

Executive Summary

Environmental Impact Assessment

Proposed Modernization and Expansion of Port Infrastructure
for Fishing, Coastal, Multipurpose Cargo Berth and Liquid /
General Cargo at Mormugao Port, Goa



Prepared for



Mormugao Port Trust, Goa

Prepared by



Environmental Consultancy and Laboratory

NABET/EIA/1417/RA010

Lab Recognized by MoEF&CC – Govt. of India

October 2017

1. PROJECT INTRODUCTION

Mormugao Port, commissioned in 1885 is one of the oldest ports on the west coast of India in the state of Goa and is blessed with a protected open type natural harbour. Over the years, it has developed a deep draft channel. With its location at the mouth of the Zuari River, it is a crucial component in the flourishing export industry of the state of Goa. It became one amongst the major ports of the country in 1964 and has been relentlessly serving the nation in its economic development.

Mormugao Port managed by the Mormugao Port Trust (MPT), currently has total 11 berths out of which 6 berths (Berth No. 1,2,3,5,6,7) are leased out to some other organizations and remaining 5 berths (Berth No. 4,8,9,10,11) are under the operation of Mormugao Port Trust. Significant cargoes handled at the Port include coal, ammonia and phosphoric acid fertilizer components, steel coil and slab, limestone, petroleum oil lubricants, molasses, and a small volume of containers. Non-cargo vessels include cruise ships, oilfield supply vessels, vessels of Navy, Coast Guard, NIO, Fisheries Survey of India etc. In addition, supplies for the Indian Antarctic expeditions are marshaled at Mormugao.

The existing facilities at Mormugao Port includes

- Berths and Mooring Dolphins
- Cargo Handling and Storage Facilities
- Mechanical Ore Handling Plant
- Streamloading, Discharging facilities, Port railway facilities and bunkering provisions
- Cruise Tourism

Mormugao Port has a total operational area of 250 acres which is inadequate to cater to ever increasing trade demands. Temporary fish landing platform occupies prominent waterfront area close to Berth No.11 making development of Port infrastructure difficult. Mormugao Port Trust therefore proposes following Modernization and Expansion of Port Infrastructure:

- a. Construction of Fishing Jetty.
- b. Development of Berth for Liquid bulk (Petroleum products including LPG) and other General Cargo.
- c. Development of Multipurpose Cargo Berth.

- d. Construction of Passenger Jetty, Launch Jetty, and Port Craft Jetty.
- e. Deepening of Berths 10 & 11 pockets from -13.10 to -15.0 m.
- f. Deepening of Breakwater Berth from -9.5 to -11.5m

1.1. EIA Methodology

Detailed review of the feasibility report for the proposed development has been carried out. Ten km radius of study area was marked using latitudes and longitudes of the project site. For all major environmental components, primary and secondary data was generated and compared with the available historical/published information for assessment of various environmental components to develop the Environmental Management Plan (EMP).

Land use pattern, drainage and contour was mapped within 10 km radius from the proposed project site using remote sensing and GIS tools followed by ground truth verification. Baseline monitoring program was undertaken during March - May 2017 to establish the marine water qualities, marine sediment quality, soil quality, air quality, ground water and surface water quality and noise levels in the study area.

The AAQ data was collected during March 2017 to May 2017. The average meteorological conditions of the Mormugao were obtained from the observations of IMD Goa from 1981-2010. Ecology and biodiversity studies were carried out for terrestrial and marine components of the study area. The Marine biodiversity impact assessment report and management plan on marine, brackish water and fresh water ecology and biodiversity was prepared by the National Institute of Oceanography (NIO) Goa. Field Survey was undertaken to develop socio-economic profile of the study area and was compared with published census data for further refinement.

A detailed review on the possible environmental pollutants such as emissions, siltation, liquid and solid wastes were undertaken. Impact Assessment of various environmental components have been carried out using standard EIA tools and techniques with appropriate input of primary and secondary baseline data to determine the significance of the impact. Various activities those are envisaged during construction and operation phases of the proposed project were evaluated for its significance. Based on the impact, suitable EMP was developed to mitigate the probable negative impacts.

