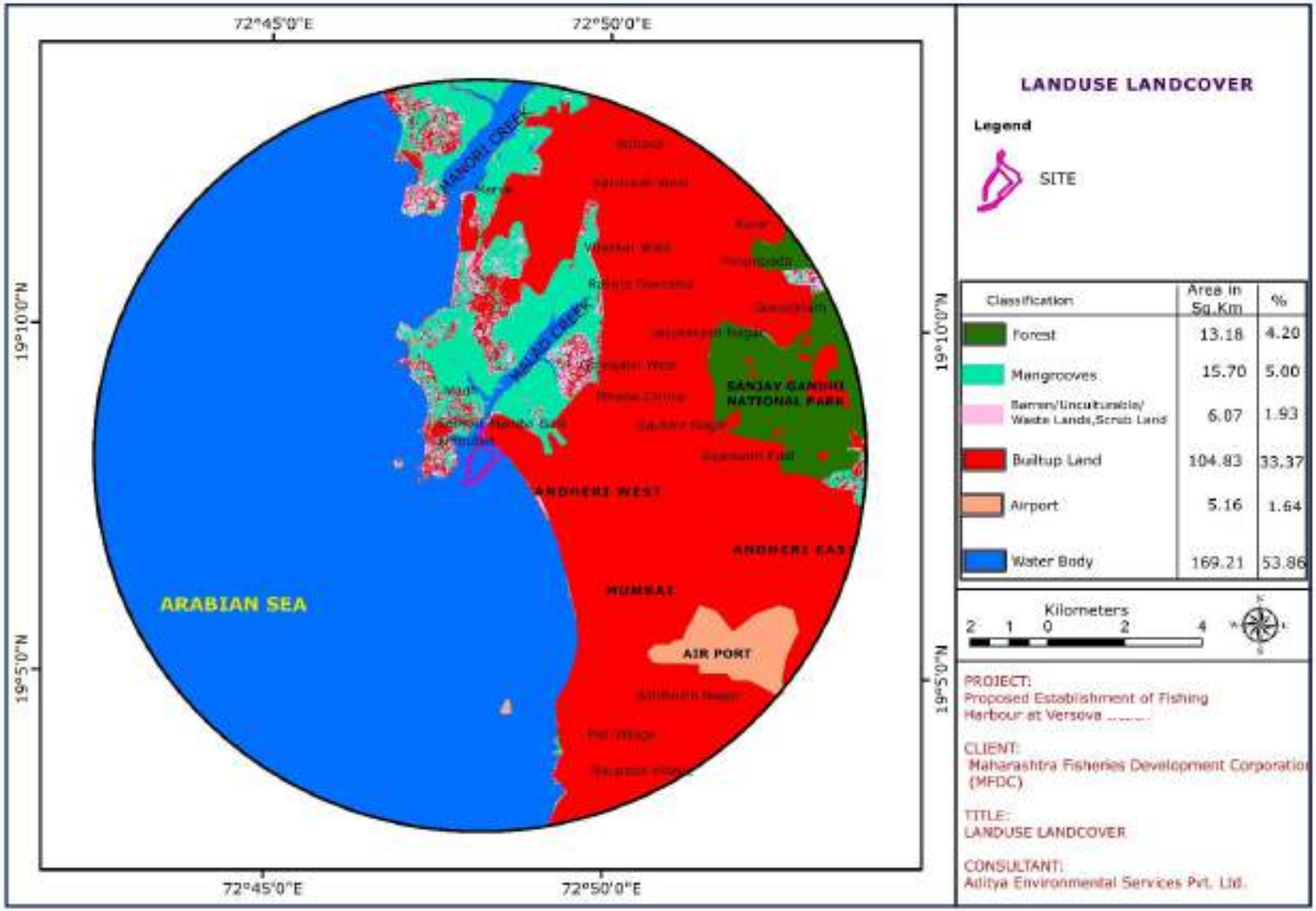


Figure 3.3 Land Use Land Cover Map of 10km Study Area

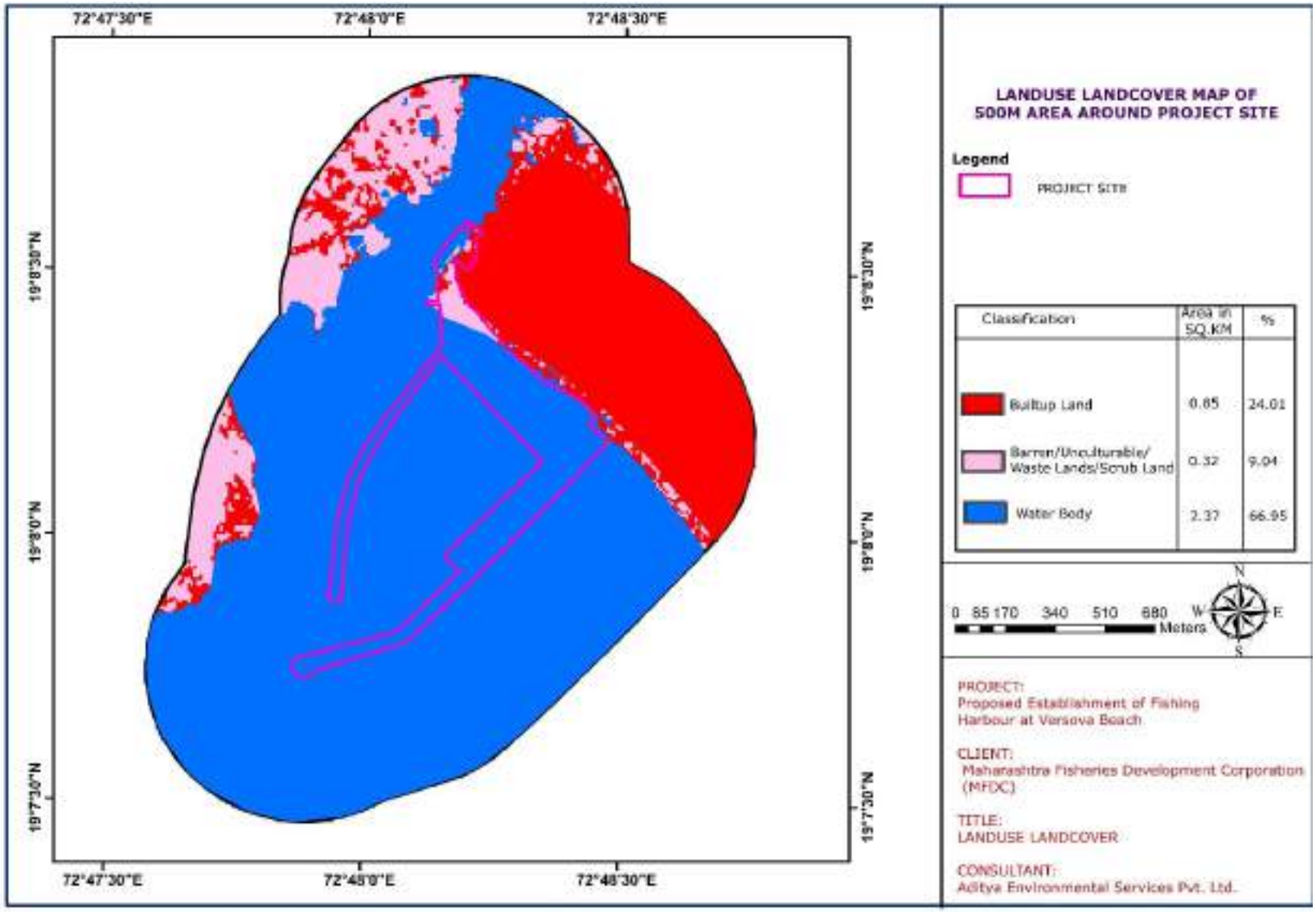


Figure 3.4 Land Use Land Cover Map of 500m Study Area

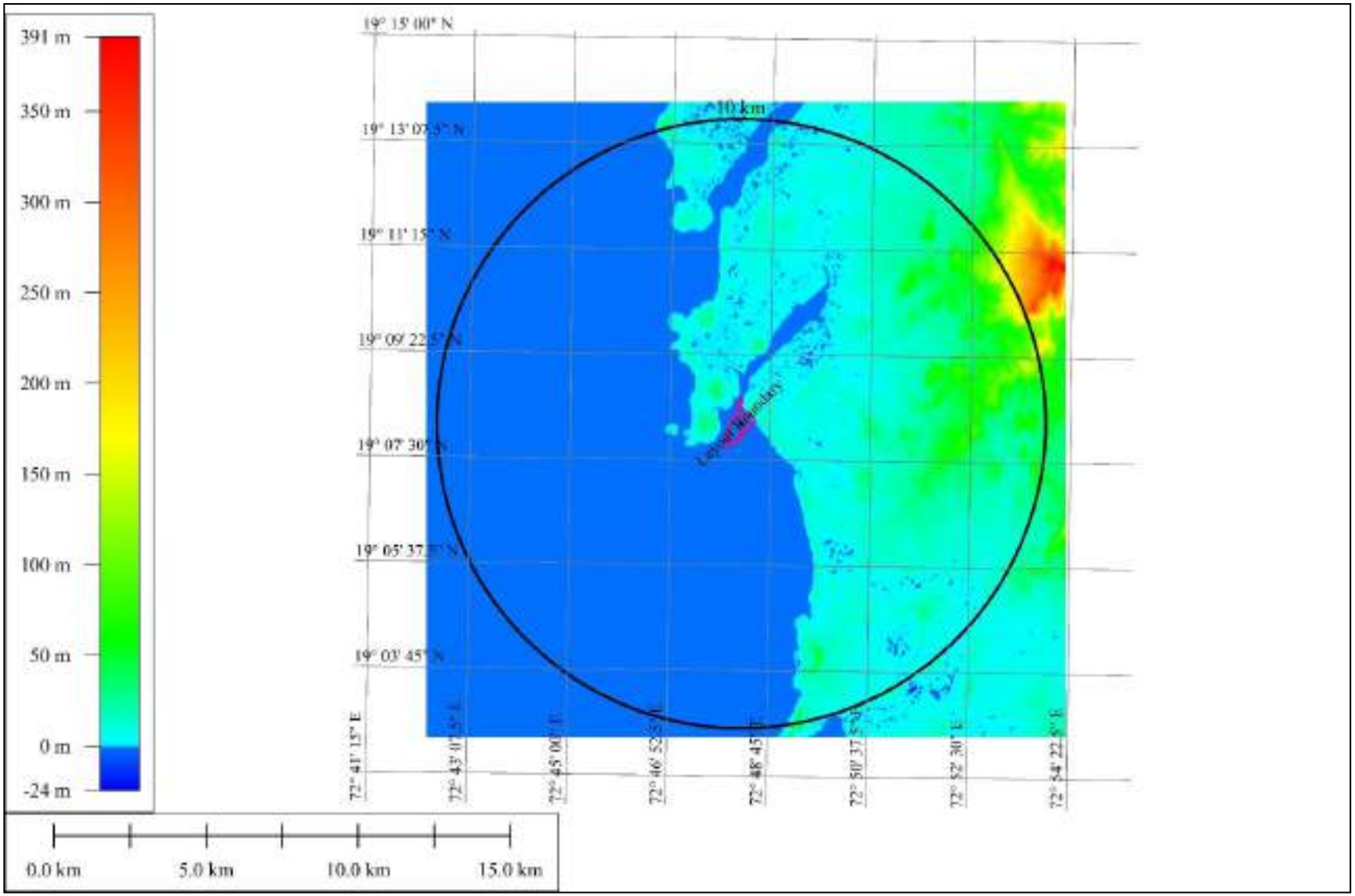


Figure 3.5 Digital Elevation Model of 10km Study area

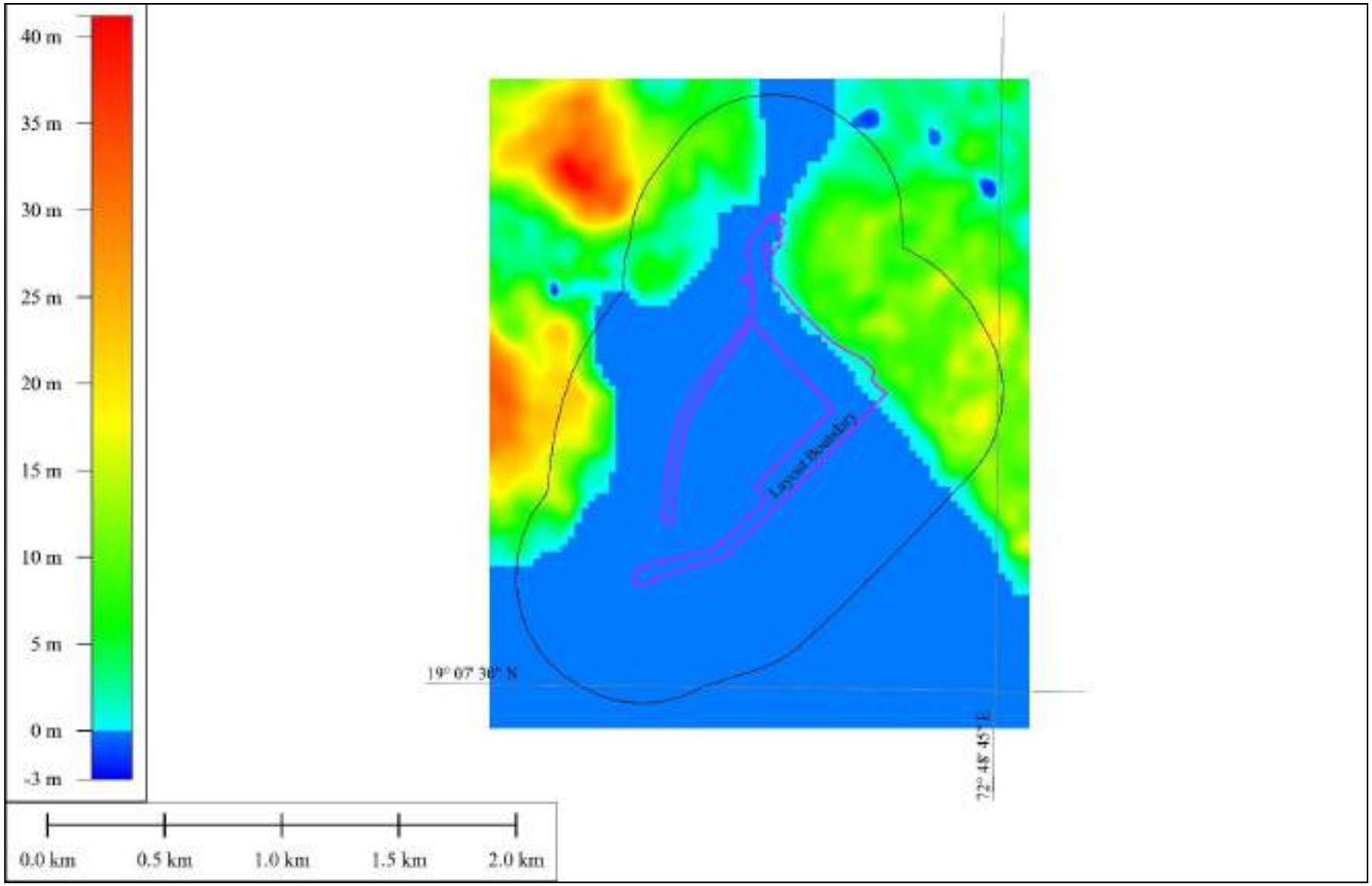


Figure 3.6 Digital Elevation Model of 500 m Study area

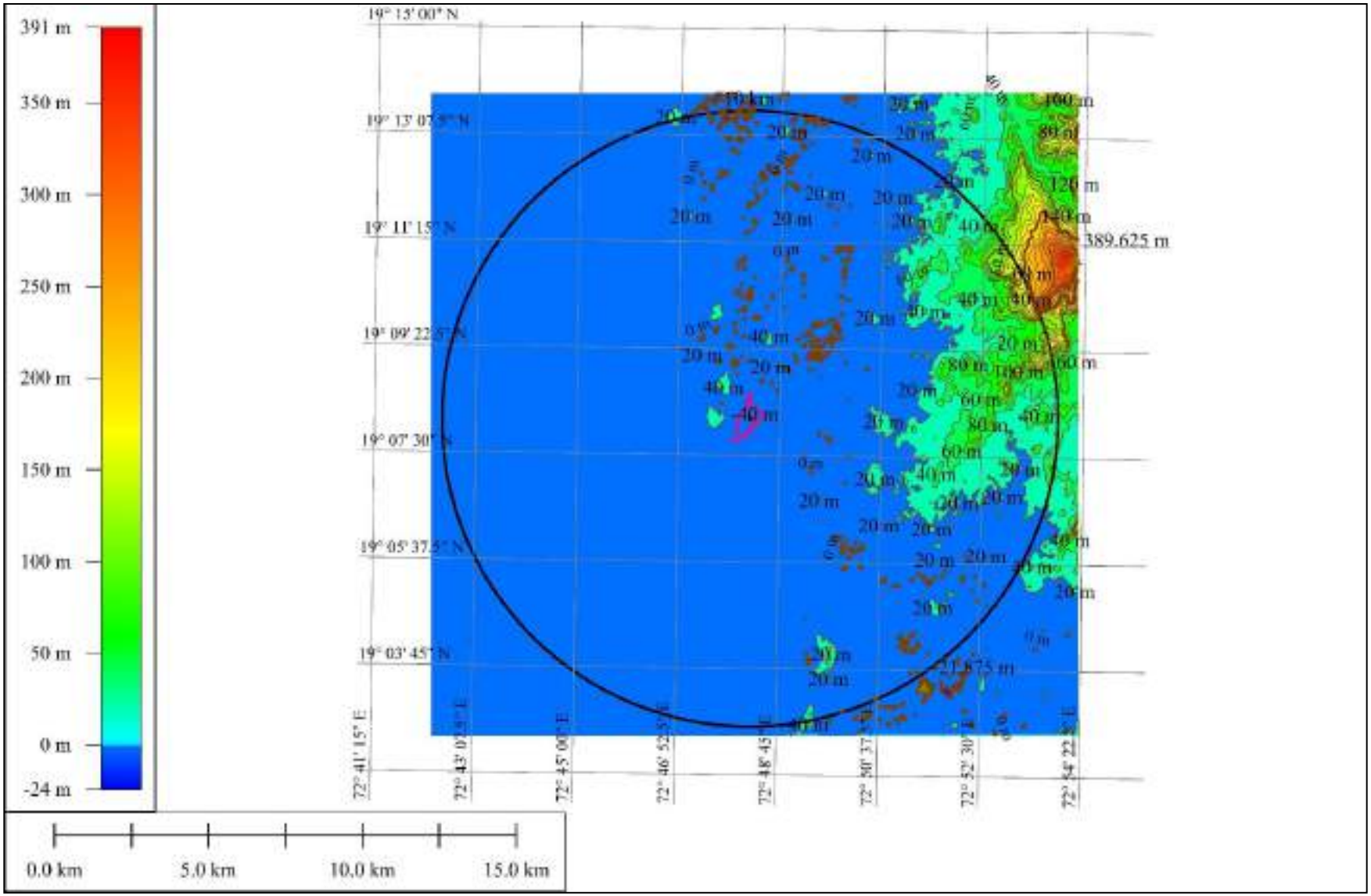


Figure 3.7 Contour Map 10km study area

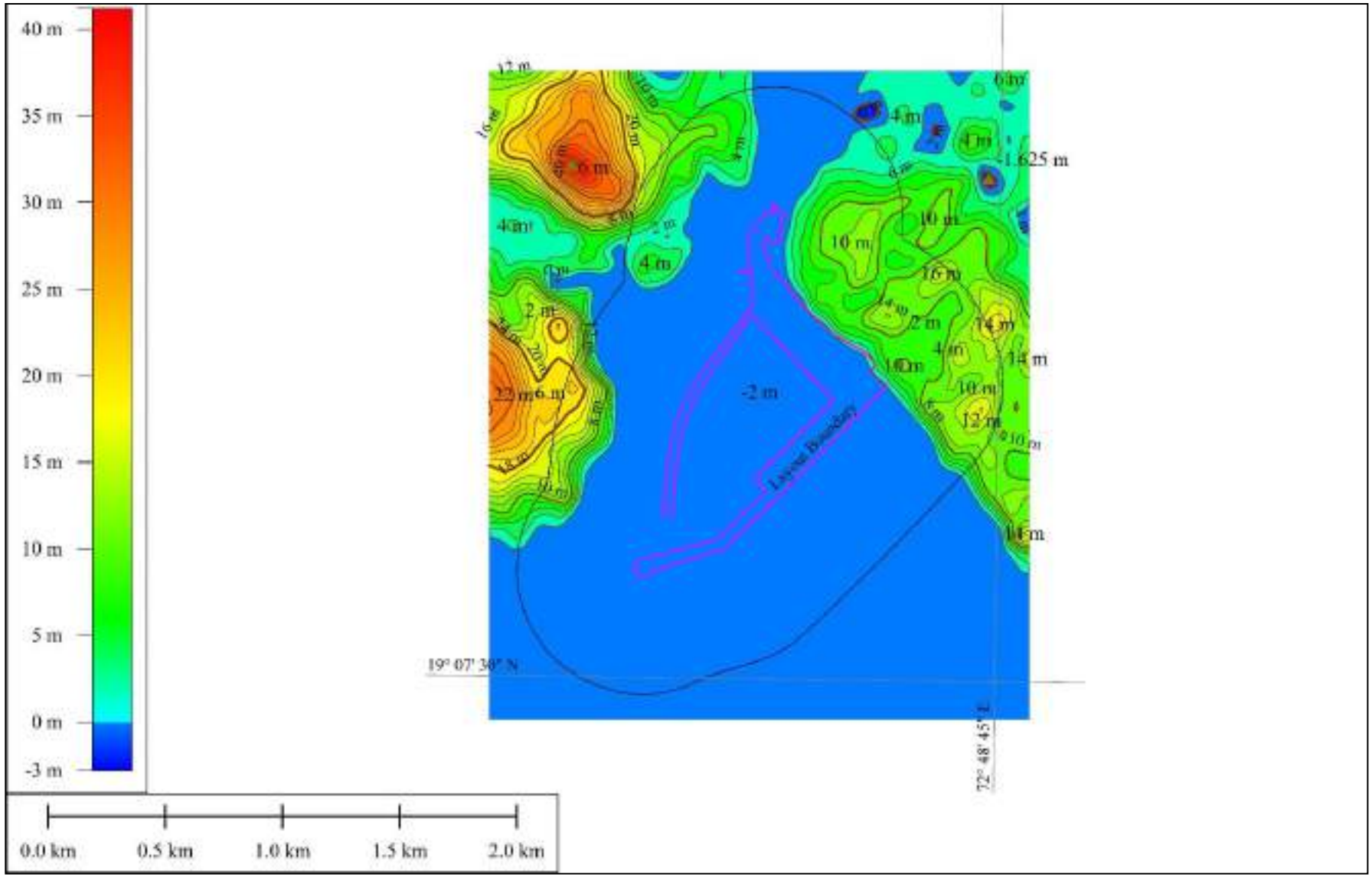


Figure 3.8 Contour Map 500 m study area

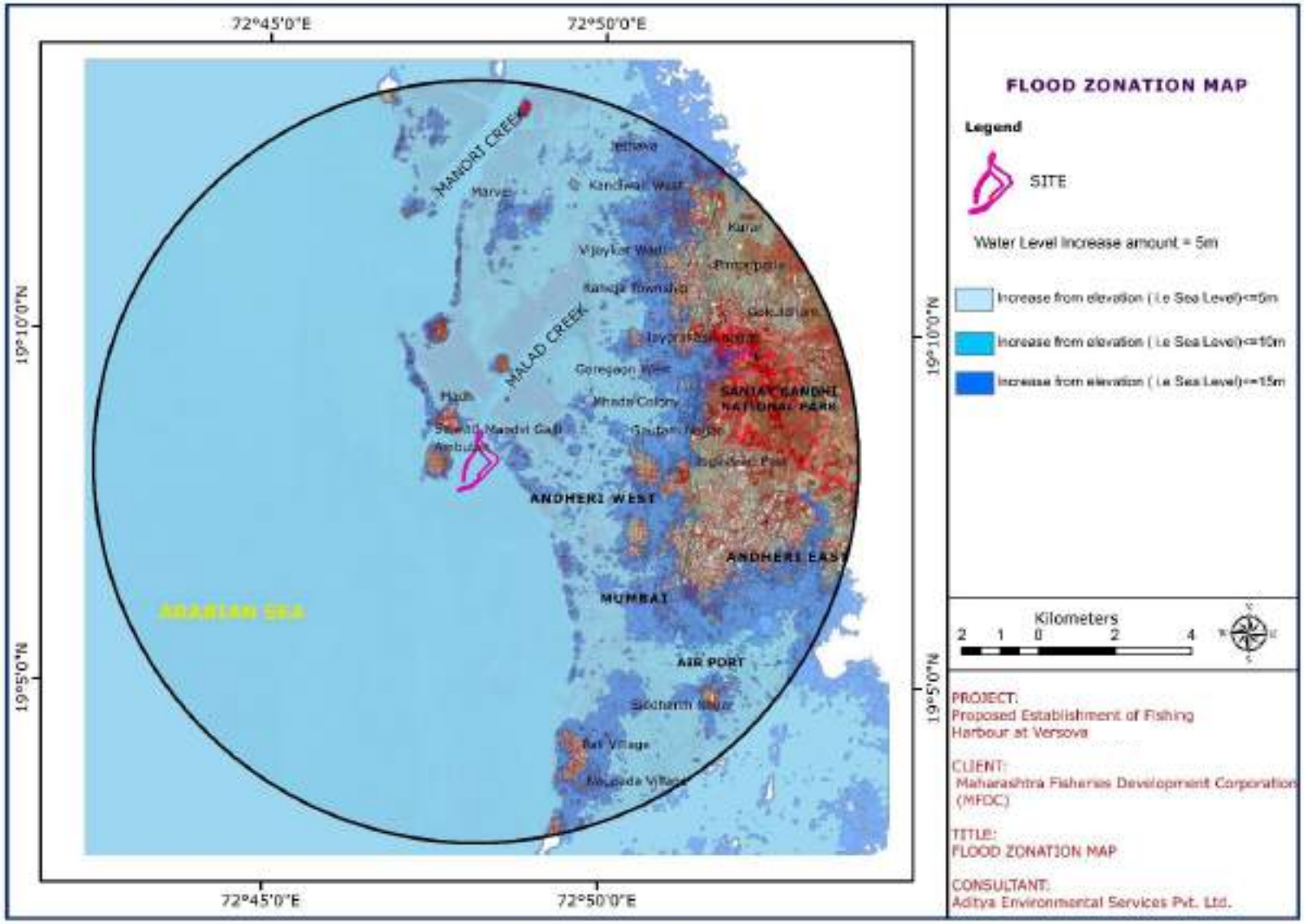


Figure 3.9 Flood Zonation Map 10km study area

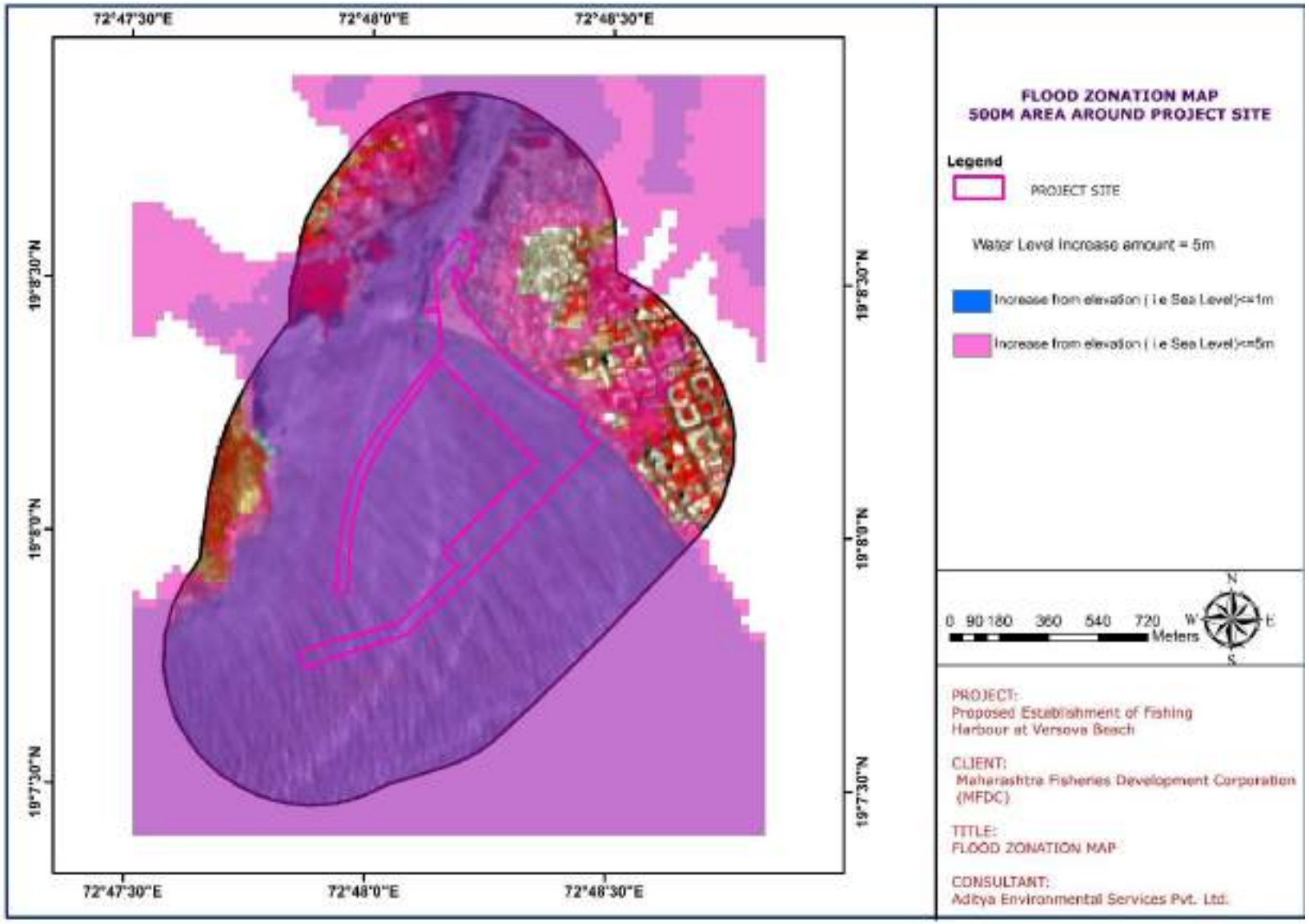


Figure 3.10 Flood Zonation Map 500 m study area

In 10 km study area six different land use land cover classes are extracted from the satellite image. The project site is located on the coastal region hence water body contributes to 53.86% of land cover that considers Arabian Sea, Malad creek & Manori creek and a number of Nalas flowing towards Arabian sea.

Build up land (33.37%) & Water body (53.86%) are the major classes covering 10 km study area. Forest (4.20%), Mangrove (5.0%), Scrub land (1.93%) and Airport (1.64%) are some of the dominant classes within 10km study area.

Mangroves can also be observed within the 10km study area they contribute to 5.0% of the overall land cover. National parks do exist in the study area. (Sanjay Gandhi National Park ~9Km towards east of project site)

Land use landcover map of 500m study are shows Built up area (24.01%), Scrub land (9.04%) and water body (66.95%) same has been shown in Figure no 3.4

Table 3.3: Percentage Distribution of LULC Classes within 10km Study Area

Class Code	Class Name	Area (Ha)	Distribution (%)
1	Forest	13.18	4.20
2	Mangroves	15.70	5.00
3	Scrub land	6.07	1.93
4	Built up area	104.83	33.37
5	Airport	5.16	1.64
6	Water Body	169.21	53.86
	Total Area	**314.15**	**100.00**

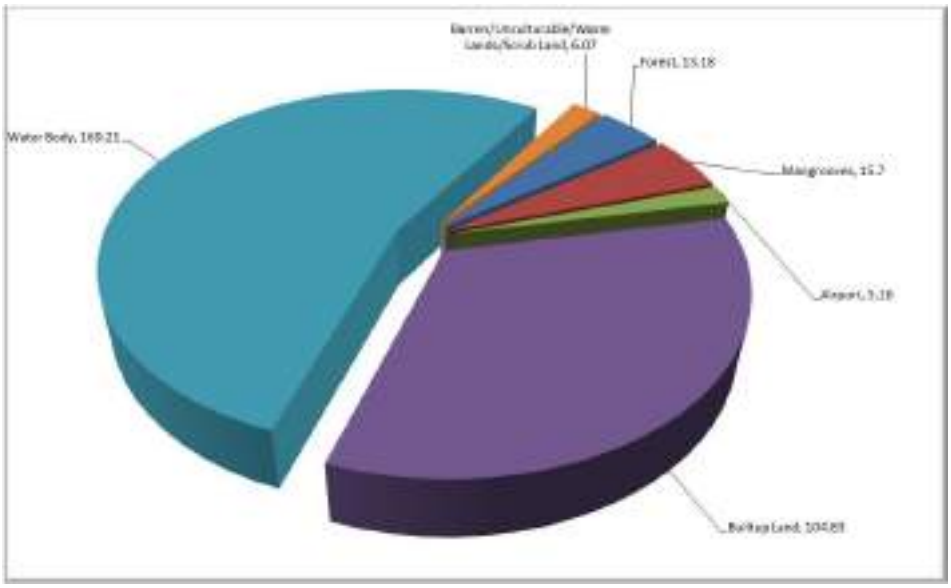


Figure 3.11 Percentage Distributions of LULC Classes within 10 km Study Area

3.2.3.2 Solid and Hazardous Waste Generation, Treatment & Disposal

Existing operations at Versova fishing harbour are limited to berthing fishing boats at dilapidated wharfs and beach landing, unloading fish catch, replenish utility/food/water stock, minor boat repair, fish drying (only sun drying), net mending covering it with tarpaulin when not in use for long time (especially in monsoon). Considering existing

activities, waste generation is mostly of non-hazardous nature and includes metal parts (worn out engine parts), wooden planks, reinforced fibre panels and resin foam pieces (from damaged fibre boat), torn pieces of fishing nets. It is observed during site visit that, MCGM carries out the cleaning activity near project site.

Geology and Soil Characteristics

3.2.3.3 Geology

Geologically, district consist of deccan basalt and its acid variants, volcanic sediments, dukes, laterite and alluvium. The deccan traps are considered to be upper cretaceous to lower Eocene in age. The laterite which is derived from the traps is much younger.

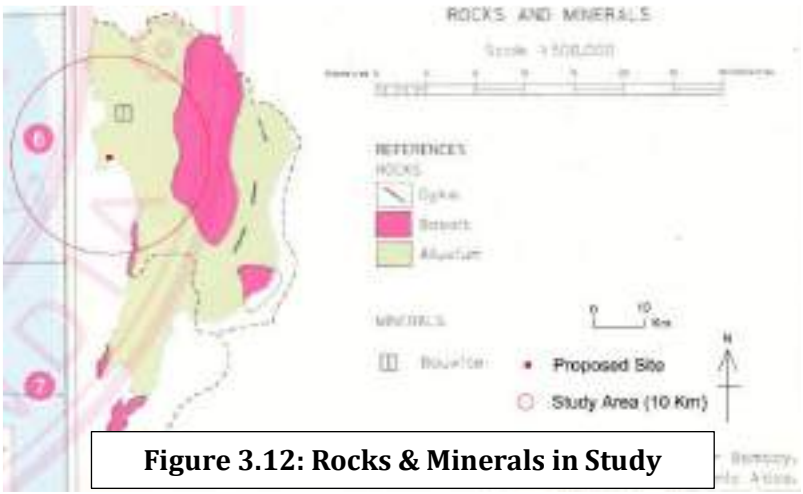


Figure 3.12: Rocks & Minerals in Study

The Deccan traps belong to the plateau basalt and are so designated on account of their step-like or terraced appearance and their extensive distribution is up to South India (Deccan). They occupy about 5,18,000 sq. km. in Maharashtra, Gujarat, Madhya Pradesh and parts of the Deccan, and form the most extensive geological formation of the Peninsular India, with the exception of the metamorphic and igneous complex of Archaean age.

Source:https://surveyofindia.gov.in/files/MUMBAI%20CITY%20AND%20MUMBAI%20SUBURBAN.compressed.pdf

3.2.3.4 Soil Characteristics

The soil formation in the district is controlled mainly by climate. Most of the soils are derived from Lateritic rocks. The soils are classified based on physical characteristics into four types viz., Rice soil, Garden soil, Varkas soil and Alluvial soil. The Rice soils are termed as 'Mali soils' when situated in higher levels, 'Kuryat soils' in lower levels and 'Panthar or Vaigam' when situated near water courses. Varkas soils are reddish brown to yellowish red in colour and are situated on hill slopes. These soils are poor in fertility, shallow in depth and coarse in texture. Garden soils are of mixed origin, yellow red to brown

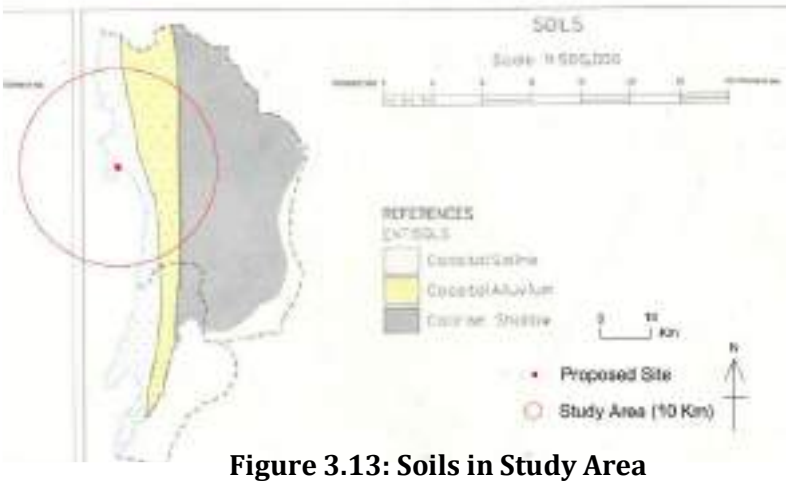


Figure 3.13: Soils in Study Area

in colour and are located in the valley portions. These soils are light, well drained and fairly fertile. Coastal Alluvial soils are recent deposits found along the coastal tracts and constitute deep loam. Due to inundation of sea, part of the coastal soils has become salty.

As can be seen from map, district has three distinct types of soils arranged in longitudinal strips parallel to coast. Study area has Coastal Saline soil towards all along the coastal belt while, Coastal Alluvial soils towards eastern side and coarse shallow soil covers maximum area of the district.

Baseline soil characteristics were studied within study area results are presented below.

Table 3.4: Soil Characteristics in Study Area

Parameters		**Locations**	
		Project site	**Versova**
Textural Class of Soil			
Texture		Clay	Clay
Particle size (%)	Clay	9.2	72.6
	Slit	74.6	8.4
	Fine sand	16.2	17.0
Physical Characteristics			
Water content		3.7	4.8
Water holding capacity (%)		41.3	42.8
Chemical Characteristics			
pH		6.62	6.78
Conductivity (µS/cm)		321.3	346.8
Available Sulphur (mg/kg)		60	160
Chloride (mg/kg)		62.7	72.2
Fertility Status			
Potassium (Kg/h)		100	120
TOC (%)		0.32	0.26
TKN (%)		0.0014	0.096
Available Phosphorus kg/h		22.4	28.1

Figure 3.14: Baseline Soil Sampling Location

Figure 3.15: Soil Sampling within Study Area

As per results presented in the above Table, Soil in study area is neutral, has average to sufficient amount of humus, average phosphorus, less to better potash, moderate fertility.

Since the project is located in marine environment, it is necessary to study sediment characteristics at proposed site & vicinity to evaluate impacts. Accordingly, sediment samples were collected at representative locations and analysed for physico-chemical and biological parameters. Results are discussed in marine section.

3.2.4 Wind Profile

Wind profile in study area giving details like wind speed wind direction and magnitude are summarised in wind rose (kindly refer figure below). The wind flows predominantly from NNE direction to NNW direction during winter season (December 2019 to February 2020).

Source: generated through AERMOD Cloud

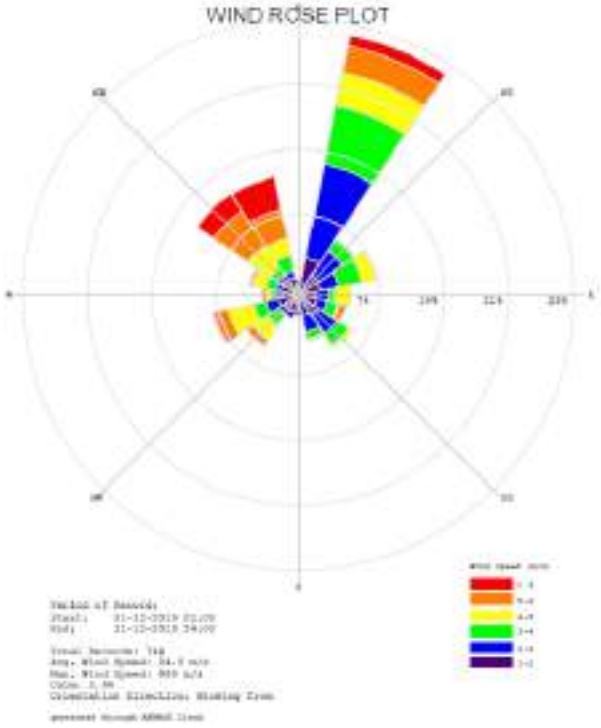


Figure 3.16 wind Rose in Winter 2019-2020

3.2.5 Temperature Profile

Being a coastal region, weather in study area remains warm & humid throughout the year. Temperature data of Mumbai suburban district and its variation in the year 2019 is given in Table and temperature profile for winter in Figure below.

Table 3.5 Temperature Variation in Mumbai Suburban District (Year 2019)

Months	Mean Daily Max Temp (^{0}C)	Mean Daily Min Temp (^{0}C)	Average Recorded Temp (^{0}C)
January	35	18	25
February	36	18	26
March	41	22	28
April	37	25	30
May	36	27	30
June	35	23	30
July	33	24	28
August	32	25	28
September	32	23	28
October	36	25	29
November	35	21	29
December	34	21	28

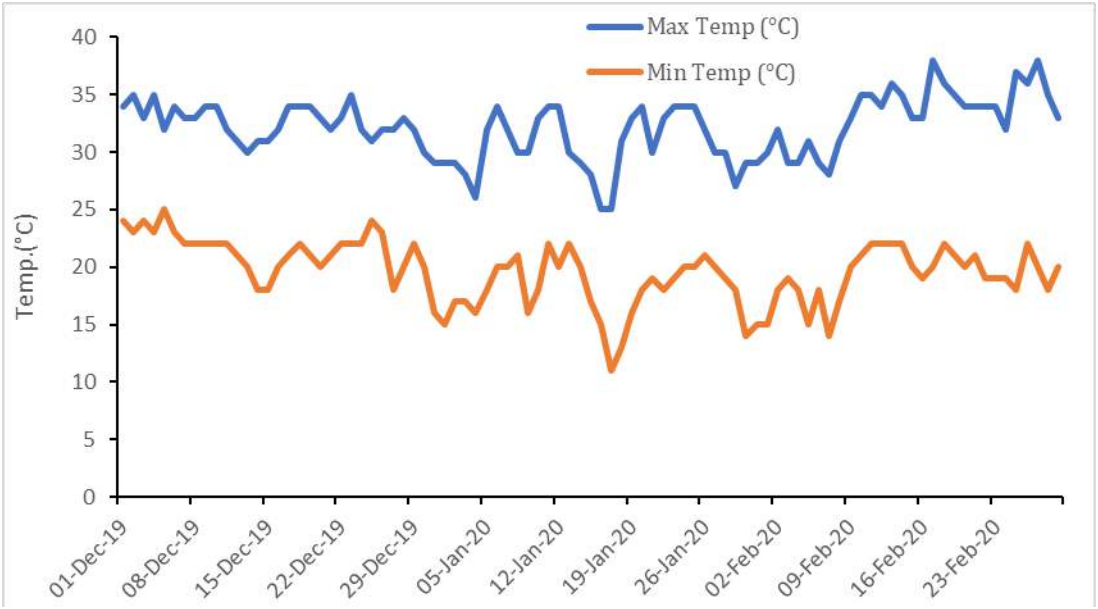
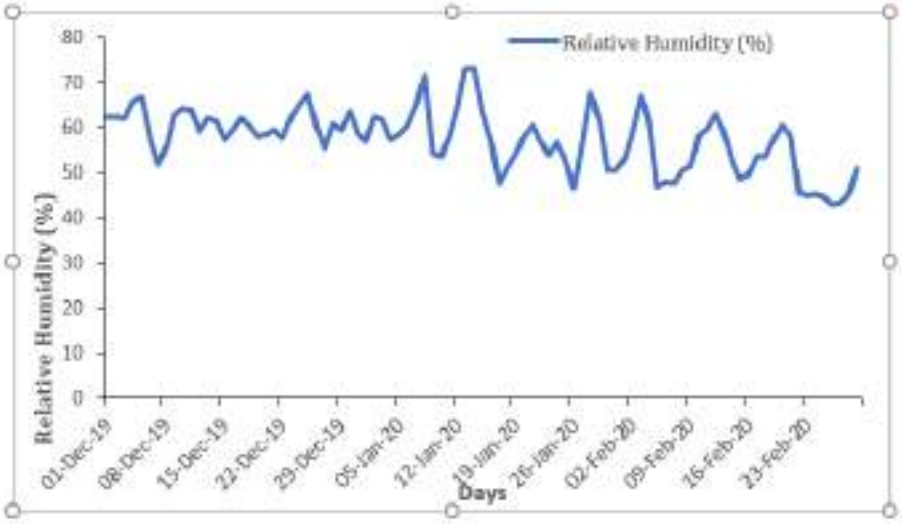


Figure 3.17 Temperature Profile of study area,

Source: www.accuweather.com

3.2.6 Humidity & Rainfall Profile

Being in coastal region, climate is warm and humid with high humidity levels throughout the year. Based on historical data of Mumbai Suburban, highest Relative Humidity exceeds 83 % throughout the year while during monsoon (June, July, August, September) it exceeds 100%.



Month	R.H. (%)	
January	83	18
February	89	13
March	100	10
April	89	29
May	84	37
June	100	53
July	100	63
August	100	62
September	100	62
October	100	34
November	100	28
December	89	31

Figure 3.18 Relative Humidity Profile near project site,

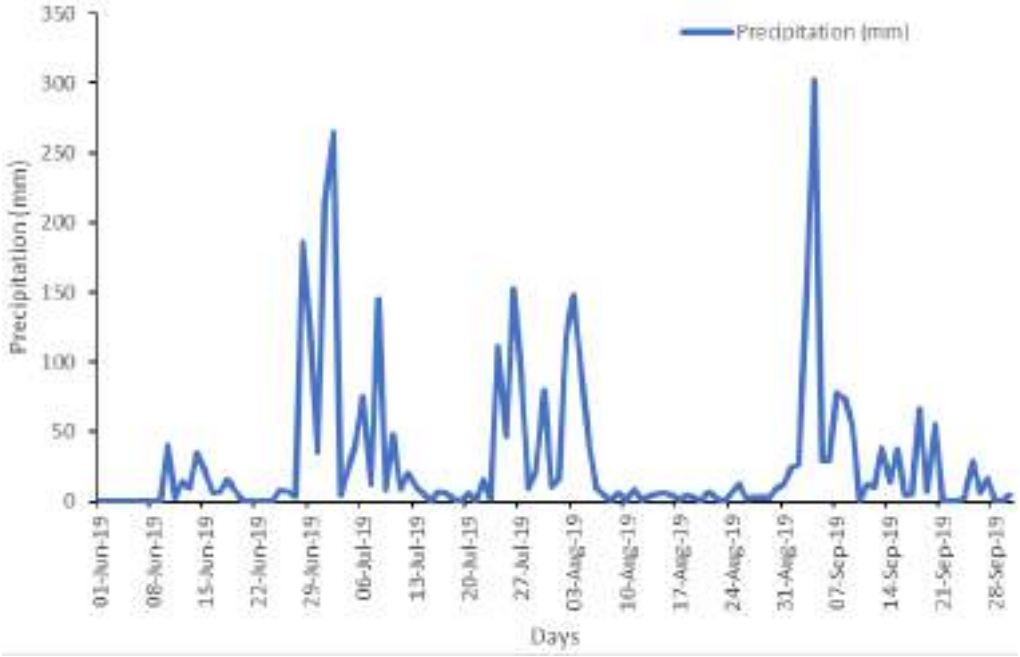
The area receives rainfall for about four months of the year, which provides main climatic variations. Out of total rainfall, 90% is experienced during Monsoon season of months June to September. The rainfall profile of Mumbai suburban district for period 2004 to 2010 and 2012-2017 is presented in following table.

Table 3.6 Historical Rainfall Profile (mm)of Mumbai Suburban District

Year	2004	2005	2006	2007	2008	2009	2010	2012	2013	2014	2015	2016	2017
January	0	0.5	0	0	0	0	0	0	0	0.9	0	0	0

February	0	0	0	2.3	0	0	0	0	0	7.8	0	0	0
March	0	0.1	10.2	0	0.1	0	0	0	0	0	13	10	0
April	0	0	0	0	0	0	0.3	0	0	0	0	0	0
May	49.5	0.2	86.5	0.4	0.5	1.3	0	0	0	0	0	0	3.5
June	281.9	561.8	456.2	776.6	768	241	947.4	290.7	1029.8	55.2	1106.7	695.2	523.2
July	812.3	1049.8	999.5	650.9	910.2	956.8	1112.7	627.9	956.1	1355.4	359.1	926	869.6
August	862.6	462.3	765.1	646.2	498.8	247.4	860.7	377.4	256.3	432.4	153.9	561.7	950.3
September	172.7	668.6	259.6	428.7	338	420.8	272.9	563.9	190.7	291.7	203.5	711.6	603.2
October	45.6	26.3	222.9	0	15.4	190.8	122.4	197.7	85.3	46.2	31.3	78.7	83.6
November	2.5	0	6.2	3.9	1.6	105.4	55.7	0	0	4.2	1.6	0	0
December	0	0	0	0	0.2	0	0	0	0	30	0	0	75.8
Annual Total	2227.1	2769.6	2806.2	2509.0	2532.8	2163.5	3372.1	2057.6	2518.2	2223.8	1869.1	2983.2	3109.2

Source: IMD, Pune



Source: https://www.accuweather.com

Figure 3.19 Rainfall Profile in Monsoon 2019

3.2.7 Inference

Climate being hot and humid, temperature inversion formation is less likely to happen. In monsoon due to heavy rains surface water runoff is observed which goes in the creek flowing adjoining the site. Even though the region experiences heavy rains no flood like situations observed since surroundings creek has wide cross-sectional area that drains towards the Arabian Sea.

3.3 Air Environment

Basic considerations for designing Ambient Air Quality Monitoring include:

- Representative selection of sampling locations (primarily guided by nature of project activity that likely to contribute to existing air quality, topography & micrometeorology of the region)
- Adequate sampling frequency
- Inclusion of all the major pollution parameters

All these aspects were given due consideration for deciding AAQM location, frequency and parameters for Environmental Impact Assessment (EIA) near project site.

3.3.1 Reconnaissance Study

The prime objective of this AAQ study was to establish the existing regional background levels in the vicinity of proposed project. The sources of air pollution were identified in study area is traffic along road and dust from movement of traffic along rural roads. Other miscellaneous sources were identified as burning of minor fuels.

The fluctuation of AAQ within study area will be governed by overall regional emissions and micrometeorology. Within project site, present activity includes berthing fishing boat, unloading fish catch, replenish utility/food/water stock, minor boat repair, fish drying (only sun drying), net mending and covering it with tarpaulin when not in use for long time (especially in monsoon). Sources of air pollution in this respect are only boat movements, and associated road transport. Fuel used is diesel. Overall air pollution at site found insignificant.

3.3.2 AAQM Locations and Parameters Selected

AAQM, sampling locations were selected near site in order to have an idea of baseline air quality at site. Based on study of existing and proposed project activities, baseline air quality was established by monitoring major air pollutants viz PM_{10}, $PM_{2.5,}$ SO_2, NOx & CO for 24 hours during Winter2019-2020. Ambient air quality monitoring locations are shown in figure below**.**

Table 3.7 Justification for Selection of Ambient Air Quality Monitoring Stations

Sampling station	Name of the place	Distance from site (approx.)	Direction from site	Reason for Site Selection
A1	Project site	-	-	Project site
A2	Versova gaon	300m	North	Populated Area near to site
A3	Bandra	9.8	Southeast	Crosswind station –Populated Area
A4	Vile Parle	7.0 km	South	Crosswind station –Populated Area
A5	CSMIA	8.8 km	South	Crosswind station- Airport

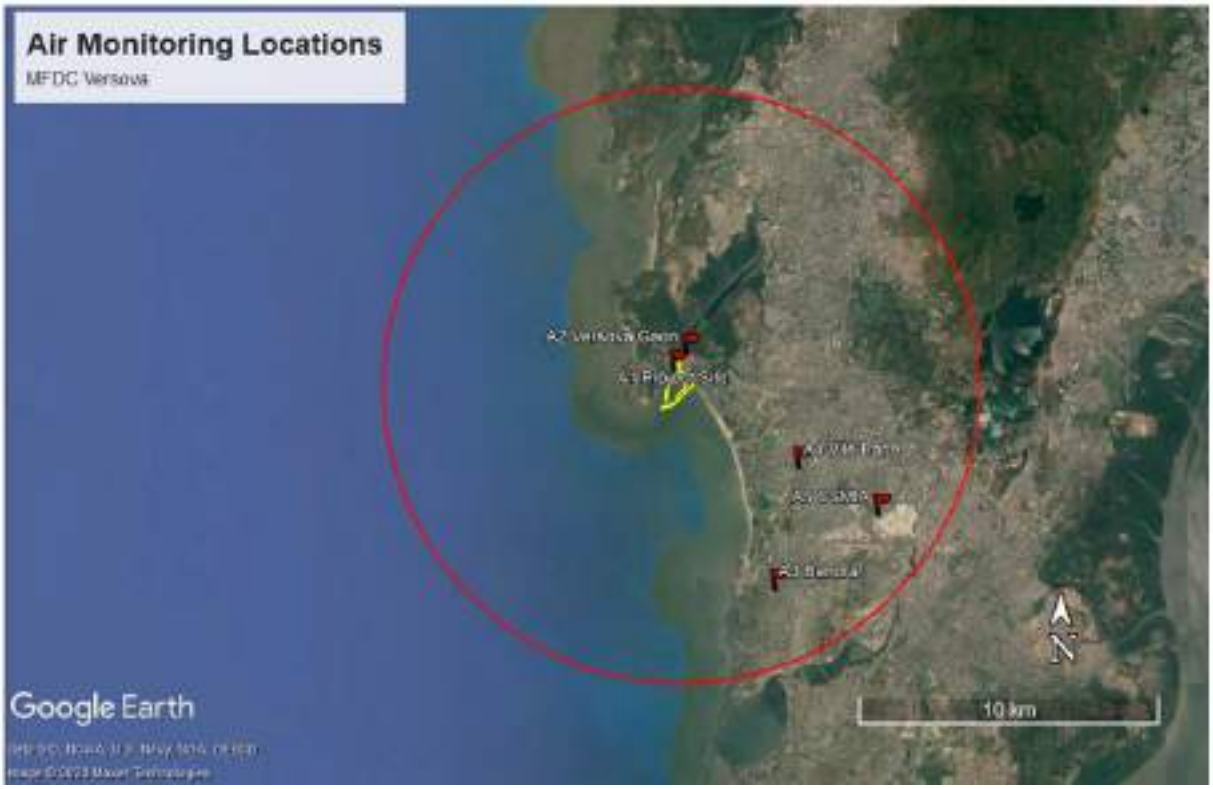


Figure 3.20 AAQM Location Map

Figure 3.21 AAQM within Study Area

3.3.3 AAQM Results

Statistical data at sampling location, standards for relevant parameters and findings are given below:

Table 3.8: AAQM Monitoring Results

Location		Parameter				
		PM_{10}	$PM_{2.5}$	SO_2	NOx	CO
		(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(mg/m³)
Project Site	Average	63.4	23.4	13.1	24.2	0.22
	Maximum	64.3	24.1	13.3	24.6	0.24
	Minimum	62.5	22.7	12.8	23.8	0.20
	98‰	64.3	24.1	13.3	24.6	0.24
Versova	Average	**61.4**	**23.4**	**12.9**	**23.9**	**0.24**
	Maximum	**63.1**	**24.0**	**13.0**	**24.2**	**0.26**
	Minimum	**59.7**	**22.8**	**12.7**	**23.5**	**0.21**

Location	Parameter					
		PM_{10}	$PM_{2.5}$	SO_2	NOx	CO
		(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(mg/m³)
	98‰	**63.0**	**24.0**	**13.0**	**24.2**	**0.26**
Bandra	Average	98.21	44.54	22.77	61.43	-
	Maximum	133.42	71.71	48.64	76.21	-
	Minimum	44.00	00	7.22	37.05	-
	98‰	132.01	70.62	47.60	75.61	-
Vile Parle	Average	166.87	85.70	4.84	43.10	-
	Maximum	247.41	151.9	6.57	59.64	-
	Minimum	111.44	42.04	3.48	30.14	-
	98‰	244.18	149.25	6.50	58.97	-
CSMIA	Average	188.59	92.62	9.41	109.95	-
	Maximum	275.38	155.28	12.57	137.31	-
	Minimum	132.29	46.8	6.03	92.94	-
	98‰	271.90	152.77	12.44	136.21	-
NAAQS norm	**24 hourly avg.**	**100**	**60**	**80**	**80**	**4**

(Source of data for Bandra, Vile Parle & CSMIA Website: https://app.cpcbccr.com/ccr/#/caaqm-dashboard-all/caaqm-landing/caaqm-comparison-data)

3.3.4 Inference on Ambient Air Quality Monitoring

Results of AAQM survey indicate that the air quality in respect of primary air pollutants viz. PM10, PM2.5, CO, SO2 & NOx are well within the NAAQS standards. Levels are high due to predominant urban development and high levels of traffic and industrialization of the area. Presence of Particulate matter is due to traffic along the road.

3.4 Noise Environment

The main objective of noise monitoring in the study area is to establish the baseline noise levels and assess the impact of the total noise expected to be generated due to the proposed Versova fishing harbour development project.

Sources of noise in study area include operations at fish landing centre and noise due to road near site having medium to heavy traffic. Also, during site visit it is observed that the proposed site is under regular flight path due to which there is noise generation.

Noise survey has been conducted in the study area while covering four zones viz., Residential & Sensitive area. Noise monitoring has been undertaken for 24 hrs at each location.

Details of noise monitoring locations are given in table below and sampling locations are shown in Figure next to it.

Table 3.9 Justification for Selection of Ambient Noise Monitoring Locations

Sr. No.	Sampling Station	Direction	Distance	Land use
1	Project site	-	-	Project site
2	Versova Gaon	East	Adjacent	Residential Area
3	Saiwadi	West	1.5 km	Residential Area
4	Madh Fort	South West	1.3 km	Sensitive Area –Historical Site

Figure 3.22 Noise Location Map

3.4.1 Methodology of Data Generation

Sound pressure level (SPL) measurements were undertaken at all locations, with an interval of 10 seconds over a period of 10 minutes per hour for 24 hours. The day noise levels have been monitored during 6 am to 9 pm and night levels during 9 pm to 6 am at all the locations.

Noise level was recorded using an integrated sound level meter (Centre 390 Data Logger)

Equivalent sound Pressure Level (Leq): 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 sound from noise source often fluctuates widely during a given period of time.

This is calculated from the following equation:

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

L_{day} is defined as the equivalent noise level measured over a period of time during day (6 am to 9 pm).

L_{night} is defined as the equivalent noise level measured over a period of time during night (9pm to 6 am).

A noise rating developed by EPA for specification of community noise from all the sources is the Day-Night Sound Level, (L_{dn}).

L_{dn}: The noise rating developed for community noise from all sources is the Day-Night Sound Level (L_{dn}). It is similar to a 24 hrs. equivalent sound level except that during night-time period (9 pm to 6 am) a 10 dB (A) weighting penalty is added to the instantaneous sound level before computing the 24 hrs average.

This night-time penalty is added to account for the fact that noise during night when people usually sleep is judged as more annoying than the same noise during the daytime.

The L_{dn} for a given location in a community may be calculated from the hourly Leqs, by the following equation.

$$L_{dn} = 10 \log \{1/24[15(10^{Ld/10}) + 9\ (10^{(Ln+10)/10})]\}$$

Where L_d is the equivalent sound level during the daytime (6 am to 9 pm) and L_n is the equivalent sound level during the night-time (9 pm to 6 am).

Figure 3.23 Noise Level Monitoring in Study Area

3.4.2 Standards for Noise Levels

Ambient Noise Quality standards in respect of noise have been notified by the Ministry of Environment & Forests vide Gazette Notification, dated 26th December 1989. It is based on the 'A' weighted equivalent noise level (Leq). The standards are given below.

Table 3.10 Ambient Air Noise Standards

Area Code	Category of Area	Limits in dB(A) Leq	
		Day time	Nighttime
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone**	50	40

** Silence zone is defined as area up to 100 meters around premises of hospitals, educational institutions and courts. Use of vehicle horns, loud speakers and bursting of crackers are banned in these zones.

3.4.3 Ambient Noise Levels in Study Area

The ambient noise levels measured at various locations around the proposed fishing Harbour site are given in table below. The table indicates equivalent noise levels *viz*., L_{day}, L_{night} at these locations.

Table 3.11 Noise Levels in the Study Area

	Locations/	Leq	Norms*	Leq.	Norms*
	Category of area	**Day (dBA)**	**dB(A)**	**Night dB(A)**	**dB(A)**
1	Project Site	52.2	55	43.0	45
2	Versova	53.8		44.2	
3	Saiwadi	54.1		41.0	
4	Madh Fort	52.3		38.0	

3.4.4 Observations

It was observed that noise levels during daytime and night time were within the limits.

3.5 Water Environment

3.5.1 Drainage Patern

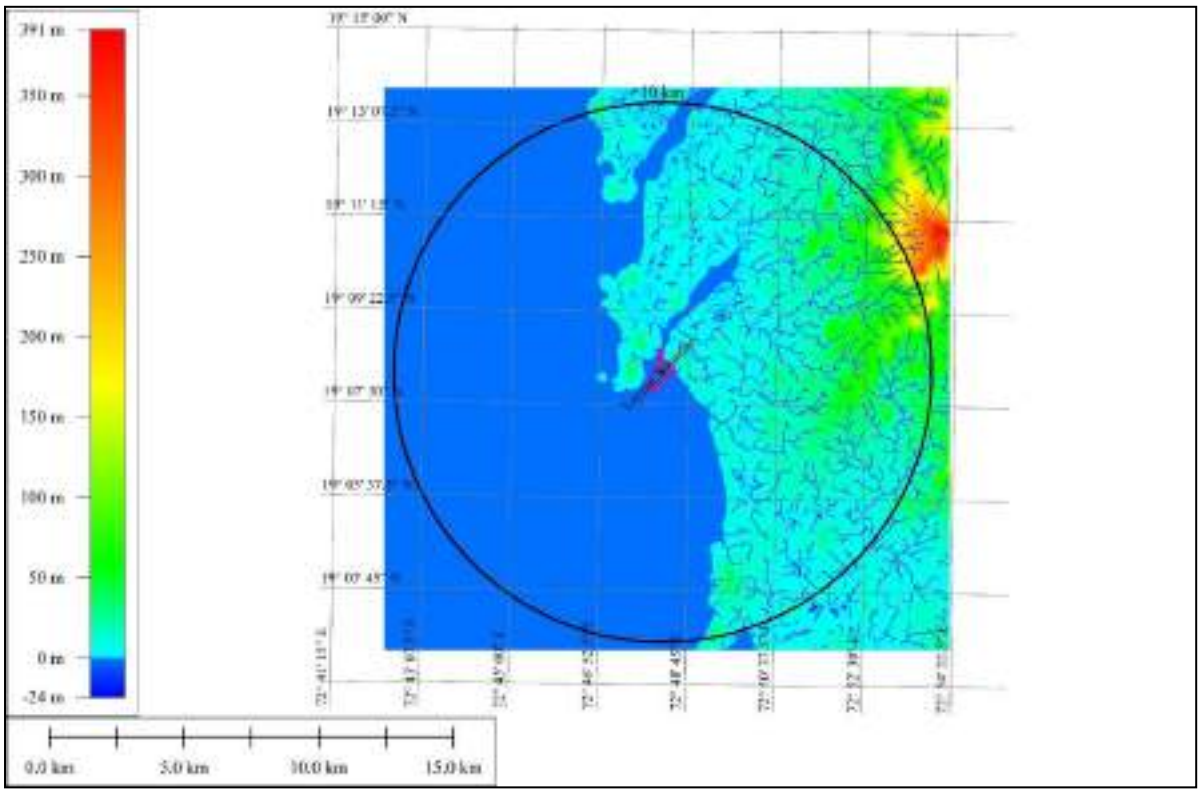


Figure 3.24 Drainage Pattern in 10 km Study Area

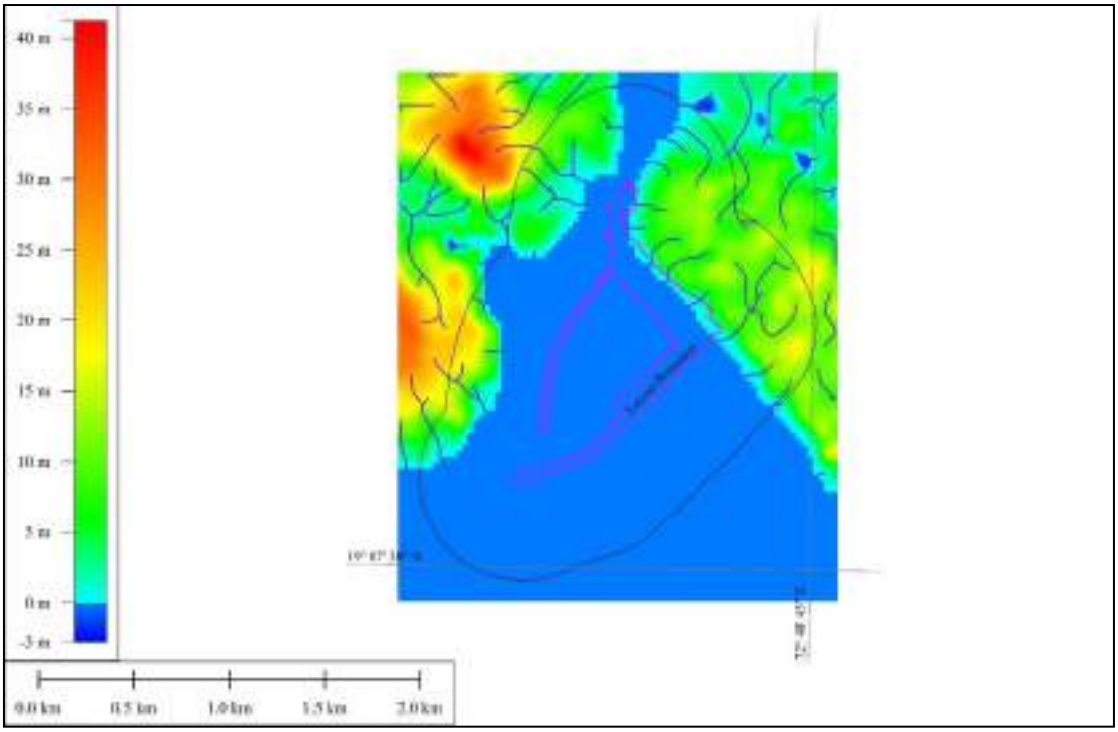


Figure 3.25 Drainage Pattern in 500 m Study Area

Overall, the study area displays distinct and sub-dendritic drainage pattern. The study area shows drainage pattern wherein majority of the streams flow towards south and contribute to Arabian Sea. Project site is located in Versova confluence of Malad creek and Arabian Sea.

3.5.2 Baseline Ground Water Quality

Water samples were collected from 4 locations as part of the baseline studies during winter (Dec 2019 – Feb 2020). Sampling was done at the following stations. Selected physico-chemical and biological parameters were analysed to describe the baseline status of ground water environment.

Table 3.12 Ground Water Sampling Locations

Monitoring Location	Name of the place	~ distance from site	Direction from site	Type
GW1	Project site	-		Dug well
GW2	Versova Gaon	East	Adjacent	Bore well; Hand pump
GW3	Saiwadi	West	1.5 km	Bore well; Hand pump
GW4	Madh Fort	South West	1.3 km	Bore well; Hand pump

Figure 3.26 Ground Water Sampling Location Map

Table 3.13 Ground Water Quality in Study Area

Parameter	Location Detail				Limits as per IS 10500:2012 (*)	Permissible
	Project Site	Versova	Saiwadi	Madh Fort	Desirable	
Colour, Hazen	<5	<5	<5	<5	5	25
*Odour	Unobjectionable					
pH @25°C	6.73	6.82	6.81	6.96	6.5 – 8.5	No Relaxation
*Taste	2.8	Agreeable	2.4	Agreeable	Agreeable	Agreeable
Turbidity, NTU	220	2.6	224	6.4	1 Max	5 Max
TDS, mg/l	6.73	310	6.81	220	500 Max	2000 Max
*Aluminium, mg/l	BDL	BDL	BDL	BDL	0.03 Max	0.2 Max
*NH_3(as N), mg/l	BDL	BDL	BDL	BDL	0.5 Max	No Relaxation
*Detergents, mg/l	BDL	BDL	BDL	BDL	0.2 Max	1.0 Max
*Barium, mg/l	BDL	BDL	BDL	BDL	0.7 Max	No Relaxation
Boron, mg/l	BDL	BDL	BDL	BDL	0.5 Max	1.0 Max
Calcium as Ca, mg/l	33.6	35.2	38.6	33.6	75 Max	200 Max
*Chloramines, mg/l	BDL	BDL	BDL	BDL	4.0 Max	No Relaxation
Chlorides, mg/l	40	38	46	40	250 Max	1000 Max
*Copper, mg/l	BDL	BDL	BDL	BDL	0.05 Max	1.5 Max
Fluoride, mg/l	0.28	0.32	0.32	0.30	1.0 Max	1.5 Max
Free $ResCl_2$, mg/l	0.56	0.56	0.56	0.56	0.2 Min	1.0 Min
Iron, mg/l	0.034	0.036	0.033	0.042	1.0 Max	No Relaxation
Magnesium as Mg, g/l	8.3	25	6.9	8.3	30 Max	100 Max
*Manganese, mg/l	BDL	BDL	BDL	BDL	0.1 Max	0.3 Max

Parameter	Location Detail				Limits as per IS 10500:2012 (*)	Permissible
	Project Site	Versova	Saiwadi	Madh Fort	Desirable	
*Mineral oil, mg/l	BDL	BDL	BDL	BDL	0.5 Max	No Relaxation
*Nitrate, mg/l	BDL	BDL	BDL	BDL	45 Max	No Relaxation
*Phenolic comp, mg/l	BDL	BDL	BDL	BDL	0.001Max	0.002Max
*Selenium, mg/l	BDL	BDL	BDL	BDL	0.01 Max	No Relaxation
*Silver, mg/l	BDL	BDL	BDL	BDL	0.1 Max	No Relaxation
Sulphate, mg/l	32	52	40	33	200 Max	400 Max
*Sulphide, mg/l	BDL	BDL	BDL	BDL	0.05 Max	No Relaxation
Alkalinity, mg/l	130	240	118	130	200 Max	600 Max
Hardness, mg/l	128	192	114	128	200 Max	600 Max
*Zinc, mg/l	BDL	BDL	BDL	BDL	5 Max	15 Max
*Cadmium, mg/l	BDL	BDL	BDL	BDL	0.003 Max	No Relaxation
*Cyanide, mg/l	BDL	BDL	BDL	BDL	0.05 Max	No Relaxation
*Lead, mg/l	BDL	BDL	BDL	BDL	0.01 Max	No Relaxation
*Mercury, mg/l	BDL	BDL	BDL	BDL	0.001 Max	No Relaxation
*Molybdenum, mg/l	BDL	BDL	BDL	BDL	0.07 Max	No Relaxation
*Nickel, mg/l	BDL	BDL	BDL	BDL	0.02 Max	No Relaxation
*Arsenic, mg/l	BDL	BDL	BDL	BDL	0.01 Max	No Relaxation
*Chromium, mg/l	BDL	BDL	BDL	BDL	0.05 Max	No Relaxation
*Sodium as Na mg/l	12	11.2	12.8	13.8	--	--
*Potassium as K mg/l	8.2	5.6	7.8	8.2	--	--
Electrical Conductance at 25 °C, µS/cm	343.75	484.37	350	343.75	--	--
Coliforms by MPN (MPN/100ml)	>1600	>1600	>1600	>1600	Absent	No Relaxation
E-coli	Present	Present	Present	Present	Absent	No Relaxation

Note: IS10500:2012 Drinking water specification (rev. 02), May 2012

The results of analysis show that the ground water quality meets the IS 10500-2012 standards. Ground water does not show presence of heavy metals, toxicity. Microbiological analysis shows presence of Coliform and E coli. Thus, the water cannot be used for drinking purposes.

Figure 3.27 Ground Water Sampling in Study Area

3.5.3 Baseline Surface Water Quality

Surface water samples were collected from 3 locations as part of the baseline studies during winter (Dec 2019 – Feb 2020) to analyse surface water quality. Sampling was done at the following stations:

Table 3.14 Details of Surface Water Sampling Locations

Monitoring Location	Name of the place	Approx. dist. from project site in Km	Direction from site
SW1	Deval Lake-Bhavari Village	7.7	East
SW2	Lake-Khardi Village	6.3	North
SW3	Lake-Charkop Village	7.3	North

Figure below shows surface water sampling locations.

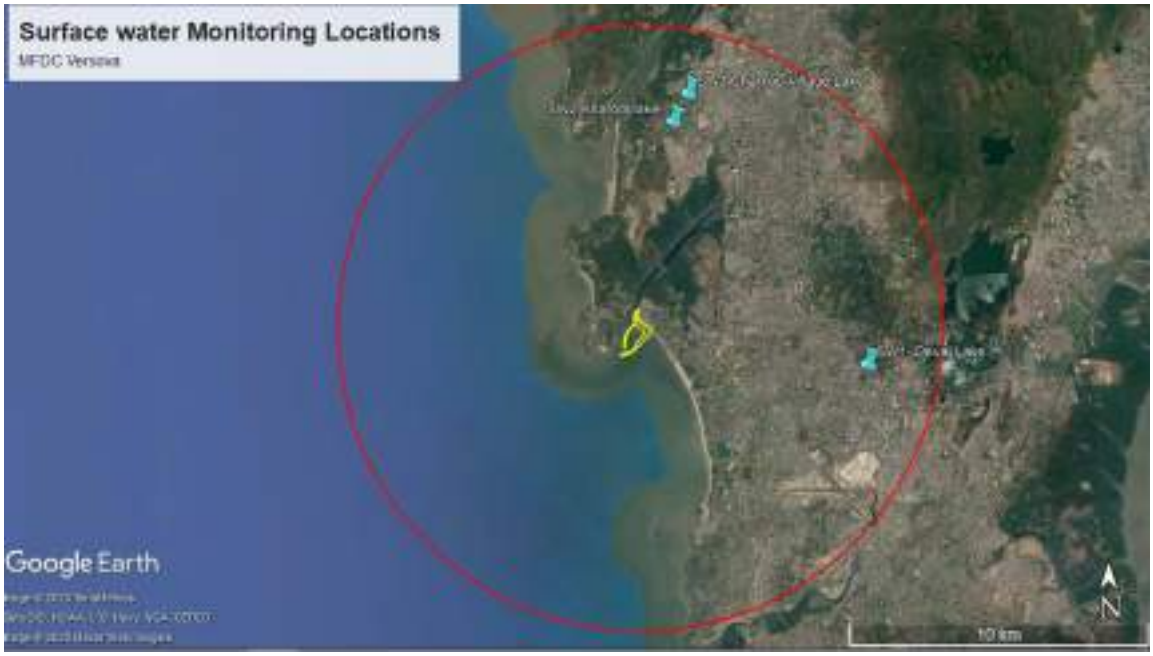


Figure 3.28 Surface Water Sampling Locations

Figure 3.29 Surface Water Sampling in Study Area

Surface water samples are analysed for parameters described in IS 10500:2012 to know surface water quality, results are presented below.

Table 3.15 Surface water quality in study area

Parameter	Location Details				
	Deval Lake-Bhavari Village	Lake-Khardi Village	Lake-Charkop Village	Desirable	Permissible
Colour, Hazen	<5	<5	<5	5	25
*Odour	Agreeable			Unobjectionable	--

Parameter	Location Details				
	Deval Lake-Bhavari Village	Lake-Khardi Village	Lake-Charkop Village	Desirable	Permissible
pH	6.94	6.86	6.80	6.5 – 8.5	No Relaxation
*Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
Turbidity, NTU	5	2.6	2.8	1 Max	5 Max
TDS, mg/l	158	230	230	500 Max	2000 Max
*Aluminium, mg/l	BDL	BDL	BDL	0.03 Max	0.2 Max
*NH_3(as N), mg/l	BDL	BDL	BDL	0.5 Max	No Relaxation
*Detergents, mg/l	BDL	BDL	BDL	0.2 Max	1.0 Max
*Barium, mg/l	BDL	BDL	BDL	0.7 Max	No Relaxation
Boron, mg/l	BDL	BDL	BDL	0.5 Max	1.0 Max
Calcium as Ca, mg/l	20.8	18.4	32.8	75 Max	200 Max
*Chloramines, mg/l	BDL	BDL	BDL	4.0 Max	No Relaxation
Chlorides, mg/l	38	54	42	250 Max	1000 Max
*Copper, mg/l	BDL	BDL	BDL	0.05 Max	1.5 Max
Fluoride, mg/l	0.26	0.28	0.33	1.0 Max	1.5 Max
Free $ResCl_2$, mg/l	0.56	0.56	0.56	0.2 Min	1.0 Min
Iron, mg/l	0.033	0.034	0.033	1.0 Max	No Relaxation
Magnesium as Mg, g/l	7.29	22.1	16.3	30 Max	100 Max
*Manganese, mg/l	BDL	BDL	BDL	0.1 Max	0.3 Max
*Mineral oil, mg/l	BDL	BDL	BDL	0.5 Max	No Relaxation
*Nitrate, mg/l	BDL	BDL	BDL	45 Max	No Relaxation
*Phenolic comp, mg/l	BDL	BDL	BDL	0.001Max	0.002Max
*Selenium, mg/l	BDL	BDL	BDL	0.01 Max	No Relaxation
*Silver, mg/l	BDL	BDL	BDL	0.1 Max	No Relaxation
Sulphate, mg/l	28	22	30	200 Max	400 Max
*Sulphide, mg/l	BDL	BDL	BDL	0.05 Max	No Relaxation
Alkalinity, mg/l	78	142	162	200 Max	600 Max
Hardness, mg/l	82	138	166	200 Max	600 Max
*Zinc, mg/l	BDL	BDL	BDL	5 Max	15 Max
*Cadmium, mg/l	BDL	BDL	BDL	0.003 Max	No Relaxation
*Cyanide, mg/l	BDL	BDL	BDL	0.05 Max	No Relaxation
*Lead, mg/l	BDL	BDL	BDL	0.01 Max	No Relaxation
*Mercury, mg/l	BDL	BDL	BDL	0.001 Max	No Relaxation
*Molybdenum, mg/l	BDL	BDL	BDL	0.07 Max	No Relaxation
*Nickel, mg/l	BDL	BDL	BDL	0.02 Max	No Relaxation
*Arsenic, mg/l	BDL	BDL	BDL	0.01 Max	No Relaxation
*Chromium, mg/l	BDL	BDL	BDL	0.05 Max	No Relaxation
*Sodium as Na mg/l	13.8	12	5.2	--	--
*Potassium as K mg/l	9.4	8.4	3.5	--	--
Electrical Conductance at 25 °C, µS/cm	248.87	359.37	359.37	--	--
Coliforms by MPN (MPN/100ml)	>1600	>1600	>1600	Absent	No Relaxation

Parameter	Location Details				
	Deval Lake-Bhavari Village	Lake-Khardi Village	Lake-Charkop Village	Desirable	Permissible
E-coli	-	-	-	Absent	No Relaxation

Results do not show presence of heavy metals or toxicity. Microbiological analysis shows presence of coliform.