2. ENVIRONMENTAL BASELINE CONDITIONS

2.1. Land Environment

Different Physio-chemical Parameters of soil like Colour, pH, Electrical Conductivity, Organic Matter etc. were analysed during the monitoring. Landsat 8 cloud free data has been used for Landuse / landcover analysis and Cartosat-1 data for analysing topographic features. Water body (73.36%) dominates in the present land use pattern covering 10 km surrounding of the proposed development area. 8.89% of lands have dense vegetation, while 4.33% have open vegetation. Barren lands were occupied 5.76% of the total land use. Built-up land use occupies in 4.36% and 2.66% areas were agricultural lands. Remaining land use were Sandy/Beaches (0.48%) and mangroves (0.16%). Due to the proposed development there were no variations in the existing land use pattern within the study area. But within in proposed development area there may be some minor change in land use to Built-up.

2.2. Surface and Groundwater Quality

To understand the status of ground water quality in the study area, ground water samples were collected from 2 locations in the study area. Samples were collected from bore well. In order to study the existing surface water quality within the study area, samples were collected from 3 different stations. Different Physio-chemical Parameters like Temperature, Turbidity, pH, Electrical Conductivity, Total Dissolved Solids, Total Hardness etc. were analysed during the monitoring.

2.3. Tides

The nature of tide prevailing at Mormugao is mainly semi-diurnal exhibiting two high and two low waters in a tidal day. The mean tidal variation is of the order of 1.6m at spring tide and around 0.7m at neap tides.

2.4. Bathymetry

Bathymetry details indicate that the seabed over a major portion of the surveyed area is generally smooth. Natural water depth (not including the dredged channel) increases gently from 4m along the eastern boundary to 8m near the harbor entrance, 3.5 km to the west.

In the western part, however, the water depths are extremely irregular, with depths increasing to more than 11m, while rocks outcrops are found within the northern boundary. The depths within Vasco Bay between the eastern headland and the existing cargo Berth11 are generally less than 3.5 m below chart datum.

2.5. Marine Water Quality

Marine water monitoring was conducted in April 2017 to establish the existing status of seawater around the proposed project site. The study covered sample collection and analysis of physicochemical and biological characteristics of seawater and sediment samples. Marine water was collected from eight representative locations.

There was no significant difference in the water temperature which ranged between 26.9°C to 27.6°C in entire area. pH values were stable and did not show much variations. pH ranged between 7.6 to 7.9. The salinity of the water varied from 33.4 ppt to 37.0 ppt. The dissolved oxygen, the most important parameter that influences the health and diversity of biota, varied in 5.0 to 6.2 mg/L range indicating well mixing of water. In natural marine waters free from organic pollution the dissolved oxygen is generally close to 100% saturation. Depressed values at the project site indicate influence of oxidizable organic matter such as sewage entering the system.

2.6. Marine Sediments

Total Organic carbons in study area were between 0.7-2.8 % in subtidal sediment samples and 0.2-0.5 % in intertidal sediment samples. Organic Nitrogen concentrations were ranges between 338-1092 mg/kg in subtidal sediments samples and 23-97 mg/kg in intertidal sediment samples respectively. Total Phosphorus concentrations were 1437-8577 mg/kg in subtidal sediment samples and 215-248 mg/kg in intertidal sediment samples respectively while Iron concentrations were 8954-13029 mg/kg in subtidal sediment samples and 1135-9694 mg/kg in intertidal sediment samples at the respective stations. Manganese concentrations were 50-706 mg/kg in subtidal sediments and 14-20 mg/kg in intertidal sediment samples respectively. Zinc concentrations were 31-69 mg/kg in subtidal sediments and 9-10 mg/kg in intertidal sediment samples respectively.