3.6 Biological Environment

3.6.1 Biogeographic Setting of Mumbai District:

Mumbai Suburban is one of the coastal districts of Kokan. Which is surrounded by Thane District on the East and North; Mumbai City and Arabian sea towards the South and West respectively. Mumbai suburban is situated at northern bank of Ulhas River and Thane creek is following in between Mumbai Suburban and Thane District. The habitation of district is urban in nature. The district has coastal belt in length of 114 km. the major creeks found within study area are Versova /, Malad Creek and Manori Creek, which give rise to mudflats and swamps. The Poisar and Mithi River are flowing within study area.

The soil cover of district is coastal saline due to proximity of the Arabian sea. The coastal alluvium and coarse shallow soils predominant the inner region of district. The underlying rocks of this region is made up of Black Deccan Basalt pours, its acid and some basic variables.

The Mumbai Suburban district has forest type of southern moist deciduous forest found in Sanjay Gandhi National Park (SNGP) and mangrove swamp forests. The project site is covered by coastal area and urban settlement (no R& R is involved in this proposal). Urban vegetation comprises gardens, avenue trees, ornamental plants near human habitation. The main urban trees are *Acacia arabica, Albizia lebbeck, Azadirachta indica, Ficus Benghalensis, Ficus religiosa, Peltophorum pterocarpum, Samania saman, Mangifera indica, Syyzimum cumini, Bauhina racemosa, Thespesia populnea* etc. Dense mangrove vegetation found on tidal waters, estuaries and Creeks. The common mangroves species recorded in the Mumbai Suburban district are *Avicennia alba, Avicennia marina, Avicennia officinalis, Aegiceras corniculatum, Acanthus ilicifolius, Rhizophora mucronata, Rhizophora apiculata*, *Bruguiera parviflora, Sonneratia alba, Sonneratia apetala*, and mangrove associated species *Acrostichum aureum, Derris heterophylla* and *Clerodendrum inerme*.

The climate in the district is generally humid and dry. The average temperature varies between 16.3 to 29.1°C with high relative humidity. the rainfall in the district increases from the coast towards the interior. The average annual rainfall in the district is 2457 mm, mostly contributed by south westerly monsoon.

According to "India State of Forest Report, 2019", Forest survey of India; forest cover in Mumbai Suburban is 31.36% of geographical area (km^2) distribution of forest cover in Mumbai Suburban District is presented below:

Geographical Area	Very Dense Forest	Moderately Dense Forest	Open Forest	Total

446	0.0	67	72.86	139.86

3.6.2 Survey Methodology:

Survey has been done by making flied visit to various habitats within the study area. The observations recorded are site, time and season specific. The assessment of wild flora and fauna was mostly based on random sightings. For animals, other than directly sighted, secondary evidences were recorded through calls, dug holes, scats, and spoors, rub signs, drag mark etc. For birds, actual observation at each sampling site were made, by walk through stretch of the site and the number of birds were identified and listed. A species list was prepared along with taxonomic position of each species. Listing of Flora and fauna was done based on actual sighting, interviewing locals, indirect evidences, literature survey and internet references.

3.6.3 Biogeographical profile of Study area

The study area falls under Three Talukas, majorly in Borivali and Andheri; and some part in Kurla. Most of study area is Urbanized and followed by some Industrial areas, deciduous forest ecosystems of SNGP, Aarey Colony and mangroves vegetation.
Study area covers stretch creek lets, wetlands with mangrove vegetation in it, with human habitation viz. Jogeshwari, Vile Parle, Malad etc. The industrial area observed under study area are MIDC Andheri and MIDC Chakala etc.

In the study area, the vegetation diversity can be divided into mostly urban and forest based. Common plants such as *Ficus* sp., *Syzygium cumini* and *Peltophorum* species can be observed near the residential complexes and industrial areas. In the forested landscapes, the floristic diversity is composed of wild flora *Tectona grandis, Terminalia tomentosa, Acacia catechu, Adina cordifolia, Mitragyna parviflora, Pterocarpus marsupium, Holarrhena antidyssentrica, Butea monosperma*, and *Diospyros melanoxylon* etc.

Mangrove reserve forest are present around the project site towards NW, N and E direction. Different habitats observed in study area like Forest (4.20%), Mangroves (5%), Built Up land (33.37%), Airport (1.64%), Watre body (53.86%). These habitats possess distinctive characteristics which support typical flora and fauna within them. Occurrence of species in respective habitats are presented in **Table EB1, EB2, EB3, EB4, EB5 Annexure VIII,** respectively.

Major portion of creeks, which comes under the study area are Malad Creek ~~and Manori Creek~~, which possess mangroves and other plant species associated with these creeks are present nearby. This ecosystem is surrounded by both urban populace and industries. Creek noted in study area encompasses vast species composition of Flora and Fauna.

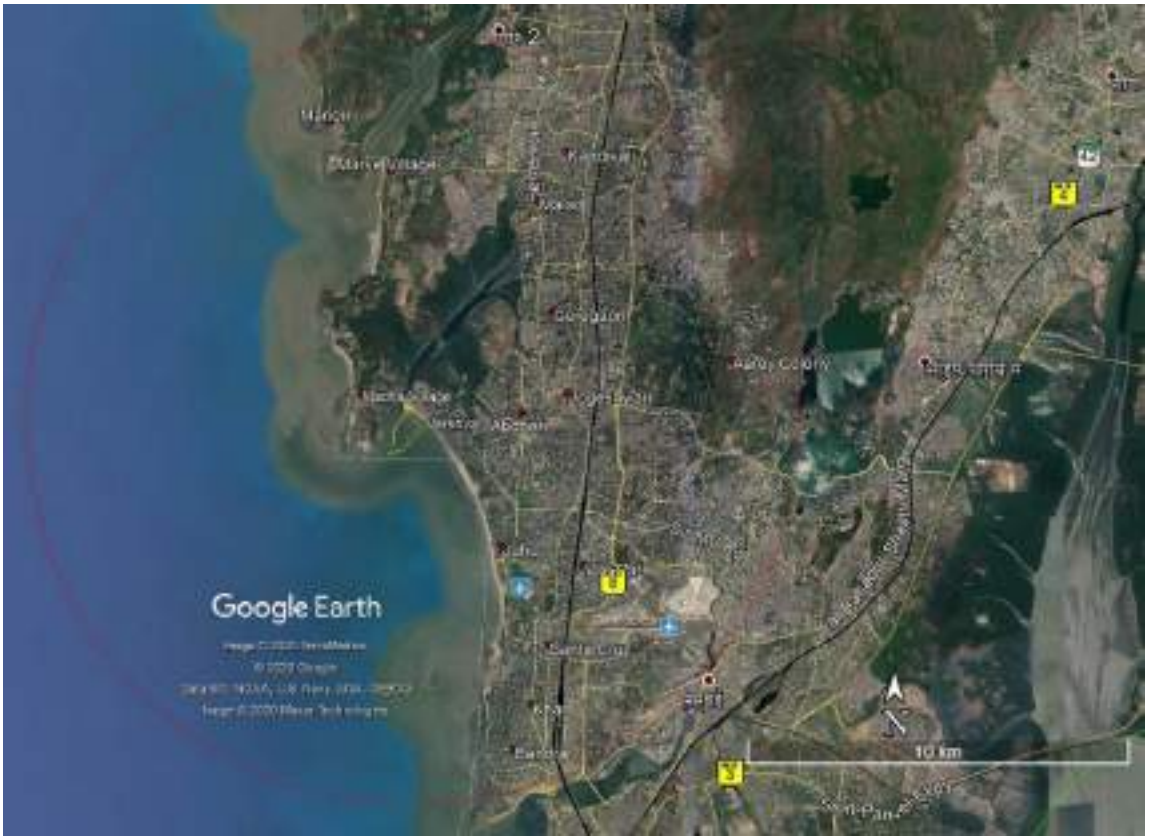


Figure 3.30: Google Earth Image showing study area of 10 km

Figure 3.31: Toposheet showing site & study area of 10 km

Different habitats of study area described in detail as below:

3.6.4 National Park:

The study area consists some part of Sanjay Gandhi National Park (SGNP) as protected area within study area. The total area of SGNP is 103.09 km^2. The closest distance from proposed project boundary to SGNP is 8.58 towards NE. The ESZ of SGNP is situated at distance of 5.30 km towards E. The SGNP has 286 species of birds, 150 species of butterfly, 43 species of mammals,12 species of amphibians and 50 species of herpetofauna. Mammals such as *Panthera pardus, Sus scrofa, Tetracerus quadricornis Felis Chaus, Canis aureus etc*. Bird species like *Pavo cristatus, Ardea purpurea*, reptiles like Cobra and Vipers occur in SGNP. 84 species of tree, 17 species of shrubs, 37 species of herbs, 20 species of climbers 3 species of Bamboo etc. The forest of SGNP is of four types viz. 3B/C1 southern moist teak bearing forest, 3B/C2 southern moist mixed deciduous forest, 4B/TS1 mangrove scrub and 8A/C2 western tropical Hill forest. The southern moist mixed deciduous forest most prominent in SGNP and covers majority of area. The forest tree in SGNP comprises *Mangifera indica, Saraca asoca, Bombax malabaricum, Butea monosperma, Erythrina indica, Cassia fistula, Delonix regia, Peltophorum pterocarpum, Borassus flabellifer, Madhuka indica* etc.

Figure 3.32 Part of Sanjay Gandhi National Park and its ESZ within study area

3.6.5 Human Settlement

No vegetation is present at Project site. Patches of vegetation are observed near project site within human habitation, which include plants like *Saraca asoca*, *Mangifera indica*, *Polyalthia longifolia, Ficus benghalensis, Ficus Religiosa* etc. human habitation present around project site are Andheri towards East, Madh Village toward West and Malad towards N. Juhu towards south East. The densely populated area nearer to Project site is Versova Village.

The livelihood of population in study area mainly depends on private jobs, services as populace close to industrial areas, less dependent on agriculture.

The urban vegetation includes the Avenue plantation along the roads, gardens, recreational areas, trees planted near Human habitation. This vegetation can improve the air quality and enhance the aesthetic beauty of City.

3.6.6 Agricultural Fields

Agricultural fields are not present near the project site. Vegetable Farming land is allotted to farmers at Western railway line near Malad, Goregaon, Jogeshwari etc. where farmers used to grow vegetables Lady's finger, leafy vegetables like Spinach, Carrots, radishes etc.

3.6.7 Water bodies

The Arabian Sea is present towards the west side as major water body within study area. The Versova Creek is present on northern side adjacent to project site other Creek named Manori Creek is present 6.5 km towards northern side of project site. The Poisar River is flowing within study area and it merges with Malad Creek which proceeds into Versova Creek. Another Mithi River is present towards ESE end of the project site at distance of 8.8 km. Lokhandwala Lake is present towards ENE from project site at distance of 1.27 km. A part of this creek is marshy and of Mud flats which forms wetland comprising mangroves and other vegetation supports vivid avifauna. There are lakes and ponds present within 10 km study area which are good birding sites such as Lokhandwala Lake at Versova and Godzilla Lake at Kandivali. Number of nallas Mogra Nallah one of them are merges into Versova Creek and others nallahs into Manori Creek near the project site. Other water bodies present within study area is shown in figure below.

Figure 3.33 Water bodies present within study area

3.6.8 Biodiversity within project site

The project site is located at Versova Village, Andheri taluka, Mumbai suburban District. The project site is sandy in nature being a region associated with Arabian sea does not possess vegetation. Mangroves were observed around the project site at distance of 180 m and 350 m towards W and ENE directions respectively.

Figure 3.34: Observations made at Project site

Figure 3.35 Faunal species within the Project site

Table 3.16 Faunal species within the Project site

Sr. No.	Scientific Name	Common Name	Family	Schedule as per WLPA 1972
Mammal				
1.	*Canis lupus familiaris*	Dog	Canidae	
2.	*Felis catus*	Cat	Felidae	
Birds				
1.	*Corus spendens*	House Crow	Corvidae	V
2.	*Passer domesticus*	*House Sparrow*	Passeridae	IV
3.	*Columba livia*	*Pigeon*	Columbidae	IV
4.	*Bubulcus ibis*	Cattle Egret	Ardeidae	IV
5.	*Egretta garzetta*	Little Egret	Ardeidae	IV
6.	*Chroicocephalus ridibundus*	Black headed gull	Laridae	
7.	*Chroicocephalus genei*	Slender billed Gull	Laridae	IV

3.6.9 Conclusion

The primary observations were compared with secondary sources (reports, research papers, literature survey). The status of vegetation was mix deciduous and open scrub type throughout the study area.

Comparative table showing flora and fauna observed during primary studies mentioned in Table EB1 EB3 for flora and Fauna. The secondary data reported from forest Dept. and other secondary sources mentioned in Table EB2 and EB4 for flora and fauna respectively.

During survey, numbers of floral species were observed in project site and study area as follows:

Location	Trees	Shrubs	Herbs	Grasses	Climbers
Project site	0	0	0	0	0
Primary observation in Study area	125	104	66	23	39
Secondary data in study area	196	133	196	50	92

During survey faunal species were observed are as bellow:

Location	Mammals	Birds	Reptiles	Amphibians	Insects
Project site	2	7	0	0	0

Location	Mammals	Birds	Reptiles	Amphibians	Insects
Primary observation in Study area	22	114	15	10	9
Secondary data in study area	38	251	36	16	152

Owing to presence of Schedule I species present in study area, capital expenditure (on time) of Rs. 65 lakhs distributed over 5 years is allotted for conservation of schedule I species. Species/ Wildlife Conservation Plan is prepared (kindly refer **Annexure VI**).

3.7 Marine Environment

The proposed project activity is situated at Versova, a coastal fishing village in metropolitan Mumbai is located on the mouth of the Malad Creek (Versova Creek) with the Madh Island in its neighbourhood is an area affected by sewage disposal. Versova Creek, is a minor creek in north-west Mumbai where Poiser River drains into it. The creek sustained vast mangrove areas (~1000 ha) in the past which have been gradually reduced due to urban pressures and at present estimated to be around 400 acres. The total length of Malad Creek is about 5 km & the creek dries during low tide except for a narrow channel extending 5-6 Km inland from the entrance. Oshiwara River originates in the Aarey Milk Colony and crosses Goregaon before emptying into the Versova Creek. On the way it is joined by another creek near Swami Vivekanand Road, before picking up industrial effluents and sewage while crossing the Oshiwara industrial estates and slums of Andheri. The river resembles a sewer and highly polluted and encroachments have shrunk it to a narrow stream. Presently, the Versova Creek receives wastewater and sewage from open drains and partially treated sewage from Malad (23 MLD) and Versova (260 MLD) treatment plants. Few pharmaceutical and other small industries also use the creek for waste disposal.

Even a long-term monitoring program on marine pollution has been conducted by the Ministry of Earth Sciences and MPCB, where marine water quality in the study area was assessed by above said program by National Institute of Oceanography, Reference: MPCB Part A & B Report, NIO-Mumbai, Dec 2009. The concurrence of this secondary data set has been considered for reference.

3.7.1 Physical Oceanography

The hydrographic survey details prevailing at site is provided in navigational chart no. 211 for 'Satpati to Dighi Harbour in a limited sense and more details are available in chart no. 1104/2009 prepared by Maharashtra Maritime Board (MMB) for Malad creek. The entire creek region is having bed as mixture of rock outcrops. The maximum water depth at the centre is hardly 1.5 m below CD. Further east, the water depths reduce below chart datum. It may be seen that over the intertidal area, the bed slopes are extremely gentle

and are around 1: 500 or even 1: 1000. But in the open sea region, the slopes are not gentle. Between 1m 2 m contour, the bed slopes are around 1:50 to 1:100 Obviously while entering from open sea into the creek, due to sudden change in the bed slopes, the wave refraction can be of higher degree and hence the wave pattern is bound to be complex at the entrance. Thus, inside the creek water can enter only during flood phase of the tide and return to the sea during ebb phase of the tide. Due shallow water depths over limited period of tide combined with difficulties caused by rock outcrops over this region, fishermen find it risky to navigate in this region and only highly experienced and knowledgeable persons can navigate without any damage to the vessel. Rest of the period, a large area of the bed is exposed, and no navigation is possible. The seabed region surrounding the entrance to the Malad creek and large distance inside the creek, the sea bed is mixed with rock outcrops. While vessel travels from the sea to enter the mouth of the creek, the complex wave field generated by the incoming waves, breaking over shallow depths at the entrance of the creek and sudden changes in the seabed slopes make navigation difficult. Hence, deepening the same with regular maintenance deepening is a need. Also due to complexity of the flow, the deep channel is also observed along the western bank of the creek (refer MMB survey chart no, 1104/2009).

Based on the navigational charts and MMB detail survey chart, it is observed that the wave climate, prevailing littoral drift and sediment load brought by the river, the near shore region is shallow posing severe problem while entering from the open sea to reach the mouth of the creek leading to Versova. Similarly, for the fishing vessels returning from sea with fish catch, crossing the shallow region poses severe problem as the required water depth is increased due to fish load in the vessel. The fishing vessels find it difficult to navigate due to prevailing wave field; prevailing complex wave pattern required to be negotiated while entering the creek.

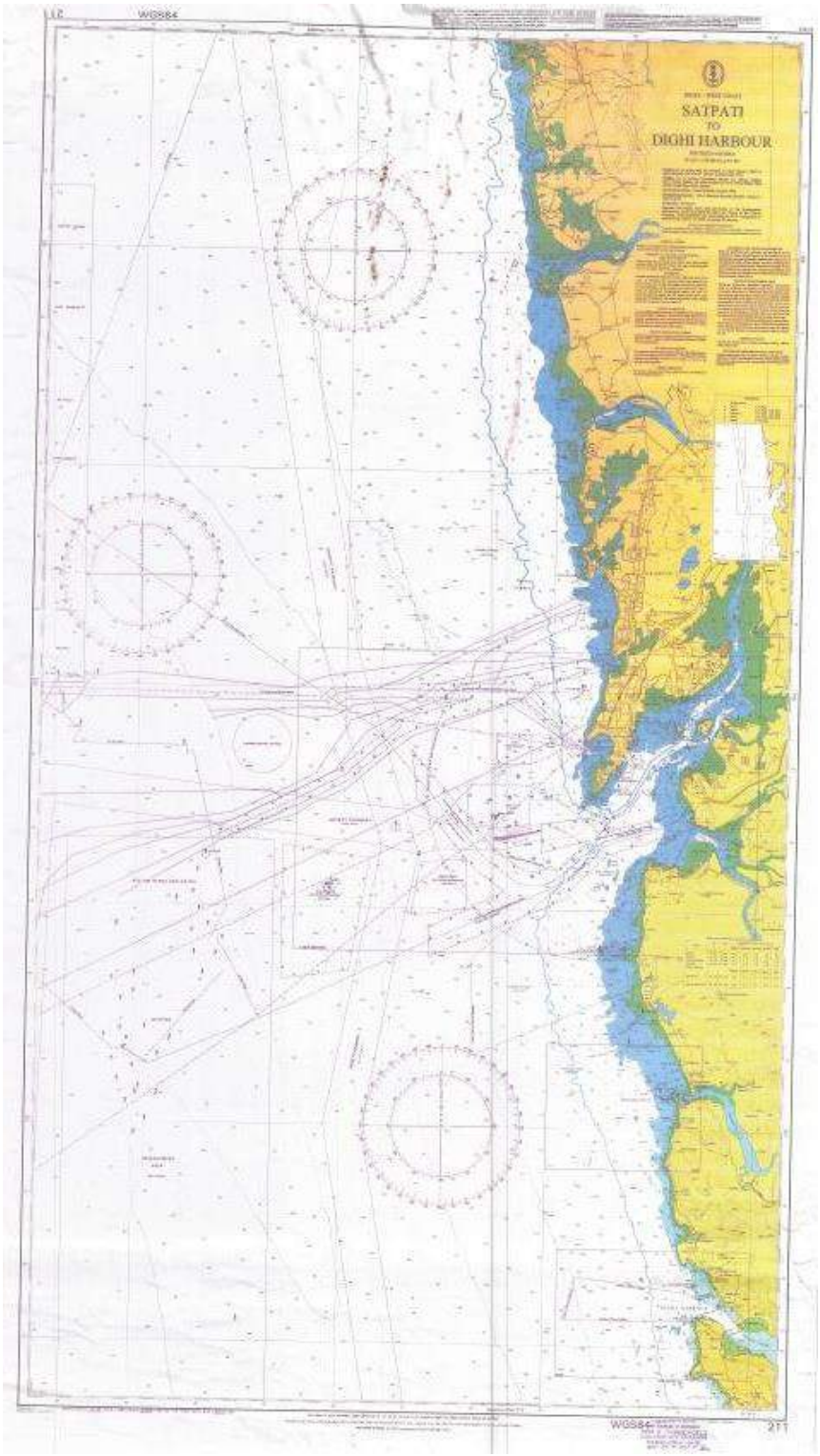


Figure 3.36: Navigational Chart – 211; Versova

3.7.1.1 Tides:

Tidal observations are not taken in recent years at the proposed site of Versova. However, the predicted tide table regularly published by the Maritime Board of Maharashtra (MMB), provides information on the predicted values of high water and low water for

entire year along with time of occurrence of the same, for the nearest tidal station at Apollo Bunder which is in proximity of the site under consideration. Similarly, the navigational chart 211 also provides information on the tidal values. The values of tidal water levels with respect to the Chart Datum indicated on the navigational chart no. 211 can be considered for this site also which are as follows:

Table 3.17: Tidal amplitude near project site

Water level		Colaba
Mean High Water (Spring)	MHWS	+ 4.40 m
Mean High Water (Neap)	MHWN	+ 3.30 m
Mean Sea Level	MSL	+ 2.50 m
Mean Low Water (Neap)	MLWN	+ 1.80 m
Mean Low Water (Spring)	MLWS	+ 0.80 m

It is clear from the values of mean HWL and LWL indicated above that the tidal range is quite good, just around 1.5m (neap tide) to 3.20 m (spring tide). As a result, there is quite reasonable time to operate taking advantage of the tidal window under normal circumstances, however due to rock outcrops, coupled with shallow water depths at site and complex wave field at the entrance to the creek, it's a risk to navigate & reach the existing facility.

3.7.1.2 Tidal currents:

The tidal currents are driven by the tidal amplitude. Obviously if the tidal range is moderate, the tidal currents will also be correspondingly of medium magnitude (say 0.4 to 0.5 m/s or so). However, the site is just at the mouth of the creek and the tidal currents may cause formation of eddies over a large shallow region.

The coastline at the creek mouth is aligned almost North-South. Thus, waves approaching from Southwest direction will approach at an angel to the shoreline resulting in creating littoral currents and due to sediment supply provided by the river discharge, correspondingly littoral transport will result. No information on tidal currents is provided on the chart 211 or even in MMB chart, in the proximity of the project site under consideration. During monsoon season, along with the freshet discharge brought from the upstream region and surrounding region of the creek, large quantity of the sediments may be flowing through the creek and gets discharged to the creek in the mouth region, making it shallow depth region over a large area.

3.7.1.3 Wind

Based on the 'Climatological tables for 1951-1980, published by India Meteorological Department (IMD), information on meteorological parameters is available for weather

station at Colaba (Mumbai) (Lat. 18° 54'N and Long. 72° 49'), which is in proximity of the site. It will provide some guidelines of prevailing wind field for the project:

Table 3.18: Monthly wind speed data for Colaba (Mumbai) for the period 1951-1980

Months	Wind Speed (Kmph)	Number of days with wind speed (kmph). (In each row, values at top are for 0830 hours and bottom is for 1730 hours)			
Colaba (Mumbai)		62 & more	20-61	1-19	0
January	8.0	0 0	0 3	29 28	2 0
February	8.6	0 0	0 5	25 23	3 0
March	9.3	0 0	0 6	27 25	4 0
April	9.5	0 0	0 6	26 24	4 0
May	9.3	0 0	0 3	29 28	2 0
June	11.9	0 0	2 3	27 26	1 1
July	14.2	0 0	6 6	25 24	0 1
August	13.3	0 0	4 4	27 26	0 1
September	9.2	0 0	1 2	26 27	3 1
October	6.8	0 0	0 1	28 29	3 1
November	6.7	0 0	0 1	28 29	2 0
December	7.3	0 0	0 1	29 29	2 1
Yearly	9.5	0 0	13 41	326 318	26 6

It indicates that the wind activity is quite low for non-monsoon period of the year and as is obvious, it is relatively strong only during south-west monsoon i.e. during May-August, but still not of considerable value. In general, the average wind speed over the year does not exceed speed 10 km/h. During monsoon period, the fishing vessels might have marginal problem while loading/unloading of material at wharf/ramps but in general, fishing is banned during this period by the state government. As such, considering the main activity of existing Fish Landing Centre, and based on the prevailing wind field information provided by Colaba Weather station as well, will not have any adverse effect on operations at the proposed harbour.

3.7.1.4 Waves:

- Versova is located at mouth region & on east bank of the Malad creek along the west coast of India. The Arabian Sea and correspondingly the west coast of India is relatively

calm in comparison to the Bay of Bengal. The Arabian Sea is rough only during the monsoon months of June-September. Rest of the year, the Arabian Sea is quite calm. The waves get propagated from the deep sea to reach the coast. The low-lying area extends over a large region in front of the shore, in this region. The seabed slopes in this region are quite gentle, 1:500 to 1000 over intertidal region. While waves propagate from the deep water to shallow region, it has to undergo the process of shoaling, refraction, diffraction during which considerable wave energy dissipation takes place. The project site being located at lee ward side though at creek mouth, will have practically low waves effect hence will experience minimum disturbance during monsoon. Yet during monsoon other problem that may be faced would be freshet discharge flowing from the upstream will make it difficult for the fishing vessels to safely enter the channel & continue its due course like repairs and maintenance of the vessels.

- The ship reported data was obtained from India Meteorological Department (IMD) for last 50 years period for some other project covering the same region in the sea. The results of analysis of the data are presented in the results of analysis of the data are presented in Table 13 to 36 and Plate 3 to 6 in **Annexure VI**. It was observed from the analysis of the data presented in Tables and figures that:

- The maxim significant waves in the open sea, of 3.5 m to 4.5 m are seen to propagate from the deep sea with wave period of 10 to 14 seconds from westerly direction.
- The percentage of occurrence of these significant westerly waves varies from 20% to 40%. The amplitude reduced quite low.
- While the waves from South-west quadrant travel from the deep region to the project site, its direction is changed to WSW. Due to the obliquity the sea waves approaching in the region are likely to cause littoral drift movement along the shore from south to North direction. Further as the waves travel, initially from creek mouth inside the creek, the waves will get filtered due to well-spread shallow depths of water and rock outcrops, while reaching the Malad creek mouth. Further when waves enter the shallow region inside the creek and travel to reach Versova, the wave energy will be dissipated to a great extent and very low magnitude waves will be witnessed at site.

3.7.1.5 Storms

With due consideration to the project site, all cyclones passing through the quadrant of Latitude 15°to 20° N and Longitude 71° to 74° E were taken into consideration. Initially all tracks of storms occurred during 1891 to 2007 were viewed. It was observed that most

of the storms in the Arabian Sea occur during the months of May, June, September and October month. Tracks of storms which occurred during this period and which can have bearing on the Mumbai Suburban region are presented in plate 7, 8, 9 &10. It is observed in general that,

- There are about 20 storms which occurred during the period of last 110 years.
- Most of the storms have occurred in the vicinity of Panaji and moved further northwards but rarely crossed the west coast of India. Some of the storms moved further north and eventually crossed the coast of Middle East or Africa. Only a few storms have crossed Gujarat coast, near Veraval. Thus, Versova, the proposed project site and in fact, the entire coast of Mumbai-Suburban district does not have any danger of storm directly hitting the coast. Some of the storms do crossed land in the vicinity of the Rajpuri creek, several km south of the project site, but only after the intensity of the storm has reduced to 'Depression' which is no way of any concern for navigational activity.
- While the storm passes close and parallel to the coast, due to circular movement of the winds, there is storm-surge generated on the right side of its path i.e., in the present case, the West Coast of India. As such, during such storms, there is momentary rise in water level along the coast. Due to rise in water level and wind movement, waves of higher amplitude may reach the coast. During the storms, the ships are advised to avoid the route of the storm and in general ships try to keep the track of the storm on the right side of its path of navigation, so the effect of storm waves on the ship movement is of no concern. As such, the ships are unable to report the storm generated waves which could really be much severe than the waves reported by the ships plying in the sea.
- However, as the project site is located at the Malad creek mouth & behind Mud head land hence is protected by same, while also the propagating waves have to initially cross the large area of shallow rocky region and then travel over the shallow water depths for reaching the project site and during this process, severity of the storm surge and high amplitude waves reaching the site would reduce to almost extremely low value.

With due consideration to above, the site is well protected from the eventuality of the storm and storm-surge.

3.7.1.6 Status of Shoreline Change/ Erosion/ Accretion

As per Shoreline Change Atlas of Indian Coast, Volume 2 (Maharashtra and Goa), prepared by Space Application Centre (ISRO) Ahmedabad 380015 and Coastal Erosion Directorate, Central Water Commission, Ministry of Water Resource, Government of India, New Delhi 110606, published in May 2014, coastline of Versova is stable. Shoreline change map is presented below.

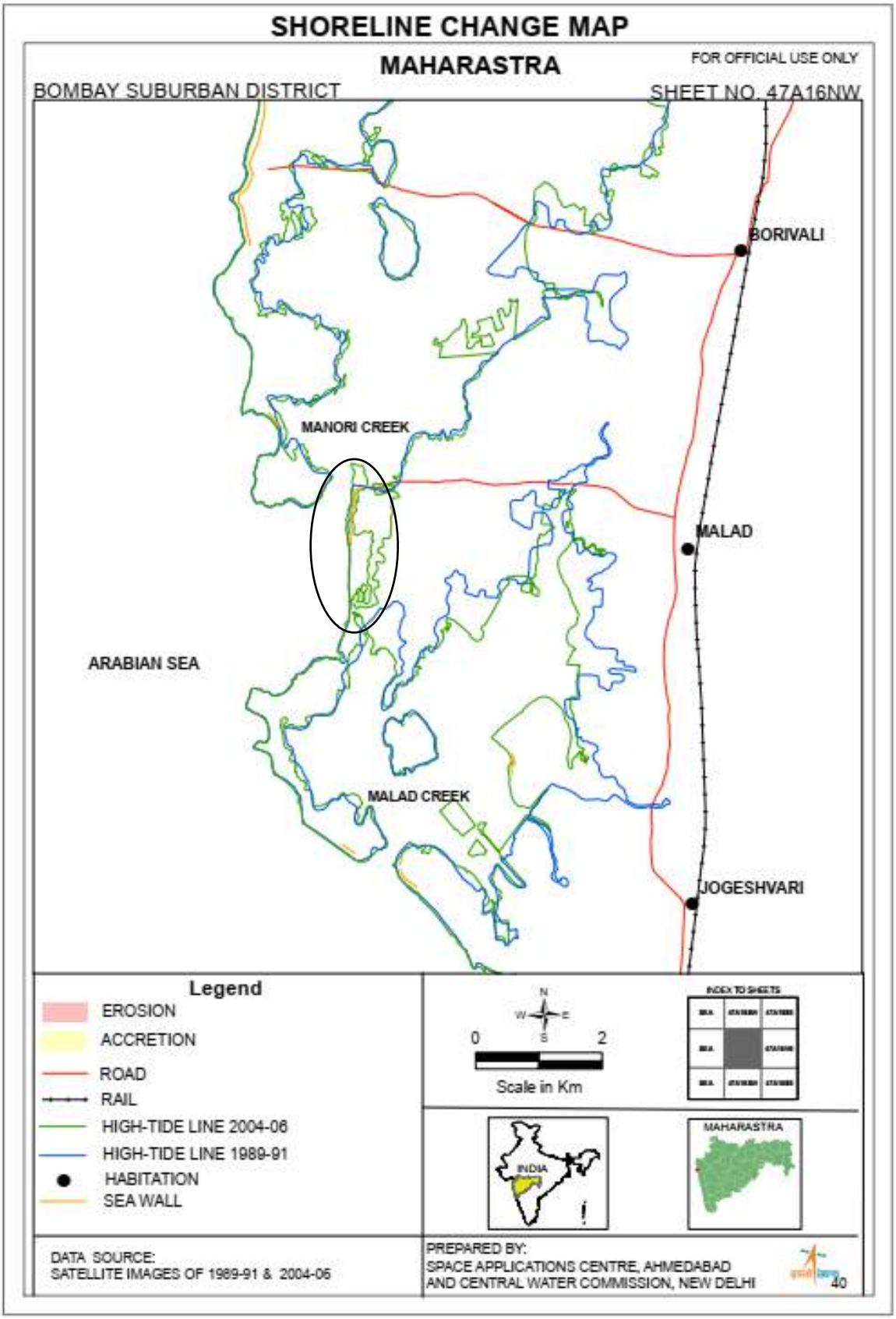
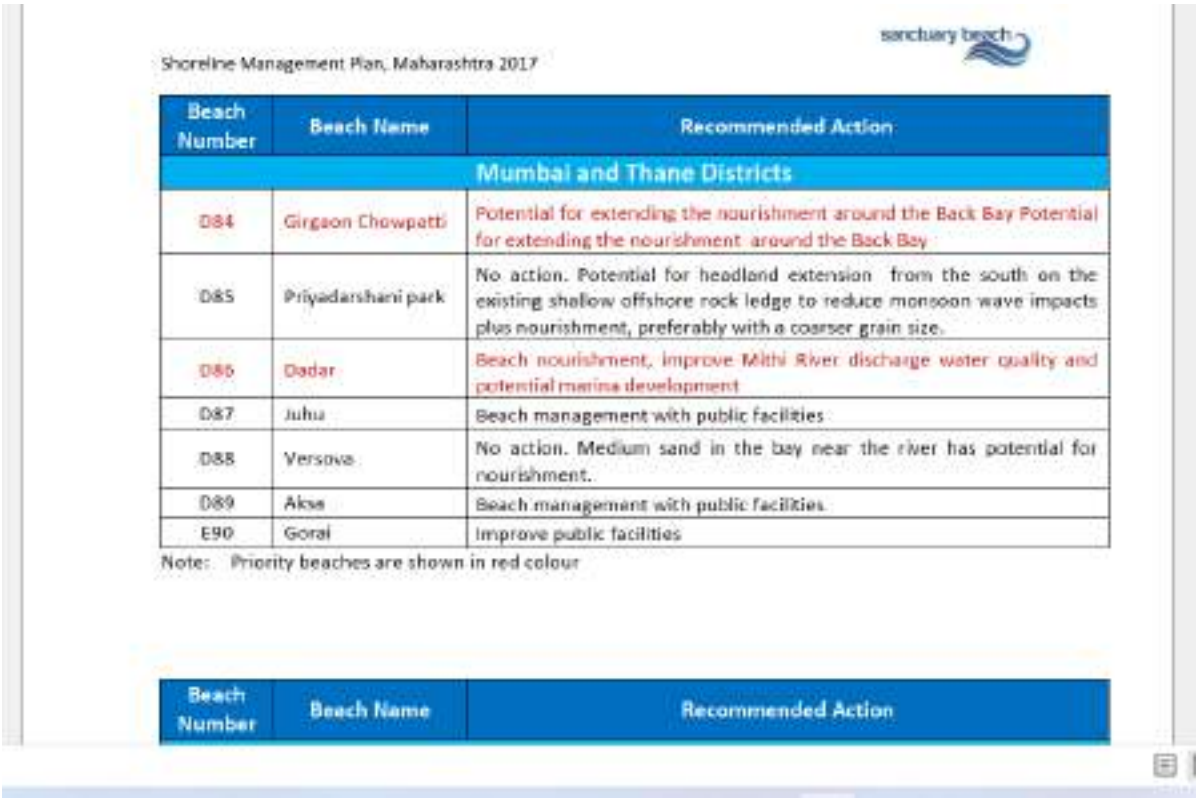


Figure 3.37: Shoreline Change Map

Similarly, as per Shoreline Management Plan Maharashtra prepared under Sustainable Coastal Protection and Management Investment Program – Tranche 1 of Maharashtra

Maritime Board (prepared by Sanctuary Beach Pte Ltd. Singapore), June 2017, priority actions are identified by consultation with MMB and through detailed assessments (Black and Mathew, 2017) which revealed several beaches require priority actions. A needs-based assessment was made which was guided by development needs, urgency, public use and tourism planning. These beaches are presented in chapter 8, section 8.2, Table 8.1- Action plans for priority beaches (page no. 56) wherein Versova beach is not identified. On the other hand, in section 8.3, individual beach assessment showing actions recommendations are given in table on page no. 61, screenshot is given below:



Shoreline Management Plan, Maharashtra 2017

Beach Number	Beach Name	Recommended Action
	Mumbai and Thane Districts	
D84	Girgaon Chowpatti	Potential for extending the nourishment around the Back Bay Potential for extending the nourishment around the Back Bay
D85	Priyadarshani park	No action. Potential for headland extension from the south on the existing shallow offshore rock ledge to reduce monsoon wave impacts plus nourishment, preferably with a coarser grain size.
D86	Dadar	Beach nourishment, improve Mithi River discharge water quality and potential marina development
D87	Juhu	Beach management with public facilities
D88	Versova	No action. Medium sand in the bay near the river has potential for nourishment.
D89	Aksa	Beach management with public facilities
E90	Gorai	Improve public facilities

Note: Priority beaches are shown in red colour

Beach Number	Beach Name	Recommended Action

It is very clear from above; no action is required for Versova Beach which indicates it is stable.

3.7.1.7 Marine Water-Sediment Quality (Primary Studies)

Marine water quality in the study area was assessed in winter 2019-2020 where water quality parameters were studies at 3 subtidal spots, restricted to basic physico-chemical, and nutrient parameters to know water quality. While assessing sediment at these spots, along with basic physico-chemical parameters, heavy metals such as Lead, Zinc and Cadmium were also selected, considering use of marine antirust solutions. Benthic studies were carried out at 2 intertidal transects along with above mentioned 3 subtidal spot locations. Station Location Map for primary studies is presented in figure below & the results for Marine water & sediment quality are presented in tables under respective sections and observations are discussed below.

Figure 3.38: Marine Sampling Locations

Table 3.19: Sampling Details

Subtidal Spots (water & sediment quality)		
MW1	MW2	MW3
19° 7'51.55"N 72°48'1.77"E	19° 7'2.36"N 72°47'49.40"E	19° 8'46.40"N 72°48'12.91 "E
Intertidal (sediment Quality)		
Level	ITR-1	ITR-2
High Tide	19° 8'24.66"N 72°48'12.42"E	19° 8'17.15"N 72°48'22.45"E
Mid Tide	19° 8'23.70"N 72°48'l1.61"E	-
Low Tide	19° 8'22.40"N 72°48'10.47"E	19° 8'16.39"N 72°48'21.74"E

3.7.2 Physico-chemical Quality

The detailed station-wise water quality scenario of marine environment around the

proposed site at Versova is given in table below.

Table 3.20: Marine Water Quality Analysis

	MW1		MW2		MW3	
	Surface	**Bottom**	**Surface**	**Bottom**	**Surface**	**Bottom**
pH	7.9	8.12	7.55	7.7	7.25	7.41
Temperature, °C	26.5	26.2	25.8	25.8	26.2	25.2
DO, mg/l	2.2	2.0	1.8	1.4	1.0	0.9
BOD, mg/l	1.5	1.2	1.1	1.6	1.2	1.3
Salinity, ppt	33.8	34.1	33.3	33.4	33.2	33.0
Nitrate, µmol/l	7.8	4.4	5.2	5.8	8.2	8.9
Nitrite, µmol/l	2.3	3.8	4.8	5.3	6.2	7.3
Total Nitrogen as N, µmol/l	12.4	11.2	11.2	12.6	15.1	16.7
Phosphorus as P, µmol/l	6.4	6.8	5.6	6.2	7.3	7.7
Phenolic compounds, µg/l	BDL	-	12	-	48	-
TSS, mg/l	38	20	62	44	56	48
Zinc as Zn, mg/l	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
Chromium as Cr, mg/l	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
Cadmium as Cd, mg/l	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
Lead as Pb, mg/l	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)

As evident from above that the pH was is in the range of 7.5 to 8.0 with invariably low pH in the upper creek due to sewage release. The average DO levels were invariably low may be due to the impact of organic loading. Overall, the nutrients were relatively high at the upper creek than at the creek mouth as expected

Overall, the physico-chem values show lower trend indicating the water quality under much stress.

Table 3.21: Sub-tidal & Intertidal Sediment Quality Analysis

				ITR 1			ITR 2	
		MW2	**MW3**	**HW**	**MW**	**LW**	**HW**	**LW**
pH		6.24	6.51	6.24	6.24	6.63	6.1	6.24
	Sand	4	45.6	91.6	72.3	48.6	66.4	56.4
	Silt	84.5	44	6.2	21.5	41.8	27.2	40.4
	Clay	11.5	10.4	2.2	6.2	9.6	6.4	3.2
Organic carbon %		2.2	1.8	0.2	2.8	3.6	0.6	2.3
Phosphorus as P, mg/l		2.5	2	1.1	2	1.8	2.1	1.6
Chloride as Cl, mg/l		112.6	138.2	132.4	122	118	134	130
Sulphate as SO4-2, mg/l		624	568	227	320	340	195	124
Nitrogen as N, %		0.028	0.0186	0.014	0.008	0.028	0.028	0.028

	MW2	MW3	ITR 1			ITR 2	
			HW	MW	LW	HW	LW
Zinc as Zn, mg/l	0.24	0.16	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
Chromium as Cr, mg/l	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
Cadmium as Cd, mg/l	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
Lead as Pb, mg/l	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)
Nickel as Ni, mg/l	0.08	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)	BDL(DL-0.01)

The creek bed was mainly composed of silty sand except few instances of hard bottom. The concentration of metals varied in the expected ranges.

3.7.3 Biological Environment

Biotic components observed are discussed below with Station-wise values.

3.7.3.1 Microbiology

Presence of *E. coli* & coliform in high numbers are attributed to anthropogenic pressures and improper disposal of sewage from surrounding habitations. Microbes were noted in higher numbers & the results are given in table below.

Table 3.22: Sub-tidal Water Microbiological Analysis

Parameter	1	2	3
TVC (Viable Count) (c.f.u/ml)	$28.2X10^3$	$20.4X10^3$	$16.8X10^3$
TBC (Bacterial Count) (c.f.u/ml)	6620	7440	5180
TFC (Faecal Count) (no/ml)	3800	5200	4160
E. coli (no/ml)	1840	1660	1440

Microbial count in sub-tidal sediment similar trend as in water column.

Table 3.23: Sub-tidal & Inter-tidal Sediment Microbiological Analysis

Parameter	Sub-tidal Sediment		Inter-tidal Sediment	
	2	3	ITR I	ITR II
TVC (c.f.u/mg)	$126\ X10^3$	$148X10^3$	160X103	178 X103
TBC (c.f.u/mg)	37650	32800	38860	45120
Coliform (no/mg)	10200	11160	13360	21480
E. coli (no/mg)	21360	18040	20220	19940

Microbial count in intertidal zone is higher comparatively at subtidal locations.

The significantly high microbial counts as evident in the shore water similar to the creek suggested the wide-spread contamination by sewage. The sediments also sustained high microbial counts in the creek as well as the offshore region of Versova. Overall, even as per the historic data, Versova creek showed the highest average bacterial counts both in water and sediment for the coastal Maharashtra, ref MPCB, Part A & B Report, NIO-Mumbai, Dec 2009.

3.7.3.1 Phytoplankton

The marine health status was primarily studied through parameters like chlorophyll, phaeophytin, cell density and generic diversity study, summarized in table below:

Table 3.24: Phytoplankton standing stock at Versova

Station	V1		V2		V3	
Water Level	S	B	S	B	S	B
Chlorophyll (mg/m^3)	3.2	3.8	2.6	1.4	3.9	0.8
Phaeophytin (mg/m^3)	1.4	1.2	0.9	0.6	1.4	0.4
Cell Count ($no \times 10^3/L$)	28.8	33.6	32	21.6	39.2	13.6
Total Genera (No)	18	13	16	15	17	13
Major Genera	*Skeletonema Thalassiosira Chaetoceros Nitzschia*	*Chaetoceros Thalassionema Pleurosigma Thalassiosira*	*Thalassiosira Rhizosolenia Nitzschia Cyclotella*	*Skeletonema Rhizosolenia Navicula Pleurosigma*	*Thalassiosira Guinardia Skeletonema Pseudonitzschia*	*Navicula Thalassiosira Nitzschia Pseudonitzschia*
Shannon Index	2.32	1.93	1.99	2.4	2.06	2.5

The Chlorophyll-a ranges from 0.8-3.9 mg/m^3, with showing low chlorophyll at bottom of V2 & V3 with highest chlorophyll at surface of station V3; phytoplankton population density ranges from 13.6-39.2 x 10^3/L, as same pattern at Station V3; total generic groups range from 13-18 nos., lowest at V3 (Bot) and highest at V1(Sur); respectively. Total Generic groups were noted as 30 of which, *Thalassiosira*, Chaetoceros, Skeletonema and *Nitzschia* are the major Genera noted in all 3 stations followed by rest of commonly observed genera like, *Navicula*, *Pleurosigma* and *Pseudonitzschia* etc.

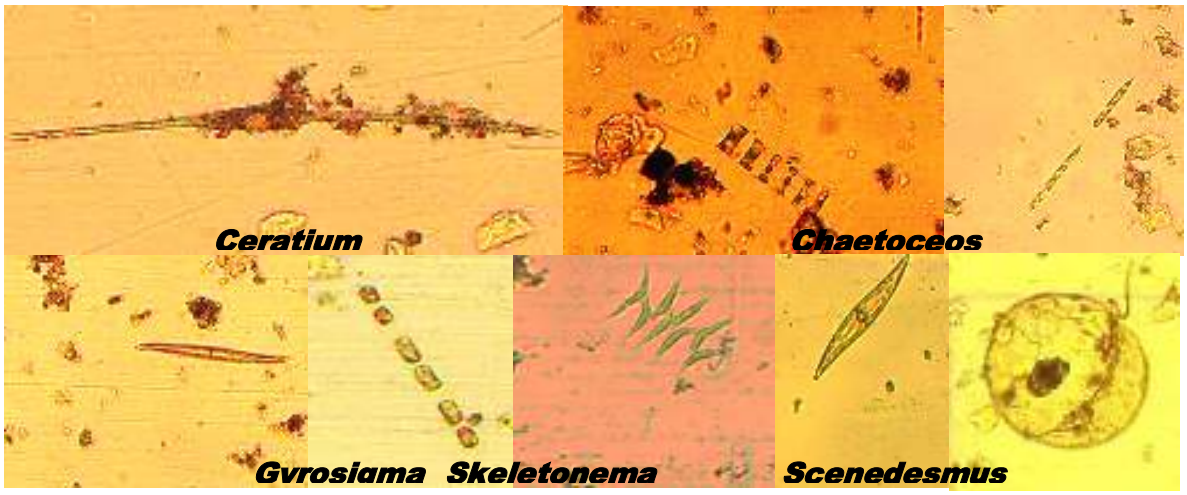


Figure 3.39: Phytoplankton found at Versova

Graphical representation of chlorophyll and phytoplankton population and genera is given in figure 3.41.

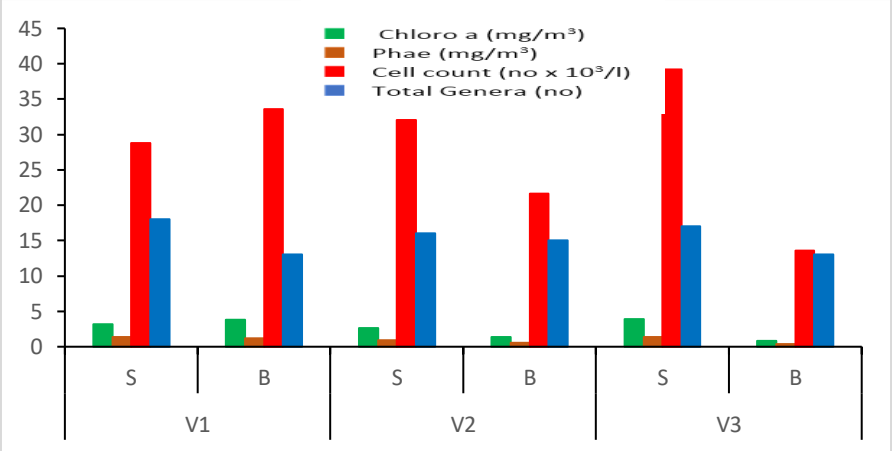


Figure 3.40: Phyto-pigments, cell count and generic diversity at Versova

Table 3.25: Phytoplankton composition (%) at Versova

	V 1		V 2		V 3	
Phytoplankton	Surface	Bottom	Surface	Bottom	Surface	Bottom
Thalassiosira	11.1	4.8	50.0	3.7	42.9	11.8
Navicula	2.8	0.0	2.5	7.4	2.0	11.8
Skeletonema	38.9	2.4	2.5	29.6	12.2	5.9
Nitzschia	5.6	2.4	7.5	7.4	2.0	11.8
Prorocentrum	2.8	0.0	0.0	0.0	0.0	0.0
Chaetoceros	5.6	40.5	2.5	3.7	2.0	0.0
Eucampia	2.8	0.0	0.0	0.0	0.0	0.0
Ceratium	2.8	0.0	2.5	0.0	2.0	5.9
Pinnularia	2.8	0.0	0.0	0.0	0.0	0.0
Pleurosigma	2.8	11.9	2.5	7.4	2.0	5.9
Rhizosolenia	2.8	4.8	7.5	11.1	2.0	5.9
Thalassionema	2.8	19.0	2.5	3.7	2.0	5.9
Gyrosigma	2.8	2.4	0.0	0.0	2.0	0.0
Meliora	2.8	0.0	0.0	0.0	0.0	0.0
Coscinodiscus	2.8	2.4	0.0	3.7	2.0	0.0
Noctiluca	2.8	2.4	2.5	3.7	0.0	0.0
Guinardia	2.8	0.0	2.5	0.0	14.3	0.0
Amphiprora	2.8	2.4	0.0	3.7	0.0	0.0
Cyclotella	0.0	0.0	5.0	3.7	2.0	5.9
Ditylum	0.0	2.4	0.0	0.0	0.0	0.0
Surirella	0.0	2.4	0.0	3.7	0.0	0.0
Leptocylindrus	0.0	0.0	2.5	0.0	0.0	0.0
Scenedesmus	0.0	0.0	2.5	0.0	0.0	0.0
Pseudonitzschia	0.0	0.0	2.5	0.0	4.1	11.8
Biddulphia	0.0	0.0	2.5	0.0	0.0	0.0
Peridinium	0.0	0.0	0.0	3.7	2.0	0.0
Thalassisothrix	0.0	0.0	0.0	3.7	0.0	0.0
Bacteriestrum	0.0	0.0	0.0	0.0	2.0	5.9
Trichodesmium	0.0	0.0	0.0	0.0	2.0	5.9
Anabaena	0.0	0.0	0.0	0.0	0	6
Total	100	100	100	100	100	100

The phytoplankton standing stock in terms of chlorophyll and cell counts, was in the lower range except for generic diversity.

3.7.3.2 Zooplankton

The secondary level biotic component of marine life was assessed through zooplankton standing stock.

The zooplankton biomass 7.7-13.2 ml/100m^3 observed low with population density of 35-45 no x10^3/100m^3 while having faunal group ranging from 12-15nos. The zooplankton standing stock was invariably low in the creek system i.e., was noted with low biomass and low population but with better faunal group diversity which was normal without any distinct trend. Copepods, Decapod larvae, Gastropods & fish eggs were common groups observed in samples.

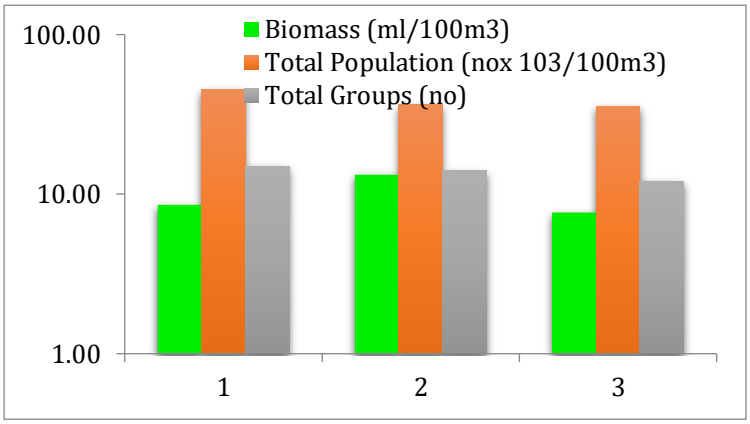


Table 3.26: Zooplankton Standing Stock

Stn	Biomass (ml/100m^3)	Total Population (no x 10^3/100m^3)	Total Groups (no)	Shannon Diversity Index	Major Groups
1	8.54	45	15	0.837	Copepoda, Decapod larvae, Gastropods, Fish Eggs
2	13.16	36	14	1.037	Copepoda, Decapod larvae, Gastropods, Foraminiferans
3	7.69	35	12	1.258	Copepoda, Foraminiferans, Gastropods, Decapod larvae
	7.7-13.2 (9.8)	35-45 (39.0)	12-15 (14)	-	Copepoda, Decapod larvae, Gastropods, Fish eggs

Table 3.27: Zooplankton % Composition

Sr No	Groups	1	2	3	%
1.	Amphipods	0.03	0.08	0.04	0.05
2.	Chaetognaths	1.10	1.01	1.06	1.06
3.	Copepoda	79.91	74.68	76.83	77.14
4.	Decapoda larvae	10.73	10.33	4.31	8.46
5.	Fish Eggs	1.82	2.02	2.55	2.13
6.	Fish Larvae	1.47	1.85	2.12	1.81
7.	Foraminiferans	0.64	2.50	5.33	2.82
8.	Gastropods	2.15	4.60	4.70	3.82
9.	Isopods	0.16	0.22	0.67	0.35
10.	Lamellibranch	0.80	0.62	0.55	0.66
11.	Lucifer	0.48	1.15	1.10	0.91
12.	Medusae	0.08	0.00	0.00	0.03
13.	Polychaetes	0.43	0.76	0.74	0.64

Sr No	Groups	1	2	3	%
14.	Stomatopods	0.03	0.06	0.00	0.03
15.	Mysids	0.16	0.00	0.00	0.05
16.	Cumacean	0.00	0.11	0.00	0.04
	Total	100	100	100	100

Similar to phytoplankton, the zooplankton standing stock in terms of biomass and population density was also found low except for faunal group diversity.

- **Benthos**

The faunal diversity observed is low suggesting that the environmental conditions at the creek sediment were not favourable for benthic organisms. The benthic fauna was entirely dominated by polychaetes. The percentage population are represented in graphical form in figure 3.42

Sub-tidal Benthos:

Macro benthos studies showed indifferent benthic pattern. Macro-benthic biomass ranged from 4.57-6.37gm/ m^2 with population ranging from 624.9-749.9no x $10^2/m^2$). The faunal group found were majorly Polychaetae & nematodes.

Intertidal Benthos:

Macro benthos studies showed indifferent benthic pattern. Macro-benthic biomass ranged from 1.14-3.47gm/ m^2 with population ranging from 41.7-541.6 no x $10^2/m^2$). The faunal group found were, Crab, Polychaetes & Gastropods.

Table 3.28: Benthic fauna in study area of Versova

Stations/ Transects		Biomass (gm/m^2)	Population Density (no/ m^2)	Major Faunal group	Shannon Diversity Index
Subtidal					
A1		Hard Bottom			
A2		4.57	624.90	Polychaete, Nematode	1.044
A3		6.37	749.88	Nematode, Polychaete	1.322
Overall		4.57-6.37 (5.47)	624.9-749.9 (687.4)	Polychaete, Nematode	1.18
Intertidal					
ITR 1	H.W	1.14	83.32	Crab, Polychaete	0.000
	M.W	3.47	166.64	Gastropod, Crab	1.040
	L.W	3.07	541.58	Nematode, Polychaete	1.378
ITR 2	H.W	1.49	41.66	Gastropod	0.000
	L.W	1.83	416.60	Polychaete	1.055
Overall		1.14-3.47 (2.2)	41.7-541.6 (250)	Crab, Polychaetes, Gastropods	3.47

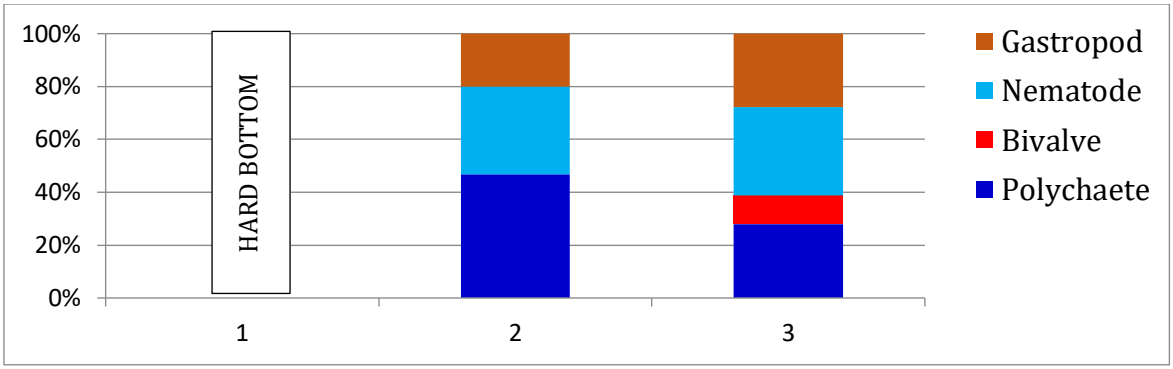


Figure 3.41: Subtidal Benthic Composition of MFDC Andheri

Table 3.29: Subtidal benthic composition at Versova

Stations	A1	A2	A3
Polychaete	Hard Bottom	46.7	27.8
Bivalve		0.0	11.1
Nematode		33.3	33.3
Gastropod		20	28
Total		100.0	100.0

Table 3.30: Intertidal benthic composition at Versova

Transects	ITR 1			ITR 2	
	H.W	L.W	H.W	L.W	H.W
Polychaete	0.00	0.00	23.08	0.00	40.00
Amphipod	0.00	0.00	7.69	0.00	0.00
Crab	100.00	25.00	15.38	0.00	0.00
Bivalve	0.00	25.00	0.00	0.00	20.00
Gastropod	0.00	50.00	7.69	100.00	0.00
Total	100.00	100.00	100.00	100.00	100.00

3.7.3.1 Conclusions:

Overall, DO was occasionally low with narrow fluctuations within low values, also the nutrients were quiet low.

The sediment was mainly composed of sandy-silt. The metals content varied in the expected ranges.

Bacterial populations were very high both in water and sediment suggesting pathogenic contamination associated with sewage disposals.

Results shows comparatively low chlorophyll, phytoplankton & zooplankton standing stock, showing stressed marine environment.

Benthic population doesn't show any specific trend instead indicated low benthic potential. The benthic fauna was entirely dominated by polychaetes indicating severity of organic pollution.

Benthic loss of 604Kg **@3.1 gm/m²** was calculated aggregating the no of observations from Subtidal/Intertidal/benthic stations affected by project activity.

Amongst the sampling locations, the richness and evenness of plankton is represented through Shannon diversity index.

The reasons to above results may be due to the creek drying during low tide except for a narrow channel extending 5-6 km inland with poor flushing. Hence the creek receives large quantum of anthropogenic wastes and indicates organic pollution, with overall, the indication of deteriorated water quality in the creek system viz; low DO, inconsistent nutrients and very high bacterial counts associated with organic load.

Thus, the data reveals severity of degradation of the creek environment & this may be as discussed above, Coz though the sewage must have been treated in aerated lagoons before being released in the Versova Creek but either the volume released is much higher than the creek could assimilate or aerated lagoons would be mal-functioning.

3.7.4 Mangrove

The proposed Site is devoid of Mangroves, but has few mangroves belt nearby on either bank of Versova creek. The mangrove has uniform one species i.e., *Avicennia* sp. only also, the surrounding substratum here is sandy & silty with intermittent rocks, constraining further growth in mangrove area.

Figure 3.42: Mangroves near Proposed Site at Versova

3.7.4.1 Mangrove Reserve Forest:

The study area covers mangrove reserve forest and dense mangrove patch were noted around project site. Mangroves of Versova, Juhu, near Madh Jetty road, Madh Village, Darvali are present 531.4 m towards NE, 1.4 km towards SE, 344 m towards West, 270 m towards NNE and 770 m toward N Respectively. Mangrove notified reserve forest area is mentioned in table. Species of vegetation include *Avicennia sp., Acanthus ilicifolius, Ceriops tagal* etc. were observed. Out of which *Avicennia sp*. is dominant. Total forest area and Notified forest area for mangrove reserve forest is shown in Table as per 17th September 2013 Notification from" Office of the Divisional Commissioner, Kokan Division, Kokan Bhavan" for Andheri, Borivali Taluka respectively.

Figure 3.43: Map showing Mangrove reserve forest in study area

Table 3.31 Mangrove Reserve Forest present within Study area

Sr. No.	Village	Total Area (Ha)	Notified Area (Ha)
1.	Juhu	6.61	6.11
2.	Versova	32.90	32.88
3.	Kandivali	28.95	0
4.	Gorai	116.54	0

Sr. No.	Village	Total Area (Ha)	Notified Area (Ha)
5.	Charkop	95.82	45.3304
6.	Borivali	230.63	50.04
7.	Gorai	493.27	493.2484
8.	Pahadi Goregaon	0.8	0.8
9.	Valnai	0.69	0.69
10.	Malvani	335.57	260.626
11.	Marve	6.62	5.62
12.	Akse	2.31	2.31
13.	Erangal	36.855	36.345
14.	Darvali	91.29	91.16
	Total	1478.855	1025.1598

Table 3.32 List of mangroves species reported in Study Area

Sr. No.	Scientific Name	Common Name	Family	Type
1	*Acanthus ilicifolius*	Sea Holly	Acanthaceae	Mangrove shrub
2	*Avicennia alba*	Tiver	Avicenniaceae	Mangrove Tree
3	*Avicennia marina*	Grey mangrove	Avicenniaceae	Mangrove Tree
4	*Avicennia officinalis*	Indian mangrove	Avicenniaceae	Mangrove Tree
5	*Aegiceras corniculatum*	River mangrove	Moringaceae	Mangrove herb
6	*Bruguiera gymnorrhiza*	Burma mangrove	Rhizophoraceae	Mangrove Tree
7	*Ceriops tagal*	Tagal Mangrove	Rhizophoraceae	Mangrove shrub
8	*Rhizophora mucronta*	Asiatic mangrove	Rhizophoraceae	Mangrove Tree
9	*Lumnitzera racemosa*	Black Mangrove	Combretaceae	Mangrove Shrub
10	*Kandelia candel*	Kandal	Rhizophoraceae	Mangrove Tree
11	*Excoecaria agallocha*	Milky mangrove	Euphorbiaceae	Mangrove Tree
12	*Carallia brachiata*	Fresh water Mangrove	Rhizophoraceae	Mangrove Tree
13	*Heritiera littoralis*	Looking Glass Mangrove	Sterculiaceae	Mangrove Tree
14	*Sonneratia caseolaris*	Apple Mangrove	Sonneratiaceae	Mangrove Tree
15	*Sonaratia alba*	Mangrove apple	Lythraceae	Mangrove Tree
16	*Sonneratia apetala*	Sonneratia	Lythraceae	Mangrove Tree

The other plants reported which are associated with mangroves in the study area as listed below:

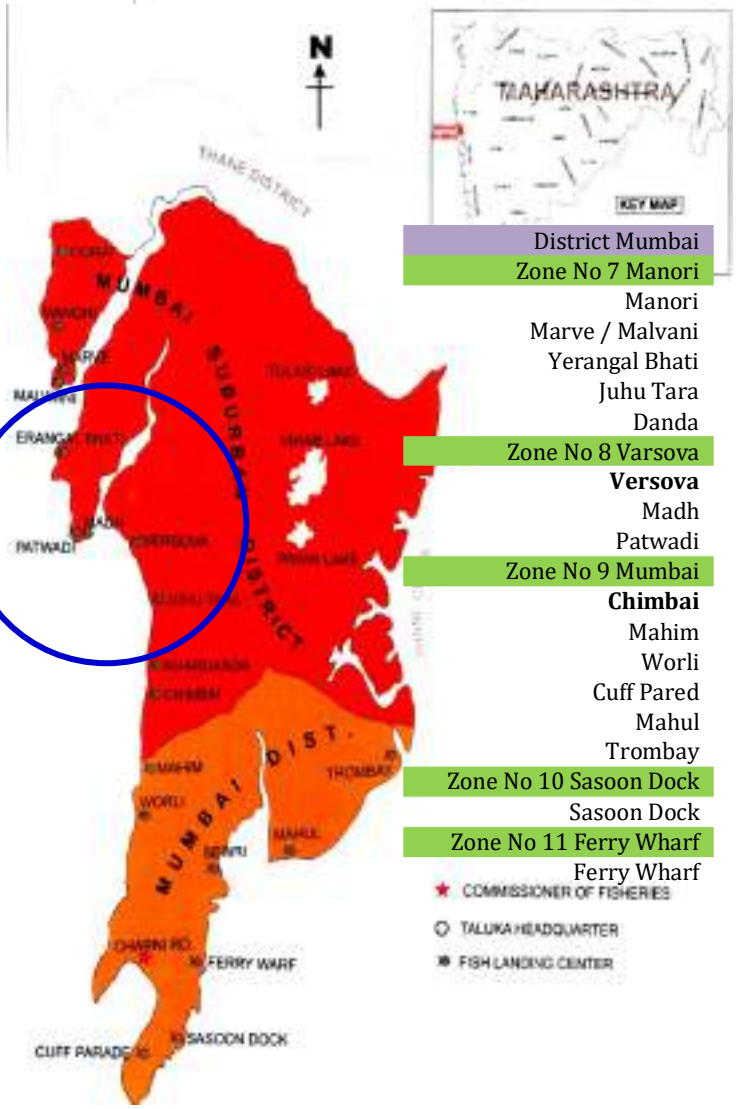
Table 3.33 List of reported Mangrove associate plant species

Sr. No.	Scientific Name	Common Name	Family	Type
1	*Hygrophila schulli*	Marsh Barbel	Acanthaceae	Mangrove associated herb
2	*Caesalpinia bonduc*	Marsh Barbel	Acanthaceae	Mangrove associated herb
3	*Derris scandens*	Jewel Vine	Acanthaceae	Mangrove associated climber
4	*Deris trifoliata*	Common Deriss	Fabaceae	Mangrove associated climber
5	*Sesuvium portulacastrum*	Sea purslane	Aizoaceae	Mangrove associated shrub
6	*Clerodendron inerme*	Glory Bower	Verbenaceae	Mangrove associated shrub

Sr. No.	Scientific Name	Common Name	Family	Type
7	*Lantana camera*	Lantana	Verbenaceae	Mangrove associated shrub
8	*Alternanthera sessilis*	Sessile Joyweed	Amaranthaceae	Mangrove associated shrub
9	*Ipomoea pes-caprae*	Goat Foot Vine	Convolvulaceae	Mangrove associated climber
10	*Ipomoea stolonifera*	Morning-Glory	Convolvulaceae	Mangrove associated climber
11	*Calotropis gigantea*	Madar	Apocynaceae	Mangrove associated shrub
12	*Zizihpus zizihpus*	Bor	Rhamnaceae	Mangrove associated shrub
13	*Fimbristylis ferruginea*	Rusty Sedge	Cyperaceae	Mangrove associated herb
14	*Cyperus rotundus*	Common nut sedge	Cyperaceae	Mangrove associated herb
15	*Cyperus scariosus*	Umbrella sedge	Cyperaceae	Mangrove associated herb
16	*Euphorbia hirta*	Asthma weed	Euphorbiaceae	Mangrove associated herb
17	*Salvadora persica*	Meshwak	Salvadoraceae	Mangrove associated shrub

3.7.5 Fishing:

Maharashtra State is one of the major Marine states in India. The State has about 173 fish landing centres along its 720 Km long coastal line spread all over the five maritime districts viz. Thane, Mumbai and Suburban, Raigad, Ratnagiri and Sindhudurg. The continental shelf area up to 40 fathoms i.e., 55,529 sq. kms (50% of the total continental shelf, State) is being exploited. There are 25 Zones in the 5 districts & the detailed zone-wise Landing centres of Mumbai District are represented here as the proposed project site "Versova" falls in Zone 8 in the figure below, itself being the Versova Zone, including Versova, Madh & Patwadi & lately also Chimbai has been included under this zone.



Source: Annual Report Department of Fisheries GoM, 2017

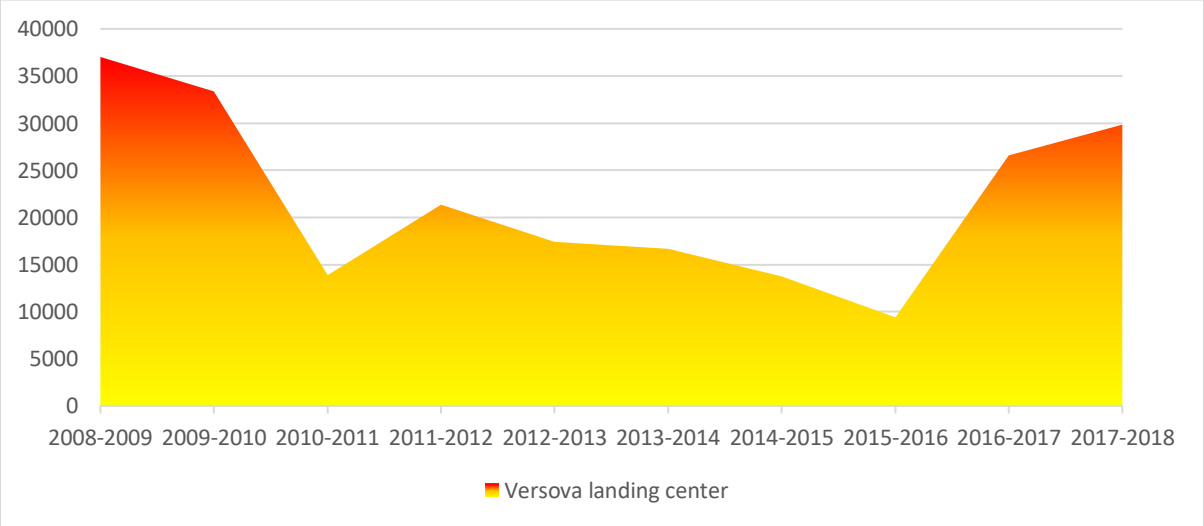
Figure 3.45: Locations of Fish Landing Centers in Mumbai

The proposed site at Versova is engaged in fishing activities. Versova is northerly coastal area in Andheri Tehsil of Mumbai Suburban district bordering with Borivali tehsil. It is about 5 Km from the Tehsil Headquarter Andheri. Fishing is a traditional activity of fishermen for last many centuries in this region. The working registered agency here for fishermen viz Vesava Machhimar Vividh Karyakari Sahakari Society Limited.

Yearly fish catch/production comparison for 10 years was studied, and graphical presentation given as below, which reveals steady gain towards gradual increase in yearly fish catch.

Table 3.34: Historical data of Versova Fish landing centre

Year	Versova Zone (Versova, Madh, Patwadi)	Versova landing centre		
	Fish Catch (M Ton/Yr)	Fish Catch (M Ton/Yr)	Mech Boats	Non-Mech Boats
2008-2009	53561	37026	411	20
2009-2010	46594	33342	411	0
2010-2011	23622	13906	385	0
2011-2012	45788	21341	446	35
2012-2013	51218	17433	393	35
2013-2014	48783	16687	380	15
2014-2015	38787	13719	343	25
2015-2016	32186	9367	338	25
2016-2017	40710	26556	338	25
2017-2018	47470	29866	322	25



About 33 varieties are found off Mumbai coasts. The percentage of the production in Mumbai city is 66% of the state potential.

Trawl fishing, Bagnet fishing, Gillnet fishing, Purseine, Long lines and Rampan fishing are the principal fishing methods adopted.

Table 3.35: Common Fish observed off Mumbai coasts

Sr No	Scientific/ Group Name	Common/English Name	Local Name in Marathi
1	Anchoviella	Golden Anchovye	Mandelli
2	Black Pomfrets	Black Pomfrets	Halwa
3	Bregmaceros/ Macelelendi	Unicorn cod.	Tendali
4	Carangids Small	Other Carangids	Kokari, Toki
5	Caranx	Horse Mackerel	Kharba Bangada
6	Cat Fish	Cat Fish	Shingada
7	Cephalopoda	Cuttle Fish	Mhakul
8	Chirocentrus	Silver bar/Walf Heming	Karli & Datali
9	Eels	Eels	Wam
10	Elasmobranchs	Shark & Rays	Mushi & Pakat

Sr No	Scientific/ Group Name	Common/English Name	Local Name in Marathi
11	Harpodon Nehereus	Bombay Duck	Bombil
12	Hilsa Ilisha / Toli	Hilsa Shad & Giant Herrings	Bhing &Palla
13	Lactarius	Big-Jawed Jumper	Soundala
14	Leiognathus	Pony Fish	Khap
15	Lobsters	Lobster	Shewand
16	Mackerel	Indian Mackerel	Bangada
17	Non-Penaeid Prawns	Shrimp	Jawala, Karandi
18	Other Clupeids	White Sardines	Bhiljee,Khavali
19	Otolithes species	Cracker	Dhoma, dhodi
20	Penaid Prawns	Prawn	Kolambi
21	Perches	Groupers	Karkara,Khajura
22	Polynomids	Thread Fins	Dadha & Rawas
23	Pomfrets	Pomfret	Saranga
24	Red Snapper	Red Snapper	Tamb
25	Ribbon Fish	Ribbon Fish	Bala & Wakti
26	Sardines	Sardines & Oil Sardines	Pedi & Tarali
27	Sciaenids	Jew Fish & Dori	Ghol & Koth
28	Seer Fish	Seer Fish	Surmai, Towar
29	Soles	Soles	Lep, Bhakas
30	Thrissocles	Mustached Anehovy	Kati
31	Tunnies	Tuna	Gedar, Kupa
32	Upenaids Sp.	Goat Fish	Chirati, Rane
33	Miscellaneous	Miscellaneous (Others)	Sankirna (Itar)

There is need for integrated strategies for balancing the marine fish production with habitat protection, restoration initiatives and harvesting methodologies more so in the hotspots like Mumbai as the coastal marine environment off Mumbai receives indiscriminate discharge of wastes from various sources including domestic wastewater and industrial effluents.

Mumbai is an important metropolis that sustains rich fishery diversity despite being highly urbanized. Fishing is one of the major occupations of a large percentage of population in Mumbai for a number of years; hence the significance of fishery cannot be ignored. But, over the years due to anthropogenic causes like widespread industrialization, developmental activities, population pressure, etc. the marine ecosystem off Mumbai has been getting polluted, threatening the sustainability of its biota.