2.7. Meteorology

Goa experiences a tropical monsoon climate under the Koppen climate classification. Goa, being in the tropical zone and near the Arabian Sea, has a hot and humid climate for most of the year. The calendar year in the project area can be divided into four main seasons. The winter season lasts from December to February followed by pre-monsoon season from March to May. The monsoon season begins in June and continues up to mid-October. The period from mid-October to November constitutes the post-monsoon season.

2.8. Ambient Air Quality

AAQ data was monitored from seven sampling stations selected around the project site. AAQ data was monitored during March 2017 to May 2017. Parameters like PM_{2.5}, PM₁₀, Sulphur dioxide (SO₂), Nitrogen Oxide (NO_x) and Carbon Monoxide (CO) were measured during the monitoring period. The 24 hourly samples were collected twice a week.

- **Observations on PM_{2.5} levels**

The average concentration of PM_{2.5} at various stations monitored ranged from 23-39µg/m³. The highest PM_{2.5} value was recorded as 51µg/m³ near Shanta Durga Temple, Cortalim and lowest value of 19µg/m³ was recorded near NIO Guest House, Dona Paula. The PM_{2.5} values monitored during the field survey were within the permissible limit of 60µg/m³ for industrial, residential, rural and other areas.

- **Observations on PM₁₀ levels**

It is observed that average concentration of PM₁₀ at various stations ranged from 43-82 µg/m³. The highest PM₁₀ value was recorded as 92µg/m³ near Sparkle Service Station, Vasco da Gama and lowest values of 40µg/m³ were recorded near NIO Guest House, Dona Paula and Aguada Light House, Aguada. The average PM₁₀ values monitored during the field survey were generally within the permissible of 100µg/m³, limits except at few occasions for industrial, residential, rural and other areas.

- **Observations on SO₂ levels**

From ambient SO₂ level as monitored during field studies the average concentration of SO₂ at various stations in the study area was well below the prescribed limit of 80µg/m³ specified for

industrial, residential, rural and other areas. The average concentration of SO₂ at various stations monitored ranged from 11-20µg/m³. The highest SO₂ value was recorded as 25µg/m³ near Sparkle Service Station, Vasco da Gama and is below detectable limit in all the locations.

- **Observations on NO_x levels**

It is observed that during the study period, average NO₂ concentration at various sampling stations ranged from 17-31µg/m³. The highest NO₂ value was recorded as 34µg/m³ near Shanta Durga Temple, Cortalim and lowest value of 10µg/m³ was recorded near Aguada Light House, Aguada. The average concentration of NO₂ at various stations in the study area was observed to be well below the prescribed limit of 80 µg/m³ specified for industrial, residential, rural and other areas.

- **Observations on CO levels**

The average concentration of CO at various stations monitored ranged from 0.7-1.3 mg/m³. The highest CO value was recorded as 1.3mg/m³ near Sparkle Service Station, Vasco da Gama and lowest value of 0.7 mg/m³ were recorded from Shanta Durga Temple, Cortalim and Glenwood Garden Main Gate, Bambolim. The CO values monitored during the field survey were below permissible limit of 2 mg/m³ for industrial, residential, rural and other areas.

2.9. Noise Levels

The day time equivalent noise level ranged from a minimum of 50.4 dB (A) to a maximum of 75.2 dB (A). The night time equivalent noise level ranged from a minimum of 40.3 dB (A) to a maximum of 62.7 dB (A). The proposed study area is located within the industrial area. Permissible noise limits for industrial area prescribed by CPCB are 75 dB (A) during day time and 70 dB (A) during night time. Recorded noise levels were observed to be within the required limits except at Zuari Nagar where noise level observed as 75.2 dB (A).

2.10. Marine Ecology

In the present study period, species belonging to four groups namely diatoms, dinoflagellates, blue greens and cocolithophores were recorded. Of these, diatoms were found to be the dominant group. Dinoflagellates were second dominant group followed by blue green algae Cocolithophore. Zooplankton groups namely Calanoida, Cyclopoida, Harpacticoida and other larval forms were recorded. Among the zooplankton, Calanoida were found to be the most

dominant group. Four groups of benthic organisms namely polychaetes, crustaceans, bivalves and gastropods were recorded. Polychaetes constituted the dominant group followed by gastropods, crustaceans and bivalves.