Table 3.36 Commercially important fish of Mumbai

Scientific Name	Common Name	Family
Stolephorus indicus	Mandelli	Engraulidae
Parastromateus niger	Halwa	Carangidae
Leiognathus equulus	Khap	Leiognathidae
Bregmaceros mcclellandi	Tendali	Bregmacerotidae
Nemipterus japonicus	Rani Fish	Nemipteridae
Rastrelliger kanagurta	Mackerel , Bangada	Scombridae
Otolithes cuvieri	Dhoma, dhodi	Sciaenidae
Caranx bucculentus	Kokari, Toki	Carangidae

Scientific Name	Common Name	Family
Caranx crysos	Kharba Bangada	Carangidae
Lutjanus campechanus	Tamb	Lutjanidae
Arius dussumieri	Shingada	Ariidae
Loligo duvauceli	Cuttle Fish, Mhakul	Loliginidae
Eleutheronema tetradactylum	Dadha & Rawas	Polynemidae
Escualosa elongata	Bhiljee,Khavali,Paturd	Clupeidae
Chirocentrus dorab	Karli & Datali	Chirocentridae
Pampus argenteus	Saranga	Stromateidae
Carcharhinus limbatus	Mushi & Pakat	Carcharhinidae
Harpodon Nehereus	Bombil	Synodontidae
Tenualosa ilisha	Bhing & Palla	Clupeidae
Lactarius lactarius	Soundala	Lactariidae
Lepturacanthus savala	Bala & Wakti	Trachipteridae
Sardinella longiceps	Pedwa,Pedi & Tarali	Clupeidae
Upeneichthys lineatus	Chirati, Rane	Mullidae
Thunnus albacares	Kupa	Scombridae
Thryssa_mystax	Kati	Engraulidae
Cynoglossus bilineatus	Lep,Bhakas	Cynoglossidae
Puerulus sewelli	Shewand	Palinuridae
Acetes indicus	Jawala,Karandi	Sergestidae

The fishing activities reported in Arabian sea present around the project site within study area. The list of fish occurring in these regions is mentioned below:

Table 3.37 Details of Marine life reported in the study area

Sr. No.	Scientific Name	Common Name	Family
Fish			
1.	*Argyrops spinifer*	Red Sea Bream	Sparidae
2.	*Chelon macrolepis*	Bigscale Mullet	Mugilidae
3.	*Coilia dussumieri*	Golden anchovie	Engraulidae
4.	*Congresox talabonoides*	Yellow pike conger	Muraenesocidae
5.	*Cynoglossus arel*	Largescale tonguesole	Cynoglossidae
6.	*Cynoglossus macrolepidotus*	Large-scale tongue sole	Cynoglossidae
7.	*Decapterus russelli*	Indian scad	Carangidae
8.	*Ephippus orbis*	Spadefish	Ephippidae
9.	*Eupleurogrammus muticus*	Smallhead hairtail fish	Trichiuridae
10.	*Euthynnus affinis*	Little Tuna	Scombridae
11.	*Euthynnus affinis*	Eastern Little tuna	Scombridae
12.	*Gerres filamentosus*	Whipfin silver-biddy	Gerreidae
13.	*Glossogobius giuris*	Bar-eyed goby/Tank goby	Gobiidae
14.	*Harpodon nehereus*	Bombay duck	Synodidae
15.	*Himantura bleekeri*	Whiptail Stingray	Dassyatidae
16.	*Himantura gerrardi*	Sharpnose Stingray	Dassyatidae
17.	*Johnius soldado*	Croaker	Sciaenidae
18.	*Lactarius lactarius*	False trevally	Apogonidae

Sr. No.	Scientific Name	Common Name	Family
19.	*Lares calcarifer*	Sea bass	Centropomidae
20.	*Lepturacanthus savala*	Savalai hairtail	Trichiuridae
21.	*Megalaspis cordyla*	Torpedo scad	Carangidae
22.	*Mugil cephalus*	Striped Mullet	Mugilidae
23.	*Muraenesox cinereus*	Daggertooth pike conger	Muraenesocidae
24.	*mystus seenghala*	Catfish	Bagidae
25.	*Nemipterus japonicus*	Japanese threadfin bream	Nemipteridae
26.	*Nemipterus mesoprion*	Mauvelip threadfin bream	Nemipteridae
27.	*Otolithes cuvieri Trewavas,*	Lesser tigertooth croaker	Sciaenidae
28.	*Otolithes ruber*	Tigertooth croaker	Sciaenidae
29.	*Pampus argenteus*	Silver or White Pomfret	Stromateidae
30.	*Pampus chinensis*	Chinese silver pomfret	Stromateidae
31.	*Parastromateus niger*	Black pomfret	Carangidae
32.	*Polynemus tetradactylus*	Indian salmon	Polynemidae
33.	*Priacanthus hamrur*	Moontail bullseye	Priacanthidae
34.	*Pseudorhombus arsius*	Largetooth Flounder	Paralichthyidae
35.	*Rastrelliger kanagurta*	Mackerel	Scombridae
36.	*Scatophagus argus*	Spotted Scat	Scatophagidae
37.	*Sciaena dussumieri*	Dhoma	Sciaenidae
38.	*scoliodon sorrakowah*	Dog Shark	Carcharhinidae
39.	*Stromateus niger*	Black pomfret	Stromateidae
40.	*Tenualosa ilisha*	Hilsa	Clupeidae
41.	*Terapon jarbua*	Three striped Tiger Fish	Terapontidae
42.	*Tetraodon nigroviridis*	Puffer Fish	Tetraodontidae
43.	*Thenus orientalis*	Sand Lobster	Scyllaridae
44.	*Thryssa mystax*	moustached thryssa	Engraulidae
45.	*Tilapia mossambica*	Tilapia	Cichlidae
46.	*Trichiurus lepturus*	Largehead hairtail	Trichiuridae
47.	*Upeneus sulphureus*	Yellow-goatfish	Mullidae
48.	*Upeneus vittatus*	Yellowstriped goatfish	Mullidae
Crabs			
1.	*Ashtoret lunaris*	Moon Crab	Matutidae
2.	*Charybdis (Charybdis) feriata*	Coral crab OR Christian crab	Portunidae
3.	*Portunus sanguinolentus*	Blood spotted swimming crab	Portunidae
Molluscs			
1.	*Atagema osseosa*	Sea slug	Discodorididae
2.	*Atagema tristis*	Sea slug	Discodorididae
3.	*Babylonia spirata*	Sea snail	Babyloniidae
4.	*Belocaulus angustipes*	black-velvet leatherleaf slug	Veronicellidae
5.	*Cantharus spiralis*	Sea snails	Pisaniidae
6.	*Carminodoris grandiflora*	sea slug	Discodorididae
7.	*Carminodoris sp.*	Sea slug	Discodorididae
8.	*Cladobranchia sp.*	Sea slug	Charcotiidae

Sr. No.	Scientific Name	Common Name	Family
9.	*Clypeomorus bifasciata*	Sea snail	Cerithiidae
10.	*Clypeomorus sp.*	Sea snail	Cerithiidae
11.	*Conus achatinus*	Agate Cone	Conidae
12.	*Conus hyaena*	Neogastropod Snails	Conidae
13.	*Crassostrea sp.*	True oysters	Ostreidae
14.	*Cratena pawarshindeorum*	Sea slug	Facelinidae
15.	*Cratena peregrina*	Sea Slug	Facelinidae
16.	*Dendrodoris fumata*	Sea slug	Dendrodorididae
17.	*Dendrodoris nigra*	Sea slug	Dendrodorididae
18.	*Donax scortum*	Wedge Shells	Donacidae
19.	*Doto sp.*	dendronotid sea slug	Dotidae
20.	*Echinolittorina sp.*	Small sea snail	Littorinidae
21.	*Elysia hirasei*	Sea slug	Plakobranchidae
22.	*Erronea pallida*	Pale cowry	Cypraeidae
23.	*Eubranchus virginalis*	Sea sludge	Eubranchidae
24.	*Euchelus asper*	Sea Snail	Chilodontaidae
25.	*Goniobranchus bombayanus*	Cplourful Sea slug	Chromodorididae
26.	*Gyrineum natator*	Sea snail	Cymatiidae
27.	*Hallaxa albopunctata*	Sea slug	Actinocyclidae
28.	*Indothais lacera*	Sunset Siliqua	Muricidae
29.	*Lissachatina fulica*	African Giant Snail	Achatinidae
30.	*Littoraria undulata*	Robust snail	Littorinidae
31.	*Littorina littorea*	Periwinkle Snails	Littorinidae
32.	*Lunarca ovalis*	Blood Ark	Arcidae
33.	*Melampus sincaporensis*	salt marsh snail	Ellobiidae
34.	*Monodonta sp.*	Spiral Babylon Snail	Trochidae
35.	*Mytilus sp.*	Double-banded Creeper	Mytilidae
36.	*Nassarius stolatus*	Sea snail	Nassariidae
37.	*Neripteron violaceum*	Brackish water snail	Neritidae
38.	*Nerita albicilla*	Sea snail	Neritidae
39.	*Orania sp.*	Java Turret Snail	Muricidae
40.	*Palmadusta lentiginosa*	Sea snail	Cypraeidae
41.	*Patellogastropoda sp.*	True Limpets	Patellidae
42.	*Perna viridis*	Asian Green Mussel	Mytilidae
43.	*Peroni asp.*	Sea slug	Onchidiidae
44.	*Pirenella cingulata*	Mud Snails	Potamididae
45.	*Planaxis sp.*	Sea snail	Planaxidae
46.	*Plocamopherus ceylonicus*	Sea slug	Polyceridae
47.	*Polyplacophora sp.*	Chitons	Chitonidae
48.	*Scutus unguis*	Limpet	Fissurellidae
49.	*Semele sp.*	Marine Bivalve	Semelidae
50.	*Semiricinula konkanensis*	Sea snail	Muricidae
51.	*Sepia aculeata*	Needle cuttlefish	Sepiidae

Sr. No.	Scientific Name	Common Name	Family
52.	*Sepia pharaonis*	Pharaoh Cuttlefish	Sepiidae
53.	*Sepiella inermis*	Spineless cuttlefish	Sepiidae
54.	*Siliqua radiata*	Razor Calm	Pharidae
55.	*Subulina octona*	Miniature Awlsnail	Achatinidae
56.	*Tanea lineata*	Sea Snails	Naticidae
57.	*Thais sp.*	Rock Snails	Muricidae
58.	*Tibia insulaechorab*	Arabian Tibia	Rostellariidae
59.	*Trochus maculatus*	maculated top shell	Trochidae
60.	*Turricula javana*	Java turrid	Clavatulidae
61.	*Umbonium vestiarium*	Vesta's Button Top Shell	Trochidae
62.	*Uroteuthis duvaucelii*	Indian squid	Loliginidae
63.	*Uroteuthis duvaucelii*	Squid	Loliginidae
64.	*Venus sp.*	Saltwater calm	Veneridae
65.	*Volegalea cochlidium*	spiral melongena	Melongenidae
Crustaceans			
1.	*Acetes johni*	Acetes johni Shrimp	Sergestidae
2.	*Akiami paste shrimp*	Acetes japonicus	Sergestidae
3.	*Fenneropenaeus merguiensis*	Banana prawn	Penaeidae
4.	*Metapenaeus brevicornis*	Yellow shrimp	Penaeidae
5.	*Parapenaeopsis hardwickii*	Spear Shrimp	Penaeidae
6.	*Parapenaeopsis stylifera*	Kiddi Shrimp	Penaeidae
7.	*Penaeus monodon*	Giant tiger prawn	Penaeidae
8.	*Rainbow Prawn*	Parapenaeopsis sculptilis	Penaeidae
9.	*Solenocera crassicornis*	Coastal mud shrimp	Solenoceridae
10.	*Trachysalambria curvirostris*	Southern rough shrimp	Penaeidae

3.8 Socio Economic Environment

As an integral part of EIA, the socio-economic study includes demographic structure, population dynamics, infrastructure resources, status of human health and economic attributes like employment, per-capita income, agriculture, trade, industrial development, tourist attraction, historic and cultural monuments etc. in the study area. The study of these parameters helps in identification, prediction and evaluation of likely impacts on socioeconomics and parameters of human interest due to proposed project.

The socio-economic data was collected & generated through both sources i.e., primarily by field survey in sampling locations & it has been substantiated with relevant socio-economic data from secondary sources i.e., concerned office's documented records. The latest available primary & secondary data have been complied & amalgamated to delineate the existing baseline scenario of socio-economic environment in study area.

3.8.1 Reconnaissance

The Government of Maharashtra has proposed to construct a fishery harbour at Versova to provide fish landing facilities to the fishermen of Versova and surroundings fishing villages to help the displaced fishermen of Versova and nearby fishing villages.

Fishery is an important sector in India. It provides employment to millions of people and contributes to food security of the country. Maharashtra has 720 km. of coastline with the continental shelf area of 111512 sq. km. There are as many as 32 inland varieties of fish produced in this state. Brihanmumbai and Thane are the only two major regions of the state accounting for bulk of the total inland fish production. Continued growth in fish production with increase in fish exports have the potential for increasing the living standards of fishermen. For uplifting fishery sector and socio-economic status of in Versova fisherfolk above said project has proposed.

The socio-economic study helps in identification, prediction and evaluation of likely impacts on socioeconomics and parameters of human interest due to proposed project. The socio-economic study in the present case includes demographic structure, population dynamics, infrastructure resources, status of human health and economic attributes like employment, per-capita income, agriculture, trade, industrial development, tourist attraction, historic and cultural monuments etc. in the study area. Due to this study, it will helpful to understand the study area and its characteristics.

3.8.2 Methodology

The study used both primary and secondary data. For the primary data collection, structured questionnaires were used by survey team. For the survey purpose, there were two types of survey format has been used, these were Focus group discussion (FGD)and fishermen format. These formats include all type of village information like demographic details, infrastructure details, fishermen details etc. For focus group discussion male, female group, fishermen group were interviewed in open spaces like community hall, school ground, fishermen cooperative societies etc. Direct observation during transit walks in fish markets, fisherfolk areas was also performed by the survey team. For the selection of location mainly fishermen communities chosen for the survey (6 locations). In each FGD at least 4 to 5 respondents were present and gave their opinion, suggestion, demands during survey. Random sampling used by surveyor for respondents (Male-female, young, elder population covered under FGD).

For FGD with fishermen cooperative society members, survey team visited at cooperative society offices and informed their members about the survey 1 day before and visited again for survey purpose. To collect the fishermen data, team visited at fish landing centre, at net mending sheds, fish market etc.

Sampling location of primary data collection & public consultation photographs are presented below.

Objectives of the study

- To prepare baseline data based on secondary & Primary sources
- To know the existing infrastructure facilities in the fishermen community, major needs of the fishermen community
- Impact due the proposed project on fishermen community/surrounding areas

Table 3.38 Distance & Direction of Surveyed Villages/Towns from Project Site.

Sr. No.	Surveyed Village/Town	Distance from project site (km)	Direction from site (approximate)
1	Versova	0	East

Sr. No.	Surveyed Village/Town	Distance from project site (km)	Direction from site (approximate)
2	Bhati/Yerangal Bhati	2.70	North West
3	Manori	7.40	North West
4	Madh	1.00	West
5	Juhu Moragaon	3.10	South East
6	Chimbai	9.30	South East

Visit in Versova fishermen cooperative society

Group discussion in Versova

Group discussion in Versova

Group discussion in Manori

Visit in Versova fishermen cooperative society Group discussion in Chimbai
Discussion with Fishermen Community at Mad Talapsha

Figure 3.46 Survey photographs (Public consultation)

3.8.3 Demographic Structure of the Study Area

The socio-economic data was collected & generated through secondary source. Secondary data collected from documented record of 2011 CD from Directorate of Census Office, Town directory 2011, various Websites & Google Earth.

Latest available data have been compiled to delineate the existing baseline scenario of socio-economic environment in study area. Details of various facets of socioeconomic environment

are described below & detailed wards wise tables pertaining to each of the aspects are presented in **Annexure IX.**

As per Census 2011, there are 29 wards coming from Mumbai Sub Urban district, MH in the 10 km radius study area

Demographic structure of the study area was studied in terms of selected parameters such as households, population, density, sex ratio, scheduled caste, scheduled tribes, literacy etc. Summarized information of study area is shown below:

Table 3.39 Demographic Summary of the Study Area:

Description	Census 2011
No. of District	1
Area	Total - 29 Wards
Population: Male (%)	23,56,500(53.72%)
Female (%)	20,29,928(46.28%)
Total	43,86,428
No. of Household	10,08,285
Child Population (0 - 6 years) (%)	4,07,773(9.29%)
Sex Ratio (No. of females per 1000 males)	861
Family Size (person per household)	4.35

Scheduled Caste (%)	182793(4.16%)
Scheduled Tribe (%)	47302 (1.07%)
Literates (%)	3605441(82.20%)

Source: Primary Census Abstract 2011 Mumbai Sub Urban district, MH

Population, Households & Avg. Family Size: Total population of the study area is 43,86,428 out of which 23,56,500 are males and 20,29,928 are females. There are 10,08,285 households in the study area with average family size is 4.35 persons per household as per 2011 census.

Child Population of Age Group 0 – 6 Yrs.: In the study area children population within the age group of 0 – 6 yrs. are 4,07,773.

Sex Ratio: As per 2011 census record, study area sex ratio is 861 compared similar with Mumbai Suburban District i.e., 860, but lower with Maharashtra State i.e., 929 females per 1000 male.

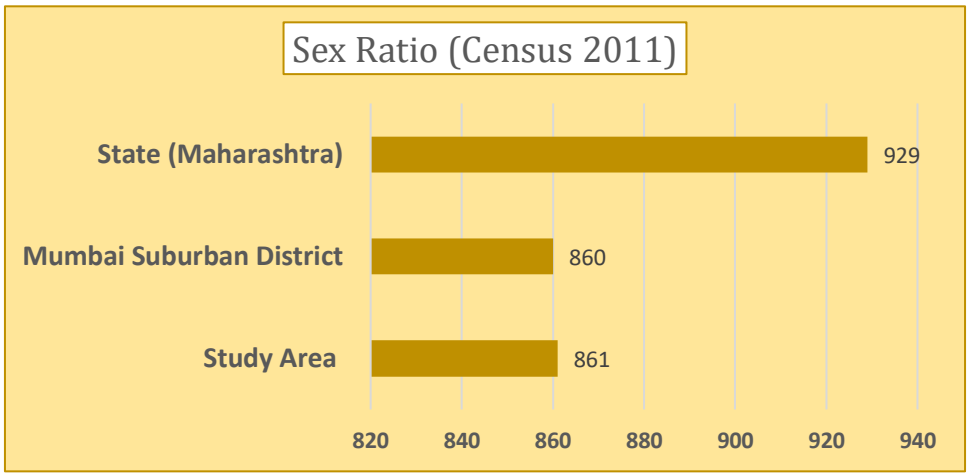


Figure 3.47 Sex ratio

Category Wise population: As per 2011 census, about 4.17% of the population in the study area belonged to Scheduled Castes (SC) and 1.07% to Scheduled Tribes (ST). Thus, indicating that socially backward castes constitute about 5.24% of the population.

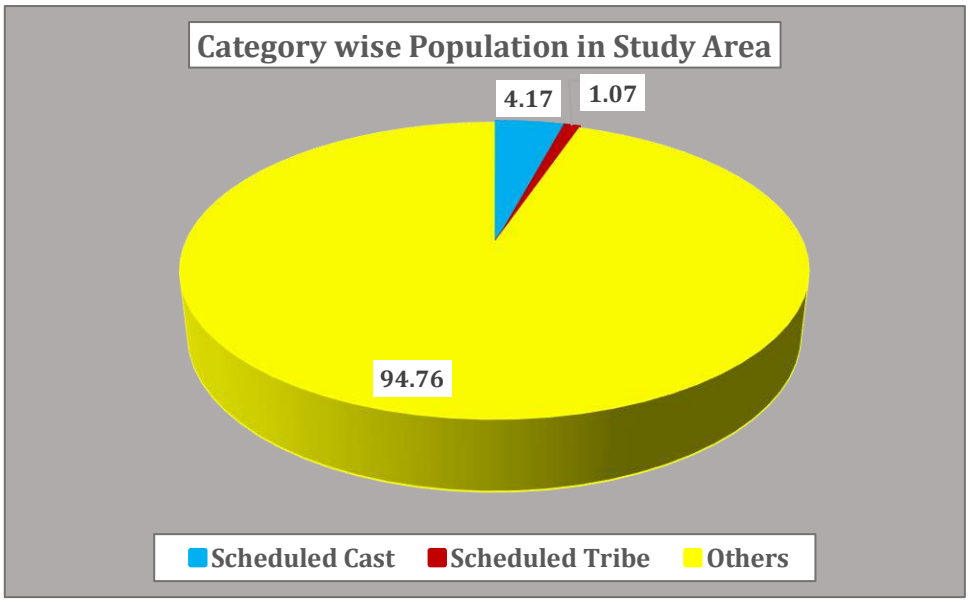


Figure 3.48 Category wise population in the study area

Literacy: Literacy rate of the study area is 82.20% and illiteracy rate is 17.80%.

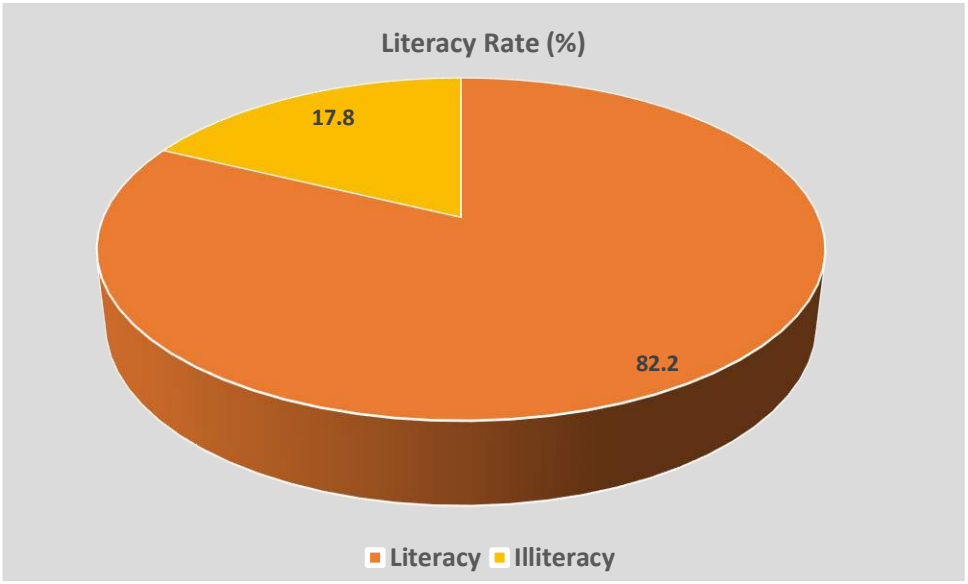


Figure 3.49 Literacy rate in the study area

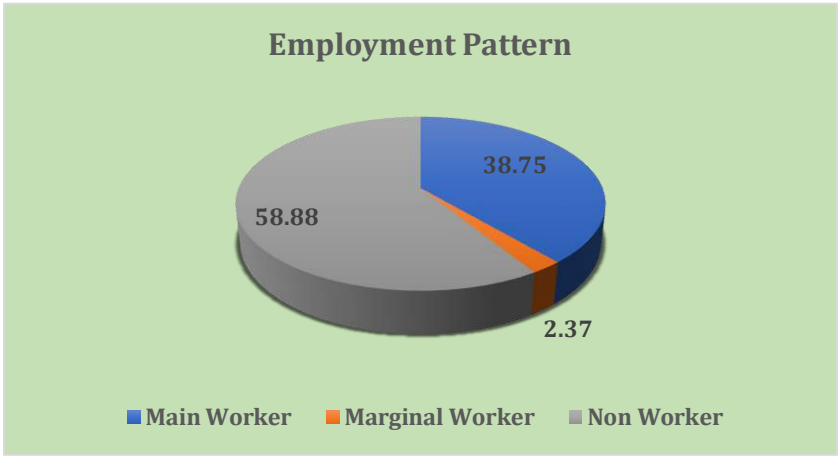
3.8.4 Employment Pattern

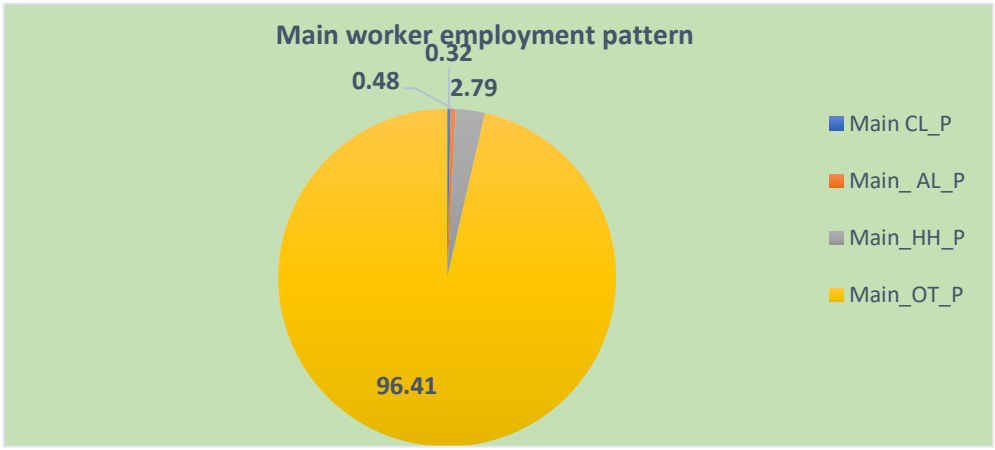
Total worker population is 18,04,038 i.e.,41.12% of total population. Total male workers are 14,00,182 (77.61%) and female workers are 4,03,856 (22.39%). Total main workers were 17,00,144(38.75%) and marginal workers were 10,3894(2.37%). Total non-workers were 25,82,390(58.88%). In the study area there were total 5,490 (0.32%) population was engaged in cultivation. Total 8,163(0.48%) were engaged in agriculture works Household industry workers were 47,450(2.79%) & Other working population was 16,39,041 (96.41%)

Table 3.40 Employment Pattern

Employment Pattern						Main Worker Employment Pattern			
Total Workers	Male Workers	Female Workers	Main Workers	Marginal Workers	Non-Workers	Cultivator	Agricultural workers	Household industry workers	Other Workers
1804038	1400182	403856	1700144	103894	2582390	5490	8163	47450	1639041

Source: Primary Census Abstract 2011 Mumbai Sub Urban district, M





Study area is totally urban area. All ward area comes under Mumbai Suburban district, Maharashtra. Below given details are taken from Town handbook 2011 of Maharashtra. Mumbai city is class I city and it has Municipal corporation. Mumbai suburban is densely populated city and availed all types of major infrastructure facilities.

Table 3.41 Town details

Town Name	Greater Mumbai (M Corp.) Part
Class	I
Civic Status of Town	M Corp.
Area (sq. km.)	603.00
Growth Rate Town (Census 2011)	8.3
Density (Census 2011)	15517
Sex Ratio (Census 2011)	860
Bus Route Name	Greater Mumbai
Drainage System	Open/Closed
Protected Water Supply Source-1	Tap water from treated source
Protected Water Supply Source-2	Uncovered well
Manufactured Commodity (First)	Readymade Garments
Manufactured Commodity (Second)	Chemicals
Manufactured Commodity (Third)	Petroleum

Source: Town handbook 2011 of Maharashtra state

3.8.5 Marine fisheries census details of fishermen villages covered under proposed project

Village summary

Details of 7 fishermen villages has been taken from marine fisheries census 2010, to know the fishermen village details, religion details, occupation profile, ownership of carts etc. Versova & Khar Danda village has more than 4000 population. Total 3974 fishermen families residing in 7 villages, all families are traditional fishermen families. Details presented below.

Table 3.42 Village summary

Sr. No	Taluka	Name of the village	Fishermen families	Traditional fishermen families	BPL families	Fisher folk population
1	Gr. Mumbai	versova	1072	1072	19	4943
2	Gr. Mumbai	Madh	724	724	2	3253
3	Bandra	Khar danda	849	834	431	4423
4	Bandra	Bandra Chimbai	39	39	0	162
5	Mumbai	Bhati	165	165	0	698
6	Mumbai	Juhu Tara Koliwada	465	465	1	1755
7	Borivali	Manori	675	675	27	3018
Total			**3989**	**3974**	**480**	**18252**

Source: Marine fisheries census 2010, state Maharashtra

3.8.6 Population distribution:

Population distribution details indicates 51.55% population is male and 48.45% population is female. Details presented below.

Table 3.43 Population distribution

Sr. No	Name of the village	Adult Male	Up to 5 yrs	above 5 yrs	Adult Female	Up to 5 yrs	above 5 yrs	Total
1	versova	1962	171	452	1825	195	338	4943
2	Madh	1193	112	371	1178	103	296	3253
3	Khar danda	1491	262	505	1405	255	505	4423
4	Bandra Chimbai	61	4	15	62	6	14	162
5	Bhati	281	32	73	245	21	46	698
6	Juhu Tara Koliwada	696	73	122	693	64	107	1755
7	Manori	1156	98	280	1105	83	296	3018
Total		**6840**	**752**	**1818**	**6513**	**727**	**1602**	**18252**

Source: Marine fisheries census 2010, state Maharashtra

3.8.6.1 Family size & sex ratio details

Average family size is 4.41 for all villages, data indicates majority of the families are nuclear families. In Bandra Chimbai sex ratio is highest which is 1025 females to 1000 males. Details presented below.

Table 3.44 Family size & Sex ratio

Sr. No	Name of the village	Average family size	Sex Ratio
1	versova	4.61	912
2	Madh	4.49	941
3	Khar danda	5.21	959
4	Bandra Chimbai	4.15	1025
5	Bhati	4.23	808
6	Juhu Tara Koliwada	3.77	970
7	Manori	4.47	967

Source: Marine fisheries census 2010, state Maharashtra

Religion details

Hinduism is main religion in the villages, 77% families come under this category. After Hinduism Christianity religion is followed by 12% of population. Details presented below

Table 3.45 Religion & community

Sr. No	Name of the village	Hinduism	Islam	Christianity	Others
1	versova	840	61	2	169
2	Madh	396	153	129	46
3	Khar danda	849	0	0	0
4	Bandra Chimbai	39	0	0	0
5	Bhati	112	1	52	0
6	Juhu Tara Koliwada	465	0	0	0
7	Manori	374	1	299	1
Total		**3075**	**216**	**482**	**216**

Source: Marine fisheries census 2010, state Maharashtra

3.8.6.2 Occupation profile

Out of total population, 11.37% population is engaged in full time fishing activity as an active fisherman, 21.90% family members engaged in marketing of fish. Other members are engaged in repairing of net, curing processing, pilling etc. Details are presented below in Table 9 & Figure 6.

Table 3.46 Occupation profile/ No. of members involved in fishing allied activities

Sr. No	Villages	Active fishermen	Marketing of fish	Marketing/repairing net	Curing Processing	Pilling	Labourer	Others	Other than Fishing	Total Occupied
1	versova	317	1095	183	0	0	1358	0	26	**2979**
2	Madh	513	773	343	5	0	387	0	2	**2023**
3	Khar danda	482	1190	216	19	270	34	20	26	**2257**
4	Bandra Chimbai	25	14	0	0	0	0	0	0	**39**
5	Bhati	187	211	1	1	2	74	0	0	**476**
6	Juhu Tara Koliwada	389	449	27	4	0	1	0	2	**872**
7	Manori	162	266	1	0	49	1372	0	26	**1876**
Total		**2075**	**3998**	**771**	**29**	**321**	**3226**	**20**	**82**	**10522**

Source: Marine fisheries census 2010, state Maharashtra

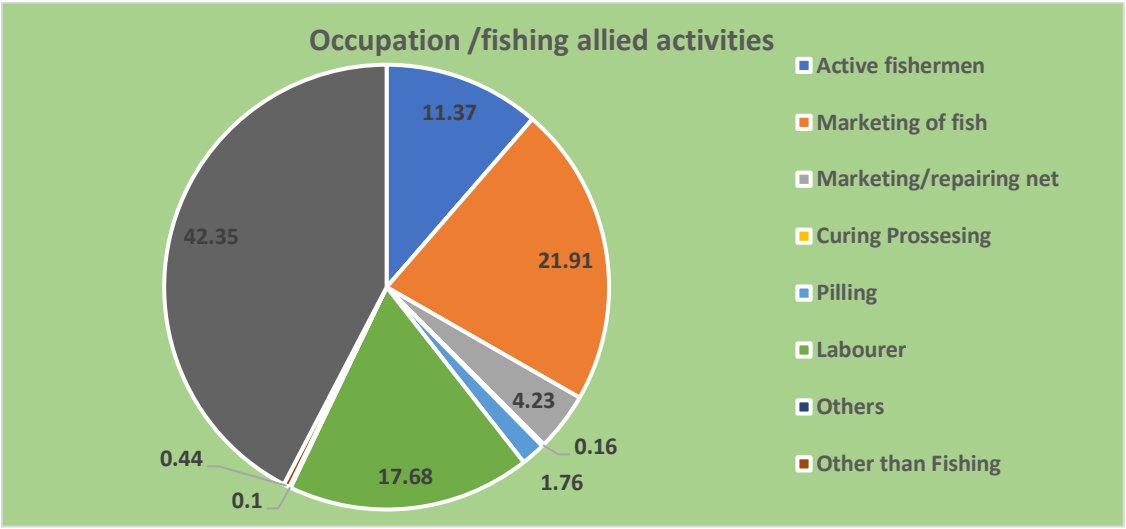


Figure 3.50 Occupation/members engaged in fishing and allied activities

Ownership of craft

Details of craft owned by fisherfolk is presented below. Total 806 mechanized, 51 outboard & 44 non- motorized crafts owned by fisherfolk of 7 villages. Details presented in Table 10.

Table 3.47 Craft owned by fisherfolk full ownership

Sr. No	Name of village	Mechanized	Outboard	Non-Motorized
1	versova	179	3	2
2	Madh	278	21	2
3	Khar danda	125	3	20
4	Bandra Chimbai	9	0	10
5	Bhati	112	0	5
6	Juhu Tara Koliwada	13	17	5
7	Manori	90	7	0
Total		806	51	44

Source: Marine fisheries census 2010, state Maharashtra

3.8.7 Places or Archaeological / Historical / Tourist / Religious Importance

There are various famous tourist places like Archaeological Notified Heritage Sites (declared by Archaeological Survey of India), Historical Places, Religious Places, Picnic Places in study area. Details are presented below:

Table 3.48 Historical/World heritage sites/tourist place (15 km radius)

Sr. No.	Place Name	Specific about Place	Approx. Distance (km) from project site	Approx. Direction
1	Kondivate Caves/Mahakali Caves, Andheri	Notified Heritage Sites	7.58	East
2	Jogeshwari Caves	Notified Heritage Sites	5.76	East
3	Mandapeswar Caves	Notified Heritage Sites	12.82	North East
4	Buddhist Caves, Kanheri	Notified Heritage Sites	13.25	North East
5	Sion Fort	Notified Heritage Sites	12.40	South East
6	Portuguese Church, Mandapeswar	Notified Heritage Sites	12.61	North East
7	Portuguese Monastery, Mandpeshwar	Notified Heritage Sites	12.82	North East
8	Castella de Aguada/Bandra Fort	Historical Place	10.98	South
9	Riwa Fort, Dharavi	Historical Place	12.20	South East
10	Madh Fort	Historical Place	1.14	South West
11	Mahim Fort	Historical Place	11.47	South East
12	Worli Fort	Historical Place	12.94	South
13	Gillbert Hill, Andheri	Historical Place	4.52	South East
14	Basilica of our lady of the mount/Mount Marry Church, Bandra	Historical & Religious Place	10.54	South
15	St. Michael's Church, Mahim	Historical & Religious Place	11.48	South East
16	Siddhivinayak Temple, Prabhadevi	Religious Place	13.90	South
17	Global Vipassana Pagoda, Gorai	Meditation Dome Hall	9.77	North
18	Essel world Amusement Park, Gorai	Picnic Place	10.14	North
19	Sanjay Gandhi National Park, Boriwali	Picnic Place	12.45	South East
20	Film City, Goregaon	Picnic Place	9.00	North East
21	Chota Kashmir Boat Club, Aarey Colony	Picnic Place	7.72	North East
22	Versova Beach	Picnic Place	0.15	South East
23	Aksa Beach	Picnic Place	4.05	North West
24	Juhu Chowpatty Beach	Picnic Place	5.38	South East
23	Morve Beach	Picnic Place	6.38	North
24	Manori Beach	Picnic Place	7.10	North West

Source: Google earth & various websites

Note: All above places are Well-known Tourist Places

3.8.8 Salient observation of survey

About Versova/project site

Versova is the name of a fishing village in Mumbai. In Versova Village there are Nine Gully's as Tere gully No.1 & 2, Budha gully, Patil gully 1& 2, Kharde gully, Goma gully, Bazar gully, Mandvi gully, Dongri gully & Shiv gully. Versova is an upmarket neighbourhood in the Andheri area in northern Mumbai. It is known for its beach and the Versova Fort. Versova is in the suburbs of Mumbai.

About beach /recreation

Versova is, located in the suburb of Andheri. The beach faces the Arabian Sea. A large population of Mumbai's fishing community, the Kolis, resides and are the origins of the Mumbai residing at one end of Versova beach. A continuation of Juhu Beach towards the Andheri suburbs, Versova Beach is comparatively less crowded and only separated by a creek from the former beach. The beach is rather small but is extremely popular for the humongous fish market and the fish auctions held at the spot-on daily basis.

At beach no shops observed during survey, only during evening time hawker's sale refreshment things like Ice-cream, Bhelpuri, Panipuri, Coconut Water etc.

Boats/fishing/types of fish

As per AESPL Socioeconomic Team Survey, there are 300 Mechanized Boats & 100 Non-Mechanized Boats situated at Versova Fish Land Centre, which confirm by 'Vesava Machhimar Vividh Karyakari Sahakari Society Limited'.
As per 'Fish Production Report 2017-18', there are 322 Mechanized Boats & 25 Non-Mechanized Boats situated at Versova Fish Land Centre. Fisherfolk use mainly 'Dol' net which an indigenous bag net operated coast of Versova. This is the gear prefer to use in the Bombay duck fishery. Other type of Fishing Gears is Gill Net, Drag Net, Trawl Net.
Type of fish found near sea area of Versova fish landing centre are Paplet (Pomfret), Surmai (Seer Fish), Kolambi (Prawns), Bombil (Bombay Duck), Mandelli (Golden Anchovy), Shingada (Cat

Fish), Rawas (Thread Fins), Bangda (Indian Mackerel), Mhakul (Cuttle Fish), Wakti (Ribbon Fish) etc.

Existing infrastructure at Versova

Versova fish landing centre area already has some infrastructure facilities:1) Fish Drying Platform 2) Net Mending Shed 3) Boat Repair Facility (stall with materials) 4) Loading – Unloading Platform 5) Jetty/Sloping Ramp 6) Wharf 7) Rest Platform with shed 8) Benches 9) Security Cabin etc.

Petrol/diesel pump

Open Shed of fishermen society

FRP cabin for security guards

Open Shed

Culture & lifestyle

Large scale occupation in this village is fishing. This village is culturally rich and lights up in joy with unique ways to celebrate each of its Festivals. Festivals here are a joy to watch. The most important festival of this Koli community is Narali Pournima, where Golden Coconuts are offered to the sea God. Versova fish festival, an annual festival organized by the Koli community, has a variety of fresh seafood dishes prepared by Koli women.

Koli people speak a variant of Marathi; their dialect is called.

Majority of the houses are 2 storied with small rooms. The houses are closely placed making the entire area congested, interspersed at several places with small courts and open spaces. These form important spaces, where the everyday activities of the fishing community spill out – These spaces are used to clean and repair nets, tools, etc. Most of the activities in the fishing village are done communally.

Importance of Versova Fish Market/Transportation

Versova Village Fish Market: This market starts at around 8 am near Naka/Bus Stand every day; bulk auctions are also conducted at the jetty area. The fishermen bring in all the fish from their trawlers directly on to the beach and the Fishmongers then buy from them and sell it to the general populace in the local markets. There is a fish market available at Versova. Other marketplaces where fish are sent for sale are at Andheri (5km), Marol (10 km), Malad (14 km), Matunga (15 km), Dadar (18 km), Crawford Market/Shivaji Market, Fort (45 km).

Transportation of fish to areas outside Versova by Truck, Tempo, Minidor & for local market by Minidor, Handcart.

Fish market

Women's role in fishing

Women are active participants in this occupation even though they are considered secondary helpers. They actively participate in allied activities such as fish drying, loading and unloading, net mending, retail marketing and fish processing

Fish drying/sorting

Other observation:

Study area is dominantly urban and well developed with all types of infrastructure facilities. Majority of the population is engaged in other works e.g., Labor work, Pvt. job, small business etc. All areas are well connected by roadways, local railways and various type of transportation facilities.

Hospitals, schools, banks etc. are in good numbers in the study areas. Public toilets are observed in the surveyed locations. Density of human structures, such as houses, commercial buildings, roads, is high.

Migration of workforce from other states is observed in the study area. It was observed that fishermen employ migrant labour for fishing, unloading, transportation purpose. Migrant workers migrate for 7-8 months normally, during the rainy season they go back to their hometowns due to lack of fishing activity. Majority of the population speak Marathi; the other languages are Hindi, Agri (Koli language), Gujarati, Telugu etc.




Infrastructure facilities in the form of school, post office, ferry & municipal hospital in Versova area

3.8.9 Expectations/Demand of fishermen cooperative societies

To know the expectations of fishermen cooperative societies, AESPL team visited 10 cooperative societies located in Versova, Danda, Madh, Talapsa, Juhu Morgaon etc. All cooperative societies submitted their expectations/demands in writing; a few of those are presented below:

Table 3.49 Expectations/Demand of fishermen cooperative societies

Vesava Macchimar Vividh Karyakari SAHKARI Society Ltd	Vesava Macchimar Sahkari Society Ltd. Vesava
1. Navigation facilities 2. Breakwater wall 3. Fish Auction hall 4. Net repairing yard 5. Petrol/Diesel pump 6. Drinking water supply/other water supply 7. Cold storage/processing plant 8. Yard for boat maintenance, tie 9. Radio communication towers 10. Restaurants 11. Administration building 12. Approach road	1. Centre for selling fish 2. Petrol/Diesel pump 3. Fish processing centre 4. Fish Auction hall 5. Storage tank for drinking water (1.5 lakh lit) 6. Yard for new boats and maintenance 7. Rest room for khalashi, toilet bathroom 8. Wireless tower 9. Out boat engine for small Boat owner, independent platform 10. Navigation facilities

Vesava Macchimar Vividh Karyakari SAHKARI Society Ltd	**Vesava Macchimar Sahkari Society Ltd. Vesava**
13. Place for bank 14. welfare system for small fishermen 15. Washroom 16. Small Gala for keeping fish business related equipment's 17. Godown for fish merchants 18. Parking place	11. High mass lamp facility for full night 12. Administration building 13. Place for bank 14. Parking place
Vesava kodi Sahkari Sarvodaya Society Ltd	**Vesava Kodi Macchimar Nakhava Mandal (Troller)**
1.Navigation facilities 2.Fish Auction hall 3.Petrol/Diesel pump 4.Ice factory, cold storage, processing plant 5.Breakwater wall 6.Net repairing yard 7.Drinking water supply/other water supply (1.5 Lakh lit) 8.Toilet & bathroom 9.Godown for fish merchants 10.Yard for new boats and maintenance 11.welfare system for small fishermen 12.Parking place	1.Centre for selling fish 2.Petrol/Diesel pump 3.Fish processing centre 4.Fish Auction hall 5.Storage tank for drinking water (1.5 lakh lit) 6.Yard for new boats and maintenance 7.Rest room, toilet & bathroom for Sailors 8.Wireless tower 9.navigation facilities 10.Out boat engine for small Boat owner, independent platform 11.High mass lamp facility for full night 12.Administration building 13.Place for bank 14.Ice factory 15.Place for parking

3.8.10 Perception Regarding harbour & Other Activities

As per Socio-economic Survey, it was observed that locals/fishing communities have a positive opinion about Versova's forthcoming project. But they are unaware about sanctioning of large size or extra infrastructure at fish landing centre of Versova. Versova fisherfolk have been waiting for all sanctioned activities over the last decade. They insist that all sanctioned infrastructure should be only for use by Versova's fisherfolk.

The fishing-based livelihood workforce is favourably disposed towards the establishment of a fishing harbour with all essential post harvesting infrastructural facilities for improved fishing activities and linkages.

Other communities in Versova are neutral/uninterested in the forthcoming project. Locals informed that there is no problem faced by general public due to the fishing boats, but the timing (specially morning) of fish carrying truck/tempo movement leads to traffic jams on the internal road sometimes because of the narrow internal road & heavy auto rickshaw movement (between Versova Jetty to Versova Metro Station/Andheri Station.

During discussion with Versova fisherfolk about the project activities, they gave some suggestions as well as complains. These are given below.

Suggestions/Grievances by Versova Fisherfolk:

1. Benefit of infrastructure of Forthcoming Project should be allowed only for Versova

fisherfolk community [informed by Vesawa Koli Machhimar Nakhawa Mandal (trawlers) members]

2. Fishing in Malad creek is reduced because of polluted/chemical water from various companies at Malad, Goregaon, Jogeshwari. Strict provisions should be followed to reduce chemical water discharge in sea
3. Plastic litter waste is also a big issue in Versova creek and it affects fishing activities badly. Respondents suggest that strict steps should be taken to prevent plastic litter from entering creek areas.
4. Local fisherfolk can't get enough catch because of Purse Seine. So, they want the Govt. to ban Purse Seine & LED fishing, and also follow this rule strictly.
5. Reimbursement of diesel is not given on time by dept of Fisheries. It should be given on time
6. Insurance for damages by natural calamities is not given on time. It should be given on time
7. Fisherfolk are unable to navigate the mire & shallow waters of Malad creek.

3.8.11 Conclusion:

Fishing is one of the major sources of income for persons involved with traditional and non-traditional fisheries in the study area. The fishing population in the study area faces several challenges that have impacted their livelihood to a great extent. The fishermen complained of a lack of basic infrastructure like Breakwater Wall, Cold Storage, Ice plant, Auction Hall, Net Mending Shed, Boat Building & Repairing Yard, Fish Drying Platform, Rooms for various materials related to fisheries, Rest Room, Common Toilet & Bathroom, Water Storage Tank, Approach Road, Permanent equipment facility, navigational aids, Fish Processing Centre, Godown Facility for Fish Traders etc.

To boost the incomes from fisheries, people reflected that this proposed fishery harbour development project should be started as soon as possible.

4 ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

4.1 Introduction

The proposed development of fishing harbour by Maharashtra Fisheries Development Corporation ltd., GoM at Versova fishing harbour will have various impacts on environmental parameters like marine sediment, marine water quality, air quality of surrounding area due to various operations explained in earlier chapter.

4.2 Identification of Impacts

Environmental impact identification is based on the type, scale and location of proposed project activity. Environmental components that may be affected negatively and positively due to proposed activity are identified.

Following parameters are selected for impact assessment due to proposed activity during various phases of the project cycle:

Table 4.1 Environmental Aspects and Impacts of Proposed Project

Sr. No.	Step/Activity	Environmental Aspect	Impact	
			Type	Severity
1.0	Construction of infrastructure facilities & Dredging Activity	Fuel burning, Emission to air (dust)	Air & Noise Pollution	Temporary
		Use of water, energy and materials	Natural resource consumption	Temporary
		Use of manpower	Employment	Temporary
		Waste Discharge on land	Land pollution	Temporary
		Suspension of sediment in marine water	Benthic Biodiversity loss & water pollution	Temporary
2.0	Erection and Commissioning	Waste Disposal	Marine/ Land Pollution	Temporary
		Use of manpower	Employment	Temporary
3.0	Operation	Use of fuel & energy	Natural resource consumption	Permanent
		Air Emission	Air Pollution	Periodically
		Waste disposal	Land Pollution	Permanent
		Noise generation	Noise pollution due to vessel and vehicular movement	Periodically
		Suspension of sediment in marine water	Benthic Biodiversity loss and water pollution	Temporary
		Socio-economic	Will fulfil long standing demand of about 5592 fisher folk residing in Versova	Permanent
4.0	Closure and Decommissioning	Stoppage of use of facility	Revenue & employment loss	Permanent
		Decommissioning	Land pollution	Permanent

4.3 Impact Identification & Mitigation Measures in Construction Phase

4.3.1 Land Environment

Anticipated Impacts

Construction of infrastructure facilities involves generation of solid waste in the form of cut/extra metal pieces, substratum removed during foundation, dredging activity, unused concrete, bricks, packaging materials (cement bags, plastic cans and drums) etc. Hazardous waste generated includes paint containers etc. Improper waste disposal will lead to unhygienic conditions and hazards to nearby populace and marine life.

Mitigation Measures

- Construction team will be trained for collection of solid/ hazardous waste at designated place
- Separate area will be earmarked for storage of solid and hazardous wastes generated during construction phase. After completion of construction phase, hazardous waste will be given to MPCB authorized recyclers
- Substratum removed (including dredging activity), broken pieces of concrete, bricks will be used for filling/ levelling within site itself
- Wastes like iron scrap will be sold to scrap dealers for recycling
- As traffic congestion is expected on Versova Marg/ JP road in Andheri (Figure 4.1), the following measures will be adopted to minimise traffic congestion:
  a) Light and heavy vehicle movement will be segregated on different roads
  b) Traffic of construction vehicles will be scheduled such that it will not coincide with market and school timings.

  These arrangements will help reduce chances of clogging roads in Versova Village.
- Work force will be sourced from Versova, Madh, Malad, Andheri or nearby villages. No camp site for work force will be provided

Figure 4.1 Proposed Transportation Route

4.3.2 Air Environment

Anticipated Impacts

Construction material (concrete, pipes, other ancillary material, machinery etc.) and manpower transport will lead to increase in number of vehicles plying on Jaiprakash road adjacent to site up to Versova by about 8 – 10 nos/ day. However, the existing road has 2 lanes with medium traffic within Versova village. Thus, slight traffic congestion is expected, which will lead to an increase in vehicular exhaust emissions.

Construction of facilities involves operation of concrete mixer, D.G. set, use of excavators, trucks which create localized temporary air emissions. Hence, there will be insignificant impact of construction phase on air environment in study area.

Mitigation Measures

- Screening of construction area near concrete mixers with tin sheets. Wherever possible, ready-mix concrete shall be used instead of concrete mixers.
- Construction machineries will have a valid PUC certificate, and will be well maintained, lubricated and cleaned periodically

4.3.3 Noise & Vibration Environment

Anticipated Impacts

Transportation and actual construction activities (like cutting, operation of concrete mixer, D.G. set, excavators) will increase noise levels in surrounding. This kind of noise and vibrations will be of temporary nature.

Mitigation Measures

- Adequate PPE (earmuffs/ ear plugs) for construction workers.
- Screening of construction area near concrete mixer with tin sheets. Wherever possible, ready-mix concrete shall be used instead of concrete mixers.
- Construction machineries will be maintained, lubricated and cleaned periodically
- Duty hours will be scheduled such that recipients will not be exposed to noise for continuous durations

4.3.4 Water Environment

Anticipated Impacts

Water required will be supplied from existing water supply facility or tankers. About 192 workers from nearby areas will be employed.

Excavation, filling, concreting during piling, construction of quays, dredging activity will result in temporary increase in turbidity and suspended matter.

Mitigation Measures

- Temporary arrangement of drinking water will be provided for workers
- Sanitation provisions (mobile toilets)

- Entire construction activity in intertidal and subtidal areas will be carried out in non-monsoon season during low tide period
- Dredging activity will be carried out by 'Trailing Suction' technique by trained, experienced agency. This method provides control over loose sediment as it gets pumped immediately into the system.
- Use of sea water for curing purposes

4.3.5 Ecological & Biological Environment

Anticipated Impacts

- Construction phase do not envisage any removal of vegetation. Construction activities and vehicular movement will generate noise and particulate matter that disturb flora and fauna temporarily thus insignificant impacts on flora and fauna are envisaged.
- Due to dredging activity and construction activity, benthic organisms will be permanently lost. 604Kg **@3.1 gm/m²** was calculated aggregating the no of observations from Subtidal/Intertidal/benthic stations affected by project activity. Project activity will also increase turbidity in water column which result in less penetration of light and decrease in primary productivity which overall hampers marine ecosystem. Noise, vibration and turbidity compel ichthyofauna to move away, sometimes increase in turbidity may even prove fatal.

- During the construction phase, some of the activities may lead to noise and dust generation which may affect marine fauna and avifauna.
- Impacts from air pollution due to generation of NOx and Sox; Land reclamation can affect marine fauna & avifauna in the project site.
- Precautions will be taken to ensure that construction will not take place during breeding season of fish (monsoon)

Mitigation Measures

- Any damage to mangroves due to construction activity will be strictly avoided
- Entire construction activity in intertidal and subtidal areas (including dredging activity) will be carried out in non-monsoon season during low tide period
- Dredging activity/ creation of basin area will be done with periodic halts. This allows suspended particles to settle down and giving time to flush out water from creek during low tide
- Workers will be encouraged for not to litter and dump wastes indiscriminately. Construction contractor will be asked to impose administrative control by way of charging fine if anyone found violating norms
- Green belt will be developed during construction phase till the completion of project.

Greenbelt Development Plan

The proposed fishery harbour plan provides open spaces within the complex for landscaping. Green spaces within the harbour complex would help reduce the impact of airborne pollutants, provide shade, and improve the aesthetics.

The project site is currently devoid of plants. The project proponent needs to develop a green belt consisting of local species within the premises all along the periphery. Total 19270 m^2 (10% of land area) land is allocated for green belt. Avenue plantation will be undertaken along the roadside. The green belt will not only improve the aesthetic beauty of project site but also act as sinks for air and noise pollution. Multi layered plantation comprising medium height Tree (7 to 10 m) and shrubs (5 m) should be proposed for green belt. The landscape will be developed planning suitable local species of trees and shrubs accordingly the guidelines prescribed by CPCB. The green belt development conserve the biological diversity by retaining soil moisture and will self-conserve micro-climate of area. There should be an environmental cell which will monitor the green belt area.

Selection of species for Greenbelt

Development of greenbelt is one of the sensitive issues, the plant should be selected carefully by checking their growth rate, quality, thickness of canopy cover etc. taking due consideration like abatement of fugitive noise, reduce pollution level and making the place worth dwelling for diversified species of flora.

Greenbelt development is based on following criteria:

- Local tree species shall be preferred for location
- Fast growing plants will be planted
- Preferably perennial and evergreen species will be selected
- Resistance to diseases and insects common to that region
- Enhance the environmental quality of project site
- Improve ambient air quality
- Trees having spreading canopy will be planted
- Greenbelt should provide shelter and habitat to local fauna

List of species selected for greenbelt as follows:

Sr. No.	Scientific Name	Common Name	Family	Criteria for Selection
1.	*Azadirachta indica*	Neem	Meliaceae	Sulfur dioxide tolerant
2.	*Barringtonia acutangula*	Never	Myrtaceae	Noise absorber
3.	*Barringtonia racemosa*	Samudrafal	Myrtaceae	Noise absorber
4.	*Bauhinia variegata*	Kachnar	Fabaceae	Dust tolerant
5.	*Polyalthia longifolia*	Ashok	Anonoceae	Air Pollution tolerant
6.	*Cocos Nucifera*	Nariyal	Arecaceae	Aesthetic Value
7.	*Pongamia pinnata*	Karanj	Fabaceae	Air Pollution tolerant
Shrubs				
1.	*Thevetia peruviana*	Yellow oleander	Apocynaceae	Drought resistant
2.	*Hibiscus chinensis*	Mandar	Malvaceae	Fast growing
3.	*Nerium oleander*	Kaner	Apocynaceae	Aesthetic value
4.	*Cestrum nocturnum*	Ratrani	Solanaceae	Aesthetic value
5.	*Bougainvillea spectalillis*	Kagaj phool	Nyctaginaceae	Fast growing

The greenbelt will be developed in two rows it will contain 150 number of trees. Any trees that do not survive shall be promptly replaced with new saplings.

4.3.6 Socio-economic Environment

Anticipated Impacts

- **No land acquisition:** The proposed project is not going to acquire any private land for project purpose.
- **Employment generation**: During Construction phase local workforce will be engaged (skilled, semi-skilled, unskilled).
- **Pollution due to various construction activities**: During fishery harbour construction activities like dredging , Site cleaning, temporary Shed construction, foundation digging, idle-berthing, repair quays, fishery administrative office, seawater pumping station, drainage/sewerage and wastewater treatment system, approach road/internal road, dormitory, public toilets, restaurant, boat repair shop, fish gear shed, net mending shed etc. there will be air, noise, water pollution for short term phase.
  For construction activities heavy vehicle e.g., Excavators, Dragline Excavator, Dump Trucks, Cranes, loaders will be used. Use of these vehicles will lead to noise and air pollution that may affect the population in the surrounding areas.
- **Increase in traffic:** The roads leading to Versova beach will be used by heavy vehicles for transport of material and equipment to the construction site. This will result in an increase in traffic on these roads in the short term.
- **Local economy will be boosted**: Construction activities may result in the procurement of various commodities from a local market. The local economy will be boosted by harbour-related activities.
- **Impact on archaeological sites:** The nearest Archaeological Notified Heritage Site is Jogeshwari caves, 5.76 km to the East of the project site. Disturbance to the archaeological site due to construction activities is not envisaged.
- **Construction waste**: During construction period different types of construction waste will be generated on construction sites. These can result in land and water pollution if not disposed of properly.

Mitigation Measures

- Formation of community management cell for the disaster risk reduction.
- Transmission of noise and vibration are limited by the distance from their sources. Noise could be considerably reduced by adoption of low noise equipment or installation of sound insulation fences.
- Construction as well as operational phase, may lead to the increase in vehicular density hence, traffic management is of utmost importance. careful planning, particularly at the design stage, and by controlling vehicle operations during construction work. Provide induction training for drivers, workers and visitors to minimize impact on the environment.
- Proper management and disposal of solid, liquid & construction waste.
- While transporting construction related commodities, the trucks should be covered.
- Engage local and regional communities and stakeholders in planning decisions relating to fishery harbour.

4.4 Impact Identification & Mitigation Measures During Commissioning

Anticipated Impacts

Impacts during commissioning phase will be due to:

Waste generation Solid waste in the form of packing material use for solar panels, lamps, cables etc. Unscientific disposal will create eyesore and unhygienic conditions.

Mitigation Measures

- Solid waste generated will be stored and disposed through municipal solid waste system

Socio-Economic

- Additional manpower will be required for laying cables, erecting lamp poles, solar panels, guide poles etc.
- This is deemed to be a positive impact as it will give rise to local employment for short period

4.5 Impact Identification & Mitigation Measures in Operation Phase

4.5.1 Land Environment

Anticipated Impacts

Major concern in land environment during operation phase is contamination of land by:

- Improper handling of hazardous wastes (Used batteries, used oil etc.), resulting in leachate contaminating the soil/ sediment

Mitigation Measures

- Used batteries will be sent back to the supplier in ex-change of fresh batteries whereas, used oil will be sold to authorized re-cycler.

Sources of non-hazardous waste generation due to project activity and mode of disposal will be as in table below**:**

Table 4.2 Solid Waste Disposal

Sr. No.	Type of Waste	Mode of Disposal
1	Discarded by-catch	Given it for manuring/ composting/ 'Fish Meal'
2	Iron/metal scrap	Authorized scrap dealer
3	Wooden planks	reuse in Koliwada
4	Reinforced fibre panels	reuse in Koliwada
5	Resin foam pieces	reuse in Koliwada
6	Torn pieces of fishing nets	will be given to recyclers

Sources of hazardous waste generation, their total quantities after project implementation and disposal methodologies are shown in the table below:

Table 4.3 Hazardous Waste Generation & Disposal Details

Sr. No.	Category	Type of Waste	Quantity (per year)	Mode of Disposal
1	category 33.1, schedule I as per HW rules 4th April 2016	Used oil (from boats, DG sets etc),	5 ton	Registered recycler/Dealer
		Used Batteries (from boats, harbour area)	50 nos.	
2	Bilge			

Close monitoring and control over contractors are essential to ensure that the waste reaches the designated waste disposal site and is not dumped at undesignated areas or adversely impact marine environment.

4.5.2 Air Environment

Anticipated Impacts Due to Fuel Burning

- Diesel used in fishing boats and for tempos for ferrying the fish catch will result in minor air pollution
- Handling of fish will result in odour nuisance

Mitigation Measures

- Fishermen will be encouraged to ensure regular preventive maintenance of their boats taking advantage of the various Government schemes available for refurbishment and modernization of fishing vessels

4.5.3 Noise Environment

Anticipated Impacts

- During operation phase, noise generating sources will be movement of fishing boats and tempos for loading-unloading utilities/ fish-catch

Mitigation measures

- Fishermen will be encouraged to ensure regular preventive maintenance of their boats taking advantage of the various Government schemes available for refurbishment and modernization of fishing vessels

4.5.4 Water Environment

Anticipated Impacts

- Indiscriminate disposal of bycatch and other solid waste such as torn pieces of fishing nets, plastic/ glass bottles, Polystyrene (thermocol)/ resin foam pieces, fibreglass panels, wooden planks may lead to water pollution
- Pumping out bilge water into marine environment
- Onboard use of toilet, washing, cleaning while boat is docked in harbour
- Accidental release/ spillage or surface run-off of fuel/ oil from repair quay into marine environment

Mitigation Measures

Following mitigation measures will be provided to reduce impacts on water environment:

- Fishermen will be trained and encouraged to dispose solid waste generated during fishing voyage to be stored and re-used wherever possible or disposed through solid waste disposal system at harbour
- Fishermen will be trained and encouraged for not to pump out bilge water into sea instead, it shall be collected and stored in separate bin which will be empty in bilge water treatment system placed at harbour. This will be done immediately after unloading fish catch and before vessels docks to idle quay. Bilge water treatment system will separate oil and grease component (by passing it through oil and grease trap) and water will be sent to STP for further treatment. Oil and grease separator will be periodically cleaned, and waste will be sent to designated hazardous waste storage area
- Fishermen will be trained and encouraged for not to use onboard toilet, washing, cleaning activities while boat is docked in harbour. 2 Toilet blocks are proposed within harbour in addition to those provided in fishermen rest shelters and dormitory
- Outfitting/ berthing quays are provided with fuel/ oil dispensing units which will directly get connected with vessel's fuel tank through pipes thus, it reduces risk and chance of accidental spillage while manual handling.
- Repair quay will be provided with drain 15cm wide and 15cm deep all-around boundary, outlet will be connected to oil and grease trap. This will prevent contaminated surface runoff from maintenance and repair area to marine area.

4.5.5 Socio – economic Environment

Anticipated Impacts

- **Loss of scenic beauty**: During construction most of the Versova beach area will be covered by MFDC for the project purpose. Therefore, there will be loss of scenic beauty and beach as an aesthetic value
- **Increment in accommodation of vessel**: The harbour has been designed to accommodate 900 mechanized fishing vessels comprising 400 Numbers of motorized crafts. 170 numbers of 11 m trawlers, 290 numbers of 14 m trawlers and 40 numbers of 17 m trawlers. This facility will be beneficial for fishermen community
- **Boost in fish business:** Fishes are highly perishable products due to their biological composition., it's very important for the fishermen to sale them as quick as they can. Due to inadequate infrastructure facilities at Versova jetty, commercial fishery traders did not prefer this place. Due to less buyers'/traders' fishermen sell their fishes at low price. In operation phase all types of infrastructure facilities will attract businessmen, fishermen can sell their fish catch in short time period with appropriate rate.
- Fishing harbour will offer enormous opportunity for the promotion of responsible fisheries, specifically the reduction of wastes and preservation of fish quality.

- **Safe berthing of fishing vessels**: Safe berthing of fishing vessels, where the vessels can unload their catches, can take on bunker, water, ice and other necessary provisions, and can berth for idle times and repairs in tranquil and safe place.
- **Development of fish processing industries and markets:** Fish is a highly perishable food which needs proper handling and preservation if it is to have a long shelf life and retain a desirable quality and nutritional value. Due to the various types of facilities in the harbour development of fish processing industries and market will be benefitable for fishermen, traders as well as for fish consumers.
- **Improvement in QOL of fishermen community**: Due to better infrastructure facilities & harbour development market, increased fish business QOL of fishermen community will definitely improve.

Mitigation Measures

- Awareness programs/training programs for fishermen community for safe personal hygiene, public health (sanitation) and on how to maintain harbours and landing places in a clean condition
- Proper sign boards locating details of harbour should be posted at proper place.
- Try to avoid/minimize transportation activities, loading/ unloading during traffic peak time.

4.5.6 Shoreline Changes/ Erosion/ Accretion

Mitigation Measures

Though, coastline is stable and CWPRS in their technical report no. 5434 (October 2016) has recommended the construction of breakwater which are stable in designed wave conditions, it is proposed to monitor coastline change (through reputed agency) every year in first 5 years and then frequency may be reduced as recommended by designated agency.

4.5.7 Corporate Social Responsibilities & Socio-Economic Welfare

Proposed project itself is about provision of better facilities for fishing operations. This has been planned as per long standing demand of local fisher community.

Corporate Environment Responsibility Plan (CER Plan)

As per OM F. No. 22-65/2017-IA. III issued by MoEF & CC on 1st May 2018 on Corporate Environment Responsibility (CER), some of the activities which can be carried out under CER, are infrastructure creation for drinking water supply, sanitation, health, education, skill development, roads, cross drains, electrification including solar power, solid waste management facilities, scientific support and awareness to local farmers to increase yield of crop and fodder, rain water harvesting, soil moisture conservation works, avenue plantation, plantation in community areas, etc. As per OM F. No. 22-65/2017-IA. III issued by MoEF & CC on 30th September 2020, henceforth, the Expert Appraisal Committee or

the State Level Expert Appraisal Committee shall deliberate on commitments made by the project proponent to address the concerns raised during the public consultation and prescribe specific condition(s) in physical terms while recommending the proposal for grant of EC instead of allocation of funds under CER.

Table 4.4 Proposed CER Activities

Sr. No.	Activities under CER as per specific needs	Rs. In lakhs 1st year	Rs. In lakhs 2nd year	Rs. In lakhs 3rd year	Rs. In lakhs 4th year	Rs. In lakhs 5th year	Total
1	**Community Health & sanitation Improvement**. • Health camps and health awareness programs in Versova koliwada for child and mother care, health and hygiene practices • Donation of medical equipment in hospitals	30	10	10	10	10	70
2	**Community Education Facilities** • Award scholarship to meritorious students & Education • Vocational training & job placement for unemployed youth • Distribution of educational books, stationary, uniforms and aids etc. • Providing desktop computers to schools • Awareness programme in nearby schools on clean beach/coastal areas	25	25	20	20	20	110
3	**Activities for fishermen community** Subsidy for fishing related equipment's/financial assistance to small scale fishermen	25	25	25	25	25	125
4	**Solid waste disposal and associated activities** Dustbin facility at (beaches/coastal belt, residential area), for garbage removal on beaches mini truck/tipper provision on daily basis **(1 tipper price=7.5 lakhs- 5 tipper in first year)**	40	10	10	10	10	80
5	**Infrastructure development** • Water supply • Maintenance of streetlights/installation of solar light • Maintenance of street taps/handpumps • Maintenance of internal roads of in Versova fishery harbour	15	15	15	15	10	70
6	Plantation/landscape	10	10	10	10	10	50
Total Amount (Rupees in lakhs)						505	

4.6 Impact Identification & Mitigation Measures in De-Commissioning Phase

This section examines impacts during decommissioning of project.

Anticipated Impacts

De-commissioning phase of fishing harbour will be non-usage of various facilities. This will result in dilapidated situation of structures in long run. Such No man's land near seashore may become favoured location for unworthy elements of society which in turn is detrimental to peaceful civilization.

There will be increase in direct and indirect unemployment.

Mitigation Measures

- Decommissioning of facilities will be properly planned and finished in fixed time period. All civil structures will be demolished ensuring safety
- Concrete rubbles will be used for filling/levelling ex situ
- Iron/steel will be sold to authorized scrap dealer
- Care will be taken that none of the demolition waste will contaminate marine environment

4.6.1 Environmental Impact Matrix

The possible impacts of various construction and operational activities as identified above have been denoted in a matrix form. A rating has been devised to give severity of impacts in the following manner:

Appreciable Impact – 1
Significant Impact – 2
Major Impact – 3
Severe Impact – 4
+ Sign Indicates Beneficial Impact
- Sign Indicates Adverse Impact

Based on importance of each environmental parameter, a value has been assigned to each parameter (called as weightage). Ultimately, the final assessment is made according to the impact scale discussed below.

Table 4.5 Significance of Impact

Sr. No.	Total Score	Significance of Impact
1	Up – 1000	No appreciable impact on environment
2	1000 – 2000	Low adverse impact. Appropriate mitigation measures required.
3	2000 – 3000	Significant impact, Major control measures
4	3000 – 4000	Major impact. Project site/ technology to be reviewed.
5	4000 – 5000	Not suitable. Alternative site to be considered.

Environmental impact matrix due to proposed project activity and with and without environmental protection measures are presented in tables below.

Table 4.6 Environmental Impact Matrix without Mitigation Measures

Sr. No.	Environmental Parameter	Weightage	Phase of Activity				Net Impact	Score
			Construction	Commissioning	Operation	De- Commissioning		
1	**Land Environment**							
A	Land Use Land Cover	50	-1	0	0	- 2	-3	-150
2	**Water Environment**							
A	Water Availability	50	-2	-1	-2	+2	-3	-150
B	Ground/ Surface water quality	50	-1	0	0	0	-1	-50
C	Marine Water Quality	100	-3	-2	-2	+1	-6	-600
3	**Air Environment**							
A	Air Quality	50	-1	0	-1	+1	-1	-50
C	Odour nuisance	50	0	0	-2	+2	0	0
H	Noise Level	50	-2	-1	-1	+2	-2	-100
4	**Biological Environment**							
A	Marine Ecology	100	-4	-1	-2	+2	-5	-500
B	Marine Sediment Quality	100	-3	-2	-1	+2	-4	-400
5	**Socio Economic Environment**							
A	Employment	100	+2	+1	+2	-1	+4	+400
B	Ease in operation	100	0	0	+4	-2	+2	+200
							NET	**-1400**

As can be seen from the impact matrix, the net impacts due to proposed construction of new infrastructure facilities without mitigation measures will be -1400. This indicates low adverse impact on environment, requiring well designed control measures.

Table 4.7 Environmental Impact Matrix with Mitigation Measures as per EMP

Sr. No.	Environmental Parameter	Weightage	Phase of Activity				Net Impact	Score
			Construction	Commissioning	Operation	De- Commissioning		
1	**Land Environment**							
A	Land Use Land Cover	50	-1	0	0	- 1	-2	-100
2	**Water Environment**							
A	Water Availability	50	-1	-1	0	0	-2	-100
B	Ground/ Surface water quality	50	0	0	0	0	0	0
C	Marine Water Quality	100	-2	-1	-1	+1	-3	-300
3	**Air Environment**							
A	Air Quality	50	-1	0	-1	+1	-1	-50
C	Odour nuisance	50	0	0	-2	+2	0	0
H	Noise Level	50	-1	-1	-1	+2	-1	-50
4	**Biological Environment**							
A	Marine Ecology	100	-3	-1	-1	+2	-3	-300
B	Marine Sediment Quality	100	-2	-1	0	+1	-2	-200
5	**Socio Economic Environment**							
A	Employment	100	+2	+1	+2	-1	+4	+400
B	Ease in operation	100	0	0	+4	-2	+2	+200
							NET	**-500**

As can be seen from the impact matrix, the net impacts due to proposed construction of new infrastructure facilities with mitigation measures will be -500. This indicates non-appreciable adverse impact on environment.

5 ANALYSIS OF ALTERNATIVES (TECHNOLOGY & SITE)

5.1 Analysis of Alternative Sites

The proposed project activities are development of fishing harbour at Versova.

Following aspects are considered to evaluate alternative site:

- The proposed project is in accordance with fulfilling the needs of Versova fisherfolk. The site is also in proximity to end user.
- Location and project activities are studied by Central Institute of Coastal Engineering for Fisheries (CICEF), Bangalore for techno-commercial feasibility and given budgetary approval for project
- Central Water and Power Research Station, Pune is of opinion that, tranquillity at this location is naturally achieved. A breakwater has however been proposed to provide additional protection to the boats that will be docked at the newly constructed quays.
- The project is administratively approved.
- Government owned land hence no R&R issues
- Primary socio-economic survey reveals, fishermen are unhappy as there are no existing facilities w.r.t. navigation, berthing of vessels, post-harvest processing, repair/ maintenance of vessels etc.
- Synergy to existing use and in-line with need of infrastructure and its established operations
- Availability of power at site
- Connected by road
- Economy of the project and integration with existing fish landing centre

Thus, due to above reasons no other site was considered for the proposal.

5.2 Analysis of Alternative Technologies

Not Applicable

6 ENVIRONMENTAL MONITORING PLAN

Based on the identified & assessed impacts as well as the baseline environmental status of the study area, an environmental monitoring program is suggested for implementation during various stages of the project.

6.1 Objective of Environmental Monitoring Program

For tracking of the effectiveness of mitigation measures & EMP at specific interval, regular monitoring of the necessary environmental parameters is required. With this vision, an environment monitoring program is prepared with due consideration of the baseline status of the site, various components of project & environmental attributes likely to be affected.

Major objectives of the Environmental Monitoring Program are as under:

- To comply with the statutory requirements of monitoring conditions of Environmental and CRZ Clearance, Consent to operate and provisions under Environmental Protection Act, 1986
- Assessment of the changes in environmental conditions, if any, during the construction, operation phases of project activities.
- Monitoring & tracking the effectiveness of Environment Management Plan & implementation of mitigation measures planned.
- Identification of any significant adverse transformation in environmental condition to plan additional mitigation measures; if & as required.

Maharashtra Fisheries Development Corporation ltd., GoM will implement the environment monitoring programs in line with the planned schedule. It will be ensured that the necessary requisite facilities are made available and budgetary provision is made as & when required to ensure regular efficient environmental monitoring activities.

6.2 Environmental Monitoring Program

Environmental monitoring parameters and frequencies of monitoring are given in table below.

Table 6.1 Environment Monitoring Plan

Sr. No.	Project Phase	Environmental Component	Parameters	Frequency	Locations	Conducted by
1	**Construction**	**Air Environment**				
		Ambient Air	$PM_{2.5}$, PM_{10}, SO_2, NOx & CO	Once/ Month	Versova	MoEF & CC recognized Laboratory
		Ambient Noise Level	Leq day and night	Once/ Month	Versova	MoEF & CC recognized Laboratory
		Water Environment				
		Marine Water Quality	Temperature, pH, PHC, DO, BOD, Suspended solids, Dissolved solids, Salinity, Microbiological parameters, Nutrients, Chlorophyll, Phytoplankton, Zooplankton	Once/ month	Baseline sampling locations	MoEF & CC recognized Laboratory
		Land (Sediment) Environment				
		Marine Sediment Quality	Texture, pH, C_{org}, PHC, Macrobenthos, Pb	Once/ month	Baseline sampling locations	MoEF & CC recognized Laboratory
2	**Commissioning**	**Air Environment**				
		Ambient Noise Level	Leq (day and night)	Once/ month	At the Site	MoEF & CC recognized Laboratory
3	**Operation Phase**	**Air Environment**				
		Ambient Air	PM_{10}, SO_2, NOx & CO	Once in six Month	Versova	MoEF & CC recognized Laboratory
		Ambient Noise Level	Leq day and night-time	Once in six Month	Versova	MoEF & CC recognized Laboratory
		Land (Sediment) Environment				
		Marine Sediment Quality	Texture, C_{org}, PHC, Macrobenthos, Pb	Once in six Month	Baseline sampling locations	MoEF & CC recognized Laboratory
		Water Environment				
		Marine Water Quality	Temperature, pH, PHC, DO, Suspended solids, Dissolved solids, Salinity, Microbiological parameters, Nutrients, Chlorophyll, Phytoplankton, Zooplankton	Once in six Month	Baseline sampling locations	MoEF & CC recognized Laboratory

Sr. No.	Project Phase	Environmental Component	Parameters	Frequency	Locations	Conducted by
4	**Decommissioning**	**Air Environment**				
		Ambient Air	PM_{10}, SO_2, NOx & CO	Once/ Month	Versova	MoEF & CC recognized Laboratory
		Ambient Noise Level	Leq day and night	Once/ Month	Versova	MoEF & CC recognized Laboratory

6.2.1 Measurement Methodologies

Analysis of environmental samples shall be done as per the methods/ guidelines provided by MoEF & CC/ CPCB and /or relevant Indian Standards or methods as specified by Standard Methods for Water and Wastewater Treatment by American Public Health Association (APHA).

6.2.2 Reporting Schedules

The records of the monitoring program viz marine water, sediment, air, noise shall be prepared and preserved properly. The records showing results of the monitoring programs will be submitted as per the schedule below.

Monitoring reports will be reviewed regularly by Dy. Engineer along with Environmental Consultant for necessary improvement of the monitoring plan/ mitigation measures/ environmental technologies as well as for necessary actions of environmental management cell.

Table 6.2 Reporting Schedule of Environmental & CRZ Clearance Compliance

Sr. No.	Phase of Project	Reporting Schedule	Applicable Statute	Compliance Reporting To
1	Construction	As specified in Environmental & CRZ clearance/ MPCB Consent to Operate	Environmental & CRZ clearance/ MPCB Consent to Operate	a. SEIAA, Maharashtra b. MPCB – Regional Office c. MCZMA/ Other authorities as specified
2	Commissioning	As specified in Environmental & CRZ clearance/ MPCB Consent to Operate	Environmental & CRZ clearance/ MPCB Consent to Operate	a. SEIAA, Maharashtra b. MPCB – Regional Office c. MCZMA/ Other authorities as specified
3	Operation	As specified in Environmental & CRZ clearance/ MPCB Consent to Operate	Environmental & CRZ clearance/ MPCB Consent to Operate	a. SEIAA, Maharashtra b. MPCB – Regional Office c. MCZMA/ Other authorities as specified
4	Decommissioning	As specified in CRZ clearance/ MPCB Consent to Operate	CRZ clearance/ MPCB Consent to Operate	a. SEIAA, Maharashtra b. MPCB – Regional Office c. MCZMA d. Or Other authorities as specified

6.3 Budgetary Provisions for EMP

Capital cost of environment management plan is estimated as Rs. 1.22 Crores. MFDC has made a budgetary provision for operation and maintenance cost also which includes budget for environmental monitoring. The same is presented next.

Table 6.3 Budgetary Provisions for EMP

Environmental Controlling Measure	Capital Investment (Rs. In Lakhs)	O & M Cost/ Annum (Rs. In Lakhs)
Solar lighting	2	1
Waste management (solid, liquid including membership, annual fee)	20	2
Public awareness especially of fishermen and those working in fishing harbour about environmental safeguards implemented, proper use of facilities provided	10	2
Social welfare & upliftment	The project is based on social welfare of fishermen in Versova	
Green belt development	20	5
Appointing Project Management Consultant for ensuring statutory compliances for the project activities, vendors, contractors, proper implementation of mitigation measures, obtain feedback on effectiveness of measures implemented, suggestion on modification/ upgradation in measures (if required) to make them more effective during construction and operation phase	60	10
Environment Monitoring Program	0	10
Total	122	32

*~~As per the OM published by MoEF&CC dated 30th September 2020 regarding concerned raised during the Public Consultation & prescribed Specific conditions activities proposed in CER should be shown as part of EMP.~~

7 ADDITIONAL STUDIES (PUBLIC CONSULTATION & RISK ASSESSMENT)

7.1 Public Consultation

Proposed project does attract EIA notification thus, public consultation is applicable. This draft report is prepared to put before members of public for review, know about proposed project for conduct of Public Hearing. After completion of Public Hearing, this report will be updated suitably as required and details of public hearing will be given in this section.

7.2 Risk Assessment

Risk Assessment is a management tool for determining the hazards and risk associated with the various activities of a project and computes the damage potential of these hazards to life and property. Risk Assessment provides basis for determining the safety measures required to eliminate, minimize, and control the risks as detailed in Disaster Management Plan (DMP) to handle onsite and offsite emergencies.

Risk Assessment is carried out for the various hazards involved in harbour construction and operation.

Risk analysis follows an extensive hazard analysis. It involves the identification and assessment of risks the neighbouring populations are exposed to as a result of hazards present at harbour site. This requires a thorough knowledge of failure probability, credible accident scenario, vulnerability of population.

It provides basis for

- The type and nature of its On-Site and Off-Site Emergency Plan and,
- The types of safety measures required.
- Preventive and control measures needed for reducing risk involved.

Risk assessment is carried out for following objectives

- To identify hazard and risk resulting from the hazards
- To study and foresee the effects of such risks on the workers, public, property and
- Environment and to find out necessary control measures to prevent or minimize risk.
- To comply the legal requirement by various safety and environment laws.
- To get the necessary information for Emergency planning and evacuation.

Risk assessment Hazard analysis involves the identification and quantification of the various hazards associated with establishment and operation of Harbour at Versova.

Safety management and regulations are usually introduced as a result of an accident/incident or a series of accidents/incidents. It has now become necessary to take a proactive approach toward safety that aims to identify risks and then to control them. This has to be undertaken in a way that constantly updates identification and mitigation of risks in any process or organization.

The risk assessment has to start with identification of **hazards**.

A **hazard** can be defined as something with the potential to cause harm to:

- People
- Environment
- Property
- Harbour stakeholders

Once a hazard is identified, frequency and consequence data can be added, the result is **risk.**

7.2.1 Identification of Hazardous areas

At fishing harbour broadly, risks and dangers have been identified as below

1. **Fishing operation** - Trawling vessels may capsize when their gear snags on a fastener (any snaggy obstacle on the sea bottom), while small seiners may capsize under the downward pressure of a large catch of fish "sinking" during the last stage of net hauling. People can be swept overboard if caught up in nets or because of rope running out while they are setting the gear. Various injuries may occur during fishing both from contact with fishing gear and deck mechanisms, and from bites, stings and tail kicks by fish and other marine animals. Wading and diving fishermen are particularly at danger from large predators and various poisonous creatures.
2. **Bad weather:** Sudden gales, major storms and heavy fog causing boat accidents often resulting in capsizing, grounding, becoming lost and collisions. Several types of artisanal fishing craft are buoyant and do not sink even when capsized, which increases the survival chances of the crews. Where weather warning systems and radio communication with fishermen at sea are poor or non-existent, casualties due to bad weather are more frequent.
3. **Loss of power:** This is a major cause of accidents. Many small fishing boats are powered by an outboard motor and do not carry either a spare engine or sailing rig.
4. **Fire on board:** This is less common on-board for small fishing craft, as most of them are open boats or rafts where fire detection is usually instantaneous. However, fire on board canoes (and pirogues) powered with outboard engines and carrying large amounts of spare fuel is extremely dangerous.
5. **Inadequate boat construction standards:** Many small-scale fishing boats are not designed and constructed to sufficient safety standards. Frequently, also, the boats design and construction are unsuitable for the conditions they are used in.
6. **Unsuitable boats:** During the last decades of the twentieth century, small fishing craft are sailing farther offshore on prolonged fishing trips. Many of these craft, built for inshore fishing and day trips and often lacking basic safety equipment,

are too small and otherwise unsuitable for offshore operations. Consequently, their crews' safety has steadily deteriorated.

7. **Fisheries management:** Certain management strategies may motivate fishermen to increase their earnings by taking risks that they would not take otherwise. Such strategies involve, for example, limiting fishing time and area, and transferring and leasing catch quotas.
8. **Economic hardship**: Economic hardship, or even transitory financial difficulty, often causes fishermen to take extra risk, when their better judgement might suggest otherwise.
9. **Inadequate communication:** Problems may arise where radio-telephone contact exists, but there is no adequate common language between the people at sea and the people who may help them. Consequences may be tragic.
10. **Lack of accessible shelters**: In many parts of the world, small-scale and artisanal fishermen are unable to operate from fishing ports or shelters and are forced to cross oceanic or other surf on the way to and from the beach or to enter badly accessible shelters and anchorages. Surf crossing takes a big toll on lives and equipment.
11. **Collision at harbour.**
12. **Diesel unloading, storage and dispensing**

Risk is a combination of:

1. The frequency (likelihood, probability or chance) of a **hazard** realization.

2. The consequence (severity or impact) of the hazard reaching its potential.

In practice, **hazards** will normally have a range of consequences and associated probabilities.

There are basically two types of risk assessment undertaken - **qualitative** and **quantitative**. The **quantitative approach** requires vast amounts of incident data across different sites and requires significant resources to establish a numerical evaluation of the level of risk.