2.11. Terrestrial Ecology

Vegetation in urban area is dominated by native as well as exotic species such as *Cocos nucifera*, *Azadirachta indica*, *Delonix regia*, *Ficus* spp and *Zizyphus mauritiana*. In general, flora of study region was observed to be healthy and highly diverse. Overall 80 species of birds were observed in various habitats among study area during survey period. Water bodies like rivers and creeks were inhabited by Egrets, Cormorants, Herons, Ibis and Sand Pipers. Two species of kingfishers were recorded. Terns, Godwits and Redshanks were occasionally seen near small streams pouring into Zuari River.

Due to absence of dense vegetation mammalian density of this region was observed to be very low. No schedule I species was recorded from entire study area. Moreover, forest cover map of Goa shows that this region do not comprise any major forest range or block. Hence, no wildlife data pertaining to this region is available. Crocodiles have found an ideal habitat in the Cumbarjua canal and mangrove swamps. However, the habitat of marsh crocodile is considerably away from proposed project site.

2.12. Socio-economy

Socio-economic assessment of the study area has been prepared based on secondary data extracted from Primary Census Abstract, Census of India 2011. The issues under focus in this topic are demographic pattern, economic activity, education and literacy profile, etc. The assessment attempts to predict and evaluate the future impacts of project upon people, their physical and psychological health and well-being, their economic status, cultural heritage, lifestyle and other value system.

The study area comprises of 40 settlements, including 20 Municipal Corporation wards, 8 Census towns, 8 rural villages and 4 out growths. The total population in the study area includes 314986 persons, of which, about 10.02% comprises of children below the age of 6 years as per Census of India 2011.

3. PREDICTED IMPACTS

There will not be any major impacts due to the location of the proposed development. The proposed project activities are planned within existing port area; hence no land acquisition is required. Moreover, proposed fishing harbor and passenger jetty projects are beneficial for boosting local economy.

The only land parcel involved in this proposal is back up area of coastal and general cargo berth. Development of fishing harbor, passenger jetty and liquid berth will be on reclaimed land. Handling of any liquid or bulk cargo is not envisaged from coastal cargo berth. Hence, contamination of land through leaching is not possible.

No fresh water surface bodies are present at the proposed project site. Moreover, construction activities are confined to marine areas. Hence, there will be no significant impacts on surface water. The average no. of construction labourers likely to be deployed for the execution of the proposed project will be about 70. No labour camps are envisaged at the project site as the labours will be local residents and the existing sanitation facilities of Mormugao Port will be sufficient. The total water requirement for domestic purposes during construction phase has been estimated as 3.5 m³/day and the quantity of domestic sewage likely to be generated during construction phase will be about 3 m³/day.

Impacts on the marine ecology during the construction phase can be due to modifications in the hydrodynamic characteristics of the area, impacts on water and sediment qualities and impacts on fishing activities. Sediment samples analyzed from the project area did not show the presence of any appreciable levels of contamination and hence may not pose any problems of contamination. Dredged spoil will be disposed at pre-designated site of Mormugao Port Trust.

Pile driving, deposition of rubble, dredging, sand compaction and other construction activities increase the turbidity levels in the coastal water which is a short term impact. The turbidity level returns to the pre-project level after the completion of construction activities.

Construction activities will pose impact on the biota in the pile-footprint areas of berth and reclamation area. Project site does not sustain seaweeds or mangroves. Hence, no further impacts on marine macrophytes are envisaged. Primary production in this region is moderate and

reduction in productivity will be confined to a small segment of the marine zone due to construction activities.

Disturbance from construction activities may cause displacement of fishery resources and other mobile bottom biota. Dredging removes bottom biota and dumping of dredged material covers bottom habitat, both of which may reduce fishery resources. Settlement of re-suspended sediments on fragile marine fauna and flora damages the ecosystem particularly coral reefs. However, corals near Grande Island are almost 7 km away from construction site. Hence, impacts of construction activities on corals are remotely possible.

The major pollutant in the construction phase is Suspended Particulate Matter (SPM) being air-borne due to various construction activities. The vehicular movement generates pollutants such as NO_x, CO and HC. But, the vehicular pollution is not expected to lead to any major impacts. The impact on air environment during construction phase is expected to be local and reversible. The combustion of diesel in construction equipment could be one of the possible sources of incremental air pollution during the construction phase.

Fish/ organic wastes collected from the waste collection bins are brought to the organic waste converter platform for composting. Waste from the platform is shredded and then transferred to a organic waste composter machine where the waste is mixed with a suitable absorbent like paper or sawdust. This is followed by addition of bacterial inoculums inside the converter for organic waste digestion. The raw digested material is left for curing for about 15 days to get good quality compost. The compost can be used as manure for the greeneries in and around the Port.

The non-degradable waste will be first segregated so as to remove the material that can be recycled. Metal items shall be collected and sold to scrap dealers. Tyres can be turned into fenders. The plastic materials are to be collected and periodically handed over to authorized scrap dealers. Hazardous waste such as oily rags, empty drums, waste oil shall be disposed to recyclers authorized by Goa Pollution Control Board.

4. MITIGATION MEASURES AND MONITORING PLAN

The construction waste generated shall be partly used for land filling and restoration of the project site. Balance material will be disposed as per the guidance of Mormugao Municipal Authority at designated sites. The Hazardous Solid Waste shall be treated as per the Hazardous waste management Rules 2016.

Construction activity shall be completed within designated period. Dredging must be confined to project area and must be completed within stipulated time period. Dredging and associated activities should be avoided during the notified fish breeding season (June-July) which is considered as egg laying and larval recruitment season.

Discharge of waste wastes into sea should be prohibited. Spill control measures shall be adopted while bunkering dredgers and fishing boats, etc. Any effluent generating from fishing harbor, auction hall, ice plant etc shall be treated in ETP.

An adequate drainage system should be provided at the site with separate collection streams to segregate the storm run-off from roads, open areas, material storage areas, vehicle wash water and other wastewater streams. No construction shall be permitted during rainy days or extreme climatic conditions. Suitable measures will also be taken to prevent the washing away of construction materials into the drainage system. Contaminated storm water will be collected and conveyed to sedimentation tank for removing grit.

Monitoring Schedule during Construction and Operation Phase

Aspects	Parameters to be monitored	Frequency of Monitoring	Locations	Compliance
Air Quality	PM10, PM2.5, SO2, NO2, CO	Twice in a week during entire construction period	Project Site	NAAQ Standards, 2009
Noise Levels	Day and night noise levels	Once in month for 24 hrs	Project Site	CPCB Standards
Fresh Water Quality	pH, Temp, Salinity, TDS, TSS, DO, BOD, Hardness, Alkalinity, Chlorides, Turbidity, Conductivity, Oil and Grease, Heavy Metals	Once in a month during entire construction period	MPT Office	IS10500: 2012

Soil Quality	pH, Electrical Conductivity, Organic Matter, Organic Carbon, Phosphorous (as PO ₄ -3), Total Kjehldal Nitrogen, Potassium (as K), Sodium (as Na), Texture, Sand, Clay, Silt, Lead (as Pb)	Once in a month during entire construction period	Project Site	-
Marine Water Quality	pH, Temp, Salinity, TDS, TSS, DO, BOD, Hardness, Alkalinity, Chlorides, Turbidity, Conductivity, Oil and Grease, Heavy Metals	Once in a month both for low tide and high tide periods during entire construction period	3 locations viz. project site, upstream and downstream	-
Sediment Quality	Organic C, Organic N, heavy metals	Once in a month during entire construction period	3 locations viz. project site, upstream and downstream	-
Biological Parameters	Phytoplankton, Zooplankton and Benthic Communities	Once in a month during entire construction period	3 locations viz. project site, upstream and downstream	-
STP outlet	pH, BOD, COD, TSS, Oil and Grease	Once in month	-	CPCB Standards

5. ADDITIONAL STUDIES

Quantitative Risk Assessment

Acceptable limit of individual risk of 1.0×10^{-6} per year remains mainly confined within the proposed berth. It is also observed from FN curve that Societal Risk is in ALARP or tolerable range. Hence, it may be concluded that with the normal operation, proposed berth may be considered safe from environmental risk point of view.

Fire Fighting facilities including Hydrants, monitors and Sprinklers systems Foam systems, Fire water pumps, ESD system, Interlocking system, Gas Monitoring system shall be installed in berth area. Personal Protective equipments are also being used. Following all safe operations procedures further reduces the frequency of incidents.

All the above systems should be maintained in good working order at all times. Awareness programs should be done for the people residing in nearby location of all types of emergency situations which may happen near berth with consultation with civic bodies.

HTL/LTL Demarcation

In order to comply with CRZ Notification, 2011 detailed HTL/LTL demarcation studies were conducted with respect to the project site. The study has been conducted by an authorized agency, Institute of Remote Sensing, Anna University Chennai, Tamil Nadu. HTL/LTL map in 1:4000 scale superimposing the project layouts have been prepared and is attached with EIA report.

Hydrodynamic modeling

MPT had entrusted Central Water and Power Research Station (CWPRS), Pune to study changes in hydrodynamics due to the proposed development and impacts due to dredging. The computational model considered for tidal flow simulation covered an area of 70 km x 40 km. the model area covers the entire proposed port area up to (-) 56 m depth contour. The maximum current size in the harbor area varies from 0.05 – 0.15 m/s.

Detailed hydrodynamic modeling report is attached with EIA report.

Oil Spill Contingency Response Plan

An Oil Spill Contingency Plan will outline the steps to be taken before, during and after a spill. Proposed development location falls within the port limit of the MPT hence, oil spill at proposed expansion if occurs, will be combated as per the prevailing Oil Spill Contingency Response Plan of the MPT. The implementation of the Contingency plan for combating oil pollution off the coast of Goa is the responsibility of the Port Control Centre In-charge, MPT. Detailed plan is attached with EIA report.

6. PROJECT BENEFITS

Maritime transportation is a major means of international trade. The proposed development will mark a boost to the commercial activity in the region. Proposed modernization and expansion will lead to development of Vasco bay and thus will benefit the Mormugao Port by increasing the port capacity as well as helpful to the local people to improve their livelihood. The proposed development will improve the Port infrastructure for various activities such as fishing, cargo handling operations and tourism. Fishing industry will get boost through the development of modern fishing Jetty and other facilities which will lead to export of Marine products. Cruise facilities will positively impact the tourism industry. This will benefit the Port and hence the State of Goa.

7. ENVIRONMENT MANAGEMENT PLAN

To ensure better environment in & around the project site as well as the neighboring population, an effective EMP is developed separately for construction and operation phases. In this project EMP activities and fund flow shall be governed by Environment Management Cell (EMC) of MPT on account of maintenance of project activity. Also, the EMC will be the nodal agency interacting with the management with regards to the inputs required for EMP implementation and its operation.

Solid waste management system, traffic congestion management and other initiatives are also included in the EMP. Development of site for project activity to a certain extent, create inevitable impacts mainly during construction phase, but these impacts can be reduced significantly with the help of effective EMP. The potential environmental impacts, which need to be controlled, are the following:

- Air pollution due to the emission of particulate matter
- Noise pollution due to various noise generating equipment
- Wastewater generation from sanitary/domestic activities
- Solid waste Management (Collection- Process & Disposal)
- Labor camp with water, power, sanitation and medical facilities.
- Impact of dredging on marine environment