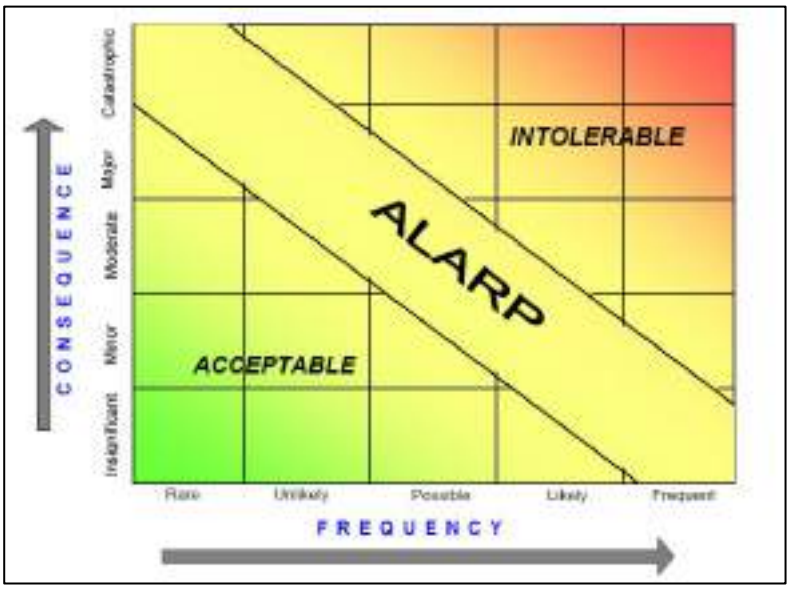
Qualitative approach uses risk in a comparative way to identify if one activity carries higher risk than another. This can provide key information needed to establish safety priority and thus inform the initiation of a safety management system.

It is beneficial for MFDC to adopt this approach as it provides answers to determine the priority of risk control within the harbour.

This allows Harbour Safety Management System to be introduced in manageable stages, concentrating first on those defences which control higher risks. The use of a risk matrix can also be easily integrated into a more sophisticated approach for larger harbours/ports to base their risk assessment on a per-movement basis.

A useful way to compare risk levels is to base the risk assessment on a matrix approach as shown in figure below. This is a 5x5 matrix to provide a conceptual example – it is used later in these guidelines to derive the risk assessment criteria for a harbour risk assessment.

Figure 7.1 Risk Matrix



In conceptual terms, at the low end of the scale frequency is extremely remote (rare) and consequence insignificant. At this point, risk can be said to be in the **acceptable region**. At the high end of the matrix, where hazards are defined as frequent and the consequence catastrophic, then risk is termed **intolerable**. At some point in the matrix there is a **reasonable balance** between the cost of further investment in risk management in relation to the consequence of outcome and the additional risk reduction achieved by the further investment.

This area is termed **ALARP (As Low as Reasonably Practicable**). ALARP is a useful concept and in a quantitative risk assessment, this can be established numerically. It is possible to define ALARP to be a line of cells in the risk matrix for a particular risk assessment. Expert judgement is needed to establish risk acceptability (ALARP), based partly on operational knowledge or evidence of incidents or near misses. An assessment of the worst credible outcome of a hazard realisation is also of assistance in considering ALARP.

Ports and Harbour Risk Assessment Criteria

The risk assessment criteria have been laid out here for guidance and to provide a consistent framework. They are recommended because they provide a consistency of standard for all ports and harbours.

Frequency criteria

When the frequency component of risk is considered, there is a choice between basing the scale on a per-movement basis or a simple per-annum basis. Where ports or harbours have a larger number of movements, a per-movement scale can be considered as this provides a simple set of criteria for reporting safety performance once the safety management system is established.

Table below provides the recommended frequency scale. Each of the Frequency categories represents a range.

Table 7.1 Frequency Matrix for Use in Port and Harbour Risk Assessment

Category	Description	Definition
F1	Frequent	An event occurring once a week to once an operating year.
F2	Likely	An event occurring once a year to once every 10 operating years.
F3	Possible	An event occurring once every 10 operating years to once in 100 operating years.
F4	Unlikely	An event occurring less than once in 100 operating years
F5	Rare	Considered to occur less than once in 1000 operating years (e.g., it may have occurred at a port or harbour elsewhere in the world).

The use of a frequency matrix is a practical translation of the chance or probability of an event occurring in a set timescale. Like the consequence scale that appears later, the frequency scale is logarithmic.

In a port or harbour, the first three categories of frequency are easily understood. Category F4 represents a frequency suggesting an event which is unlikely to happen but has been identified as a possibility. Changing conditions within the port or harbour, such as increased traffic volume or inexperienced crew may result in these hazards being more likely to occur. Category F5 caters for an event which is currently considered on the very limits of credibility. However, the associated consequence is so catastrophic that it needs to be included to take account of possible future changes in frequency. The F5 category also references events that may happen in harbours or ports elsewhere.

Consequence Criteria Across Four Categories

Applying risk assessment to navigation in ports, harbours and across marine operations generally has shown that the use of four categories of risk provides significant benefit, especially when a risk matrix approach is used. These are:

- Risks to **People**
- Risks to **Property**
- Risks to **Environment**
- Risks to **Harbour Stakeholders.**

With regard to the harbour stakeholder category, this reflects the impact on the wider interests of the harbour and its stakeholders. Thus, for example, the potential loss of trade from an incident is considered. Following a major grounding in any harbour, it is likely that loss of trade will occur for a considerable period of time due to complete or partial closure.

Each scale should be assessed individually as each provides a measure of consequence impact associated with different types of loss. Thus, if any one risk scale is showing high levels of risk (e.g., environmental and property damage), then it is reasonable to conclude that risk control in that area is necessary. The reasoning behind this can be readily understood when considering an event such as grounding. There are few groundings that directly cause harm to people, yet the environmental and property damage that ensues

can be catastrophic. If a "people safety" scale was used alone, then invalid conclusions would be drawn. This enables a more informed decision to be taken regarding the adequacy of existing risk control measures, and the need to make changes is then logically established or ruled out accordingly.

A consequence matrix based on the four different consequence categories is shown in Figure below. Each scale has five levels to provide the data for an associated 5x5 risk matrix. The consequence matrix makes a connection between each scale on the tentative basis of cost. Cost is not referenced on the people scale, but there is equivalence between the people scale and the other scales. This is the cost that society is prepared to invest to prevent a statistical loss of life but is for guidance only. *(The same cost criteria are used by the International Maritime Organization (IMO) within the Formal Safety Assessment (FSA) methodology).*

It is worth noting that on a mathematical basis, like frequency, this scale is designed to be logarithmic.

Table 7.2 Consequence Matrix for use in Port and Harbour Risk Assessment

Scale	People	Property	Environment	Harbour stakeholder
C0	**Insignificant** Possible very minor injury (e.g. bruise).	**Insignificant**	**Insignificant** Negligible environmental impact. Tier 1 may be declared but criteria not necessarily met.	**Insignificant**
C1	**Minor** Single slight injury.	**Minor**	**Minor** Tier 1 to Tier 2 criteria reached. (small operational spill).	**Minor** Bad local publicity or short-term loss of revenue, etc.
C2	**Moderate** multiple minor or single major injury.	**Minor**	**Moderate** Tier 2 Spill criteria reached, capable of being limited to immediate area within harbour or port zone.	Bad widespread publicity, temporary navigation closure or prolonged restriction of navigation
C3	**Major** Multiple major injuries or single fatality.	**Major**	**Major** Lower Tier 3 criteria reached, with pollution outside harbour or port zone expected. E.g. Chemical spillage or small gas release. Potential loss of environmental amenity.	**Major** National Publicity. Harbour faces temporary closure of a navigation channel affecting movements to a port or ports for several days. Ensuing loss of trade.
C4	**Catastrophic** Multiple fatalities.	**Catastrophic**	**Catastrophic** Tier 3 criteria oil spill reached with support from international clean up funds.	**Catastrophic** International media publicity. Port closes, navigation seriously disrupted for an extended period.

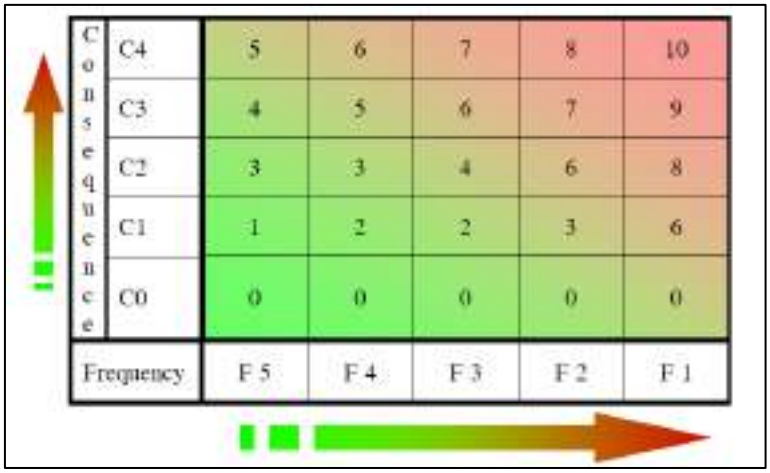
Scale	People	Property	Environment	Harbour stakeholder
			Widespread beach contamination or serious chemical/gas release. Significant threat to environmental amenity.	Serious and long-term loss of trade.

The "Property" consequence criteria, by necessity, consider the loss of a larger commercial vessel to be greater than the loss of a leisure cruiser or small craft.
However, the loss of a smaller craft can mean loss of the operator's livelihood and this should be reflected in the "Harbour Stakeholder" consequence criteria selected. The loss of a small craft may also pose higher risk to human life and therefore the selection of "People" consequence criteria may increase in significance. Therefore, the impact of a small craft loss is measured on more than one scale. When undertaking a risk assessment at any particular port or harbour, review of the criteria in each of the property consequence level can be considered.

Derived Risk Matrix

Having defined the categories in an understandable way, a numerical translation provides a risk matrix that can be used by any Harbour/port owner/company for its risk assessment. This is shown in Figure below.

Table 7.3 Risk Matrix for use in Port and Harbour Risk Assessment



Suggested definition of the numbers in the matrix is as follows:

0 & 1 Negligible Risk
2 & 3 Low risk
4 & 5 The extent of the As Low as Reasonably Practicable area (ALARP)
6 Heightened Risk
7 & 8 Significant Risk
9 & 10 High Risk.

Risk Control Criteria can be applied to the different levels of risk. For example, risks that are 7 & 8 should be reduced by risk control options becoming effective within two years. Those with scores of 9 or 10 require immediate attention. The concept of Control Adequacy Assessment is a method by which implementation of risk management strategies can be managed and the ensuing risk control monitored for effectiveness.

Defining the Framework

The framework for any marine risk assessment logically needs to follow the established Formal Safety Assessment (FSA) marine incident categories that are relevant to assessment in a port or harbour. These are:

- Collision
- Contact (which can include a sub-category of Berthing Contact)
- Grounding
- Loss of Hull Integrity
- Fire/Explosion
- Equipment Failure (Often a cause of other accident categories)
- Personal Injury.

DEFINITIONS

Frequency

F1	Frequent	One or more times in 1 year.
F2	Likely	One event in 1-10 years.
F3	Possible	One event in 10-100 years.
F4	Unlikely	An event in less than 100 years.
F5	Rare	An event in less than 1,000 years.

Consequence

Scale	People	Property	Environment	Harbour Stakeholders
C0	Insignificant	Insignificant	Insignificant	Insignificant
C1	Minor	Minor	Minor	Minor
C2	Moderate	Moderate	Moderate	Moderate
C3	Major	Major	Major	Major
C4	Catastrophic	Catastrophic	Catastrophic	Catastrophic

Table 7.4 Derived Hazard List with Frequency and Consequence Scores

No	Category	Hazard title	Hazard detail	Possible cause	Most Likely Consequence	Hazard assessment					Remark
						People	Property	Environment	Stake holder	Frequency	
1	Contact	Inner harbour quays	Contact with jetty during berthing operation	Mechanical failure (steering or main engine). Vessel blackout. Misjudgement by pilot/master. Failure to appreciate weather or tidal effects. Failure to appreciate vessel power to weight ratio.	Minor damage to bow or side plating of vessel. Minor damage to quay or fendering system.	0	1	0	1	1	Overhang of bow could topple cranes if too close to quay edge.
2	Personal injury	Port approaches	Pilot boarding in port approaches	Vessel unable to make a suitable lee. Swell/weather boarding criteria exceeded. Pilot boat error. Pilot ladder incorrectly rigged. Incorrect clothing (PPE) worn by pilot.	Pilot sustains minor injury, bruising	1	0	0	0	1	Scored in consideration that 1 or more times in ten years a pi lot will fall onto the pilot boat and sustain serious injury (not a fatality). If fatality considered the frequency would drop to 3.
3	Grounding	Grounding on Monks Bank	Grounding on Monks Bank during pilotage	Incorrect assessment taken of vessel's draught and squat during underkeel clearance calculations. Vessel transiting over bank too fast (increased squat). Incorrect chart datum	Indentation of bottom hull plating	0	2	0	1	2	Extent of grounding damage is dependent on vessel's speed.

No	Category	Hazard title	Hazard detail	Possible cause	Most Likely Consequence	Hazard assessment					Remark
						People	Property	Environment	Stake holder	Frequency	
			of deep draught vessel	assessed (hydrographic survey outdated). Bank shifted during inclement weather.							
4	Collision	Collision in port approaches	Collision between one inbound, one outbound fishing vessel	Non-compliance with collision regulations. Human error, improper lookout, lack of communication, radio channel congestion, equipment breakdown, incomplete passage plan, other dishing boat interfering with planned manoeuvres.	Avoiding action fails resulting in glancing blow with moderate damage to one or both vessels. Delay to berthing.	0	3	0	3	3	Sub-standard crews of vessels required to be identified by Pilot during Pilot / Master exchange.
5	Grounding	Grounding in harbour approaches	Vessel grounds in the port approach area off entrance	Strong tidal set across entrance of Channel.	Major damage to vessel. Partial flooding and increase in draught. Stranding. Possible loss of cargo to atmosphere. Lightering may be required to refloat vessel.	0	3	4	3	4	--

Table 7.5 Hazard identification

Type of Activity /Process	Type of Hazard / Risk involved with the activity	Precautions/Suggested control measures
Fall, Slip & Trip on floor /ground	Construction, Loading/ Unloading Activities at Harbour, Boat operation/Repair, Fish transportation & other allied fishery / Harbour activities.	The risks associated with the hazards are cut, wound, serious injury. Occurrence of the hazard is frequent, and the impacts would be minor in almost all cases. The risk is identified to be higher especially during the construction phase of the harbour. Cleaning of floor, removal of obstacle from path, adequate lighting, Training for work, PPE & Safety Plan would eliminate/reduce the risk due to the hazard. First aid facilities shall be available to the susceptible personnel at harbour site.
Fall from Height	There will be only selected activities which may cause this hazard and even the event will be expected only in extreme cases. The main activities are suspected on boat and harbour building. During the construction, risk is more.	During the construction, the hazard may occur. The risk is high as hazard may cause severe injury to head/bones. The victim may lose its capability and can sleep into the condition of disability. Fatality may also occur hence the hazard shall be considered seriously. Fall protection measures & adequate PPEs like safety harness/helmet/safety shoes shall be provided at potential site and to associated personnel. Construction work shall be done with adequate technology having less potential of the hazard. Scaffolding shall be well designed and managed for its strength & fall safety. Area of the working at height shall not be slippery or breakable. Supervision for strict implementation of the safety procedure & safe working shall be done.
Electrical hazards & Fire	Electrical shock & fire may occur in rare incident. shock hazard may occur. The fire incident may occur only in extreme cases of electrical short circuit.	Risk of human health/fitness as well as risk of loss of property may occur due to the hazard. The hazard may also affect the harbour activities due to failure of the electrical system. Adequate wiring and frequent supervision and regular monitoring/repairing may prevent the hazards. In addition to this PPEs shall be provided. Safety procedure for electrical work shall be followed strictly. Necessary measures and procedures shall be implemented & practiced.
Vehicular Traffic & Accident	Transport Routes / Road, Harbour Area for vehicle movement.	The occurrence of the hazard can mainly be in case of disaster or careless practice of driver or other at road / harbour. Sometime fault in vehicles may also cause the hazard. Adequate traffic and vehicles maintenance as well as transportation management practice can prevent the occurrence of the hazards.
Noise & Vibration	Harbour Area & nearby area, navigation Channel, Auction hall and Area / locality of the route of transport. Fish landing & Loading unloading activities, Transportation.	The hazard does not have high risk as the hazard is mainly associated with the noise from transport vehicles and the dredger/ boat engines & some machineries/ equipment like DG sets. The frequency of the occurrence is high, but the significance of the hazard consideration is very low as the impacts of the hazard are being extremely low and localized. The risk is associated with the person working with or exposed to the sources of noise as well as and the impact would be very less if proper PPEs are used to avoid the risk. Adequate Earmuff/plug shall be provided, and noise reduction measures shall be installed wherever required.

Type of Activity /Process	Type of Hazard / Risk involved with the activity	Precautions/Suggested control measures
Infectious material generation	It occurs often in the harbour area as management of the spoil fishery resources is concerned with the hazards.	The hazard can be most likely as it is associated with the waste material & spoiled fishery resources dumped/ thrown/ stored in the harbour area. Even the hazard may occur due to the fish drying activity. Major risks of the hazard are diseases caused by the infection, contamination of the fish catch, spoilage of the fishery resources (catch). Waste/spoil management practice shall be controlled properly considering the regulatory guidelines. Strict rules/code for the management of the waste/spoil shall be implemented. Adequate facilities for the storage/management of the waste/spoil shall be available in harbour area. The area of the facilities shall be controlled for working & entry. All necessary practice and monitoring shall be done on regular basis for the management of the waste/spoil to prevent the hazard.
Human / fishermen Violence	Harbour Area including Channel, Auction Hall, Jetty, Dormitory etc.	The hazard may occur less frequently but shall be considered seriously for the occurrence as it may cause severe risks. The occurrence can be moderate considering the significance of the associated risk. The adequate data & practice of traffic management in channel can prevent maximum chances of hazard. Social factors may cause the hazard in rare cases. The severity of the hazard is associated with the risk of cut, burn, severe injuries, loss of assets (boat, harbour facilities/structures/fishery resources or catch). Security system & appointment of personnel capable of handling the hazard shall be done with the beginning of the project. Frequent counselling of the socially affected fishermen & cultural activities for the integration of the fishermen shall be conducted to avoid hazards due to the social factors. Whenever required police or other riot/violence control authorities shall be consulted/called up for assistance to control the hazard.
Natural Disaster Cyclone/ Flood/ Earthquake	Fishing area, Harbour area Fishing in sea, movement of the boats in sea/channel, all activities at the harbour and surrounding area.	Extremely rare occurrence of the natural disaster of consideration for the purpose of the Hazard & risk management. The major hazards are flood &cyclone which can occur in the area. Emergency shall be declared as per the protocol defined by the authority and project authority. Disaster management plan shall be executed as per the guideline. Emergency & disaster management cell shall immediately start activity on occurrence of the hazard and shall execute the sequential action plan to prevent/minimize the risk/damage due to the hazard
Cold & Heat	Ice Factory, Cold Storage area, Fishing area due to exposure to cold or sunlight (adverse weather) Fishery resource storage / chilling / freezing / transportation, Fishing in	The hazard is less likely occurring only during the identified activities (works at Ice factory/cold storage or Hot machines/surface). The major effects are not expected as the exposure to such condition is very less (almost negligible) however the adequate PPEs and safety procedure planned for the work will reduce the chances of the risk to almost negligible extent. Beside this, hazard occurrence in sea area during the fishing may have significant risk as the emergency medical assistance to the victim will take considerable time to start. The hazard at sea is rarely expected but it is suggested that the shelter for

Type of Activity /Process	Type of Hazard / Risk involved with the activity	Precautions/Suggested control measures
	sea, hot works with machines /hot surfaces.	extreme sun light & cold protection as well as some protective measures like blanket & body warmer/heater shall be available on the boat.
Extreme weather & heavy Rain	Fishing area, Harbour area especially near jetty, Wharf wall and adjoining area at water course.	The worst weather hazard can only be avoided by following the guideline of the weather department and by avoiding fishing in sea as well as preparedness at harbour as required. Mainly heavy rain may create high run off at the shore area of the harbour which may cause damage to the structure adjoining the bank of the creek. Erosion may be caused by such run off of water. The heavy rain may also have severe risk for boats & fishermen in sea if the guideline of restricted fishing is not followed by the fishermen. It is to be noticed that during the monsoon the fishing is not practiced normally by the associated fishermen hence the hazard may not occur. However, the accident may occur at extremely rare chance where any fishermen may go for the fishing during the heavy rain. Extreme weather except in monsoon may also cause accident like sinking of boat. Hence rescue team with adequate requisite and rescue vessel shall be available at site to prevent the risk of the hazard. Emergency shall be declared & Emergency activity shall be started whenever required for the hazard considering the severity of the hazard incident.
Heavy Traffic in channel / at Harbour and Collision of the boats	Navigation Channel & Harbour area of the channel, Jetty Movement of Boats in navigation channel, Landing of fish, other loading – unloading activity, repairing /refuelling of boat in channel/at jetty or harbour.	The likelihood of the hazard is very less and the major risks identified for the hazard are sinking/damage of the boats due to the accident caused by the congestion, damage to the harbour shore structures due to collision of the boat with the structure, disturbed harbour activity causing the economic loss, occurrence of other hazards like collision of boats, contamination of environment, noise etc. some time due to collision of boats and hit of boat with harbour structure may cause fire hazard. Adequate traffic management system/practice shall be planned and implemented. Associated personnel & fishermen shall be provided with the necessary data & facilities like tidal data, navigation chart, hydrological chart, signal/sign guidelines, safety or work procedure/guidelines for movement in channel, communication system etc. Training shall be given to the fishermen & personnel associated with the harbour activities & traffic management. PPE shall be provided. Rescue team & vessel with adequate requisite shall be available at site for emergency of boat sinking, Fire fighting system & team shall be available at harbour; Fire protection measures shall be available on boats.

Table 7.6 Hazard identification - Unloading, storage, dispensing of Diesel at Harbour site

Activity /Process	Hazard / Risk involved with the activity	Engineering Control measure / recommendation	Administrative Control measure / recommendation
Diesel Tanker unloading at harbour site	o Overfill/crossover o Impact o Actions by unauthorized personnel o Spillage o Uncontrolled vapour release o Fire/explosion caused by ignition of vapour following uncontrolled release of Diesel o Leak o Ignition sources	o Overfill prevention/high level alarm o Correct labelling of fill points/signage o vapour recovery o Vent pipe location o Location/protection of fill pipes (tanker stand) o Impervious surface to tanker stand o Drainage of tanker stand/tank fill point area to a retention system (interceptor) o Driver controlled delivery equipment o Adequate lighting o Hazardous area classification/suitability of equipment o Provision of firefighting equipment & absorbent material o Safety signage	o Inspection/maintenance o Staff training o Delivery documentation o Provision of personal protective equipment (PPE) o Emergency procedures
Diesel storage at site	o Leak o Uncontrolled vapour release o Fire/explosion caused by ignition of vapour following uncontrolled release of product	o Secondary containment o Leak detection system o Observation/monitoring well(s) o Vapour recovery o Gauge systems o Automated reconciliation system o Cathodic protection o Provision of firefighting equipment & absorbent material /Spill control kit	o Staff training o Third party statistical inventory reconciliation o Wet stock reconciliation o Inspection/maintenance regime and records o Provision of personal protective equipment (PPE)
Dispensing of Diesel	o Leak o Spillage o Fire/explosion caused by ignition of vapour following	o Dispensers/pumps to approved standard o Labelling/signage o Adequate lighting o Position of dispenser(s)/pump(s) (vision/impact) o Isolation/emergency switches	o Staff training o Inspection/maintenance regime o Provision of personal protective equipment for staff o Provision of first aid equipment and first aid training

Activity /Process	Hazard / Risk involved with the activity	Engineering Control measure / recommendation	Administrative Control measure / recommendation
	uncontrolled release of product o Vehicular impact o Equipment failure o Ignition sources o Members of the public	o Impact protection of dispensers/pumps o Under pump valves o Loud speaker system o Impervious forecourt surface o Drainage of dispensing area to a retention system o Electrical equipment suitable for hazardous zone o Provision of firefighting equipment & absorbent material	o Emergency procedures
Carrying out repair, maintenance, or modification	o Ignition o Leak o Spillage o Unauthorized personnel o Vapour release o Fire/explosion caused by ignition of vapour following uncontrolled release of product o Impacts	Correct equipment to be used in hazardous areas 2. Provision of suitable lifting equipment available for access chamber covers 3. Provision of firefighting equipment & absorbent material 4. Provision of cones and barriers 5. Adequate lighting of working area	Competent contractors/safety passport 2. Staff training 3. Provision of personal protective equipment 4. Emergency plan 5. Contractor's documentation: clearance certificates method statement risk assessment / Job safety analysis 6. Visitors book
Regulatory Reform (Fire Safety) Order 2005: *(Consideration of staff and public within associated premises (or may be affected by a fire at the premises)*	o Fire/explosion caused by ignition of vapour following uncontrolled release of product o Fire caused by ignition of combustible materials	o Suitable and sufficient means of escape o Suitable and sufficient provision of firefighting equipment o Fire alarms and detection o Fire resisting separation	o Staff training o Maintenance of firefighting equipment/alarms o Emergency plan o Risk assessment o Competent persons

7.2.2 Wastewater (Harbour Sewage, Stormwater, and vessel wastewater)

Liquid effluents associated with land-based activities at harbour (such as construction activities, vehicle maintenance and washing, fuel and fish / material storage and transfer) include stormwater, wash water and sewage.

Ship-generated effluents include sewage, bilge water, and vessel-cleaning wastewater. Wash water from land- and sea-based activities may contain oil/grease residue. Trawler/ship sewage and wastewater contains high levels of BOD, total suspended solids, and coliform bacteria.

Stormwater and sewage from harbour facility should be managed according to the **General EHS Guidelines**. Additional recommendations specific to stormwater and wastewater from harbour facilities include the following:

- Avoid installing storm drainage catch basins that discharge directly into surface waters.
- Install filter mechanisms (e.g., draining swabs, filter berms, drainage inlet protection, sediment traps and sediment basins) to prevent sediment and particulates from reaching the surface water.
- Install oil/grit or oil/water separators in all runoff collection areas.
- Regularly maintain oil/water separators and trapping catch basins; and
- Manage recovered, contaminated solids or liquids in accordance with the general and hazardous waste guidance in the General EHS Guidelines.

Harbour operators should provide collection, storage, and transfer and/or treatment services, and facilities of sufficient capacity and type for all wastewater generated by fishing vessels at the harbour in accordance with national regulations, including the following:

- Oily waste and wastewater should be collected in barges, vehicles, or central collection systems and storage tanks. The capacity of oily waste collection should be established based on applicable standards.
- Harbour should provide ship operators with details on the pertaining ballast water management requirements, including the availability, location, and capacities of reception facilities, as well as with information on local areas and situations where ballast water uptake should be avoided.
- Sewage from ships should be collected and treated on-site or off-site according to the recommendations provided in the **General EHS Guidelines**.
- Smaller vessels used for harbour services should be equipped with recycling or chemical toilets, or holding tanks, that can be discharged to appropriate onshore transfer/treatment facilities.

7.2.3 Waste Management

Wastes originating at the harbour may include inert solid waste, Wastes originating from ships may include oily sludge (addressed above under “wastewater”), inert materials such as food packaging, and food waste.

7.2.4 Safety Management Systems Guidance for Preparation

The framework below is for compiling Harbour Safety Management Systems in accordance with the requirements of Directorate of general Shipping Govt of India/code of practice for Indian ports and harbours.

Example of safety system manual.

1. Introduction
2. Harbour marine safety code requirement
3. System components
4. Policy
5. Policy development and communication
6. Navigational safety policy
7. Harbour management policy
8. Traffic management policy
9. Organisation
10. Individual accounting and responsibilities
11. Implementation
12. Risk management system
13. Standard operating procedures
14. Training
15. Audit and review

7.2.5 Food risk

7.2.5.1 Legal Background

Section 8.9 of the FAO Code of Conduct for Responsible Fisheries outlines the duties and obligations of States with respect to the design and construction of harbors and landing places, as well as the establishment of an institutional framework for the selection or improvement of sites for harbors.

The guidance to States is elaborated in Annex VI of the FAO Technical Guidelines for Responsible Fisheries, No.1, Fishing Operations, which sets out the procedures for the development and management of harbors and landing places for fishing vessels. 2 Annex VI provides, among others, the standard procedures for management, environmental auditing, design criteria and education and training.

7.2.5.2 History of food safety and Origin of HACCP (Hazard Analysis and Critical Control Points)

Food Safety is defined as providing assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use (WHO 1995). The worldwide evaluation and reorganization of food inspection and control systems geared towards improving efficiencies, rationalizing human resources and introducing risk analysis-based approaches resulted in the convergence towards the necessity to implement a preventative approach instead of the traditional approach that relied heavily on end-product sampling and inspection and that is HACCP. HACCP is an internationally recognized food safety management system and many countries have made it mandatory in their food production sector.

In India, compulsory quality control was first introduced for fish and fishery products meant for export under the export quality control and inspection Act 1963. The in-process quality control (IPQC) system introduced in 1997 followed by the modified in-process quality control (MIPQC) system, Self-Certification (SC) scheme introduced in the late eighties and the HACCP based system, the "Quality Assurance and Monitoring System" (QAMS) which came under the Export of Fresh, Frozen and Processed Fish and Fishery Products (Quality Control, Inspection and Monitoring) Rules (1995) and founded on the then existing IPQC system by incorporating the requirements of both USFDA and the EU Directive 91/493 were all developments in the quality and safety front by India to keep in par with the developed nations. However, all these compulsory quality control systems implemented in the seafood export units could exercise controls from raw material purchase only, ignoring the primary landing centrecentre which forced the exporters to take care of the quality of the fish they purchase. Many of them have own arrangements with the vessel owners. The Food Safety and Standards Act, 2006 consolidates the laws relating to food and established the Food safety and Standards Authority of India for ensuring availability of safe and wholesome food for human consumption and requires the need for HACCP system to be adopted by the food production and retail outlets in the country.

7.2.6 The Pre- Requisite Programs

The HACCP which was originally designed as a food safety management system, further expanded in practice to include the quality and hygiene parameters also, reducing the effectiveness of HACCP as a food safety control mechanism which resulted in the genesis of a new concept, the Pre- requisite programs(PRP). The WHO has defined PRP as the "Practices and conditions needed prior to and during the implementation of HACCP and which are essential for food safety". These programs include areas such as supplier control, temperature monitoring, personal hygiene standards, cleaning and sanitation programs, proper facility-design practices, equipment maintenance, and cross-contamination control and pest control programs. PRPs control the operational conditions within a food establishment allowing for environmental conditions that are favorable for the production of safe food.

7.2.7 Safety and Quality Management System

The introduction of the two concepts HACCP and PRP, created big confusion in companies regarding their relations, how they should be managed etc. mainly because of negative guideline factors and lack of understanding. In some countries, initially, it has been the practice to include quality issues and hygiene issues in HACCP plans which, in fact has led to the over complication of HACCP. The inclusion of CCPs in HACCP which are not true CCPs caused major problems in practice. Some companies developed both PRP and HACCP plans, yet failed to link the two systems. The HACCP evaluators found that here, the issues are either duplicated or missed due to assumptions that one or the other system already covers them. At this juncture, another school of thought evolved which indicated that the PRP can be used to work effectively with HACCP and a better approach is to control significant hazards with the HACCP plan and to keep generalized quality and hygiene issues to the PRP where they are less likely to cloud the HACCP plan or divert attention from the essential controls, the CCPs. The solution to overcome all such problems was recommended to be through the use of an integrated approach of management of safety and quality in a total quality management system. Consequently a few workers suggested a quality management system which takes into consideration all the controlling points, the safety hazards addressed through the HACCP system and the quality and hygiene issues met with through the PRP and can be achieved by managing both HACCP and PRP within a quality management system such as ISO 9000.

7.2.8 Food Safety from the 'Net to Plate'

The 'Net to Plate' concept with respect to capture fisheries is like the 'Farm to Table' concept in the case of culture fisheries. The present international markets demands that the fish sold is traceable not only to its country of origin but also the waters it was fished-in and the entire post-harvest infrastructure which handled the exported product viz; the vessel which landed the product, the harbor which handled the product and the entire cold chain; and inspection procedures are also expected to include harvest area, fishing vessels, landing sites, auction hall, transport facilities and the staff involved in these operations. Whether or not required by international regulations, good practices and conditions with regard to food safety should be in place as part of any operation. Safe food handling is the responsibility of each and every person in the food handling chain and negligence in any of these stations can have serious consequences on the final quality and safety outcome of the product. The fishermen, the primary processors, the retailers, all should take care to see that the food is kept safe as long as it is under their control. Moreover, the product should reach the end user within the shortest possible time. Therefore, it becomes significant and the need of the hour to assure food safety conditions in capture fisheries, onboard the vessel, in fishing harbors and landing centrecentre, and the subsequent stages. All possible strategies for controlling the hazards present at the level of primary production should be adopted to ensure the safety of the consumer. Several countries have come up with guidelines for Assuring Food Safety Conditions in Capture Fisheries. Export Inspection Council (EIC) of India has laid down regulations for the proper maintenance of hygiene and cleanliness for handling fish for export on board vessel and in the landing centrecentre in parity with the international regulations. Document No EIC/F & FP/Ex.Inst./March/2012/Issue 4 ; Appendix D Deals with Requirements for Approval of The Landing CentreCentre / Fishing Harbours. / Auction CentreCentre; Appendix E Requirements For Approval Of Fishing Vessels; Appendix- F , General Requirements For Approval Of Factory Vessels For Processing Fish & Fishery Products For Export And Appendix – G, General Requirements For Approval Of Freezer Vessels For Processing Fishery Products For Export (Annex 1).

7.2.9 Food safety management system (FSMS) based on HACCP in Capture Fisheries

HACCP is a science-based system that aims to prevent food safety problems from occurring rather than having to react to non-compliance of the finished product. The HACCP system accomplishes this by identifying specific hazards and implementing control measures. Prior to the application of HACCP to any segment of the product-processing chain, that segment must be supported by PRPs. The establishment of PRPs will allow the HACCP team to focus on the HACCP application to food safety hazards that are directly applicable to the product and the process selected, without undue consideration and repetition of hazards from the surrounding environment. The PRPs would be specific to the individual establishment or vessel and would require monitoring and evaluation to ensure their continued effectiveness. PRP assures quality, whereas HACCP assures quality and safety.

The application of the HACCP system begins with the development of HACCP plan. It is a systematic process, a sequence of twelve tasks has been described, in which after the first five steps, the seven basic principles of HACCP are included (CAC, 1997).

The process flow chart is a sequential listing of all the processing steps in the production process. In other words, it is a schematic and systematic presentation of the sequence and interactions of the steps and indicates the direction of movement of the process or product. With respect to implementation of HACCP, the subsequent documentations can be based on the flow chart.

Hazard is a biological, chemical or physical agent or factor that cause an adverse health effect (NACMCF 1992). For the purpose of HACCP, hazards only refer to the conditions or contaminations in food that can cause illness or injury to the consumers. An important aid to hazard analysis is the process flow chart which documents all the major steps in the operation. Hazard analysis involves the identification of hazards and assessment of the severity of the hazard. The severity of hazards and the probability of their occurrence is evaluated according to the epidemiological data about the foodstuff. Assessment of risk and severity makes the hazard analysis quantitative and thereby informative. Risk expresses the chance of a hazard occurring whereas severity relates to the magnitude of the hazard. "Risk" in relation to any article of food means the probability of an adverse effect on the health of consumers of such food and the severity of that effect consequential to a food hazard. "Risk analysis" in relation to any article of food means a process of consisting of three components, i.e., risk assessment, risk management and risk communication. "Risk assessment" means a scientifically based process consisting of the following steps: Hazard identification, Hazard characterization, Exposure assessment and Risk characterization. All the activities associated with harvesting, handling and storage on board, transportation to the harbor, unloading, handling, auction and storage in the harbor etc. should be evaluated. Activities like sorting, grading, washing etc. are classed as low risk; freezing, filleting etc. are classed as medium risk whereas cooking is considered as a high-risk activity and in such cases stricter controls are required. "Risk communication" means the interactive exchange of information and opinions throughout the risk analysis process concerning risks, risk related factors and risk perceptions, among all involved and interested parties including the explanation of risk assessment findings and the basis of risk management decisions. "Risk management" means the process of evaluating policy alternatives in consultation with all interested parties considering risk assessment and other factors relevant for the protection of health of consumers and for the promotion of fair trade practices and even selecting appropriate prevention and control options.

A CCP must be identified for each hazard identified during the hazard analysis step. To aid in deciding what operations are CCPs a decision tree has been developed (CAC 1997). To be a CCP, an operation must be such that appropriate action will prevent, control or minimize the hazard. If a hazard can be controlled at more than one place, the most effective place to control it must be chosen. Examples of control measures are listed below:

1. **Biological hazards**- Time/ temperature control, thermal processing, cooling and freezing, hygienic practices, source control, drying, addition of salt or other preservatives etc.

2. **Chemical hazards** – Source control (vendor certification and raw materials testing) and production control (proper use and application of food additives etc.)

3. **Physical hazards –** Source control, production control, use of metal detectors, UV light etc.

Critical limit is the criteria which separates acceptability from unacceptability. Hence, they must be associated with a factor which can be measured and monitored on a routine basis.

Monitoring should be undertaken by persons involved in the operation which involves making visual observations, sensory evaluations, taking physical measurements and testing of samples. It should be specified as to who will perform monitoring, what will be monitored, how monitoring will be done and when monitoring will be done.

Corrective Action Procedures must be taken to rectify the situation and get the process back under control, when monitoring indicates deviation from the specified range or critical limits. All suspected products should be placed on hold until its safety is ensured. Corrective action is also important in the point of view of its importance in reviewing the process and preventing the recurrence of the deviation and the hazard.

The verification process assists in improving the HACCP system and determines whether the HACCP system achieves its goals. The questions which may be asked during the verification process include whether the correct CCPs are selected, have effective criteria for control been specified, are there control measures in place, are the monitoring activities effective, etc.
Record keeping assists in carrying out verification activities, trouble shooting, data analysis for production improvements and to review production history. Records like HACCP plan, Product traceability, records of CCPs monitoring, corrective action, nature of coding, analytical details etc. should be properly documented.

7.2.10 Pre-harvest and post-harvest hazards

Pre-harvest hazards can be classified into the following

1. **Biological hazards**- Microbes, parasites, toxigenic animals,
2. **Chemical hazards** – Natural toxins, pesticides, heavy metals, antibiotic residues, cleaning compounds,
3. **Physical hazards** – Stones, sand, mud, bones, metal fragments, glass.
4. **Environmental hazards** – Prohibited/endangered species/area, undersize

The most significant pre harvest hazards are marine biotoxins (ciguatoxin, PSP, DSP etc.) which are often heat-stable. Molluscan shellfish are filter feeders and toxins associated with the phytoplankton can accumulate and become concentrated in the bivalve molluscs. Scientific data has shown that when algal blooms producing marine biotoxins are present in harvest areas, toxins may accumulate in fish at a hazardous level and the only possible control measure is to follow good monitoring practices, check the identity of the used species.
Harvesting of endangered sps and/ or from prohibited areas, catching of undersize fish etc. are all matters connected with food security issues and should not be mistaken for food safety issue. For U.S. federal waters, no molluscan shellfish may be harvested from waters that are closed to harvesting by an agency of the federal government. All molluscan shellfish must have been harvested from waters authorized for harvesting by a shellfish control authority. All containers of molluscan shellfish received from a harvester must bear a tag that discloses the date and place they were harvested (by state and site), type and quantity of shellfish, and information on the harvester or the harvester's vessel (i.e., the identification number assigned to the harvester by the shellfish control authority, the name of the harvester or the name or registration number of the harvester's vessel).

7.2.11 Harvest

Onboard the Vessel There are separate definitions and hence regulatory requirements for traditional, freezer and factory vessels in the Regulation ((EC) No. 853/2004). Hence it is important to classify the vessel correctly. Traditional vessels are generally classed as low risk, and therefore, have fewer food safety requirements. Fishermen are exempt from the seafood HACCP regulation. However, although the legislation simplifies food safety requirements, it places a greater responsibility on the skippers or owners to ensure that the necessary measures are in place to assure food safety onboard their vessels. In some countries, therefore, the primary processors, who are generally the processors that off-load fish from the harvest vessels, demand recorded observations like video from the fishermen which focuses on the efforts taken by the primary processor as well as serves as a recorded proof of good harvest vessel practices and activities.

Fish are highly perishable foods and should be handled carefully and chilled without undue delay. Harvest vessels are the first and the most important segment in preventing scombrotoxin

formation. As per FDA recommendations, whole, uneviscerated fish should be placed into the chilling medium not more than 9 hours after the fish dies. Removing the gills and guts of the fish eliminates a significant portion of the bacteria that cause scombrotoxin formation and hence the fish can safely be held longer before chilling, upto 12 hours after the fish dies.The time limit is shortened when either the water or air temperature are high because it takes longer to chill the fish and scombrotoxin forms more rapidly at higher temperatures.

FDA recommended time-to-chill limits

Water/air temperature, Deg C	**Type of product**	**Time to chill in hours**
4.4	Whole, un-eviscerated	9
>28.3	Whole, un-eviscerated	6
4.4	Whole, gutted	12

Time of death is readily apparent when fish are captured alive and slaughtered aboard the fishing vessel. But sometimes fish will die in the water before being brought aboard, in such cases, the fishermen will not know the precise time of death. A trawler will be landing live fish and so it is easy to arrive at the critical time to chill limit when the water temperatures are known, whereas in the case of other gears, the fishermen should record the time the net is fully deployed, the time the last fish from the net is safely stored in ice. The deployment of a longline typically take 3 to 4 hours, then allow a 6-hour soak, followed by another 3 to 5 hours to haul back the line. The time temp knowledge, type of gear used, and method of capture are essential as the HACCP plan should include the time limit as part of the critical limit for the receiving critical control point.

Since activities like sorting, grading, gutting, washing etc. performed on board the vessel is classed as low risk type, the food quality and safety can be achieved through the PRP plan. PRP which outlines the minimum requirements for a harvesting vessel prior to the application of HACCP are Vessel design and construction, Design and construction of equipment and utensils, Hygiene control programs such as Cleaning and disinfection, Water and ice, Pest control, waste management, Personal hygiene and health, traceability and recall procedures, training and documentation etc. HACCP approach requires food products to be prepared or processed in certified plants and establishments for which it is essential that the plant meets minimal requirements in terms of layout, design and construction, hygiene and sanitation. The EIC of India has formulated guidelines pertaining to requirements for fishing vessels and is presented below.

7.2.12 Post-harvest

7.2.12.1 Food Safety in Fishing harbours and landing Centres

In a fishing harbor again, the activities carried out like sorting, grading, beheading, evisceration, washing, filleting, weighing, chilling, freezing, transporting etc. are classed as low and medium risk nature and hence achievement of food quality and safety can be achieved through strict adherence to the PRP plan. PRPs which outlines the minimum requirements for a major fishing harbor prior to the application of hazard analysis can broadly be classified into infrastructural, operational, auxiliary and additional services. The infrastructural requirements are concerning location and surroundings, building and equipment, berthing facilities, landing quays, auction hall, chill room, toilets and rest place, pest control etc. water and ice, incoming fish, cleaning and maintenance, handling and storage, waste disposal, premises and housekeeping are the operational PRPs. Workshop, net repairing yard, maintenance and repair, ice plant, fuel/oil pump, effluent treatment plant etc. are auxiliary facilities while training, traceability, tracking and recall, surveillance and monitoring, documentation, internal audit and management review, security, control room, harbor management/monitoring cell, disaster management unit,

etc. are managerial PRPs. A major harbor still can provide additional services like specialty production unit, dried fish storage, retail market, vehicles shed, laboratory, canteen, health centre etc.

Meeting food export requirements has generally been a strong motivation to introduce the HACCP system. The system is also capable of accommodating changes introduced, such as progress in equipment design, improvements in processing procedures etc. Therefore, fish and fishery products being a highly valued export commodity, the HACCP system can be expected soon implemented in the fishing harbors in our country. The harvesting and post-harvest handling and storage operations of fish in a fishing harbor includes many points where control is needed, but most of these are not critical. Hence most of these can be controlled through the PRPs. However, it goes without saying that HACCP is a process control approach, whereas the activities in a fishing harbor are much more than that. Guidelines formulated by EIC towards requirements for approval is given below.

Table 7.7 Requirements for approval of the landing centre / fishing harbours / auction centre

Sr No.	Requirements for approval of the landing centre / fishing harbours / auction centre
1	**Premises & Infrastructural facilities.**
1.1	The Landing Site / Fishing Harbour of fish and fishery products shall be located at a site ideal for the purpose and shall be free from undesirable smoke, dust, other pollutants and stagnant water. The premises shall be kept clean.
1.2	The layout and design of landing site / fishing harbour shall be such as to preclude contamination. Adequate working space shall be provided for hygienic handling of fishery products
1.3	Suitable covering shall be given at the landing site / fishing harbour to protect fishery products from environmental hazards such as sun light, rain, wind blown dust etc.
1.4	Floor and walls shall be smooth and easy to clean and disinfect. The floor shall have sufficient slope for proper drainage and to avoid stagnation of water.
1.5	Drainage lines of adequate size and slope shall be provided to remove waste water, the outlet of which shall not open to the sea near the landing berth.
1.6	Provision of adequate quantity of potable water or clean sea water shall be available in the landing sites for cleaning and sanitation.
1.7	There shall be provision for hygienic handling and storing of sufficient quantity of good quality ice.
1.8	Provision for crushing the ice hygienically shall be provided, as applicable.
1.9	Sufficient artificial lighting shall be provided, and the lights shall be protected with suitable covering.
1.10	There shall be sanitary facilities at appropriate places for hand washing with sufficient number of washbasins, soap, disinfectants and single use hand towels.
1.11	Appropriate number of flush lavatories shall also be provided outside the landing sites / auction centre.
1.12	The utensils and equipment used to handle fish and fishery products shall be smooth and made of corrosion free material, which is easy to clean and disinfect and kept in a good state of repair and cleanliness.
1.13	Landing site shall be constructed in such a way to avoid entry of exhaust fumes from vehicles.
1.14	Suitable mechanism shall be adopted to prevent entry of birds / other pests inside the landing platform, auction areas and other storage areas.

1.15	There shall be a provision for lockable refrigerated storages for product declared unfit for human consumption and separate lockable refrigerated storage for detained fishery products.
2	**Auction Hall**
2.1	Preferably, separate auction hall(s) may be provided, which is well protected from the entry of pests/insects, for display and sale of fishery products. Since, fishery products shall not be kept directly on floor, as far as possible, provision may be given for raised platforms for display of fishery products, which are smooth, easy to clean and disinfect. However, instead of raised platforms, any other suitable provision can be made so as to ensure that fishery
3	**Good Hygiene Practices**
3.1	Landing sites / fishing harbours shall be maintained hygienically. Cleaning and sanitation shall be implemented at all areas of the landing site on a laid down frequency to avoid cross contamination.
3.2	Landing site / fishing harbour / auction centre shall depute a responsible, experienced person, as hygiene inspector, to ensure the implementation of cleaning and sanitation effectively and good hygienic practices. Hygiene inspector shall ensure the quality of fishery products meant for export and also adequate icing of fishery products.
3.3	Floors, walls, partitions, ceilings, utensils, instruments and other food contact surfaces shall be kept in a satisfactory state of cleanliness and repair.
3.4	The premises and all the surfaces that come in contact with fishery products shall be cleaned before and after each sale. The crates / utensils shall also be cleaned and rinsed inside and outside with potable water or clean sea water and disinfected before use.
3.5	Detergents / disinfectants used shall not have adverse effect on the machinery, equipment and products. They shall be stored in a suitable place away from fish landing area.
3.6	Sign boards prohibiting smoking, spitting, eating, drinking etc. inside the landing sites shall be exhibited at prominent positions.
3.7	Fishery products shall be properly iced using good quality ice made up of potable water so as to maintain the core temperature of fishery products below 4ºC. Refrigerated room of adequate size for storing fishery products may be provided, if required.
3.8	Proper waste management shall be adopted to remove solid and liquid wastes immediately after its formation so as to avoid cross contamination.
3.9	Adequate pest management system shall be developed to avoid entry of insects, rodents and other pests into the landing, auction and storage areas. Insecticides and other toxic chemicals shall be stored in lockable cupboards.
3.10	Separate area may be earmarked for storage of fishery products unfit for human consumption.
3,11	Workers engaged in handling fishery products shall maintain highest degree of cleanliness. They shall wash their hands properly before and after handling fishery products, ice and food contact surfaces.
3.12	Workers shall adopt good personal hygiene practices to avoid contamination of fishery products.

7.3 Disaster Management Plan

Emergency prevention through good design, operation, maintenance, and inspection are essential to reduce the probability of occurrence and consequential effect of disaster eventualities.

The overall objective of the DMP is to make use of the combined resources at the site and outside services to achieve the following.

- Localize the emergency on property and people.
- Minimize effects on property and people
- Effective rescue and medical treatment.
- Evacuation.

A disastrous event strikes suddenly, violently and without warning. Identifying the potential hazards ahead of time and advance planning can reduce the dangers of serious injury, loss of life and damage to environment in the event of an incident occurrence.

The first response to a disaster is the job of the local government's emergency services with the help from the nearby corporation and the volunteer service agencies.

In a catastrophic disaster, Government can provide the rescue search on the disaster site, resumption of electric power, food, water, medicines, cloths, shelter, and other basic human needs.

It takes longer time to get aid from the Government for rescue work when there is a natural calamity because of various constraints such as reaching the site, priority of personnel involved, availability of material, equipment, and rescue team personnel.

It is always advisable to develop teams within the organization (in this case MFDC) for taking immediate rescue action if possible.

MFDC has to prepare a detailed disaster control measures and give information such as the quantity of hazardous material stored, the location of storage, the approximate population living in the vicinity and the detail of the hazardous characteristic of the material to the Employees, District Collector, Police, Fire service department, Director of Factories, State Pollution control Board and the Public living in the vicinity regularly to enable the Government to prepare the offsite disaster management plan, educate employees and the public living in the vicinity the safety measures required to be taken in the event of an accident taking place.

What are the types of likely emergencies / accidents / disasters that can occur in a fishing harbour?

- Accidents involving fishing boats.
- Accidents involving fish transporting trucks/tempos.
- Fire in Godown / harbour area.
- Oil Spill from fishing boats.
- Fire and explosion during diesel handling.
- Fire on board a fishing boat within the harbour limits.
- Breakdown of boat engine in deep sea.
- Sabotage/Terrorism.
- Cyclone and Tsunami.
- Heavy rains leading to flooding area /due to high tides.
- Earthquake.
- Contamination of soil and water due to leakage of oils/diesel while handling.

A comprehensive plan needs to be developed considering above probable accident scenarios which will address

- ✓ Communication system and infrastructure.
- ✓ Early warning sounding system.
- ✓ Temporary safe zones.
- ✓ Training and awareness.
- ✓ Emergency control centre.
- ✓ Roles and Responsibilities of facility owner.
- ✓ HSE system and management.

7.3.1 Communities

Community is the most essential part of the disaster warning. They are the first who is going to affect so they must be aware of hazards & negative impacts of the disaster. They must be able to take proper decisions in such a way that there will be minimum damage or loss to their lives & properties. For this, communities should be trained how to face specific disaster. E.g., Coastal communities should be educated & prepared for the possibility of Tsunami.

7.3.1.1 Communication systems

On time communication of the disaster / warming to the surrounding community will be lifesaving for many people.

Communicating hazard effectively and correctly is considered very important step for limiting losses both in terms of property and life by way of actuating preventive or remedial actions.

The communication aspects are

- o Communication infrastructure.
- o Sounding of early warning notification.
- o Siren Warning Systems.

7.3.1.2 Communication infrastructure

It is advised that different channels of communication be made available in the fishing harbour for effective communication in case of any emergency:

- o Police station, Versova.
- o Telephone links (within the harbour).
- o Link between harbour office and Indian meteorological Department (IMD).
- o Local fire station and Chief Fire officer of Corporation.
- o Satellite link with other major ports and harbour in the area.
- o Ambulance service within the fishing harbour.
- o Local cable TV network for telecasting the emergency to the public at large along with dos and Don'ts.
- o Nearby hospitals and medical Services, and corporation medical services

- Harbour manager and emergency staff
- Nearest residential areas and communities.

The emergency control room telephone numbers should be pasted (and updated, as required) on a stand post at various places within the fishing harbour to ensure that the number are available for ready use in the event of an emergency.

The stand display board should always read the following numbers to facilitate ease of dispatching the information:

Fire Station, Hospitals and the Security Officer control room.

Installation of a Public Address (PA) system is highly recommended at the harbour.

The PA system shall be such that it is capable of addressing all the harbour areas/offices at least, to ensure that all the personnel are informed as well as are told to take preventive actions for safeguard to life of the people working in the area.

All the security personnel patrolling the area should be given Walkie Talkie sets to ensure quick communication of the emergency.

7.3.1.3 Communication Functionary

Harbour authority will appoint designated person/functionary to maintain following task.

- To maintain control room and manned all the time.
- To ensure all available communication links remain functional.
- To quickly establish communication links between incident site and the control room.
- To maintain voice record of significant communications with timings received/passed from the control room.
- Maintain siren system and periodically test it.

7.3.2 Warning sounding

Raising of an alarm timely is the key to minimize the extent of damage to both life and property in the event of an emergency.

Versova fishing harbour will have a minimum of three modes of raising an alarm:

- Siren/hooter.
- Public Address system.
- Raising of flag, at top the building.

In addition to three modes of raising an alarm there could be other modes i.e., by providing the following system:

- Blow horn speakers mounted on vehicles

- Break glass fire alarm
- Local Doordarshan Kendra, Local cable TV operators
- Local AIR (Radio)
- The raising of alarm becomes critical for the following events:
  - An impending cyclone or any natural disaster on receiving an information from IMD or TV Channel
  - Major fire on the Harbour.

7.3.3 Siren warning system

Raising the alarm is the first step in the activation of Onsite Emergency Plan/Disaster Management Plan (DMP).

The alarms are basically used to notify people of an emergency or an event, which is likely to cascade into a major disaster.

The various categories of alarms are as follows (Harbour authority cab decide levels of alarms depending on scenarios),

- Cyclone alarm
- Fire
- Flooding
- Building collapse
- All clear

7.4 Temporary safe areas

In the event of an emergency / disaster the affected population at large would have to be transported to intermediate temporary shelter. The temporary shelters could be nearby schools. The temporary shelters would greatly depend upon the emergency condition and the nature of the emergency.

Certain basic amenities also must be available before the temporary safe shelter can be decided upon which are as follows:

- Water supply
- Shelter for putting up the refugees/affected population.
- Structure of temporary shelter need to be of concrete made to withstand natural disaster (earthquake) if the need be. It is in this regard that schools with RCC building are ideal as sheltering spaces for the displaced population.
- Emergency shelters identified are also from the point of view of obtaining relief i.e. food supplies from the town. In the event of an impending disaster all the temporary shelters shall be provided with wireless sets.

7.5 Training and awareness

Training sessions need to be provided in which personnel are briefed on their specific duties in an emergency. The concerned personnel are shown how to wear and properly use of personal protective clothing and devices.

Periodic drills shall be conducted to test the overall efficiency and effectiveness of the emergency response plan and emergency response capabilities.

The types of training required for emergency response personnel with responsibilities in any or all phases of the response is based upon the types of incidents most likely to occur and the related response and planning activities.

7.6 Emergency control centre

One control at Harbour will be provided and will be sufficiently equipped to inform Collector, Police Department, Coast Guard, Corporation, Medical services.

The key activities of the control shall be,

- Have IMD web site available through Internet connection in the control room for ready reference.
- Display a map of the whole harbour area and the population distribution in the nearby area.
- Emergency Control Room to be constructed in a fashion that it should be able to survive the various manmade and natural contingencies like, cyclone, high wind velocity, flooding, etc.
- Equipped with diesel driven electric generators.
- Automatic display name, address, telephone numbers of any incoming call once the emergency control centre number is dialled the same should be registered in computer.
- Map depicting railway station, Ferry start points, bus stands and taxi stands should be available.
- Map depicting the inter-tidal zone.
- Map depicting temporary shelter as well as food supplying store.
- List of Personal Protective Equipment (PPE) suppliers and availability in the harbour.
- Adequate number of flameproof searchlights numbering shall be made available at the control room.

7.7 Roles and Responsibilities

7.7.1 Role of Harbour owner

The harbour owner will have to ensure the following in the event or emergencies arising out of

- Accidents involving fishing boats.
- Fire in Godown / harbour area.
- Fire and explosion during diesel handling.
- Fire on board a fishing boat within the harbour limits.
- Breakdown of boat engine in deep sea.
- Sabotage/Terrorism.

- Cyclone and Tsunami.
- Heavy rains leading to flooding area /due to high tides.
- Earthquake.

Facility owner to ensure

a. that adequate staff are posted at the harbour to meet any eventuality. Ensure all operations are shut down, Provide 48 hours food supply as well as portable water supply at the harbour
b. Inform local fire station and Chief Fire office of the area
c. Inform district collector about the emergency.
d. Ensure trolley mounted pumps area available, preferably of flame proof type to ensure dewatering of the site.
e. Ensure availability of adequate no of gum boots at harbour control room.
f. Ensure a speed boat with GPS, rescue equipment, food, potable water, fuel, medicine, etc. is always available at the harbour for use in case emergency e.g. breakdown of fishing boat in deep sea.

7.8 HSE (Health, Safety & Environment) Management

HSE management system is an effective means of ensuring that proper attention is paid to the health and safety of individuals working at the harbour site as well as the protection of the environment from the environmental impacts associated with construction activities.

It is recommended that if the Fisheries Department intends to assign a contract to carry out work, whether construction or repair, it should be ensured that the project has its own HSE policy and perform all task/work under a formal HSE Management system.

The HSE system should be well documented within a HSE Manual and be shown to be effective in implementing the aims and objectives of the HSE Policy.

Such a system should ideally be behavioural based and designed to deliver continual improvement (PDCA Cycle - Plan, Do, Check and Act).

The system should address

- Incorporate measures to demonstrate that all workers/labourers are medically fit and competent to perform their tasks safely.
- Ensure that all personnel are conversant with the working conditions at the worksite, the rules and standards related to the working environment and the HSE hazards and risks associated with the work programme.
- Provide means whereby hazards have been identified, assessed, and eliminated where possible, or are being controlled / mitigated through formal planning methods and procedures.
- Allow for periodic review triggered by site or system changes that may affect the HSE risk of the work programme.

Ensure that all contractors understand the principles and requirements of the system.

- Require sub-contractors to have an equivalent HSE standard.

- Contain a written HSE plan

Contractor and Fisheries Department management should make all personnel fully aware that they are empowered, and expected, to bring all health, safety and environmental risks which they believe not to be under adequate control to the immediate notice of their Supervisor so that prompt action may be taken to prevent injuries or other losses and provide a safe and healthy workplace.

7.9 Basic First Aid for fishing and fishery harbour activity

7.9.1 First aid kit

A well-maintained first-aid kit can help respond effectively to common injuries and emergencies. Maintain at least one first-aid kit in office and one at Harbour. Store the kits in easy-to-retrieve locations. Preferably, office section, auction hall area, security and vehicles should have an accessible first-aid box.

Following are the common material/requisites & medicines that every responsible personnel should have in the first aid box.

Table 7.8 First aid kit material

First-Aid Material	
o First-aid book. o Sterile adhesive bandages in assorted sizes o Small roll of absorbent gauze or gauze pads of different sizes o Adhesive tape o Triangular and roller bandages o Cotton (1 roll) o Band-aids (Plasters) o Scissors o Pen torch	o Latex gloves (2 pair) o Tweezers o Needle o Moistened towels and clean dry cloth pieces. o Antiseptic (Savlon or Dettol) o Thermometer o Tube of petroleum jelly or other lubricant o Assorted sizes of safety pins o Cleansing agent/soap
Non-prescription drugs	
o Aspirin or paracetamol pain relievers o Anti-diarrhoea medication o Antihistamine cream for Bee Stings.	o Antacid (for stomach upset) o Laxative o Other Hazard Specific Non-prescription Drug for Emergency
Emergency Items	
o Emergency phone numbers, including contact information for doctors. o local emergency services, emergency road service providers and the regional poison control centre o Small, waterproof flashlight and extra batteries o Candles and matches for cold climates o Sunscreen o Emergency blanket o Life Saving Jackets for Flood Emergency	

First aid kit is to be kept at easily accessible location. Drugs to be replaced whenever they reach the expiry date.

7.10 Oil Spill Contingency plan

Possibility and sites of spill

HSD will be used as fuel in the boats, material handling machinery, in transport vehicles, and in the mobile harbour cranes on the berthing facility. Apart from this no other liquid cargo will be handled at proposed project site. Owing nature of heavy equipment handled at the site, there is no likelihood of any chemical spill on the onshore.

Possibilities of oil spill are:

- Spill due to handling of HSD
- Spill due filling of fuel into the boat
- Spill from HSD operated vehicles

The proposed fishing harbour will be prepared for any event of oil spill by means of preparing an Oil Spill Disaster Contingency Plan (OSDCP) and providing oil spill containment equipment and disposables.

Need for an OSDCP

Pollution from blowout, Refuelling, stranding, and other marine accidents can threaten marine life in the inter-tidal zones, fisheries, seabirds, harbours, wildlife, human health, recreational beaches, tourism and industrial plants with subsequent loss of revenue. Hence such incidents warrant an advanced preparedness or contingency planning making it desirable to coordinate activities amongst several agencies.

Classification of Oil Spills

Categorized in accordance with the internationally recognized three tier classification system; the tier spill sizes have been specified by the Coast Guard.

Tier-1 is concerned with preparedness and response to a small spill within the capabilities of an individual facility or harbour authority. 700 tons is often cited as the upper limit of 'tier-I' however, the circumstances of the spill and the surrounding environment will determine the actual level of response. The proposed project site falls under Tier one.

Tier–2 is concerned with preparedness and response to a spill that requires the co-ordination of more than one source of equipment and personnel. For a tier-2 response, assistance can come from a number of entities within a port area or from sources outside the immediate geographic area. Tier-2 describes a wide range potential spill scenario and deals with operational spills up to 10,000 tons.

Tier-3 is concerned with a major spill requiring the mobilization of all available national resources and depending upon the circumstances will likely involve mobilization of regional and international systems. It deals with the spills of more than 10,000 tons.

Oil Spill Response Policy and Plan

An accurate assessment of spill incident is essential before appropriate spill control and clean up procedures can be activated. Generally, containment and recovery are preferred but, in some instances, it may be necessary to use chemical dispersants. The OSDCP proposed by the fishing harbour will be made operational by the following teams:

(A)Techno - Management team

(B)Environmental team

(C)Logistics team

Role and responsibilities: Role and responsibilities of various teams proposed in the fishing harbour are as follows,

Techno-Management team:

The management team will have overall responsibility of the spill response operation. Its main functions relate to:

Overall execution of the plan

Determining strategies for priority areas

Reviewing operations

Gathering and collating information

Authorising media releases

Controlling general financial aspects of the operation

Interacting with other agencies involved in the clean-up operation, central government, the media and public.

Preparing formal detailed management and situation reports

Deciding when to terminate operations.

The Terminal In-charge will be the designated nodal officer for Management team of the OSDCP. The nodal officer will be supported by the Head Engineering, assisted by the Fire and Safety In-charge on the technical aspects of the OSDCP. The technical team will be responsible for the management of all tactical operations at the site of the incident. On the basis of the oil pollution risk assessment, the technical team working in close co-

operation team with the environmental team, will assess the situation, plan and implement the response operation. The basic function of technical team will be:

Collecting and evaluating incident information
Identifying high risk areas
Determining the best response strategy
Monitoring the progress of the operation
Preparing daily incident logs of operations
Allocating resources on a priority basis
Allocating outside contractors to specific sites and tasks
Implementing the chosen strategy
Directing the clean-up operations

All the tugs and barges will be pressed to carry out the oil spill response. The yard will have one special tug with an aft mounted A frame to toe skimmers and facilitate skimming and decantation operations. Record of the spill will be maintained and updated in the following format:

Descriptive Details of Spilled Oil		
1	**General**	
a	Identity of Information	
b	Time of receipt of information	
2	**Spill Details**	
a	Source of Spill	
b	Reason for Spill	
c	Type of Oil	
3	**Spill Geometry and Configuration**	
a	Colour code information	
b	Configuration	
c	Radius	
d	Tail	

e	Volume	
f	Quantity	
g	Weather / Fresh	
h	Density	
i	Viscosity	
J	Wind	
K	Wave height	
l	Current	
m	Layer thickness	
n	Ambient sea temperature	
4	**Spill Trajectory**	
a	Executive trajectory predictions for information	
b	Confirm classification of spill size	

Environmental Team:

The environmental team will have local knowledge of shoreline habitats and species likely to be affected by clean-up operations. The team will be able provide advice on human health ecological, wild life and amenity interests.

Responsibility of the Environmental teams will be:

o Help to implement the chosen strategies

o Monitoring and ensuring that priorities of clean-up techniques adequately reflect environmental concerns

o Directing the wildlife response

o Co-ordinating all environmental monitoring and sampling programmes

o Providing liaison links with other interested environmental organizations Environmental team will be led by the Yard Environment In-charge.

Logistics team:

The logistics team, headed by the HR and Administration In-charge will be responsible for organizing, providing, marshalling, and routing essential personnel, equipment, facilities, services and supplies to meet all the requirements of the teams involved in the incident management. 5. Oil Spill Containment and Control Equipment Following oil spill

response hardware and consumable will be stocked in the yard as part of the OSDCP. Responsibility of maintaining the stock and its upkeep will lie with the harbour Marine Terminal Incharge.

a. Fixed Type Oil Spill Booms - 75 m 01 no.
b. Oil skimmer – Capacity 10 Ton/hr – 01 no.
c. Oil Absorbent rolls – 02 nos.
d. 15-20 m3 multipurpose barge
e. Dispersant System Hand Pumps – 02 nos.
f. Oil Absorbent Pads - 50 nos.

8 PROJECT BENEFITS

8.2 Improvement in Infrastructures

The proposed project is to be located at existing Versova fish landing centre. It does not require additional transportation facilities like road connectivity. But, due to this project, fish landing infrastructure will be upgraded which gives ease in operations, fish landing, post-harvest processing and dispersal of catch.

8.3 Employment Potential

The proposed peak manpower requirement during commissioning will be 192 Persons. The project will also offer benefit to society as it would create temporary employment and business opportunities in construction phase while, in operation phase too it will offer another kind of employment and business opportunities.

Most of the recruitments will be done from local area which will be the considerable benefit to the local area considering the demography of the region.

8.4 Other Tangible & Intangible Benefits

Demand of sea food is increasing in India as well as foreign country day by day. Thus, the proposed project will help in reduction in time required for distribution of perishable sea food till end user. This will benefit the community in earning appropriate revenue against their efforts.

9 ENVIRONMENTAL COST BENEFIT ANALYSIS

All the required Environmental protection measures will be implemented appropriately to ensure compliance with the norms.

The overall project cost is estimated at Rs 336.70 crore.

The Department has made a budgetary allocation for environmental protection measures at a capital cost of Rs. 120 lakhs and an annual budget of Rs. 22 Lakhs/year.

Implementation of project in turn will give better infrastructure facilities, employment and business opportunities and will increase ease in lifestyle of local fishermen.

10 ENVIRONMENTAL MANAGEMENT PLAN

10.2 Introduction

Description of the administrative aspects of ensuring mitigation measures are implemented and their effectiveness monitored, after approval are presented in this chapter.

10.2.1 Objective & Scope of EMP

Environmental Management Plan is prepared with the main objective of enlisting all the requirements to ensure effective mitigation of adverse impacts for all the components of the proposed project. The objectives taken into account in preparation of EMP are summarized here as follows:

a) Prevention, control and abatement of pollution, i.e., air pollution, marine water pollution, sediment pollution and noise pollution,

b) To comply with the stipulated enviro-legal requirements and standards,

c) To direct the steps to be followed, for effective maintenance and regulation of infrastructure facilities provided.

10.3 Environmental Management Cell

MFDC will form an environment management cell (EMC) with vision to implement the EMP as suggested in the EIA. The illustrative presentation of the EMC is presented below.

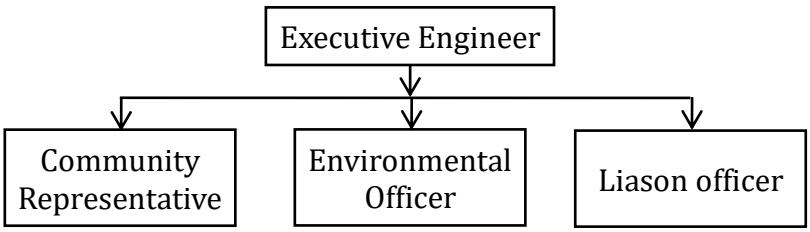


Figure 10.1 Environment Management Cell

As indicated in Organogram, Executive Engineer will lead as head of the EMC and will be assisted by, one Community Representative from each fishermen society, Environmental Officer (Dy. Engineer, MFDC) and Liaison Officer (project officer, MFDC).

The responsibilities of the above personnel are as below:

Executive Engineer will lead the team and will direct the EMC in timely manner and make budget available.

Dy. Engineer will take lead and supervise all functions of EMC and also act as Environmental Officer. He/ she shall be responsible for environment management works and all legal and statutory compliances, including environmental and CRZ clearance.

Community Representatives will be responsible for creating social awareness w.r.t. solid waste management, water pollution prevention etc.

liaison Officer will look after maintenance of environmental infrastructure created such as solar lights, STP, waste storage area, oil and grease separator etc.

Standard operating procedures will be prepared by Environmental Officer well before the inception of operation phase of the project. SOPs will be reviewed and approved by Executive Engineer.

10.3.1 Environmental Activities

- Major environment protection features are providing STP, Oil and Grease separator, designated impervious areas for waste storage, green belt, awareness program for habituating fishermen and others who work in harbour about clean operations and solar lights.

  STP, Oil and Grease separator, designated impervious areas for waste storage, green belt development, awareness program will be started along with construction phase itself.

- Maintenance will be done throughout the extent of operation phase.

11 SUMMARY AND CONCLUSIONS

Development of fishing harbour proposed by Maharashtra Fisheries Development Corporation ltd. requires prior environmental and CRZ clearance under EIA and CRZ notifications.

The proposed activities will be located at existing fish landing centre, village Versova, Tal. Andheri, Dist. Mumbai Suburban of Maharashtra state.

MFDC is proposing to develop fishing harbour which will cater to 900 fishing boats

Basic raw materials for construction work will be sourced from nearby marketplaces.

The proposed project will meet its water and energy requirement by MCGM and MSEDCL respectively.

Wastewater generated will be treated in STP of Capacity 120 CMD and ETP of capacity 250 CMD. Treated effluent will be recycled to maximum extent for flushing and gardening and excess treated water will be disposed into the existing sewer line adjacent to the project site. Hazardous waste such as empty containers, Used oil from boats & DG sets, Bilge oil and used batteries will be given to MPCB authorised recyclers and solid waste to authorized recycler.

Baseline monitoring has been done in Winter (Dec 2019 – Feb 2020) to understand ambient air quality, water quality (including marine), soil quality (including sediment), noise level, biological and socio-economic status of study area.

Study area of 10 Km area around site is taken as to establish baseline environment. Study area consists of the total area 314.15 Km^2, built-up land covers 104.83 Km^2, forest covers 13.18Km^2, barren area covers 6.07 Km^2, Mangroves covers 15.70 Km^2, Airport is 5.16 Km^2 whereas water bodies covers 169.21Km^2. Classes like, wildlife sanctuaries, mining area do not exist in the study area. Sanjay Gandhi National Park is approx. 9.4 km to the east side of the project site. Soil quality has been checked in Versova village Soil in Versova is neutral, has sufficient humus, low phosphorus, potash, good concentration of micronutrients, moderate fertility, and heavy metals viz. Lead, Chromium and Manganese below detectable limit. AAQM has been done for $PM_{2.5}$, PM_{10}, SO_2, NOx and CO near site in Versova and, it is observed that all parameters are within the prescribed limits. Ambient Noise levels found to be within limit during daytime as well as during night time. Water quality has been checked at Versova (4- Ground water and 3- Marine subtidal, 2 intertidal locations). Mangroves of Versova, Juhu, near Madh Jetty road, Madh Village, Darvali are present 531.4 m towards NE, 1.4 km towards SE, 344 m towards West, 270 m towards NNE and 770 m toward N Respectively. Species found at site and surrounding are commonly found in other parts of region.

Study area and data from Government agencies is assessed to check socio-economic status of the region. The area is urban in nature and has moderate sex ratio and good literacy rate. The area has good transportation facility, infrastructure, education, and banking and health facilities etc. Major source of income in the area is fishing and employment etc.

Environmental impact matrix evaluation has been done for land environment, air environment, water environment, solid and hazardous waste management, biological environment socio-economic environment with & without control measures. Proposed facilities will have negative impacts if proper mitigation measures are not taken. Details impacts and mitigation measures for four stages of projects cycle namely Construction, Commissioning, Operation & Decommissioning phases are described in chapter 4.

Detailed Environmental monitoring program covering all four stages of project cycle has been presented in chapter 6, along with EMP budget and schedule for compliances.

The Environmental Management Plan is prepared giving roles and responsibilities throughout the EMC for implementation of EMP.

The proposed project of Maharashtra Fisheries Development Corporation ltd., GoM will have low adverse impact with due implementation of control measures as suggested. Continued vigilance with budgetary support is required from the industry in order to implement the EMP.

12 DISCLOSURE OF CONSULTANTS ENGAGED

Name	ADITYA ENVIRONMENTAL SERVICES PVT. LTD.			
Reg. Office	107, Hiren Light Ind. Estate, Mogul Lane, Mahim, Mumbai – 400016			
Phone No.	022 42127500	**Email id**	:	contact@aespl.co.in
Website	http://www.aespl.co.in/ Aditya Environmental Services Pvt. Ltd. is a consultancy organization rendering a wide range of environment related services for more than twenty years.			
Laboratory	Aditya Environmental Services Pvt. Ltd P-1, MIDC Mohopada, P.O. Rasayani, Dist. Raigad PIN 410222			
Phone No.	02192 252008	**Email ID**	:	pglab@aespl.co.in
Branches	Goa, Pune, Ahmedabad, Delhi & Vadodara			
Accreditations/ Certifications Obtained	1. Recognized by MoEFCC as "Environmental Laboratory" vide S. O. No. 1190 (E) dt. 01.05.2014 valid up to 24.04.2024 2. NABL vide certificate no. TC-7085 3. NABET vide certificate no. NABET/EIA/1922/SA 0129 4. ISO 9001:2015 Certified 5. OHSAS 45001:2018 Certified			
Accredited Sectors	**Sector 1**	Mining of minerals Open Cast only		
	Sector 3	River Valley projects Irrigation Projects only		
	Sector 4	Thermal Power Plants		
	Sector 8	Metallurgical industries - ferrous only		
	Sector 9	Cement Plants		
	Sector 17	Pesticides industry and Pesticide specific intermediate		
	Sector 20	Petrochemical based processing		
	Sector 21	Synthetic Organic Chemicals Manufacturing Industry (SOCMI)		
	Sector 29	Airports		
	Sector 31	Industrial estates/parks/complexes/Export processing zone/Special Economic Zone (SEZ)/ Biotech parks/Leather complexes		
	Sector 32	Common Hazardous Waste Treatment Storage and Disposal Facilities (TSDF)		
	Sector 33	Ports, Harbours, Jetties, Marine Terminals, Break waters and Dredging		
	Sector 34	Highways, Railways, Transport terminals, Mass Rapid Transport Systems		
	Sector 36	Common Effluent Treatment Plants (CETPs)		
	Sector 38	Building and Construction Projects		
	Sector 39	Townships and Area Development Projects		

	Services Offered by AESPL	▸ Environmental planning studies ▸ Policy planning studies for MoEFCC, CPCB, MPCB and other agencies like World Bank. ▸ Environmental Impact Assessment (EIA) & Environment Management Plan (EMP) ▸ Risk Analysis Studies & On Site/Off Site Emergency Management Plan. ▸ Environment Health & Safety audits & Due Diligence audits ▸ Effluent Treatment Treatability Studies & Project Management Consultancy ▸ Analytical Services covering entire spectrum of environmental analysis ▸ Environmental Training and awareness ▸ Project management consultancy for installation of effluent treatment plant ▸ Environmental monitoring and legislation compliance services ▸ Operation of effluent treatment plants

Quality Council of India

National Accreditation Board for Education & Training

Certificate of Accreditation

Aditya Environmental Services Pvt. Ltd.

110, Hiran Light Industrial Estate, Moghul Lane, Mahim, Mumbai- 400016

The organization is accredited as ***Category-A*** *under the QCI-NABET Scheme for Accreditation of EIA Consultant Organization, Version 3: for preparing EIA-EMP reports in the following Sectors –*

Sl.No	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1	Mining of minerals - opencast mining only	1	1 (d)	A
2	River Valley projects – Irrigation Projects only	3	1 (c)	B
3	Thermal power plants	4	1 (d)	A
4	Metallurgical industries - ferrous only	8	3(a)	A
5	Cement Plants	9	3(b)	A
6	Pesticides industry and pesticide specific intermediates	17	5 (b)	A
7	Petrochemical based processing	20	5 (e)	A
8	Synthetic organic chemicals industry (dyes & dye intermediates; bulk drugs and intermediates excluding drug formulations; synthetic rubbers; basic organic chemicals, other synthetic organic chemicals and chemical intermediates)	21	5 (f)	A
9	Air ports	29	7 (a)	A
10	Industrial estates/ parks/ complexes/ Areas, export processing Zones (EPZs), Special economic zones (SEZs), Biotech Parks, Leather Complexes	31	7 (c)	A
11	Common hazardous waste treatment, storage and disposal facilities (TSDFs)	32	7 (d)	A
12	Ports, harbours, break waters and dredging	33	7 (e)	A
13	Highways	34	7 (f)	A
14	Common effluent treatment plants (CETPs)	36	7 (h)	B
15	Building and Construction Projects	38	8 (a)	B
16	Townships and Area development Projects	39	8 (b)	B

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in SA AC minutes dated Mar.12, 2021 posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in QCI-NABET's letter of accreditation bearing no. QCI/NABET/ENV/ACO/21/1736 dated May 17, 2021. The accreditation needs to be renewed before the expiry date by Aditya Environmental Services Pvt. Ltd, Mumbai following due process of assessment.

Sr. Director, NABET
Dated: May 17, 2021

Certificate No.
NABET/EIA/1922/SA 0129

Valid up to
01-05-2022

For the updated List of Accredited EIA Consultant Organizations with approved Sectors please refer to QCI-NABET website.

National Accreditation Board
for Education and Training
(Member - International Accreditation Forum & Pacific Accreditation Cooperation)

QCI/NABET/EIA/ACO/22/2437 July 20, 2022

To

Aditya Environmental Services Pvt. Ltd.
110, Hiren Light Industrial Estate, Mogul Lane, Mahim,
Mumbai

Sub.: Extension of Validity of Accreditation till October 19, 2022 – regarding
Ref.: Certificate no. NABET/EIA/1922/SA 0129

Dear Sir/Madam

This has reference to the accreditation of your organization under QCI-NABET EIA Scheme, the validity of Aditya Environmental Services Pvt. Ltd is hereby extended till October 19, 2022, or completion of the assessment process, whichever is earlier.

The above extension is subject to the submitted documents/required information with respect to your application and timely submission and closure of NC/Obs during the process of assessment.

You are requested not to use this letter after the expiry of the above-stated date.

With best regards.

(A K Jha)
Sr. Director, NABET

National Accreditation Board for Testing and Calibration Laboratories

NABL

CERTIFICATE OF ACCREDITATION

ADITYA ENVIRONMENTAL SERVICES PVT. LTD.

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

PLOT P-1, MIDC COMMERCIAL PLOT, RASAYANI,TALUKA KHALAPUR, MOHPADA, RAIGAD, MAHARASHTRA, INDIA

in the field of

TESTING

Certificate Number: TC-7085

Issue Date: 28/04/2021 Valid Until: 27/04/2023

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.
(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Identity : Aditya Environmental Services Pvt Ltd

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer