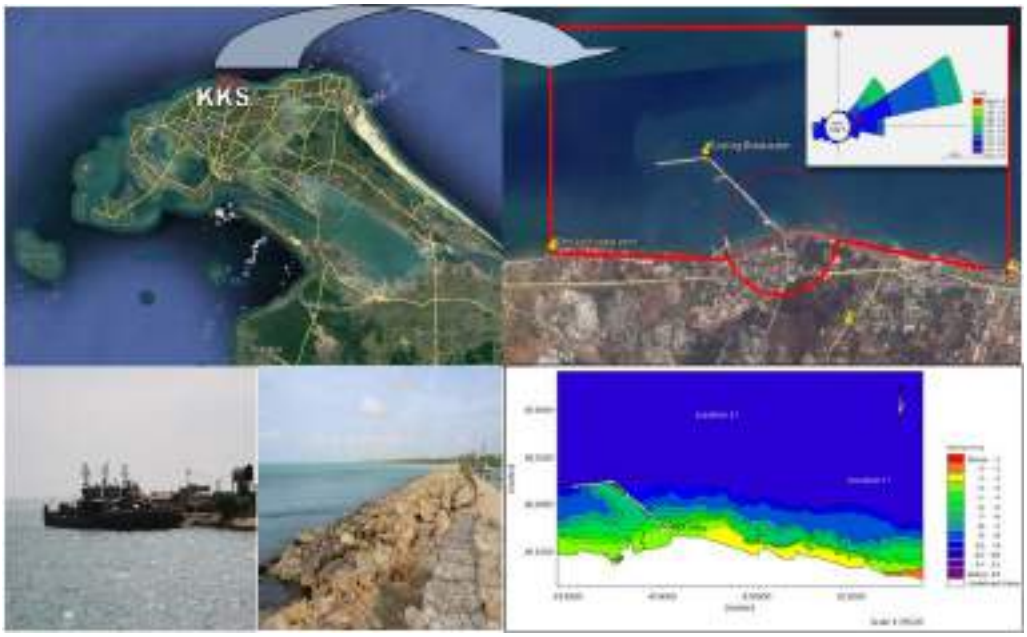
Environmental Impact Assessment Report

The Proposed Rehabilitation of Port of Kankesanturai (KKS) in Jaffna District



Project Approving Agency:

Coast Conservation and Coastal Resources Management Department

Project Proponent:

Sri Lanka Ports Authority

EIA Consultant:

Lanka Hydraulic Institute

ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR)

THE PROPOSED REHABILITATION OF PORT OF KANKESANTURAI (KKS) IN JAFFNA DISTRICT, SRI LANKA

Project Title	: The Proposed Rehabilitation of Port of Kankesanturai
Provincial Council	: Nothern
District	: Jaffna
Divisional Secretariat Division	: Tellipallai
Grama Niladari Division	: J 233 Kankesanthurai West
Nature of the Project	: Rehabilitation of the Existing Port
Details of the Project	: Rehabilitation of the main Breakwater
	: Rehabilitation of the Pier No 1
	: Construction of New Commercial Berth
Name of the Project Developer	: Sri Lanka Ports Authority
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Executive Summary

Port of Kankasanthurai (KKS) is located on the northern coast of Sri Lanka; about 15 km north of Jaffna, at 9° 49´1.92´´N and 80° 1´53.76´´E. It was built by the KKS cement factory as a private port for limited use with a draught of 6 m, using locally available resources to ferry raw materials and to transport cement. It is reported that no scientific studies or project reports have been done or prepared before the construction of this port. The breakwater cum jetty was constructed using lime stone boulders and quarry run. It is reported that the breakwater in the KKS Port and the berthing piers were extensively damaged during the 'TSUNAMI' in 2004 and the cyclone 'NISHA' in 2008. Besides damage to the existing infrastructure there were sunken ships inside the Port in several locations which were major hindrance for safe vessel movement.

The Government of Sri Lanka (GOSL) with the financial assistance from the Government of India (GOI) intends to rehabilitate the Kankesanthurai (KKS) Port to be used as a commercial port. In order to develop the port operations it is required to rehabilitate the existing breakwater and berthing pier of the Port while constructing a new cargo berth for commencement of commercial operations. The location and the orientation of the existing 1400m long breakwater will not be changed and two jetties along the breakwater will be added. This Environmental Impact Assessment is prepared to evaluate the potential impacts and to propose mitigation measures to minimize the significant impacts, if any, of this proposed intervention.

The proposed development is to rehabilitate the existing Kakensanthurai (KKS) Port and therefore no additional breakwater/gyone type structures are built. The area coverage of the port is also the same. Since the existing port is operated over a long period without any impact to the surrounding environment the new development also proposed along the same trace without considering any alternative locations. In view point of the above the overall impact to the beach and shoreline due to rehabilitation works in KKS port could be considered as minimal.

Further, all wastewater and sewage will be managed and properly discharged during construction period. No effluent will be released into the environment without treatment. Additionally, no anticipated problems related to solid waste disposal during the construction and operational phases have been identified. Therefore, no significant impacts have been encountered for the existing physical environment.

Ecological status was assessed within the impact zone, 2 km radial distance from harbour entrance towards sea and 1 km radial distance towards land. Lack of previous studies on the ecological aspects of the area, the baseline data was basically collected through field surveys. Ecological habitat and species survey of coastal terrestrial area comprised a systematic walk through the study area while the marine survey was conducted with application of underwater visual survey tools and boat surveys of the area that would be potentially affected by the proposed development. Biodiversity and their relative abundance were recorded with special attention to rare, protected and threatened species and other species of conservation concern.

There are no protected areas such as a natural park, sanctuary and conservation site within or proximity to the study area. Terrestrial habitats mainly comprised of disturbed secondary woodland and buildup lands. The woodland habitat appeared to have established on abandoned

village housing and lime pits, and as such was dominated by widespread native and exotic tree species. Faunal species of conservation interest was not recorded from terrestrial habitats. The habitat types recorded in the Assessment Areas were considered to be of relatively low ecological value due to their disturbed nature and low diversity of flora/fauna.

The KKS port basin water was quite polluted and dark and lack of biodiversity. This condition extended even across the area of port approach and entrance channels. Beyond the harbour locality dead coral reef fingers the intertidal zone along the coast. Shell molluscs dominated the faunal diversity in the area. Sub-tidal zone was biologically rich environment. Seagrass and live coral patches were reported in more offshore waters and of distance away from the harbour approach. Soft corals represented a diverse and widespread benthic group within coral reefs in the area. They are much more tolerant than stony corals of adverse environmental conditions.

Coastal sea of the KKS port is either free of fishing or other sea-based activities. There are no "Madal Fishing" activities performed within 2km distance from the port boundary. The fishermen use to cross the vicinity of port area to launch their boats to the deep sea in their boats for fishing activities. There is a boat landing site in a point in the coast on right side of the coast about 750m distance from the boundary of the port.

There are no places with historical, Archeological or cultural significant located within the port land or in its vicinity within 500m radius. Nevertheless, 7 religious locations are observed located within 600m radius. There are no houses located within the land area demarcated for the project. It is noted that the land area in the vicinity of KKS port had been occupied by fairly large population but, this population left the area during War. About 15 Acres of land has been allocated for the use of KKS port. Three buildings belong to Navy are located within this land plot at present. The rest of the area is bare land. There are no houses located facing to the boundary of the port land too. The Navy camp and another small army camp are located adjacent to the port boundary.

The ongoing resettlement activities may get accelerated due to improved port, if it is rehabilitated as proposed. The local communities who left the area may get motivated to come back seeking income generation opportunities under the port. This impact can be defined as long term sustainable positive impacts. The construction activities of the port will be confined to the sea area that is being already used for port related activities. Therefore, the fishermen presently moving through the vicinity of port area to launch their boats for deep sea fishing will not have any negative impacts.

The project developer and Navy should not disturb the present movement of fishermen in their boats launching to other areas of the sea for fishing. The project developer should convince the contractors about the need of providing priority in employment and other income generation opportunities for the local community members during construction and operation phases of the project

The current EIA has identified the potential environmental impacts arising during the construction and operation stages of the proposed development. A significant impact could mostly be emerged during construction of the new jetty and dredging of access channels and construction of other land based project components near the beach which could cause some

adverse impacts to the surrounding physical and marine environment. Turbidity generated during construction and dredging and dumping of dredged material will cause a significant, but short term impact on marine water quality. Noise and vibration generated during construction may cause some disturbance to the nearby sensitive receptors. Dust and other air pollutions emanating from construction activities and vehicles used to transport construction material also may cause some nascence to the people of in the area.

However, application of the proposed mitigation measures and good engineering practices is expected to alleviate the majority of impacts to the extent that no significant issues will remain. Thus the proposed rehabilitation works of KKS port is recommended, subject to the implementation of proposed mitigation measures and carrying out the proposed environment monitoring programme.

1 INTRODUCTION

The Government of Sri Lanka (GOSL) with the financial assistance from the Government of India (GOI) intends to rehabilitate the Kankesanthurai (KKS) Port to be used as a commercial port. This project consists of rehabilitation of the existing 1400m long breakwater in the same location without changing the orientation and to construct two jetties along the breakwater. This Environmental Impact Assessment is prepared to evaluate the potential impacts and to propose mitigation measures to minimize the significant impacts.

1.1 Main objectives of the proposed project

The existing breakwater in the KKS Port and the berthing piers were extensively damaged during the 'TSUNAMI' in 2004 and the cyclone 'NISHA' in 2008. Besides damage to the existing infrastructure there were sunken ships inside the Port in several locations which were major hindrance for safe vessel movement. In order to develop the port operations it was proposed to rehabilitate the existing breakwater and berthing pier of the Port while constructing a new cargo berth for commencement of commercial operations.

1.2 Justification of the project

Port Policy in Sri Lanka is developed as a National Strategy and within it Sri Lankan government has established the Port Development Plans to develop major ports in Sri Lanka including KKS port. It is proposed to develop KKS port as a commercial port with a separate passenger terminal.

At present scenario, the KKS port is utilized mainly to import cement in dry, break bulk form and clinker, gypsum in dry bulk form. However the present demand for cement/clinker/gypsum was fulfilled mainly by the Colombo and Trincomalee ports. Based on the 2017 statistics volume of imported cement/clinker/gypsum via Colombo, Trincomalee and Galle ports were reported as 46%, 39% and 15% respectively whereas KKS port has contributed only 1% in 2017.

Further there is an approval from Board of Investment (BOI) to start a cement factory in Kilinochchi based on cargo import through KKS Port to enhance the local cement product to achieve the future demand in the country. Their basic proposal is to set up a cement grinding and a packing plat of capacity of 750,000 MT per annum at Veravil in the Poonakary DS Division in Killinochchi District to manufacture cement using raw materials such as clinker and gypsum imported through KKS port. After the Killinochchi plant has been established, the most ideal port to import the cement/clinker/gypsum will be the KKS due to the low cost in shipping and inland transport as the approximate distance between KKS and Killinochchi is the lowest considering from Colombo, Galle and Trincomalee.

The annual requirement of cement/clinker/gypsum is directly correlated with the development indexes of Sri Lanka as many development project as well as individual constructions may take place with the uplifting wealthy of people. Due to the revival of the people in the Northern Region, the population growth is expected to be increased and lot more constructions are scheduled under the government and private sector to uplift the livelihoods of the regional people. Therefore, the volumes of imported cement /clinker/gypsum via Sri Lankan ports have to

be increased and the majority part of demand in the Northern Region will be covered through the KKS Port.

If the imported volume of cement/clinker/gypsum via Colombo port can be reduced by utilizing the import via KKS port, the rush and traffic congestion in the Colombo Port can be reduced and that void berth capacity can be used for another conventional cargo handling according to the future demand of Sri Lankan.

Under those circumstances, the development works in KKS ports will directly impact to the day today living style of the people in Northern Region and it is optimize to utilize this port to import cement/clinker/gypsum to fulfill the cement demand in future in this particular area and ultimately all over the country.

Furthermore, other than to this industrial cargo, it is a perfect port that can be utilized to enhance the free trade between the India and Sri Lanka in the aspect of agricultural and allied foods as it will be the smallest distance between two countries when comparing to the other major ports in Sri Lanka. In the present scenario, KKS port is utilized only to import cement/clinker/gypsum from India as there were no any records regarding the importing of commodities. After the rehabilitation of the port, considerable proportion from import volume of agricultural foods from India can be handled through the KKS Port. Import of some selected principle commodities (potatoes, onions and sugar) may commence through the KKS Port and which will be possibly fulfilled the 25% of forecasted demand in the Northern Region.

Under the Tourism Policy in Sri Lanka, Government planned to transform the tourism sector into the largest foreign exchange in the economy in Sri Lanka in 2020 and targeted to earn USD 7 billion in 2020 with the employment of 600,000 Sri Lankans, where women accounting for 10% of the workforce. There are many famous tourists‟ attractions and upcoming tourists‟ projects in Northern Area of Sri Lanka after the end of civil war in 2009. Therefore development in the KKS port as a commercial and a passenger port would be beneficial to develop the tourism industry within the northern province of Sri Lanka.

Jaffna peninsula has been identified historically and religiously important place and there are many tourist attractions, especially for Indian such as Nallur Kovil, Delft Island etc. By providing proper passenger facility for KKS port number of pilgrims from India will be increase. Further it is possible for Indian tourists to visit our ancient cities like Anuradhapura, Polonnaruwa via KKS port. Similarly, with the development of the KKS port, there will be increasing number of pilgrims from Sri Lanka to India for worshiping the religious places like Dambadiwa (places in north India) and Thirupathi Kovil. Arrival and departure of passenger vessels may increase Port revenue directly however, the indirect benefit to the Sri Lanka economy would also be considerable as foreigners will brings foreign currency.

The main target of the development of the KKS port is to promote the economic infrastructure in the Northern Province (Jaffna peninsula), which would support domestic as well as regional commerce and connectivity.

On completion of project, the port will be having a capacity of handling cargo vessels or bulk carriers for commercial operations. The Jaffna peninsula will be connected with rest of the world

through sea routes. This will support rapid development and economic growth in the northern region of Sri Lanka. The implementation of project will generate huge potential for employment of Skilled/Semi skilled/Non skilled labour available in the region.

1.3 Objectives of the EIA report

The objective of this report includes the environmental assessment of the proposed Kankesanthurei Port development project with respect to the design, construction and operation phases of it. The main purpose of this assessment is to ensure the project activities under consideration are environmentally sound and sustainable. This EIA report is prepared to facilitate the decisions that are based on understanding the environmental consequences of this Project and the decisions taken will facilitate to protect, restore and enhance the environment. The report structure is developed based on the Terms of Reference (TOR) issued by the Department of Coast Conservation and Coastal Resources Management (CCCRMD) which is attached in ANNEX 1.

The environment Study specifically aims at the following activities:

- Assimilate baseline data and information relating to physical, biological and social environment in and around the project site;
- Have a series of dialogues with the line agencies, local communities / households living in and around the project site as well as other stakeholders of the project to obtain their views;
- Assess the positive impacts and potential negative environmental and social impacts that might emanate during construction and operation phases of the project;
- Formulate necessary countermeasures against the potential adverse impacts so as to avoid, minimize or remedy the possible negative impacts due to project implementation and to enhance potential positive impacts;
- Identify practical approaches in implementation of mitigatory measures and monitoring throughout the implementation of the project and contribute to the overall process of project monitoring and auditing;
- Prepare an environmental monitoring plan (EMoP) so that the project proponent can take timely action to prevent negative environmental impacts before they become irreversible and also to achieve overall environmental sustainability of the project.

1.4 Aim and scope of the EIA study

The TOR issued by the Department of Coast Conservation and Coastal Resources Management (CCCRMD), the Project Approving Agency (PAA), defines the scope of this EIA study. The study area for the assessment is defined in the TOR as follows:

a) **Project site/s**: Kankasenthurei Port

b) **Study Area:** project site, an area extending up to 500m periphery from the boundary of the port and 02 km on either sides on coastal belt and 1km toward sea from the boundary of the project site.

c) **Any area beyond the** project **site/sites, where there is potential for environmental impacts:** The EIA study team shall determine the limits of the influenced area.

The TOR outlines the report structure and the issues to be addressed during the study. The study covers the existing environmental parameters of the Project area (present situation) and impacts, both short-term and long-term in nature. The analysis proposes effective mitigation measures and monitoring programmes.

The scope of this report is the environmental assessment of the design, construction and operational phases of the project and an EMP of pre-construction, construction and operational activities. The assessment is based on the site location, design and configuration of the project. The TOR specifies that the study area proposed for the EIA covers the Project Area (PA) site – which includes the area directly impacted by the project's scope of work, and the Project's Influencing Area (PIA) that extending up to 500 m periphery from the boundary of the PA, two km on either side of the coastal belt and one km seawards from the boundary of the project site.

The initial development process undertaken for the project includes: •

The initial scoping during which the environmental consultants had consultation with Project staff and the Design Team (DT) to familiarize with the project background, proposed interventions, construction methodologies and equipment to be used, pre-construction activities,

Establish the general baseline condition of the physical, biological and socioeconomic environment on-site as well as off-site through reconnaissance visits, ecological and social surveys of the project area.

Carry out scoping of environmental issues that may arise as a result of project activities to the physical, biological and socio-economic environments by stakeholders and local community consultations, particularly with the beneficiaries and affected communities, and Community Based Organizations (CBO) in the area.

Identify necessary approvals/clearances needed by the project prior to its implementation

Prepare a detailed Environmental Mitigation and Monitoring Plan (EMMP)

1.5 Methodologies and technologies adopted in EIA report preparation

A number of methods have been adopted to assess the environmental impacts of the proposed development Project. The assessment methodologies have been used to evaluate impacts arising from the development at the study area and the surrounding areas. These methodologies are described in the paragraphs below.

1.5.1 Desk Studies

The approach in the preparation of this EIA report was to draw on and build upon the Detailed Project Report, Financial Feasibility Report, and information provided by the client. In addition, available study reports, and literature related to the area have been used extensively to obtain the site specific data and baseline situation.

1.5.2 Methodological approach for studying ecology and fisheries

1.5.2.1 Study area

The ecological study covered the area of 1 km distance towards the sea and 500 meters towards land of the coastline stretching from Keerimalai Nagileswaram Kovil point ($9^0$49'0.13"N; 80^0 1'26.74"E) to Thalsevana Holiday Resort ($9^0$49'0.14"N; 80^0 2'54.08"E) while the study of fisheries (Figure 1.1) was confined to the KKS West Fisheries inspector Division.

Figure 1.1: Study Area of Fisheries – KKS West FI Division

1.5.2.2 Ecological study

The current study was carried out as a combination of desk study and a field assessment. The literature review and field sampling was designed primarily as a descriptive study to provide baseline information on the existing ecological status of the area under investigation.

The baseline ecological condition was established by undertaking the following:

I. Desk review

A desktop review was carried out to identify features of ecological importance within the study area and surrounding region in order to establish an ecological profile of the study area through reviewing the relevant literature, including previously approved Environmental Impact Assessment reports, scientific publications, independent and Government published data, academic studies, vegetation and bathymetric maps and land use maps. Since there is limited information available several professionals and people with lifelong experience were interviewed to explore the ecological status and also the ecological changes over the past years of the area.

II. Field surveys

In addition to the general review of ecological information in the study area, updated site specific information and filled up information gaps through field surveys to secure an accurate impact assessment, particularly in the areas that are likely to be subject to direct loss or indirect impact.

Field surveys in both aquatic and terrestrial habitats were conducted during August 2018 by employing a variety of methods and techniques appropriate for ecological assessment. All surveys were conducted during day time at dry season. The sampling methods and techniques used are outlined below.

(a) Onshore (terrestrial) ecological Survey

There is no existing proper information on the ecology of this area, so qualitative surveys of the flora and fauna were conducted. The terrestrial ecological survey was carried out by the study team and has identified the terrestrial flora and fauna that may be impacted by the Port development project. Field survey comprised a systematic walk along the line transects established across the study area to record vegetation types and collect information on flora, fauna and habitats. Plant species recorded from each transect were visually identified where possible, consultations with communities and by taking photographs and removing samples of leaves and fruiting bodies for analysis in the laboratory. Further, turtle nesting places along the beach which were not previously recorded were documented with the assistance of the community.

The fauna species present in the project area were identified based on the following methods of recording:

(i) Direct observation of individuals in the field, coupled with expert recognition of indirect signs (calls, pellets and tracks) for individuals that were not actually sighted. These observations were made by following the same transects as the flora survey and also by diverging away from transects where necessary.

(ii) Discussion with local people and officials, if the informants were judged to be sufficiently skilled in animal recognition for the record to be accepted with confidence.

(iii) Some other additions were made based on sightings reported in published literature and reliable unpublished data.

(iv) Direct observation of individuals in the field, coupled with expert recognition of indirect signs (calls, pellets and tracks) for individuals that were not actually sighted.

In addition, photographs of vital importance and concerns on the current situation of the various sites and the surrounding physical, biotic and social environment were taken using digital cameras to record empirical evidence. Spatial data were captured using GPS.

(b) Marine Ecological Surveys

The marine environment comprises several types of habitat, namely inter-tidal communities, sub-tidal communities, marine benthos and marine water, which need to be investigated to determine the status and the ecological value.

The sea within the boundaries of the study area is characterized by habitat heterogeneity. To understand the spatial diversity of habitats across the study area; the area was divided into three zones;

- Harbour basin (an enclosed area of water surrounded by existing breakwaters, quarry walls and other structures)
- Proximity to harbor basin area (Area about 1km from either side of the harbor basin)
- Distance from the harbor basin (Area beyond 1 km from either side of the harbor basin)

- **Inter-tidal ecological survey**

Qualitative walk through and quantitative line transect methods were used to survey the inter-tidal communities by snorkeling and/or walking on the study area. During the walk through survey, the tidal habitats such as rocky and sandy shore areas and community attributes were recorded through direct sighting.

- **Sub-tidal ecological survey**

The survey included spot-check reconnaissance dives on randomly laid line transects and Rapid Ecological Assessment (REA) at selected transects where needed for more detailed survey. During the spot-check reconnaissance dives, forty transects of 50m length (randomly laid) were surveyed by experienced divers and information on the GPS location of transect distance, visibility, substrate type, presence of coral colonies and other invertebrates, fish and other animals and condition of coral were recorded. Eighteen transects with signs of coral colonies observed in the spot-check dives were further surveyed by REA. Selected each transects the benthic cover, taxon abundance, and ecological attributes within a swathe of 2 m wide were recorded.

- **Pelagic zone and open sea survey**

Visual inspection and identification of upper pelagic fish and other marine animals such as sea turtles and marine mammals was done at randomly selected sites by spot diving with snorkel and scuba.

- **Port basin**

The Port basin, including approaches, docking sites and the bordering intertidal zone was inspected by diving with scuba and direct sighting.

1.5.2.3 Fisheries

I. Desk study

A desk study of relevant published and unpublished literature and reports, including fisheries production, resources and activities, was carried out to obtain the baseline information regarding fisheries and fishery related activities in the study area.

II. Fish landing site survey

A rapid monitoring survey of fish landings was carried out at KKS West FI Division. During the study fishermen were interviewed for obtaining information, particularly in fishing effort, fishing gear used, rotational harvesting strategy, fishing grounds, fishing routes and migration patterns. Further, fish traders and processors were also interviewed concurrently at the landing site.

1.5.3 Methodological approach for the social impact assessment

1.5.3.1 Data collection methods

The data collection was carried out through chronological activities mentioned below.

- Consultation of representatives of relevant Government agencies in Jaffna on 11/07/2018. This consultation session was chaired by District secretary of Jaffna and representatives from other agencies such as Divisional Secretary of Walikamam North and Grama Niladhari of J233 division, officers from fisheries Department and representatives from Central Environmental Authority in Northern Province.
- Meetings with Divisional Secretary Walikamam North- this meeting was attended by Grama Niladhari of J233. The secondary data related to Divisional Secretariat and also J233 GN division was collected after the meeting. The DS and other offices provided information about the justification of the proposed project and also possible impacts.
- Transect walk with the GN of J 233 on 31/07/2018 and identified the existing environment and also the possible impacts.
- Interviews and group discussions with community leaders and also community members residing in the vicinity of KKS port during 01/08/2018 – 05/08/2018.

1.5.3.2 Data analysis

Several criteria and indicators were used to analyze the data collected to identify possible impacts. The criteria and indicators used are mentioned below.

Criteria	**Indicators**
Demographic condition	No of families and population Diversity of the population Economic activities Housing and Employment Land use and land ownership
Infrastructure facilities	Road, electricity Drinking water and business infrastructure facilities Institutions and sensitive places Sanitary facilities
Resettlement issues	Land required for the project Ownership of land Need for land acquisition Need for resettlement of houses and other properties
Vulnerable issues	Income related poverty Families headed by women Families headed by Disabled persons Heads of families having chronic diseases
Possible impacts during construction and operation phases	Types of impacts and their magnitude
Measures to mitigate negative impact	Suggestions to mitigate negative impacts and also suggestions to enhance the positive impacts
Views of the relevant stakeholders on the proposed project.	Views of the key stakeholders

1.6 Main beneficiaries

The development of Kankesanthurai Port is a nationally important project and it will directly and indirectly provide jobs and increase income generation opportunities across a wide spectrum of services associated with a commercial port. The Port area and the surrounding could accommodate a number of operations and services that are related to the commercial and maritime industry. In the long term, development of the Port operations would stimulate Port related business enterprises and increase local employment.

The local communities within the area will directly benefit from the project by: (i) direct employment opportunities during construction and the operational period; (ii) enhance the possibilities of export agriculture. Apart from these, the land value in the area will be increased due to the development of the proposed Port.

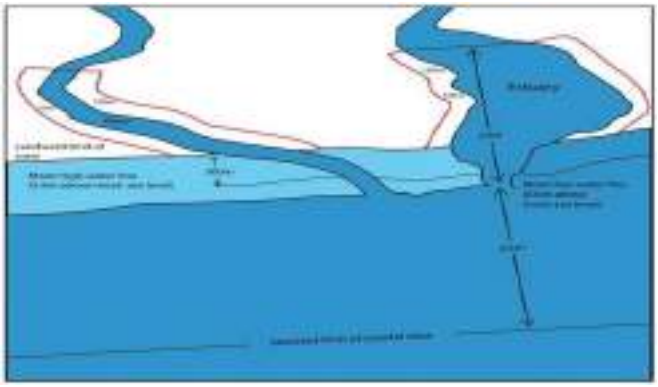
The main parties having potential for benefits from the proposed project include following,

Beneficiary	**Benefit**
Sri Lanka Port Authority	Opportunity to get dilapidated KKS port to be rehabilitated and brought back for operation.
Sri Lanka Navy	Suitable strategic location with infrastructure facilities supporting their operations will be available
Industrialists	Opportunity for investment in industries such as Petroleum
People in Kankesanturai and Jaffna	Employment opportunities
Farmers	Possibilities for export agriculture

1.7 Policy legal and administrative frame work with reference to the project

There are a number statutes and regulations that are applicable to the project, which are discussed in the paragraphs below along with statutes that are not applicable.

1.7.1 Coast Conservation Act No. 57 Of 1981



The Coast Conservation Act No. 57 of 1981 together with the Coast Conservation (Amendment) Act, No. 64 of 1988 and Coast Conservation (Amendment) Act, No. 49 of 2011 governs the Coastal Zone. This Zone comprises mainly "the area lying within a limit of three hundred meters (300m) landwards of the Mean High Water line and a limit of two kilometers (2km) seawards of the Mean Low Water line". Any person desiring to engage in a development activity

within the Coastal Zone will be required to obtain a permit issued by the Department prior to commencing the activity.

The EIA process is part of the permit procedure mandated in Part II of the Coast Conservation Act (CCA). Section 16 of the Coast Conservation Act (CCA) confers on the Director General of Coast Conservation and Coastal Recourse Management Department (CC&CRM), the discretion to request a developer applying for a permit (to engage in a development activity within the Coastal Zone) to furnish an Initial Environmental Examination or Environmental Impact Assessment relating to the proposed development activity. The CCA does not however specify how and when this discretion should be exercised. The Coast Conservation and Coastal Recourse Management Department interprets this provision as requiring an EIA when the impacts of the project are likely to be significant.

The list of "prescribed projects" published in the Gazette Notification No. 772/22 dated 24.06.1993 under the National Environmental Act states that the CCA applies to those prescribed projects if they are located wholly within the Coastal Zone. The proposed KKS Port development project is within the coastal zone.

Upon the EIA process being concluded satisfactorily, as the Project Approving Agency, the CC&CRM will under Part III Section 14 of the Coast Conservation & Resource Management Act No 57 of 1981, issue a Development Permit for the proposed development activities.

1.7.2 National Environmental Act No. 47 As Amended By Act No. 56 of 1988 (NEA)

The National Environmental Act (NEA) No. 47 of 1980 defines the regulatory framework for environmental conservation and protection, with Central Environmental Authority (CEA) as the regulatory and enforcement agency. The first amendment to this Act in 1988 through Act No. 56 stipulates EIA as a mandatory requirement for establishment of various large scale developmental projects. According to Part IV C of the above-mentioned amendment act, and the regulations published in Gazette (Extra Ordinary) No 722/22 dated June 24, 1993 requires all "prescribed" development projects which are wholly or partly located outside the Coastal Zone to be subjected to Environmental Impact Assessment. Since, the KKS Port is within the coastal zone, provisions under Part IVC of NEA do not apply directly to this project.

However, the regulatory instruments set out under NEA to control Water Pollution (Surface, Ground and Coastal) and air/noise/vibration emissions that needs to be considered during all construction activities are listed below:

- National Environmental [Protection & Quality] Regulations No. 01 of 2008: Issue of Environmental Protection License for Emission or Disposal of Waste and Management of Waste (Gazette Notification No. 1534/18 dated 01/02/2008) and activities for which a license is required (Gazette Notification No. 1533/16 dated 25.01.2008)
- National Environment [Ambient Air Quality] Regulation 1994. (Gazette Notification Number 1562/22 dated 15th August 2008.)
- National Environmental [Noise Control] Regulations No. 01 of 1996 (Gazette Notification No. 924/12 dated 23.05.1996)

- National Environmental [Air Emission, Fuel and Vehicle Importation Standards] Regulations – 2000 (Gazette No. 1137/35 dated 23rd June 2000)
- National Environmental [Air Emissions, Fuel & Vehicle Importation standards] Amended Regulation No. 01, 2003 (Gazette No. 1295/11 dated 30th June 2003)
- Amendment to National Environmental [Air Emissions, Fuel and Vehicle Importation Standards] Regulations No 01, 2003 (Gazette Notification Number 1557/14 dated 9th July 2008).
- Motor Traffic [Emission Control] Regulation of 1994 (Gazette Notification Number 817/6 dated 3rd May 1994)
- Regulation published under Section 23W [Prohibition of Use of Ozone Depleting Substances] (Gazette Notification Number 1309/20 dated 10th October 2003)
- Interim standards on vibration control being imposed as per CEA notice dated 4/12/2008, on the following vibration causing activities until such time the final vibration control standards are gazetted.
    - Interim standards for vibration of the Operation of Machinery, Construction Activities and Vehicle Movements Traffic
    - Interim standards on Air Blast over Pressure and Ground Vibration for Blasting Activities
    - Standards for Inconvenience of the occupants of buildings

1.7.3 Marine Pollution Prevention Act No. 35 of 2008

As per requirements of the Marine Pollution Prevention Act No. 35 of 2008, all ships that enter the territorial waters of Sri Lanka should comply with appropriate measures for preventing and controlling pollution of the sea from a wide range of sources ranging from sewage to harmful chemicals. This act enables carrying out the requirements and conditions stipulated in the international convention for prevention of pollution from ships (MARPOL Convention) to which Sri Lanka is a signatory.

Therefore, all the vessels that would enter and berth within the Port should comply with the provisions of the Marine Pollution Prevention Act 35 of 2008. The executing agency of the act is the Marine Pollution Prevention Authority of Sri Lanka. The said Act requires that developments such as Port should include sufficient facilities for pollution abatement of marine waters as well as contingency measures in place to cope with the failure of such systems.

1.7.4 The Antiquities Ordinance No. 9 of 1940 (Now Act) and the Subsequent Amendments, In Particular Antiquities (Amendment) Act No 24 of 1998

The Antiquities Ordinance No 9 of 1940 is the legal requirement that is presently implemented in Sri Lanka with regard to the archaeological heritage. Including the amendments and regulations added to the ordinance up to this date, the Antiquities Ordinance No 09 of 1940 consists of 8 main titles and 48 sections.

Under the requirements of Sections 43A and 43B of the Antiquities (Amendment) Act No. 24 of 1998, separate approval is required from the Director General, Department of Archaeology, for the satisfactory completion of an Archaeological Impact Assessment. This is implemented through the 'Project Procedure Regulation No.1 of 2000 (published in Gazette Extraordinary No. 1152/14, October 2000).

1.8 Compatibility with other development projects/programs/plans in the area, specially with the government development plan of the area

GOSL has initiated several steps to develop the northern region after completion of 30 years civil war. Therefore GOSL has taken policy decision to improve the infrastructure in this area by providing drinking water, electricity, road connectivity, commercial airport and commercial port. Main projects are planned by the Government in the northern area are as follows;

- Iranamadu air field in the Kilinochchi District would be developed in to a domestic air port
- Industrial zone would be set up in the lands close to KKS port
- Rehabilitation of Mannar-Vavuniya-Trincomalee road

This project is part of the Government of Sri Lanka's (GoSL) strategy to provide vital infrastructure in the north of the country. Under this GOSL has sign MOU with Indian Government to rehabilitate the KKS port and signed dollar credit line agreement (DCLA) with EXIM bank of India. The project will be funded by the EXIM Bank of India for the breakwater rehabilitation and the consolidated Funds of Government of Sri Lanka will be used to develop supportive port facilities.

The Ministry of Ports and Shipping is the executing agency responsible for successful project execution, while the Sri Lanka Ports Authority (SLPA) is the project proponent.

1.9 Conformity with the Coastal Zone Management Plan (CZMP)

1.9.1 Coastal Zone Management Plan (CZMP)

The CZMP was developed in 1990 and revised in 1997, 2004 and 2018. The aim of the CZMP is to regulate development within the jurisdiction of the CC&CRM in order to ensure that development pressures are not detrimental to coastal processes. In order to achieve this, the CZMP has identified areas suitable for development activities and corresponding setback limits for intended infrastructure.

The entire coastal set-back strip of the island has divided into 105 coastal segments and each segment is further subdivided in to two areas as Reservation area and Restricted area. Reservation area is nearest to the shoreline and corresponds to a "no build zone" in which only use/activities which are absolutely essential are allowed. Restricted Area (or soft zone) can be used for a few low impact activities. The width of the Reservation and Restricted Areas will vary according to the vulnerability of the particular coastal segment.

According to the CZMP, ports and related infrastructure are considered as permissible within the Reservation area if it can be proven that the activity concerned will not have any significant adverse impacts on the particular coastal segment or on the adjacent segments. The proposed project activity fall within the framework of a development activity within the coastal zone and controls under the development permit process. The specific environmental and social concerns relating to the implications for coastal management of the proposed project have been identified by the CCCRMD in the scoping of the ToR for this EIA study.

1.9.2 Master Plan for Coastal Erosion Management

This is the key plan developed by the CCD to address the growing problem of coastal erosion in Sri Lanka. It was first developed in 1986 and revised in 1993. The CCD periodically reviews the plan in order to ensure that a consistent approach is adopted for coast protection. The CCD upgraded the Plan in 2000 under the Coastal Stabilization Component of the ADB funded Coastal Resources Management Plan (CRMP).

The proposed project does not impact on any aspects connected to the CRMP. It is pointed out later in the EIA report, in keeping with studies carried out and recommendations of Lanka Hydraulics Institute (LHI), the process of rehabilitation of the Kankasenthurei port will not create any additional barriers to the coastal environment and thereby having no impact on coastal erosion.

1.10 Contingency plan of Marine Environmental Protection Authority and any other conservation/ development plant

Barges which supply equipment and machinery for the proposed development should comply with the provisions of the Marine Pollution Prevention Act 59 of 1981. The executing agency of the act is the Marine Pollution Prevention Authority of Sri Lanka. The said Act requires that developments such as ports should include sufficient facilities for pollution abatement of marine waters as well as contingency measures in place to cope with the failure of such systems. The contingency measures are also helpful to prevent pollution of the coastal zone from oil spills.

1.11 Approvals and permits required to implement the proposed project

A number of national environmental laws and regulations are relevant to the proposed project activity. The following Table 1.1 provides a summary of the key laws.

Table 1.1: Applicable National Laws and Regulations

No.	Law	Relevance	Focal Point
1	The Coast Conservation (Amendment) Act, No. 49 of 2011	EIA process, Development permits within the coastal zone. Coastal resources management plan	CCCRMD
2	The National Environmental (Amendment) Act, No. 53 of 2000 and the Regulations under the Act	Environmental approval outside the coastal zone. Pollution prevention and control from land based sources	CEA
3	The Fauna and Flora Protection (Amendment) Act, No. 22 of 2009	Biodiversity conservation areas and protected species	DWC
4	The Marine Pollution Prevention Act, No, 35 of 2008	Pollution prevention and control from marine sources	MEPA
5	Forest Ordinance No. 16 of 1907 (as amended) and the Rules and Regulations under the Ordinance	Protection of forest lands including mangroves.	Forest Department
6	Mines and Minerals Act No. 33 of 1992	Quarries and burrow sites license and permits	GSMB
7	Urban Council Ordinance No. 61 of 1939 (as amended)	Waste management, sanitation, Category E roads maintenance	Jaffna UC
8	Urban Development Authority Law No. 41 of 1978 (as amended)	Regulate and manage the urban environment	UDA
9	Road Development Authority Act, No. 73 of 1981	Development and maintenance of Category A and B roads Approval of the RDA/PRDA/LA (if required) for transport of quarry material will be the responsibility of the individual quarry owners who will supply the material to the site	RDA

1.12 Environmental requirements of donor agencies

The source of funds (USD 45.27 million) for the proposed development is from Export-Import (EXIM) Bank of India under the Dollar Credit Line Agreement (DCLA) signed between GOSL and EXIM Bank of India. Consolidated Funds of Government of Sri Lanka also allocated mainly to acquire 50 acres of adjacent land and built some of the infrastructure facilities. There is no special environmental policy requirement from donor agency and it is anticipated to fulfill the legal requirements of Sri Lanka which have been discussed under Section 1.7 of the report.

2 DESCRIPTION OF THE PROPOSED PROJECT

2.1 Project Location

The Kankesanthurai (KKS) is in the northern coast of Sri Lanka which is about 35 nautical miles away from the Indian coast and about 15 km northward from Jaffna city (Figure 2.1). The Kankesanthurai (KKS) port is located in Kankesanthurai Centre Grama Niladari (GN) division in Valikamam North Divisional Secretariat (DS) Division of Jaffna district.

The project site can be reached through Jaffna Ponnalai Point Pedro road, which is connected to Jaffna Kankesanthurai road at Kankesanthurai. Project site is about 900 m away from the Jaffna Kankesanthurai road, about 1250 m away from the Kankesanthurai railway station and about 7 km away from the Palali airport (see Figure 2.2).

The land demarcated for the port facility has 7 ha and it has not been used for any economic or social activities other than few buildings which belong to Sri Lanka Ports Authority. Land use of the proposed plant area can be categorized as scrub with various bushes common to coastal land in tropical climate zone.

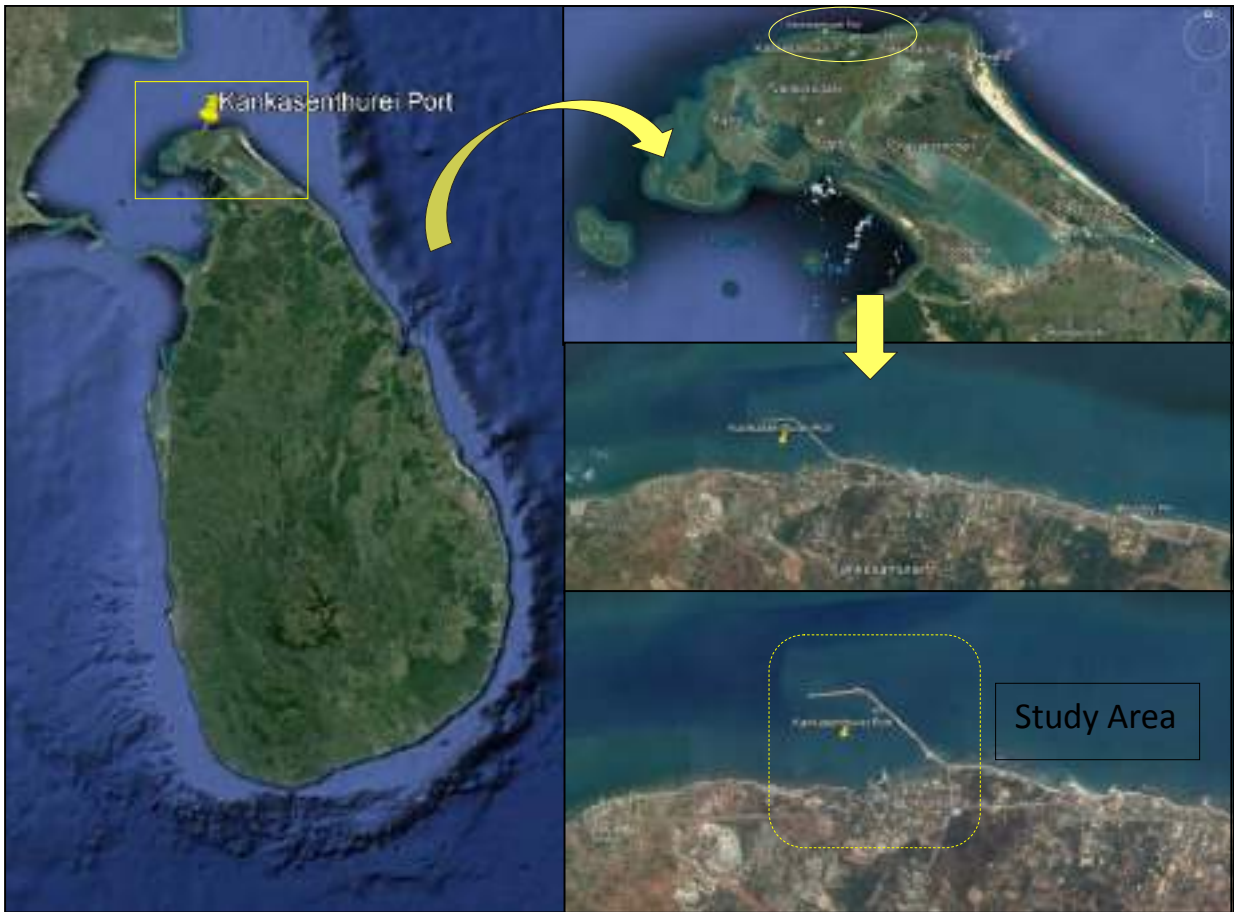


Figure 2.1: Location of the Kankesanthurai Port, Jaffna

Figure 2.2: Accessibility to the Kankesanthurai Port, Jaffna

2.2 The details of the existing port

The KKS port was built by the KKS cement factory as a Private Port for its use to ferry row materials and to transport cement before 1984. The KKS Port was constructed for limited use with a draught of 6m using locally available resources and no scientific studies or project reports have been done or prepared before the construction of the Port. The breakwater cum jetty was constructed using lime stone boulders and quarry. The sea bottom also has an extension of sedimentary rock and coral base.

The existing breakwater and the berthing piers in the KKS Port were extensively damaged during the 'TSUNAMI' in 2004 and the cyclone 'NISHA' in 2008. Layout of the existing Port including the piers and breakwaters is shown below. Details of the main piers and the breakwater including its physical condition are described below in detail.

Figure 2.3: Layout of the Existing Kankesanturai Port, Jaffna

Existing Breakwater

The length of the existing breakwater is about 1400 m. Top width of the breakwater is about 6 m and the average top level is about 2.6 m. The existing core of the breakwater was made up of lime stone boulders which are severely damaged due to rough sea condition during the North East (NE) monsoon season (November to February). About 4 m of maximum waves were reported during the NE monsoon period which was strong enough to topple over the breakwater. Further it was reported that the breakwater got extensively damaged during cyclone "Nisha" hit the coast on November 26, 2008. Due to those extensive attacks, breakwater structure was severely damaged and at a number of places caving in has also taken place.

Emergency rehabilitation of the breakwater was carried out immediately after the cyclone and about 240 m length of the breakwater was rehabilitated by March, 2009. For about 200 m length, the height of the seaside wall of the breakwater has been increased by 1.5 m to serve as a wave wall and to protect the breakwater particularly during the North East monsoon. Further work (remaining portion of the break water, construction of wave wall) was stopped due to non-availability of raw material / rock and other constraints. Although the rehabilitation was done upto certain extent, since there is no armour support for the breakwater, the boulders are loosely placed and rolled down due to wave activity.

Figure 2.4: Condition of the Existing Breakwater

Pier No. 1

The existing pier No. 1 is located at the southern end of the breakwater which is built along the structure having a length of 90 m and width of 15 m approximately. Cross section details of the berth are not available. Based on the available information the pier had been constructed using concrete bags upto the water surface and two rows of concrete blocks were built above the bags. A concrete slab forms as the top of the pier cap. The slab has slight overhang, approximately 1.0 m, extending ahead of the concrete blocks.

At present the slab has some cracks and subsided. Some of the concrete bags were detached from the wall and due to that northern portion of the pier has tilted. In order to utilize the pier it is proposed to construct a new piled jetty in extension of the existing structure.

Figure 2.5: Condition of the Existing Pier No. 1

Pier No. 2

Pier No. 2 is located at the mid-way of the breakwater as a projected jetty having a length of 90 m and a width of 18 m. based on the available information the pier was constructed using concrete bags at the edges as walls which was then bottom filled in the center using lime stones. Beams were then laid over the lime stone core and the deck was made of another reinforced concrete slab.

The pier is completely damaged during the extreme weather in the past. Concrete bag wall was damaged and some of the limestone boulders have come out in the northern side of the pier. Currently the deck slab has been tilted severely and huge cracks and holes are visible on the deck of the pier. This pier is completely unusable and appears that rehabilitation is not possible.

Figure 2.6: Condition of the Existing Pier No. 2

Northern Arm

The main breakwater of the Port was built with lime stones which are vulnerable for erosion and the breakwater is directly exposed to severe wave conditions during NE monsoon. In order to provide additional protection to the breakwater particularly during NE monsoon, a northern arm about 100 m was built. But due to the excessive wave attack during the past the northern arm of the breakwater has totally damaged and disintegrated. (see Figure below).

Under the present rehabilitation scheme it was proposed to strengthen the breakwater by providing two layers of concrete armour units. It was proposed to strengthen the sea side of the structure by providing 6 T concrete armours up to 150 m length, 10 T concrete armours between 150 m to 380 m and 18 T concrete armours up to the end structure end. Further it was proposed to provide concrete armour protection in the Port side as well. Since the proposed modification will provide enough safe guard to the breakwater and hence no need to rebuild the washed out arm.

Figure 2.7: Condition of the Northern Arm

Wreck

There were some sunken ship wrecks within the Port and outside the Port. During the previous rehabilitation those ship wrecks were removed and currently the Port is free from any wreck or under water obstructions for navigation.

2.3 Description of the project including major components, size and magnitude of each component with permanent and temporary structures

Proposed Port layout

The proposed project is to rehabilitate the existing KKS Port and hence the location would be the same. Port layout is slightly modified with the proposed design for the breakwater by removing the northern arm to provide the better calmness.

Further two port development scenarios are considered in the study namely operate the port with initial development scope for 30 years and enhance the Port basin to -11 m to increase the ships size to 20000 DWT in 2032.

Since the passenger ferries could operate in shallow berth which is close to the passenger terminal and gate.

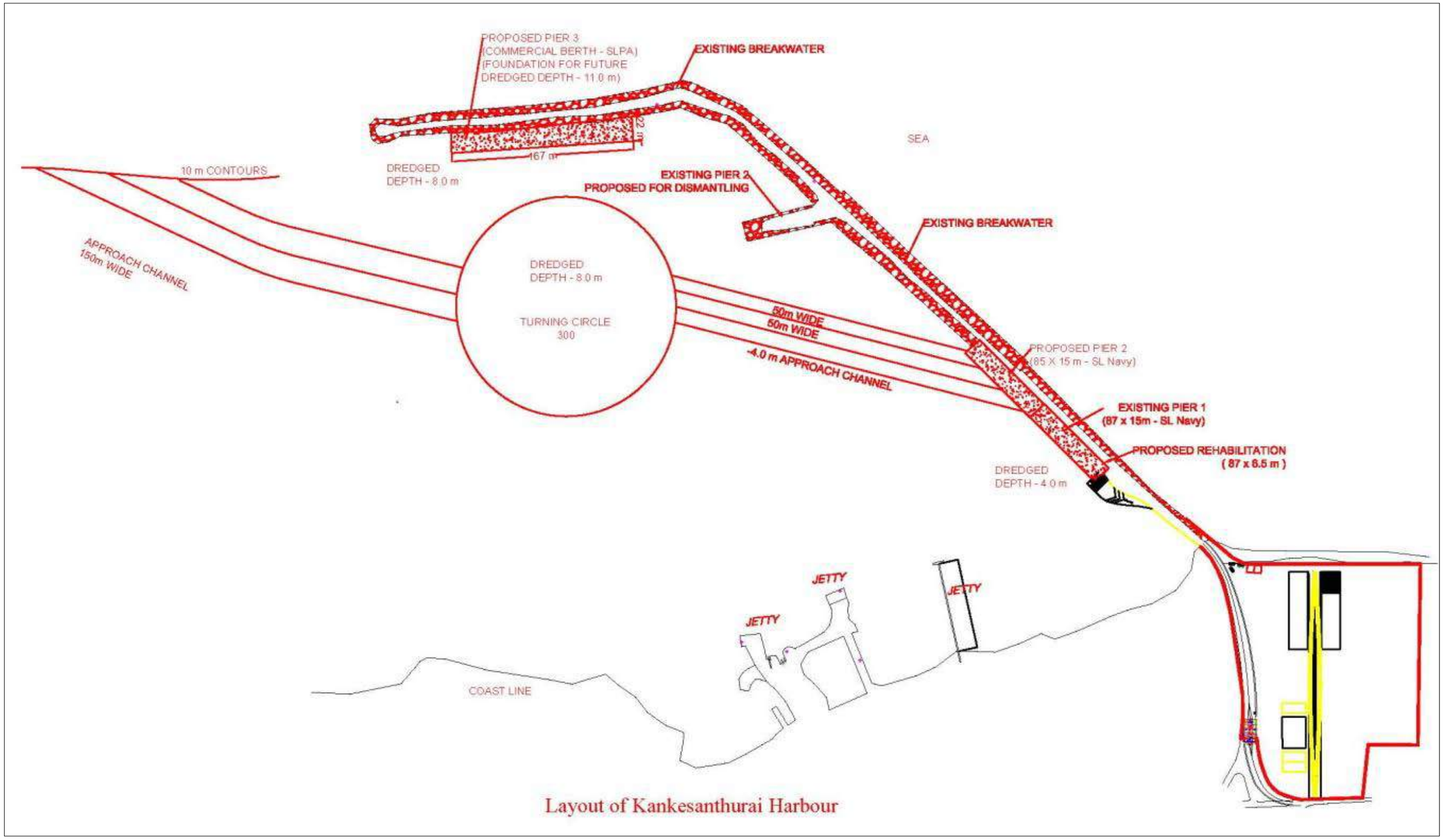


Figure 2.8: Proposed Port Layout

Proposed Infrastructure Development

The essential infrastructure facilities required to operate and rehabilitate the KKS Port have been provided as stated below:

- Navigational aids (Buoys) to demarcate the navigation channel. The floating buoys have also been considered to demarcate the naval Port area from the civilian cargo berths (Pier Nos. 1, 2 and 3).
- Lying of pipelines along the side of the breakwater has been provided for water and fuel supply to the berths (new commercial berth, Pier No. 3) and existing Pier No. 1. Exclusively about 1 m width has been earmarked along the side of the breakwater for this purpose. Water supply already exists at KKS Port.
- Provision of MS galvanized pipes, mercury lamps, electrical fittings have been considered for lighting of the breakwater and berths. Power supply already exists in KKS Port. Only rehabilitation of the electric poles on the breakwater, electrical wiring, mercury lamps and other electrical accessories have been considered in the cost estimate. No provision has been made for any transformers.
- Fixed Fire fighting System / equipment like hydrants has been provided as a mandatory for safety purpose
- Provision has been made for communication facilities such as telephones, cell phones etc.
- Concreting of the breakwater crest top has been considered in the breakwater design for vehicle movement.
- Fenders, bollards, mooring rings have been provided in the berth design for safe berthing of the vessels

The provision of port building, storage facilities, staff quarters etc are not been considered in the rehabilitation works. These facilities do not exist in the KKS Port even earlier. At present one office building exist at KKS port premises for operations of naval vessels.

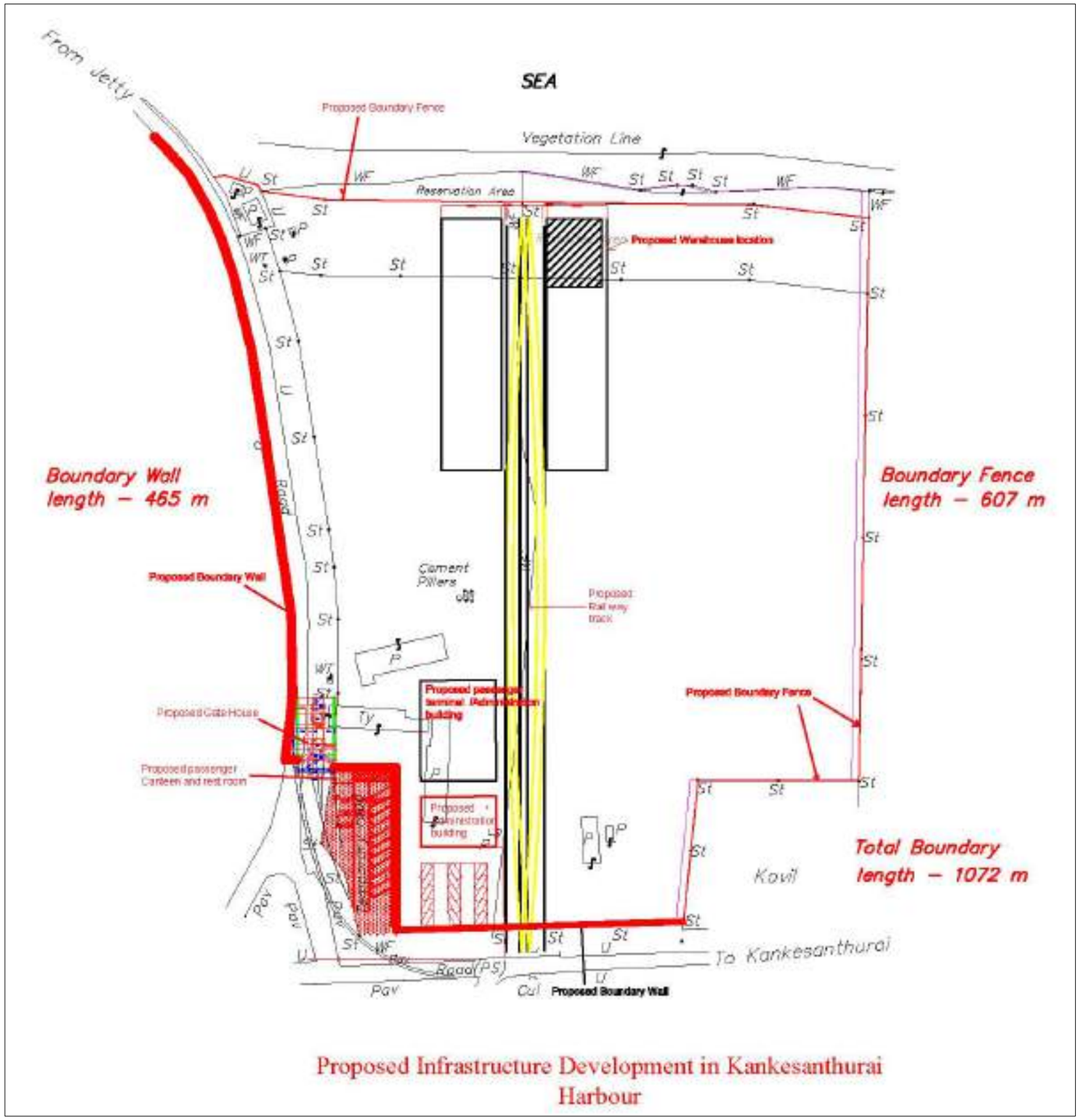


Figure 2.9: Proposed Infrastructure Development

2.4 Detailed drawings

The major project structures to be constructed include; breakwaters, establishment of Port basin, jetties, and few of land-based infrastructure facilities. Detail drawings for the rehabilitation is provided in ANNEX II of the report and brief description of proposed marine structures are given below;

Breakwater

Internationally accepted procedures and standards have been followed for the design of breakwaters. The size of armour units is computed using the well-known Hudson formula, which is recommended by CERC (1984). The design wave height is adopted as significant wave height. The size of stones in core layer, crest width, thickness of different layers and toe for the scour protection are obtained as per Shore protection Manual (SPM) of Coastal Engineering Research Centre [CERC (1984)].

Rock armoured breakwater with Tetrapods either side is proposed for the 1400 m long breakwater. The existing breakwater layout is used as same under this rehabilitation. The design details for breakwater trunk section (CD 5m to 8m water depth, middle section (CD 8m to 10m) and head section (CD 10m to 12m) has been given in the Table 2.2.

The typical cross sections of the breakwater have shown in the Figure 2.10 to Figure 2.13. Detail designs for the breakwater sections are given in Annex II of the report. The head section is shown in the Figure 2.13 can be used for the chainage from 950m to 1400m.

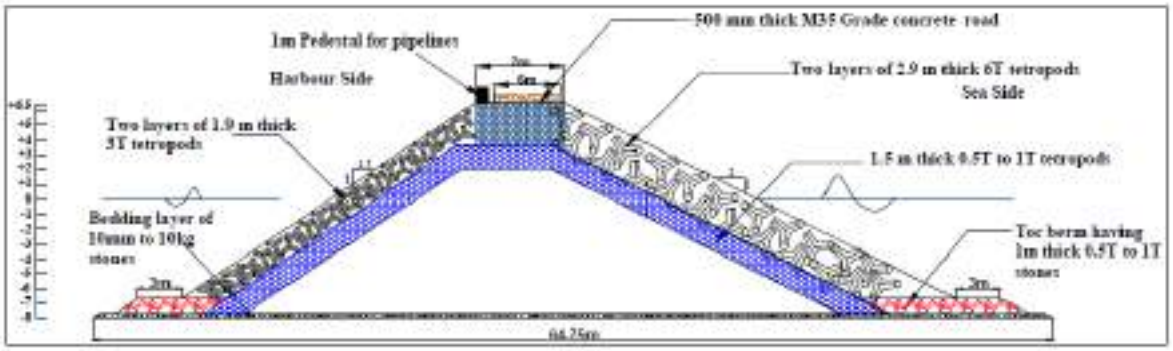


Figure 2.10: Typical breakwater trunk section for water depth of 5m to 8m

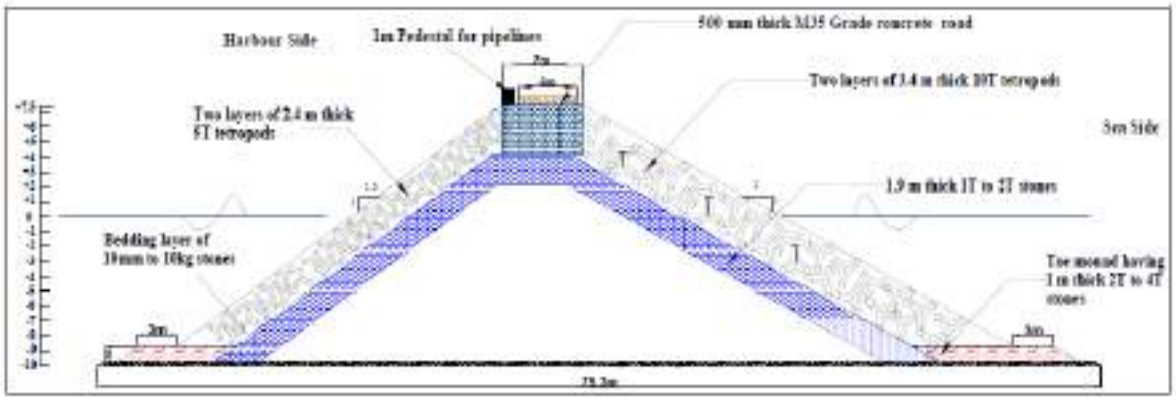


Figure 2.11: Typical breakwater trunk section for water depth of 8m to 10m

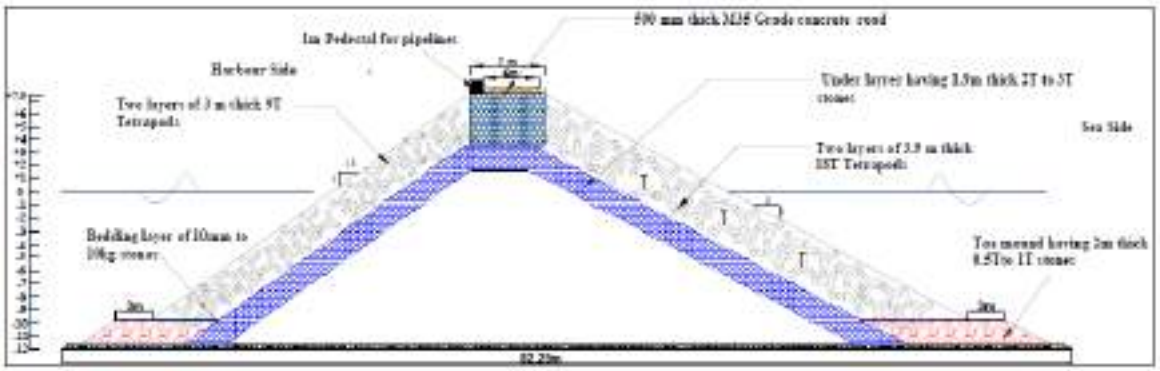


Figure 2.12: Typical breakwater trunk section for water depth of 10m to 12m

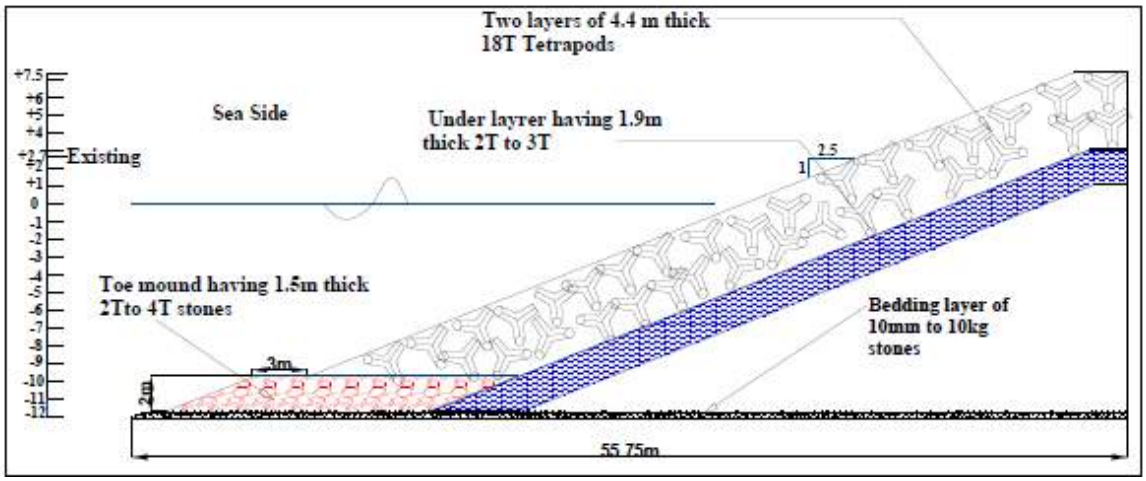


Figure 2.13: Head Section at 1400m chainage

New Commercial Berth

The proposed new commercial berth is 167m long and 22m wide with finished level of +4.075m MSL. The structural system consists of 5 rows of RCC bored cast-in-situ piles each of 1000 mm diameter spaced at 5.0 m C/C longitudinally and 5.0 m C/C transversely as shown in Figure 2.14.

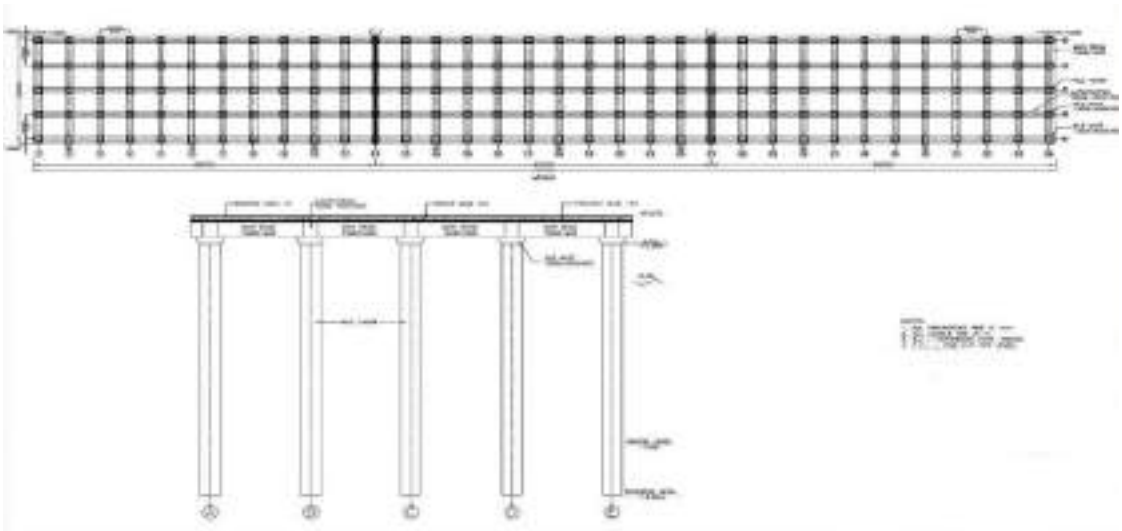


Figure 2.14: Sectional Details of Pier 1 (New Berth)

It is proposed to dredge in front of the jetty to (-) 8.0 m (As per code IS 4651 part -5, Cl. No.4.6.1, Dredge level = Draft + not less than 10% of the vessel in the channel). The alignment, length and dimensions of the Cargo Berth are as shown in the Figure 2.8 and 2.14. However, the berth will be designed to handle 6.0 m draft initially and 8.0 m draft subsequently in future depending upon requirement.

The following preliminary dimensions are given below;

Pile Diameter	=	1000 mm
Pile muff	=	1300mm * 1300 mm * 450mm
Main (Cross) beam	=	1000 * 1200 mm
Longitudinal beam	=	750 * 1200 mm
Slab	=	300 mm thick (Partially pre-cast and partially Cast in situ)
Wearing coat	=	75 mm

Rehabilitation of existing pier-1

The proposed size of the jetty is 87 m long and 6.5m wide. The structural system consists of 2 rows of RCC bored cast-in-situ piles each of 1000 mm diameter at 6 m C/C longitudinally and 5.0 m C/C transversely as shown in Figure 2.8. The finished level of jetty shall be (+) 4.075m and average bed level (-) 4.0m.

Sri Lanka Port Authority (SLPA) has suggested increasing the length of the Pier to 120 m in rehabilitation plan. The Pier No. 1 is originally designed with 87 m length with -4.0 m depth alongside the Pier to cater 2000 DWT vessel. Since depth alongside the Pier is not increased to -6.0 m, the original dimensions of the berth are retained for rehabilitation works.

Sri Lanka Port Authority (SLPA) has suggested construction of block structure in continuation of the existing structure for rehabilitation. However, piled structure is considered in the rehabilitation of the pier. While making this suggestion, the option of extending it as a block structure is also considered. Though a block structure would work out as an obvious option and may become cheaper, it is ruled out because of the following issues:

- A new block structure could not properly be integrated to the old structure, unless significant portions of old structure top layers are removed and relayed combining old and new foot prints.
- If the integration could not be carried out properly, then failure of the new extension may result due to water pressures on the back face and excessive repeated loadings from vessel and moorings.
- Hence, it is proposed that piled structure be provided for the new extension of Pier No. 1, unless there are severe difficulties/limitations with the piled structure.

The following preliminary dimensions are given below;

Pile Diameter	=	1000 mm
Pile muff	=	1300mm * 1300 mm * 450mm
Main (Cross) beam	=	1000 * 1200 mm

Longitudinal beam = 750 * 1200 mm

The minimum design life of the facility is considered as 50 Years including the maintaining system. Frequency of inspection & repairs of work is decided as 5 years where as the recoating of steelwork is proposed in every 2 years.

The deck levels proposed based on the proposed vessel sizes, water levels, and functional requirements are as follows;

Description	Levels
Deck top level	(+) 4.075 m
Average bed level (Pier No. 3)	(-) 7.0 m
Average bed level (Pier No. 1)	(-) 3.5
Dredge level (Pier No. 3)	(-) 8.0 m
Depth available at Pier No. 1	(-) 4.0 m
Founding level of pile	(-) 13.0 m

Dredging

Dredging is normally carried out in the operational area of the vessels. The bathymetric surveys for the Kanakesanturai Port were carried out by Indian Navy in July, 2010. based on the existing bed levels and the depth required for operation, the areas need to be dredged is identified. Under the proposed development dredging is proposed in the approach channel, turning basin & approaches to the proposed new berth & alongside of the operational area.

The bathymetric surveys reveal the existing depths in the Port as stated below (Table 2.1):

Table 2.1: Range of Depths in the Operating Area of the Port Basin

Location	Range of existing depths below CD in m	Design depth below CD in m
Approach / Entrance Channel	7.1 to 10.0	8.00m
Turning basin	6.3 to 7.7	8.00m
Approaches to the berth and along side	6.7 to 7.3	8.00m
Approaches to the existing Pier No. 1	4.0 to 6.7	4.00m

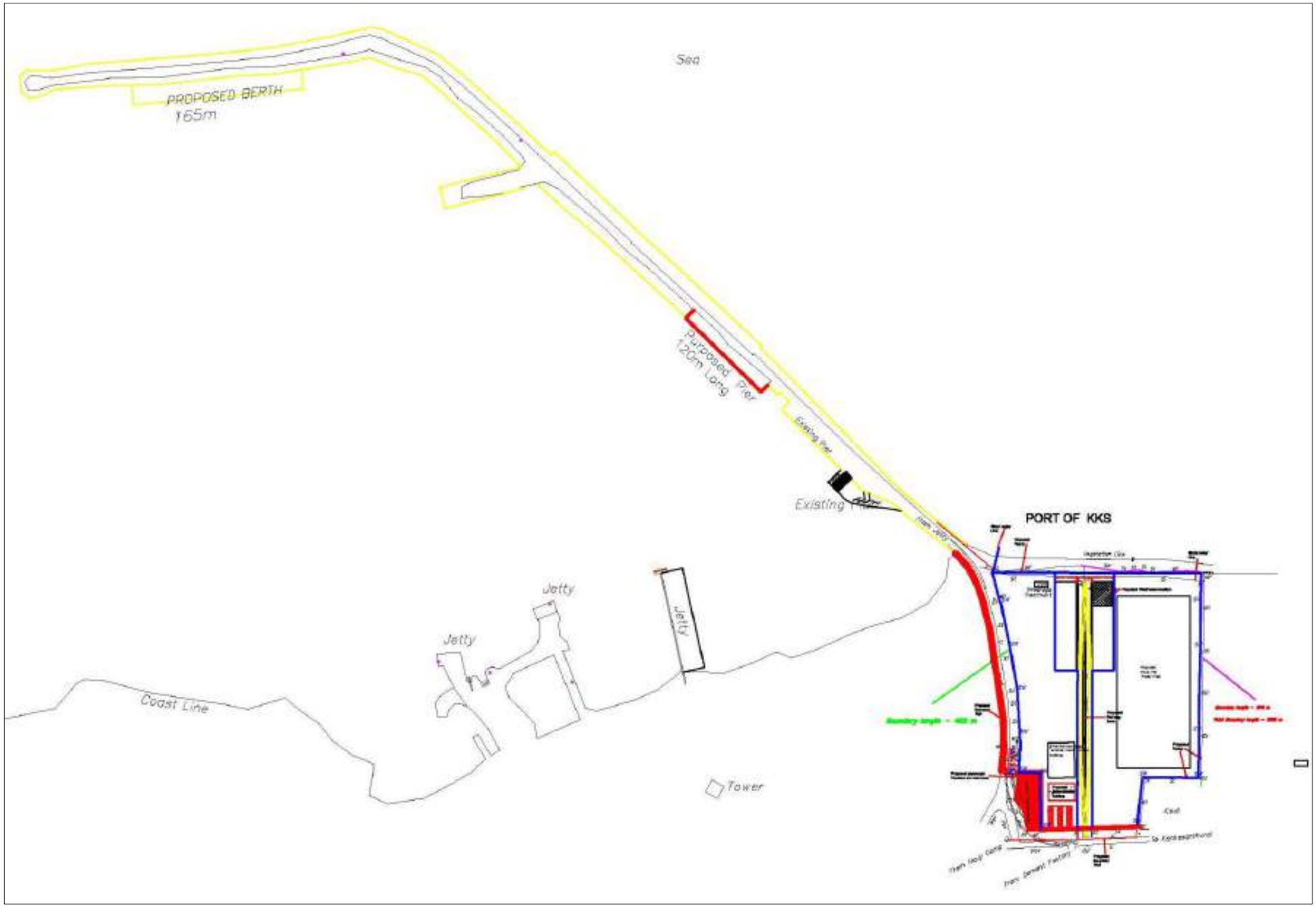


Figure 2.15: Proposed Layout

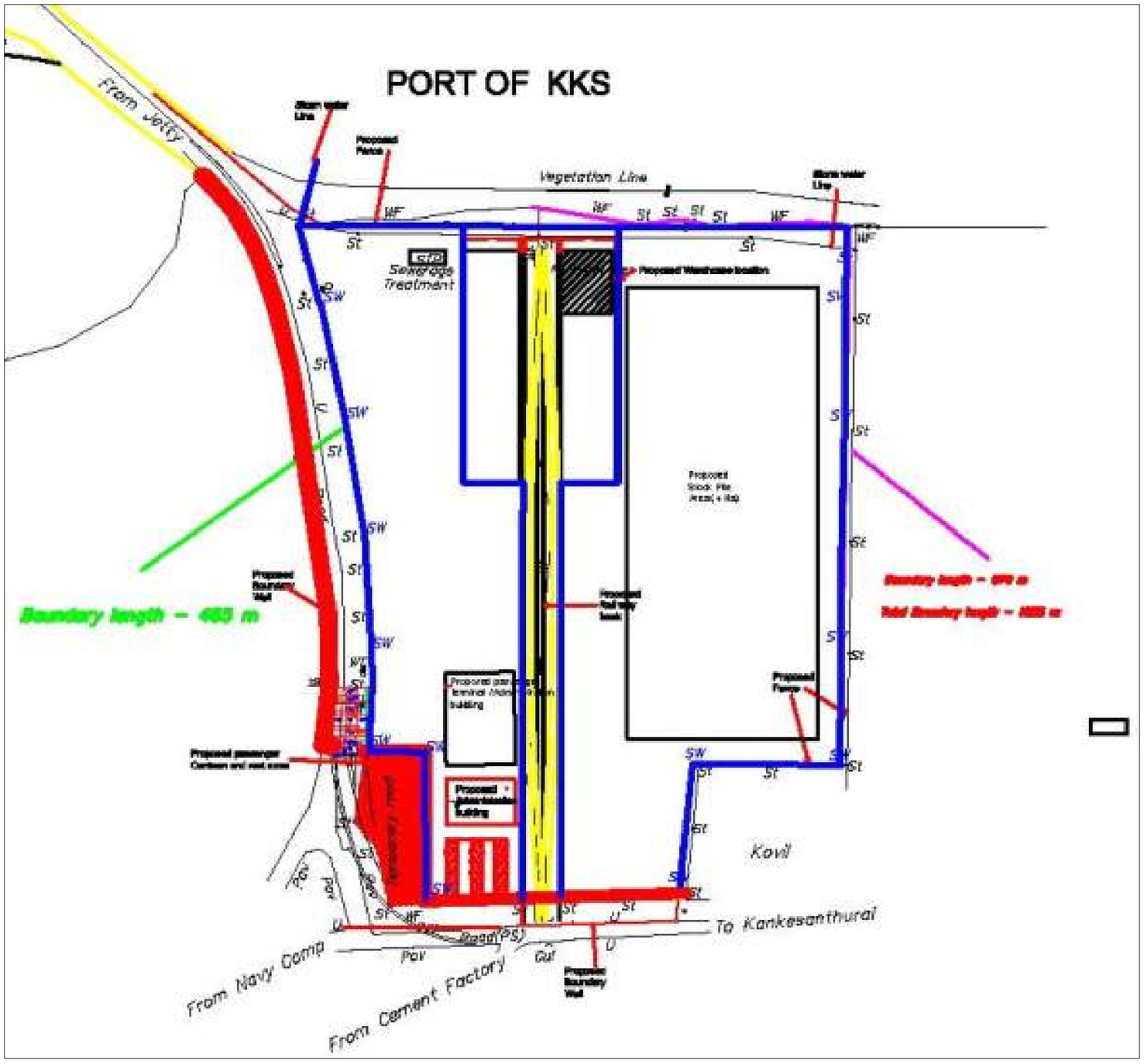


Figure 2.16: Proposed Infrastructure Development

2.5 Details of Construction and Operational Activities under following aspects

2.5.1 Details of the methodologies to be adopted during the construction

Construction will commence with the establishment of the safety measures, such as providing the boundary wall along the site, placing barricades around the working area, signage (warning) notices and construction of internal working access without disturbing existing roads.

2.5.1.1 Construction Sequence

Toe mound construction

The tipper Lorries, are taken over the core layer carrying the stones required for constructions of toe mound. The sizes of stones for toe mound are shown in Table 2.2 for different water depths. These stones shall be handled by a suitable crane with sufficient boom length and placed in toe mound location as shown in Figure 2.17 on both sides of the breakwater. The quantity to be laid in the toe mound area will be based on the theoretical quantity arrived already based on the latest soundings taken in the area.

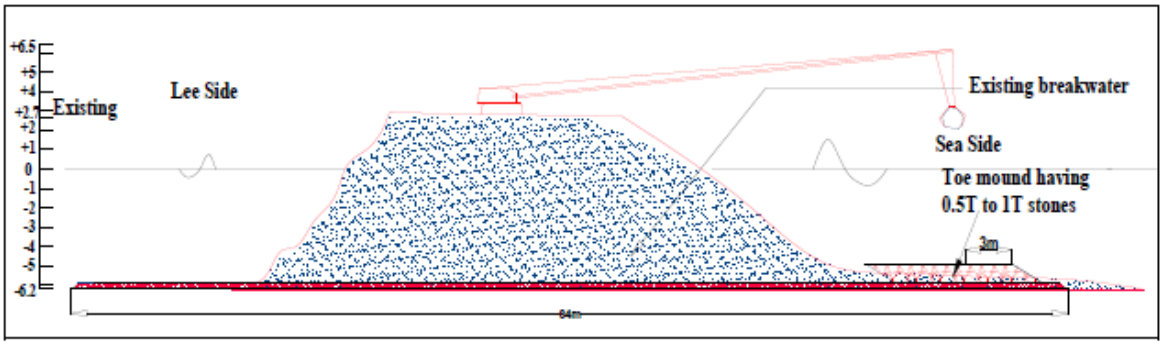


Figure 2.17: Construction of Toe mound

Secondary layer

Stones of sizes as per given in Table 2.2 are used for construction of secondary layer. This layer is to be laid either manually of placed by (Tyre mounted/ Crawler) type crane of minimum 8/10t capacity. The thickness of the secondary layer will be checked by soundings chain to ensure sufficient thickness of secondary layer is laid along in all the locations. In any location, if less quantity of stones are placed as found by taking soundings, then that area will be filled up to arrive at sufficient thickness of layer. The secondary layer will be laid as shown in Figure 2.18.

Table 2.2: Design Details Breakwater Trunk Section for Various water depths

Trunk Section	For 5m-8m water depth	For 8m to 10m water depth	For 10m to 12m water depth
Crest elevation	(+)6.5m	(+)7.5m	(+)7.5m
Crest width	6m	6m	6m
Side Slope: Sea side Harbour side	 1:2 1:1.5	 1:2 1:1.5	1: 2 1:1.5
Toe Mound	1.0m thick 0.5T to1T stones. 3m Width.	1.0m thick 2T to 4T stones 3m Width.	2.0m thick 0.5T to 1T stones. 3m Width.
Armour Layer	Two layers of 2.9m thick 6TTetrapods	Two layers of 3.4m thick 10T Tetrapods	Two layers of 3.9m thick 18T Tetrapods
Under Layers (if necessary)	1.5m thick 0.5T to 1T stones	1.9m thick 1T to 2T stones	1.9m thick 2T to 3T stones
Plain Concrete Cement	M35 grade concrete of 500mm thick	M35 grade concrete of 500mm thick	M35 grade concrete of 500mm thick

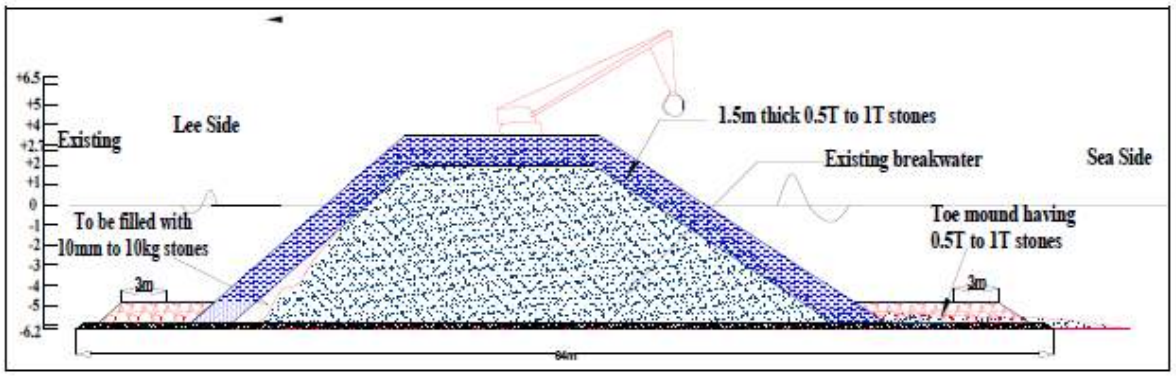


Figure 2.18: Construction of Underlayer

Armour layer

Armour layer is to place over the secondary layer on the slope as shown in Figure 2.19. The breakwater construction shall be carried out in stretches of 10 m until the tip of the breakwater structure. This ensures that breakwater is always safe during cyclonic period. The constructing agency has to ensure the safety of core and secondary layer during construction. In any case, the construction of breakwater should not be stopped by dumping only core stones and exposing them for cyclonic condition. If it is stopped without armour layer cover, it will result in removal of core material during cyclonic condition.

The alignment of breakwater shall be checked for every 50 m interval by installing a Theodilite instrument. After reaching to the tip of the breakwater, head section is formed. For placement of toe mound section at head section, a crane of 8 to10t capacity should be deployed to place the toe mound stones in the required reach.

Likewise the crane should have sufficient boom length to place toe mound and the armour layer at head section as the slope is flatter namely 1:2.5 (provided in the drawing). After completion of head in the slope, secondary layer stones are placed on top of core layer, and then armour layer

is paced on top of secondary layer using a crane of 8 to10t capacity. This operation is continued until the crane reaches the root of the breakwater. The construction of armour layer with Tedrapods will start from breakwater head till the root of breakwater is reached. Finally, the gaps between the armour stones will be filled with small size stones to form a uniform level surface.

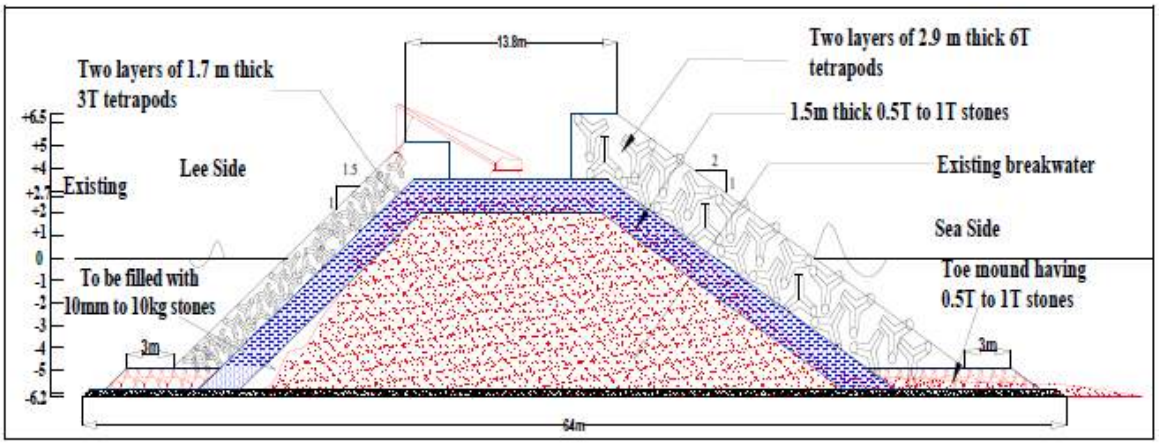


Figure 2.19: Construction of Armour layer

Sources of construction materials and transportation, Traffic Management plan

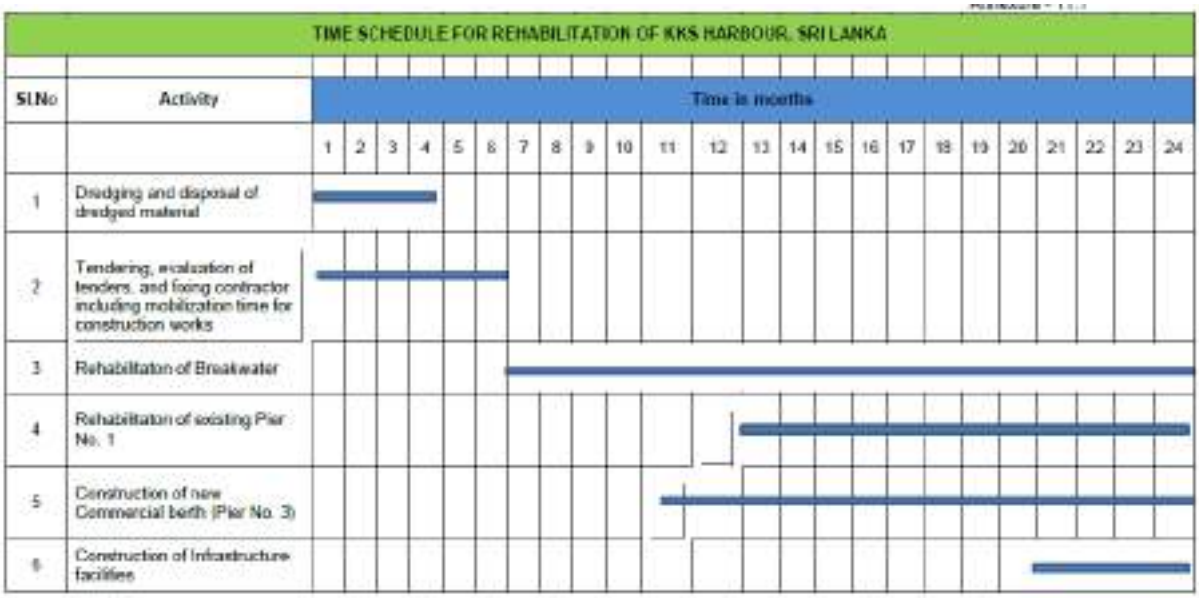
The estimated armor requirement is 260,000 m^3. There are no large-scale metal quarries in Jaffna district to source such a large quantity of armor/metals require for the projects construction. Therefore, the material will be sourced from areas of a considerable distance from the project site. Potential quarries are available in Mullaithivu district. The details of the transport routes are given in section 2.5.6.

Time schedule for the development and construction

The time schedule for construction of various activities proposed will be around two years.

- The dredging activity will be commenced prior to the internal Port works and it will take about 4 months
- The construction of the rehabilitation of breakwater will take about one and half years.
- The construction of the rehabilitation of the existing Pier No. 1 will require about one year.
- The construction of the new berth (Pier No. 3) will require about one year.

The tendering and fixing the contractor for construction is estimated to take about 6 months. If all the construction activities are taken up concurrently, it will require about one and half year's time for completion. Hence, the total time schedule for completion of all activities and commencement of operations is estimated as two years. The time schedule bar chart is enclosed below.


TIME SCHEDULE FOR REHABILITATION OF KKS HARBOUR, SRI LANKA
Sl.No
Activity
Time in months
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
1
Dredging and disposal of dredged material
2
Tendering, evaluation of tenders, and fixing contractor including mobilization time for construction works
3
Rehabilitaton of Breakwater
4
Rehabilitaton of existing Pier No. 1
5
Construction of new Commercial berth (Pier No. 3)
6
Construction of Infrastructure facilities

2.5.2 Water Requirement (Constructional and Operational Phase)

The estimated water requirement for the construction period is 50 m^3/day and about 35 m^3/day (average) during the operational period in order to cater for ship demand of 1000m^3 per month.

There is no adequate good quality water near the project for construction purposes. As such premix concrete will be used where required to minimize water requirements for the project. The remaining water the contractor required to locate suitable water for construction.

Desalination plant or any suitable source will be utilized until the public water supply is developed. Fire fitting requirement will be fulfilled by means of sea water.

2.5.3 Wastewater (Construction and Operation Phase)

Wastewater from the construction as well as the operational period is mainly generated from the workers' activities, including domestic use.

During construction period it is proposed to discharge all wastewater and sewage into portable septic tanks. The temporary septic system will include a soakage pits. During the operational period the wastewater will be directed to the onside wastewater treatment plant.

The management and treatment of the wastewater generated from the operational phase of the Port will utilize an activated sludge process. The main advantage of this systems process is the efficient and effective removal of BOD, COD and other nutrients from wastewater. The conceptual activated sludge treatment flow chart is given below and it includes;

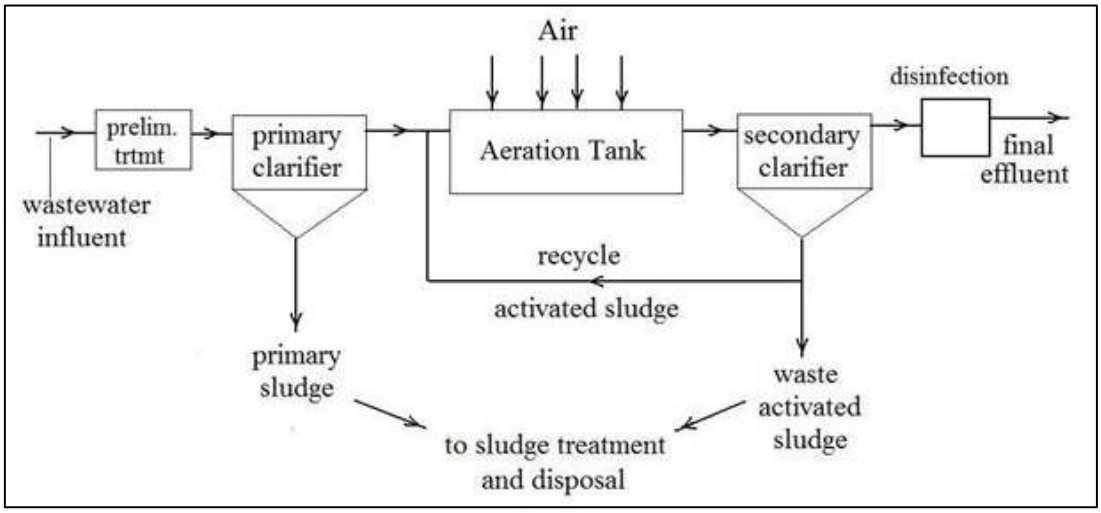


Figure 2.20: Activated sludge Water Treatment Flow Diagram

Pretreatment: The wastewater generated from the processing area and market area will be sent through screens to remove the scales and the other fish parts entering to the treatment plant. The scales and settled material will be removed from the screens and disposed within the Ports normal organic waste management regime.

Primary clarifier: The pretreated wastewater will be directed to the primary clarifier where large particles will be settled and removed at the bottom of the clarifier for disposal. The wastewater will be directed to an Aeration tank.

Aeration tank: Air is mechanically supplied to the wastewater to aerobically activate the microorganism to decompose the organic matters and to form large size flocculants, which are easily settled at the bottom of the clarifier. The treated water (mixed liquid) is discharged to the secondary clarifier

Secondary Clarifier: The mixed water is discharged into the secondary clarifier where live bacteria settle to the bottom, dead bacteria rise to the top and form a crust with a clear liquid in the middle. This clean water is then discharged into either a watercourse or a soak away. The live bacteria, called activated bacterial sludge, are returned to the Aeration tank to re-seed the new raw sewage entering the tank and the dead bacterial crust is removed as sludge in dry beds to dispose.

Sludge Drying Bed; Sludge from the primary and secondary settling tanks will be collected in a dry bed make dry solid before disposal to reduce the moisture contents. The wastewater generated from the drying beds either will be re-directed to the treatment plant or let it for soak in the dry bed itself.

The wastewater generated will be treated up to the Tolerance Limits for Industrial and Domestic Wastewater Discharge into Marine Coastal Area as published in the Gazette No. 1534/18 dated February 01, 2008.

(http://www.cea.lk/web/images/pdf/envprotection/G_1534_18.pdf)

2.5.4 Solid waste

It is expected that there will be between 10-to 20 tipper truckloads of waste material generated during the construction stage.

All construction waste will be segregated as recyclable materials and non-recyclable. All recyclable materials will be sold out for local recycle materials collectors. The non-recyclables material will be used for proposed refilling activity. Any remaining waste (small quantity) at the final stage of construction will be disposed at the local authority disposal site.

Municipal Solid Waste: The municipal solid waste (MSW) generated by the workers' camps will be segregated at the source and collected separately. The recyclable materials will be given to the local recyclable materials collectors and the others will be disposed through the relevant local authority collection system.

All domestic solid waste generated from the Port canteen, boats and other common areas will be source segregated (by keeping different colour bins for separation). The separated recyclable wastes will be sold out to local recyclable waste collectors and the un-recyclable waste will be disposed through the local authority collection system.

Collection facilities (barrels/bins) will be provided in the auction hall sales centre and the processing centre to collect the fish waste separately and used for the production of silage, which can be used as animal feed by a private contractor.

A central storage facility for waste collection will be provided in a location easily accessible to the waste collectors during operational phase. All organic wastes will be collected in bins with proper lid to avoid the spreading of waste by the scavengers. No waste disposal site will be maintained by the Port management for the MSW. All MSW wastes generated due to the Port operation will be disposed through the local authority collection systems and recyclable materials will be sold out for recycling.

All common areas will be provided with separate colour code bins to separate the different type of wastes which could easily be sold out for recycling purposes.

2.5.5 Sources of construction materials and transportation, Traffic Management plan

The required rock armor quantity is estimated as 260,000 m^3. There are no large-scale metal quarries in Jaffna district to source such a large quantity of armor/metals require for the projects construction. Therefore, the material will be sourced from areas of a considerable distance from the project site.

The available quarry locations which are having IML A and IML B license were obtained from Geological Survey and Mines Bureau. Two quarries in Mullaithivu district were identified as potential sites to obtain the required armours during construction. The details of the transport routes are given below. The transport routes from the selected quarries to the project site are given in Figure below.

Figure 2.21: Potential Quarry Sites and Transportation Routes

It is estimated that about 260,000 m^3 of rocks/armor/metals are required for the construction works which requires a large number of vehicle traffic movements between the quarry and the project site. The transportation routes pass several cities and urban centers. There could be considerable traffic congestions when passing these places.

The selection of quarries is up to the construction contractors' decision. The contractor should carry out a transport impact assessment prior to the commencement of the construction activities to determine the most viable route and determine times of travel.

Rock armors are transported from far distances and therefore it is ensured the continuous supply of armors during the construction stage as the lack of armors will inhibit the smooth progress of the construction activities. Therefore, temporary stockpiling area will be provided as given on the layout plan.

2.5.6 Requirement of labour during construction and operation period

According to statistics on population within employable ages there will be more than adequate persons available within J233 GN division adjacent to the KKS port land. There are similar numbers of persons potential for employment in KKS port in GN divisions adjacent to J233 GND during construction and operation phases. The data related to people potential to be employed in KKS port during construction and operation period is shown below.

Table 2.3: Potential Employments

Relevant area	Total population	Persons within employable ages	% of persons presently employed	% of persons presently unemployed
J233 GN division	265	132	35%	65%
GNs adjacent to project (J 234, J235,J231,J232)	2180	1120	38%	62%
Walikamam north DS division	44160	21789	36%	64%

2.6 Operation and Maintenance

Resource requirement during operational phase is addressed above.

2.7 Details of land ownership of the project (state / private / other specify)

The proposed area for the development is owned by Sri Lanka Ports Authority.

2.8 Financial Commitments

The source of funds (USD 45.27 million) for the proposed development is from Export-Import (EXIM) Bank of India under the Dollar Credit Line Agreement (DCLA) signed between GOSL and

EXIM Bank of India. Consolidated Funds of Government of Sri Lanka also allocated mainly to acquire 50 acres of adjacent land and built some of the infrastructure facilities. There is no special environmental policy requirement from donor agency and it is anticipated to fulfill the legal requirements of Sri Lanka which have been discussed under Section 1.7 of the report.

2.9 Future Expansions, if any

There will be no future expansion of the project. However, it is proposed to have a deepened port basin (-11 m MSL) in the future to facilitate for the larger vessels.

2.10Evaluation of Alternatives

Since this is the rehabilitation work for an existing Port no any alternative locations have been considered.

3 DESCRIPTION OF THE EXISTING ENVIRONMENT OF STUDY AREA

It is imperative that the existing environment in the project area and the influence areas are identified in terms of different environmental elements. In order to perceive the likely alterations of the existing environment due to the proposed interventions present status of the existing environment needs to be recorded and then the impacts on such elements need to be discussed.

The Jaffna Peninsula experiences the typical dry zone climate of Sri Lanka, characterized by a wet and a dry season. The project area lies very close to the sea (See Figure 3.1). The topography of the area is very flat. There are no well-defined streams and rivers in the area due to the flatness of the land. Entire area is covered with bushes & shrubs and there are no large areas of agriculture in the area. Existing ground levels vary from around 1.0 m MSL to 3.5 m MSL within the project area and the drainage of the area is observed towards the coast.

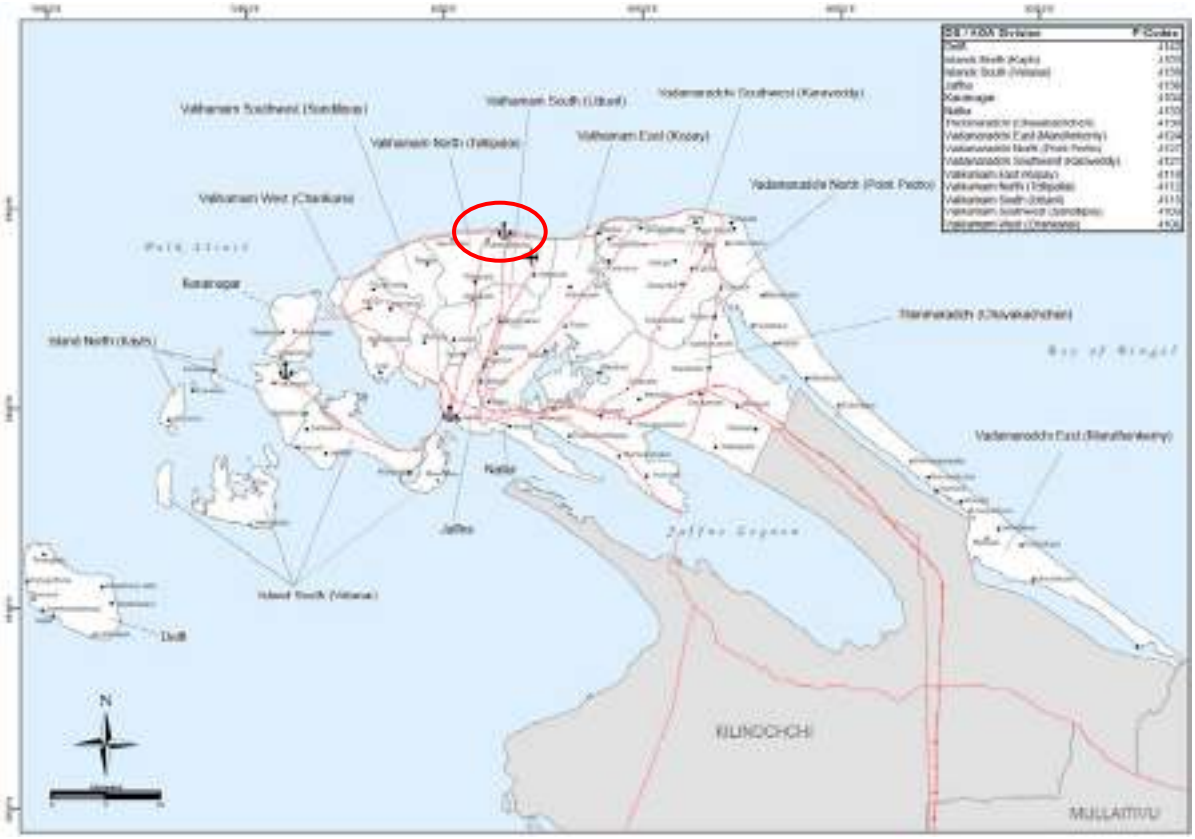


Figure 3.1: The location of the project site

The existing environment is described in five main components, viz., physical resources, ecological resources, economic development, social & cultural resources and natural disasters, respectively. Data were collected focusing on these five components and are presented below.

3.1 Physical Features

3.1.1 Topography / Drainage

Jaffna Peninsula is low and flat (maximum height of 11 m recorded in the western central area), with coastal landforms, and soils a mixture of marine deposits and wind/ wave derived sediments.

Being located in the coastal belt, predominantly flat topographic conditions (around 2.0 – 3.0 m) exist in the vicinity of the project site and the study area.

Due to the relatively flat topographical nature of the area and its geological structure (sandy soil and under laying limestone), the surface drainage (runoff) of the peninsula under normal rainfall is minimal. Heavy runoff and flooding may take place after high intensity and abnormal rains, along the drainage courses.

The Jaffna Peninsula consist of 1000 km^2 of area with three major lagoons namely Elephant pass, Vadamarachchi and Upparu. The proposed project site is located about 8-9 km away from the Vadamarachchi lagoon (Figure 3.2).

There are no streams or rivers in Jaffna Peninsula due to the flatness of the land. Groundwater has been the 'Life Blood" of the Jaffna Peninsula and recharge for the groundwater is almost entirely from the rainfall percolation. The geological formation of the sub-soil bears excellent physical character to underground storage.

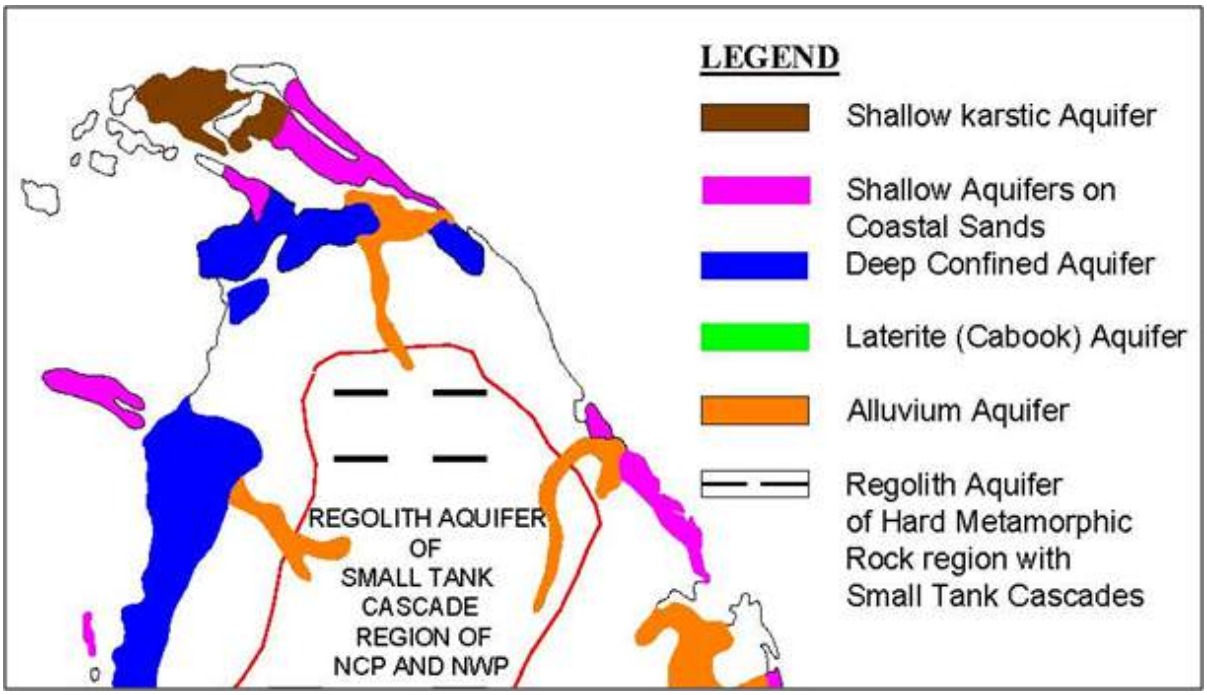
Figure 3.2: Major lagoons in Jaffna Peninsula

3.1.2 Geology / Soil

The whole Jaffna peninsula is underlain by Miocene limestone formations which are generally 100 to 150 m thick and which are distinctly bedded and well jointed and are highly karstified. The shallow aquifer of the peninsula occurs in the channels and cavities (karsts) of this Miocene Limestone. The KKS area where the project is located comprises the Shallow Karstic Aquifers (Figure 3.3). The geological formation of the sub-soil bears excellent physical character to

underground storage. Jaffna peninsula limestone with fissures, cracks and joints and with its porous characteristics permits percolation of fresh water to be stored underground. Jaffna peninsula is mainly underlined by Miocene/ limestone. The porosity of Jaffna limestone has been found vary between 4.5 % ~ 27% with a mean value of 15%.

Jaffna limestone is poorly bedded and generally flat, except in some areas where it shows a slight dip to the west. It is massive in places but some layers are richly fossiliferous, forming a honeycombed structure. The ready solubility of the limestone produces a number of underground solution caverns, which contain the main groundwater reserves on the island.



*Source: Panabokke, Groundwater resources of Sri Lanka

Figure 3.3: Different Types of Aquifers in Sri Lanka

The surface cover of unconsolidated deposits is the youngest of the geological layers and produces the sandy soil that is present over much of the peninsula. Soils are a mixture of marine deposits and sediments formed by the influence of wind and waves on the limestone. In the central area there are around 60,000 ha of well-drained and highly productive calcic Red-Yellow Latosol and similar types; near the coast are around 26,000 ha of alkaline saline soil and unconsolidated Regosol; and around the seasonal river Valukkai Aru area near Tellipallai are approximately 10,000 ha of alluvial sediments. Soil depth across the peninsula varies from 900 - 1500 mm.

The land use pattern, forest land, Agriculture statistics of the five districts of the Northern Province are shown in Table 3.1. There are no declared forest reserves in Jaffna District.

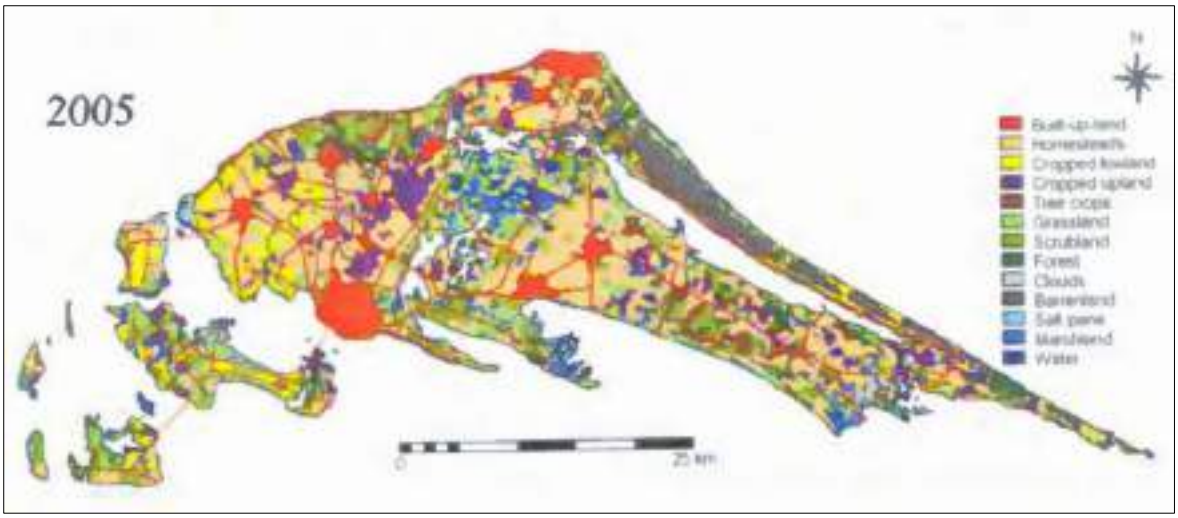


Figure 3.4: Land use pattern in Jaffna District

Table 3.1: Land use pattern, forestry and agriculture

(Source: Statistical Information, 2009-Northern Province)

Land Category	Mullaitivu	Mannar	Kilinochchi	Vavuniya	Jaffna
Urban	10	37,826*	650	440	22,000
Agricultural land	57,270	33,334	61,610	77,999	36,293
Forest land	167,850	131,046	35,110	88,801	12,870**
Range Land	13,650	-	10,650	18,120	
Wetland	1,530	-	5,680	11,250	
Water bodies	20,160	-	7,390	-	4,160
Barren land	1,230	-	5,800	90	27,000***

*Includes residential area, water bodies and barren land; **includes economic trees; includes land with severe crop damage

The coastal and marine environment in the Northern Province contains a large proportion of the coastal ecosystems; mangroves, coral reefs, sea grass beds and brackish water lagoons and salt marshes. In addition there are lagoons, inland water bodies and streams. Shallow coastal water around Sri Lanka has an estimated 680 km^2 of coral reefs; most of these shallow coral habitats are located in the Gulf of Mannar and along the east coast in the Trincomalee and Batticaloa Districts. In addition fringing coral reefs occur in the northern and southern areas of the island. Coral reefs of the Jaffna Peninsula are located mainly around islands in the Palk Bay and along the northern coastline in the Palk Strait. Mangroves found near the major islands. The west end of Jaffna Peninsula (Kayts Island), Uppuaru lagoon and Chalai lagoon comprise of important mangrove stands. Sea grass beds are distributed in the shallow coastal bays, such as Thondamaanar, Kurikadduwan, Pungudutivu, Mandaitivu and the Jaffna lagoon. There are no sea weeds in Jaffna district. Coastal and marine conservation areas in Northern Province are depicted in the following Figure. The proposed project site is devoid of any sensitive coastal or marine

features. A wading birds area is located in the nearby Vadamarachchi lagoon, along which the conveyance main is proposed.

Figure 3.5: Existing Coastal & Marine Conservation Areas

3.1.3 Hydrology

The Jaffna peninsula has no permanent rivers because of the flat terrain and limited rainfall, and there are no land forms suitable for reservoir development. Some natural depressions have been enhanced by bunds and soil removal and these and other "tanks" and "ponds" feed a cascade system of small canals and ditches to irrigate fields and recharge groundwater. Excess rainfall drains to the 4 large internal lagoons and the sea.

3.1.3.1 Rainfall and Evaporation

The Jaffna Peninsula experiences the typical dry zone climate of Sri Lanka, characterized by a wet and a dry season. Rainfall acts as a major source of groundwater recharge, and its seasonality and uncertainty greatly affects the quantity and quality of groundwater. The major wet season occurs during October to December and is associated with the northeast monsoon. The minor wet season occurs during April to May due to the southwest monsoon. The period between the southwest and northeast monsoons is dry and this dryness extends from June to September. The bulk of the rainfall is received during the months from October to January, with little or no rainfall thereafter. The average rainfall is 1276 mm per year and during the period of 1988 to 2015 the minimum recorded was 847.8 mm. These values were estimated based on the data purchased for Jaffna rainfall gauging station from Department of Meteorology, Sri Lanka. The variation of yearly total rainfall and annual average rainfall for the considered period is depicted in Figure 3.6.

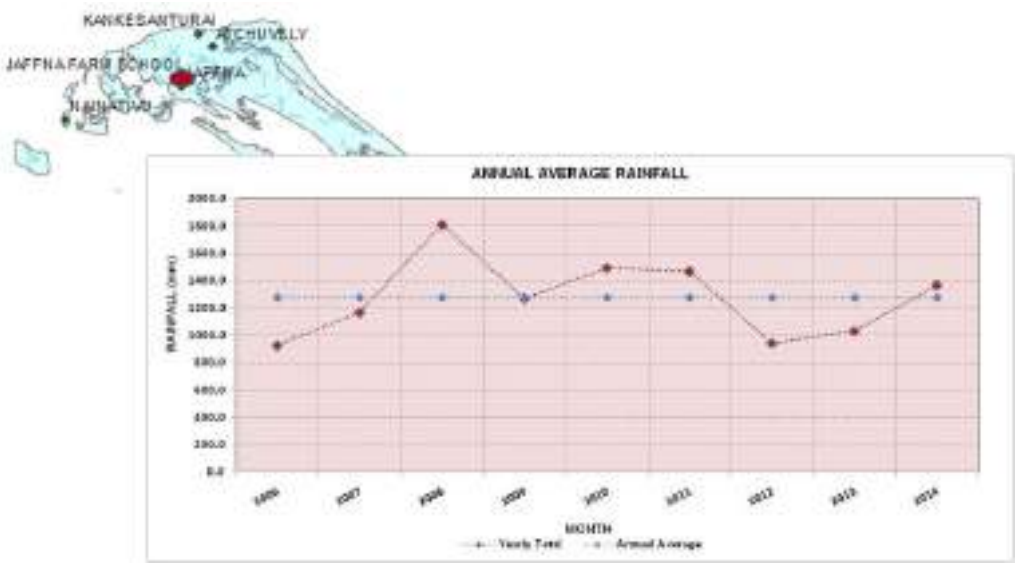


Figure 3.6: Variation of Average Annual Rainfall Pattern (Jaffna gauging station)

Rainfall records are available for a considerable number of rainfall gauging stations in Jaffna Peninsula. Recent monthly maximum rainfall data for Jaffna rainfall gauging station was collected for the period of 2006 to 2015. The annual average rainfall is around 1,276 mm and the variation is shown in Figure 3.6 above.

The rainfall during the North east monsoon is dominant with around 70% of average annual rainfall. While seasonal rainfall exhibit a definite rhythmic pattern, there is however considerable variation from year to year. The variation in monthly rainfall is depicted in Figure 3.7 below. The annual potential evaporation exceeds the annual rainfall. The monthly variation shows that during the months of January to September the evaporation exceeds the rainfall resulting very dry condition (Figure 3.8).

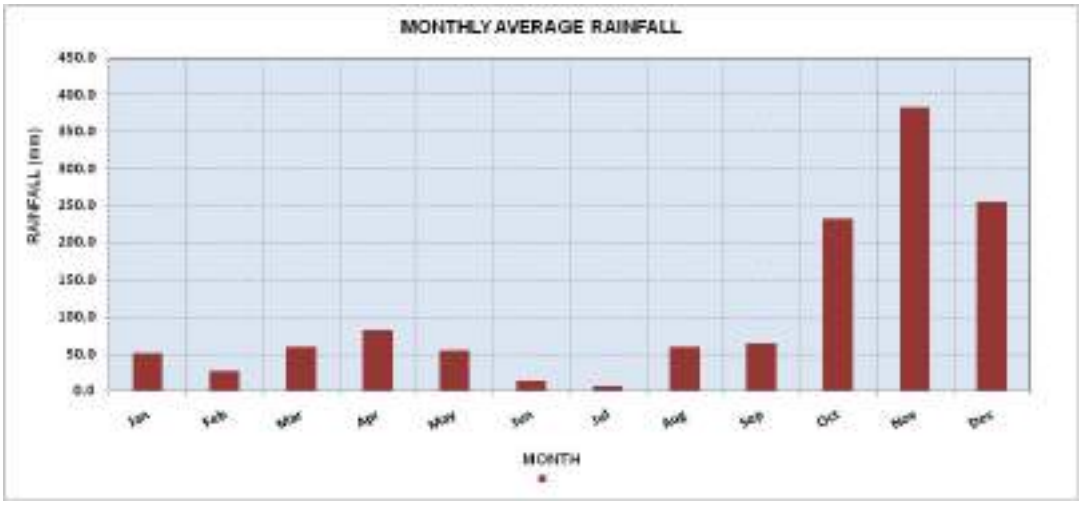


Figure 3.7: Variation of Monthly Average Rainfall (Data period 2006 to 2014)

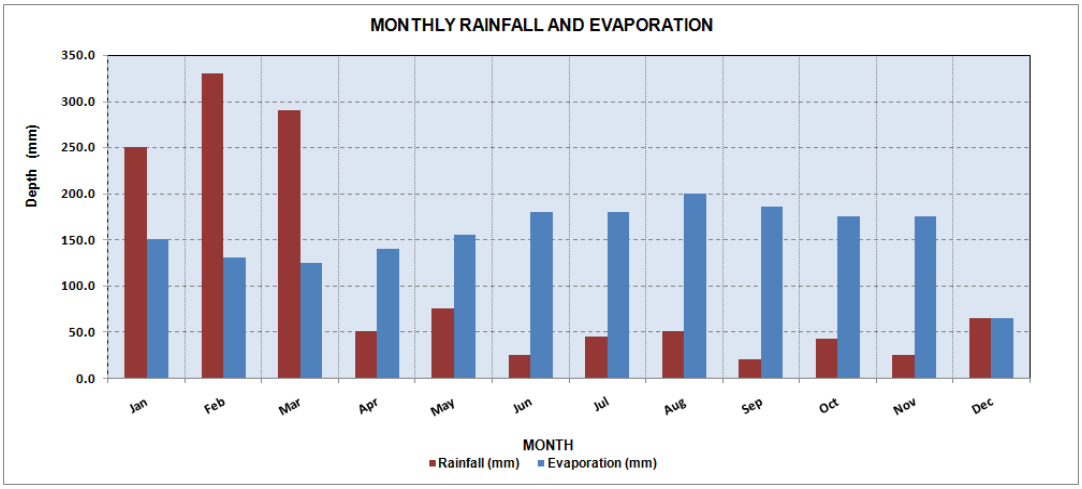


Figure 3.8: Variation of monthly rainfall and Evapo-transpiration

3.1.4 Coastal Features (Environment)

3.1.4.1 Coastal bathymetry and sediment transport

Bathymetry of the site area is shown in the below figure. Digitized data of UK Admiralty Charts is available at a coarser grid to generate the regional bathymetry. The local bathymetry data obtained from the Detailed Project Report has been used to generate the contour map as no recent local bathymetry measurement is available. In the site area, 10 m depth contour can be achieved within 1 km distance from the shoreline. The slope of the sea bed is mild and bathymetry is not complex.

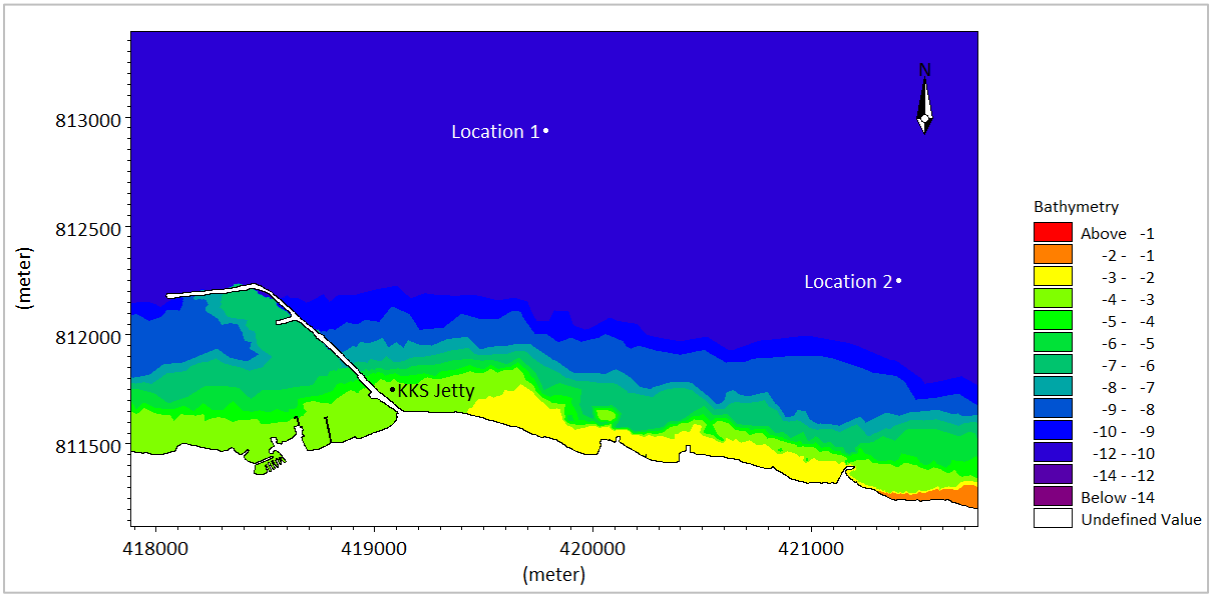


Figure 3.9: Bathymetry of the Project Area

Under the ADB project titled "Northern Province Sustainable Fisheries Development Project" done in 2016 a sediment transport study has been carried out. Even though the study was not focusing the current study area, it says that both net and gross sediment transport rate at Point

Pedro is 30,000 - 150,000 m^3/year from east to west. Therefore, it is further verified that the waves are approaching from NE to SE directions throughout the year.

Location	Net annual alongshore sediment transport rate (m3/year)	Gross annual alongshore sediment transport rate (m3/year)
Pesalai	10,000 from east to west	1,000 from west to east 11,000 from east to west
Gurunagar	5,000 from west to east	5,000 from west to east
Point Pedro	30,000-150,000 from east to west	30,000-150,000 from east to west
Mullaitivu	North of inlet 10,000-65,000 to north South of inlet 30,000(to south)-20,000 (to north)	North of inlet 10,000-65,000 to north South of inlet 30,000 to north-35,000 to south

Source: UNESCO-IHE, ADB. 2016. Delft3D model based longshore sediment transport rates at Pesalai, Gurunagar, Point Pedro and Mullaitivu, Sri Lanka (Phase 2 Final Report).

3.1.4.2 Coastal features including beach profile

The formation of varying coastal features is a function of the effects and interactions of the forcing action of waves and currents, the geological and man-made features and the supply and removal of sediment. Generally, coastal features like headlands are observed in the study area other than the manmade structures. Especially, breakwaters and piers in Myliddy Fishery Harbour which has been constructed in 1981 can be considered as man-made structures at the vicinity.

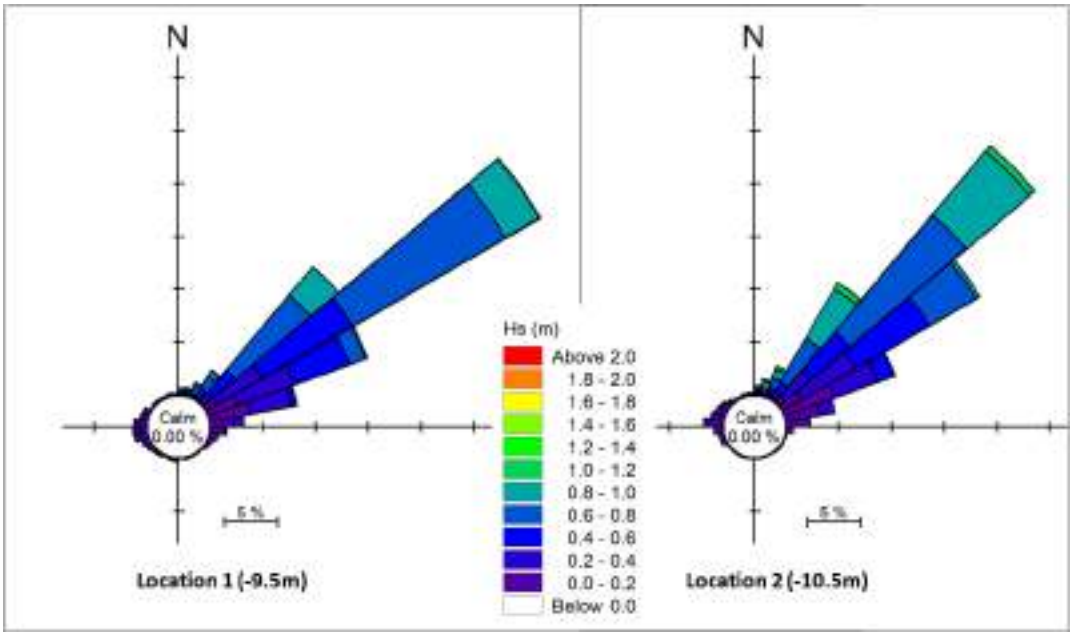
3.1.4.3 Relevant oceanographic information including near shore wave height and direction, near shore current velocity, tidal and current characteristics

Near shore Wave Characteristics:

The nearshore wave climate at 10 m water depth (at the east side of the breakwater) of KKS Port was obtained from a previously conducted wave transformation model (LHI, 2018). For this purpose wave data from offshore (2300 m depth) of Thalayadi coast was transformed to the KKS nearshore since there is no long term recorded wave data at the vicinity.This wave transformation was done using mathematical modeling of wave propagation over a large sea extent off the Northern coast. The numerical wave propagation calculations were performed through the application of MIKE 21's Spectral Wave Model (SW). Limited wave recordings at Point Pedro (14 depth) which is located at the proximity of KKS were used to verify the accuracy of the transformed wave data prior used them to establish the KKS nearshore wave data base. The transformed wave data which exhibited similar trend of behaviour with respect of direction of approach with Point Pedro site recordings were used to develop the wave data base in KKS. With the broad understanding of behaviour of sea and swell wave systems, overall wave were considered to establish the nearshore wave climate in annual basis.

The established annual wave data series at KKS nearshore 10 m depth indicates that comparatively high waves are approaching from northeast direction while during NE monsoon lower magnitude's wave are approaching from northeast southwest direction (Table 3.2 and Figure 3.10) . Further, sea component in overall waves is higher in KKS nearshore and its swell component is negligible. In other words, **the sea waves which are approaching from**

Northeast direction are dominant in KKS nearshore. Below table summarized the nearshore wave climate at KKS nearshore.



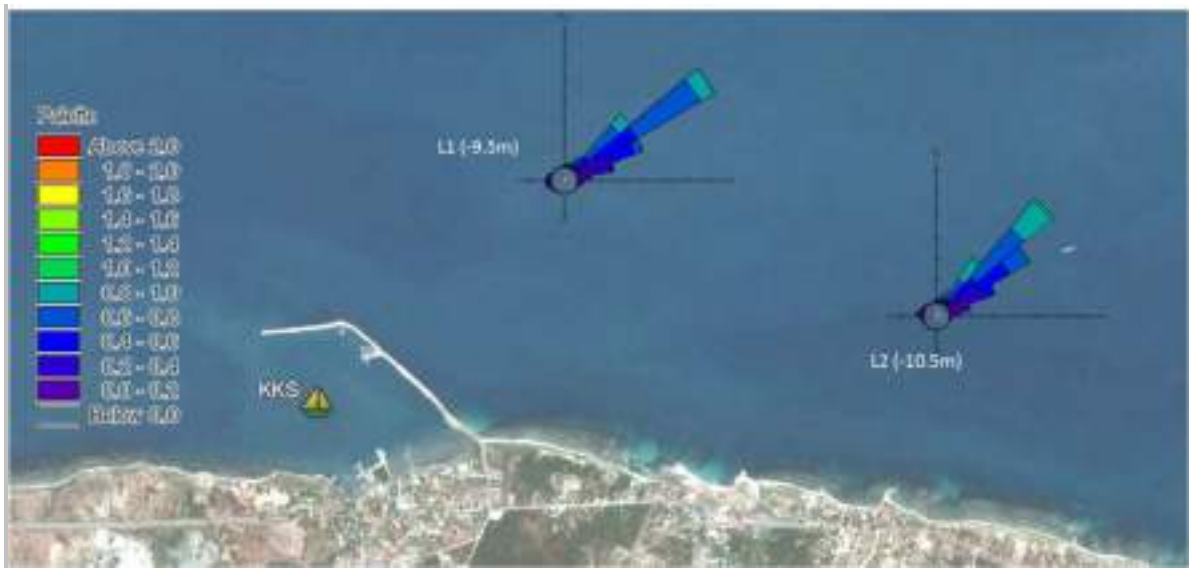


Figure 3.10: Wave Climate in the vicinity of the site

Table 3.2: Nearshore wave climate at KKS

Season	10 m Depth					
	Average (50% Exceedance)			Extreme (2% Exceedance)		
	Hs (m)	Tp (s)	MWD (˚N)	Hs (m)	Tp (s)	MWD (˚N)
Annual	0.5	4.0	55	0.9	4.5	55

Near shore Current Characteristics:

Ocean currents circulating around the country depend on monsoonal changes, and during the northeast monsoon they are towards the western direction. Since there are no any current measurements are done under the present study and wave induced current are predominant in Sri Lankan coast current direction can be predicted considering the nearshore wave climate. Therefore, the alongshore current would be towards the West throughout the year as waves are approaching from Northeast direction to the nearshore.

Wind Conditions

NE Monsoon winds occur during the period from November to January and the SW Monsoon winds occur during period from May to October. Most of the time the wind speeds are within the range of 5 to 13 m/s in two main directions NE or SW occasionally increasing to more than 20 m/s. Therefore, the site is exposed to relatively high NE and SW wind conditions.

3.1.4.4 Coastal erosion, Coastal structures, Coastal protection system

As per the Shoreline Status Report 2014, there is no continuous erosion is reported in Jaffna district. However seasonal erosion is reported especially in Point Pedro coastal area (Sri Lanka Coastal Zone and Coastal Resource Management Plan - 2018). Following figures and show the shoreline variation in right (Figure 3.11) and left (Figure 3.12) hand side of the KKS port during the monsoons.

Figure 3.11: Shoreline variation in right hand side of the KKS port during the monsoons

Figure 3.12: Shoreline variation in left hand side of the KKS port during the monsoons

3.1.4.5 Coastal water quality

Existing coastal water quality at the vicinity of KKS Port was assessed by testing water sample collected on 18th September 2018 (Figure 3.13). The collected six samples of seawater were analyzed in accordance to the standard method for water quality parameters.

Water samples were tested for in-situ parameters, Nitrogen, Phosphorus, organic matter and bacteriological parameters. Type and measured value of the parameters and standards are tabulated in Table 3.3. Due to the unavailability of ambient water quality standards at coastal water for primary contacts (e.g. swimming), and secondary contacts (e.g. boat ride), measured water quality parameters were assessed against the proposed CEA (Central Environmental Authority- Sri Lanka) Guidelines. In case of in-situ parameters, TDS (Total Dissolved Solids) has exceeded allowable values. Nitrogen and Phosphorus are unavailable or not significant at sampling locations. Organic matter (e.g. BOD) is also not exceeded the allowable limits except the location P4. Bacteriological parameters such as Faecal Coliforms, E.Coli were not detected.

Figure 3.13: Location Map for Water Sampling (Source: Google Earth)

Table 3.3: Water Quality Parameters at Sampling Sites

Parameters	Units	Sample Location						Proposed CEA Standards
		P1	P7	P3	P4	P5	P6	
In-situ Parameters								
Total Dissolved Solids (TDS)	mg/l	33585	33370	33627	33928	33342	34018	
Total Suspended Solids (TSS)	mg/l	256.4	229.2	244.8	141.6	268.8	247.6	<30
Total Nitrogen (TN) and Total Phosphorous (TP)								
Total Nitrogen (TN)	mg/l	1.75	3.30	2.09	2.14	1.25	1.60	
Total Phosphorous (TP)	mg/l	ND	ND	ND	ND	ND	ND	
Water Hardness								
Total Hardness ($CaCao_3$)	mg/l	130	120	110	140	140	120	
Organic Matter								
BOD_5	mg/l	7.0	5.0	6.0	11.0	7.0	9.0	<10
Other								
Chlorides	mg/l	19517	19421	18780	23074	18534	19062	
Oil and Grease	mg/l	13.9	18.2	7.7	10.1	14.4	6.6	<5
Salinity	ppt	31.1	30.9	30.7	31.4	30.6	31.3	
Turbidity	NTU	1.4	4.1	1.7	0.7	2.3	2.2	
Faecal Coliforms	MPN/ 100 ml	<1.8**						<600
Detection Level: Total Phosphorous-0.02 mg/l **When the total and Faecal coliforms per 100 ml are found to be less than 1.8 it indicates the absence of total and Feacal coliforms in the sample.								

3.1.4.6 Details of coastal hazard events in the past - Tsunamis, cyclones, storm surges etc. in the region

Impact from 2004 tsunami for the northern coast is evident though the impact to the KKS site is not significant. Hence, proposed site can be considered as a safe site for the adverse tsunami impact as the site is located at the western side of the northern coast. Figure 3.14 shows tracks of past cyclone and storms in Sri Lanka from 1881-2000. Accordingly, cyclonic and storm surge events has taken place in the study area infrequently. However, considerable impacts due to NISHA-2008 have been recorded.

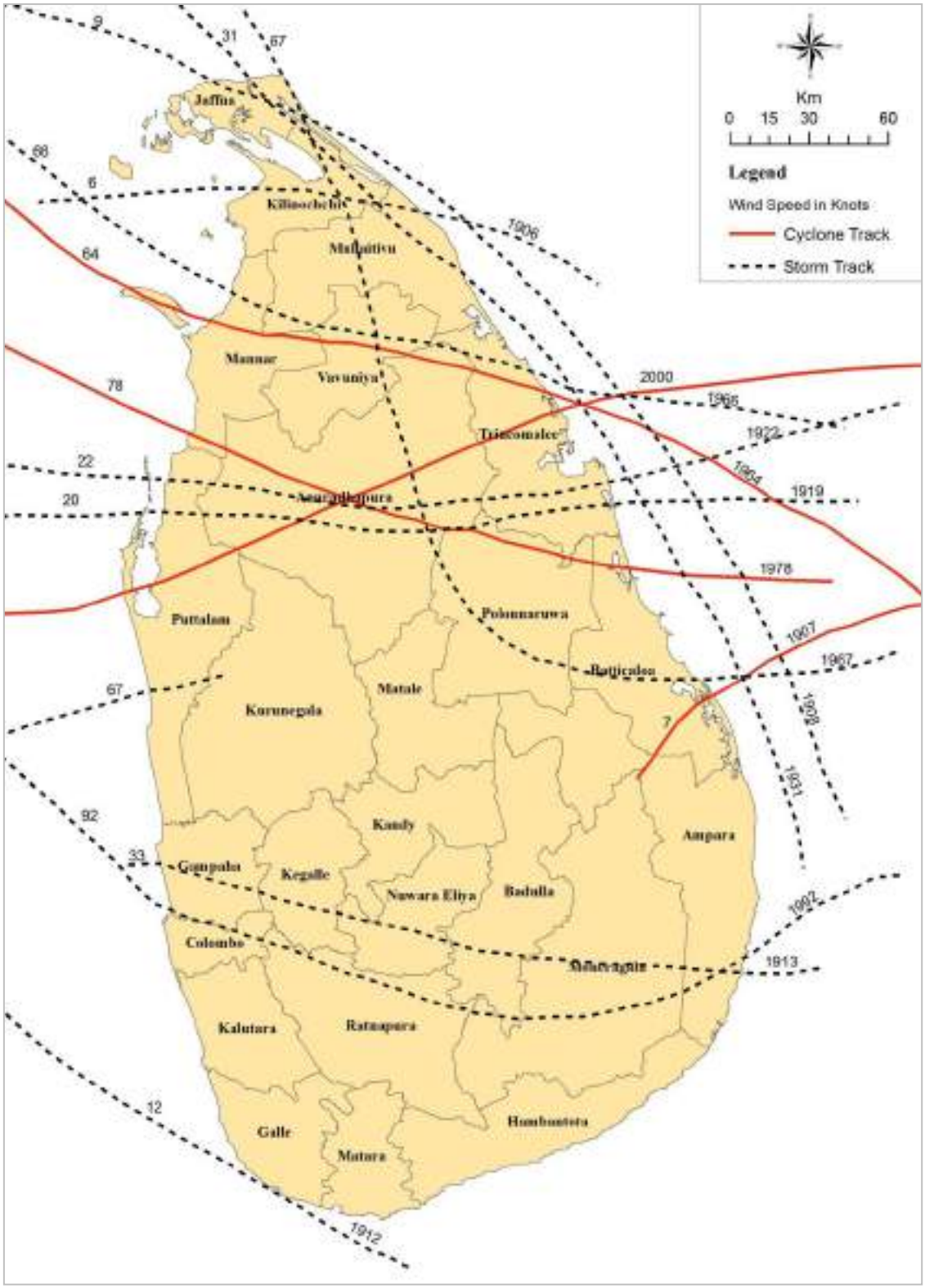


Figure 3.14: Tracks of past cyclone and storms (1881-2000)

(Source: Disaster Management Center, Sri Lanka)

3.2 Ecological Environment

3.2.1 Terrestrial environment

3.2.1.1 Terrestrial habitats

Biogeographically, the proposed project area (KKS Port and its surrounding area) lies within the lower country dry zone. Floristically it comes under Floristic Zones I (Coastal and marine belt) and II (Dry and arid lowlands) and to DL3 agro-ecological region representing species-poor area. Although the project area lies along the coastal belt study showed the area is a low form of dunes. In general the topography of the area is flat but noticeable gradient at an isolated place bordering the coast is observed towards the western side (9049'1.68"N; 8001'16.49"E). The KKS Navy camp partly occupies the western part of the coastal land strip of the study area which still remains as the High Security Zone.

There was no natural vegetation cover in the study area or in the vicinity and most of the lands were completely under human influence and cleared for human settlements, agriculture and developments. Although it was disturbed, the beach remains fairly natural habitat in the proposed project area. Major non-natural floristic habitats (human habitats) found in the area includes camp sites, home gardens and other anthropogenic sites such as Hindu temples, abandoned lime excavated pits, roadside vegetation, abandoned industrial lands (cement factory), shrub lands with some palmyra and coconut trees and cultivated lands.

Abundant lime pits

Cement factory

Abundant land

Homeland

Coastal terrain

Beach vegetation

Figure 3.15: Vegetation cover in the study area

A total number of 62 plant species (Angiosperm) were recorded during the field survey within the study area. The majority of the plant species recorded were tree species (29) followed by shrubs (14) climbers (9), creepers (6) and herbaceous species (4). Further, about 31% of the recoded plant species were exotic and invasive species, indicating that the habitats are heavily influenced by man. None of the recorded plant species were unique (endemic) or restricted to the study area and also none of the plant species was nationally threatened. However, Felling of Trees (Control)(Amendment) Act 2000 specifies obtaining permits to falling of female palmyra trees. A detailed list of the plant species recorded during the field study is listed in Table 3.4.

3.2.1.2 Onshore vegetation

Broad beach consists of white sand. The characteristic shrubbery serves as a compact coastal forest. The KKS Lighthouse is located on the eastern side of the beach, making this shoreline one of the most picturesque in the region.

Natural beach vegetation was highly disturbed and was limited to a few small patches. *Calotropis gigantea* (Wara), *Opuntia dilleni* (Pathok), *Spinifex littoreus* (Maharawana ravula), *Ipomoea pes-caprae* (Mudu Bin Thamburu), *Launaea sarmentosa* (Muudu Kaladuru) and *Sesuvium portulacastrum* (Maha sarana) were the common species observed in the beach. No endemic or threatened plant species were found in association with the beach vegetation during the study.

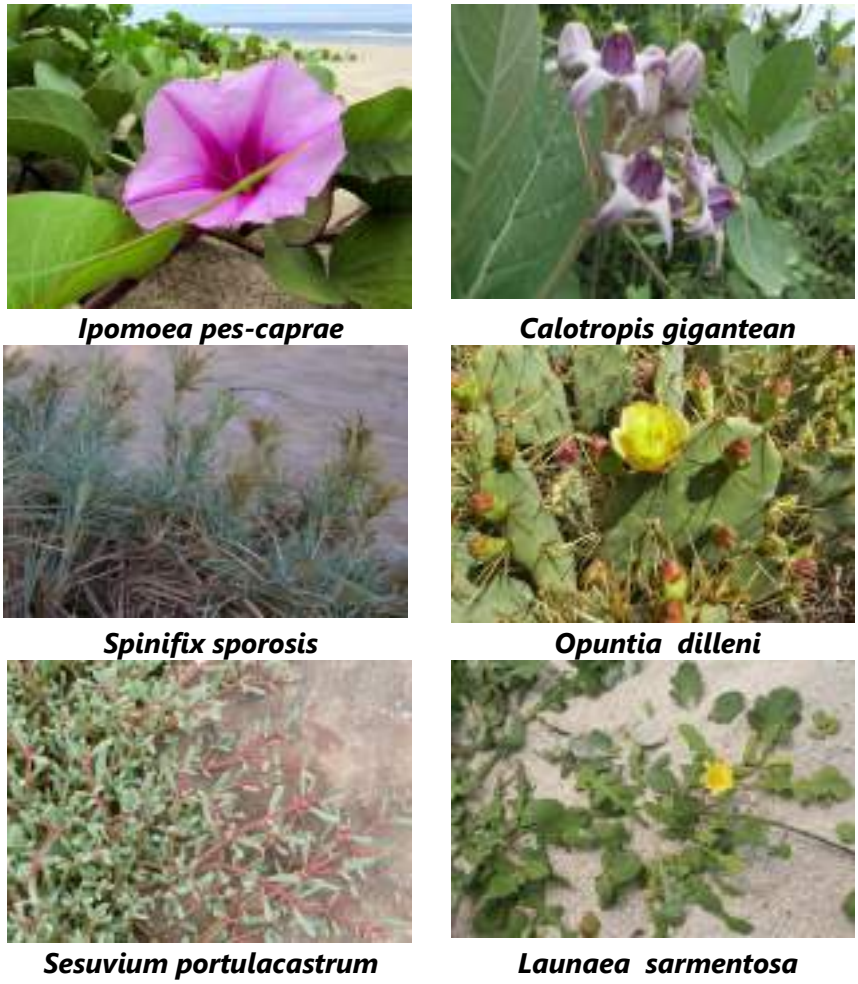


Figure 3.16: Shore plants recorded in the study area

Table 3.4: Terrestrial plants recorded in the study area and their conservation status

Species	Family	Common Sinhala name	Status of conservation	Plant type
Borassus flabellifer	Arecaceae	Tal	Naturalized exotic	Tree
Phoenix pusilla	Arecaceae	Maha Indi	LC	Tree
Acacia leucophloea	Fabaceae	Maha Andara	LC	Tree
Prosopis julofera	Fabaceae	Kalapu Andara	LC/Invasive	Tree
Casurina eqqusitifolia	Casuarinaceae	Kasa	LC/Exotic	Tree
Lawsonia inermis	Lythraceae	Marathondi	Native	Tree
Moringa oleifera	Moringaceae	Murunga	LC	Tree
Pongamia pinnata	Fabaceae	Magul Karada	LC	Tree
Hibiscus rosa-sinensis	Fabaceae	Wada	LC/Exotic	Tree
Cocous nucifera	Arecaceae	Pol	LC	Tree
Musa paradisiaca	Musaceae	Kesel	LC	Tree
Delonix regia	Caesalpiniaceae	Mara	LC/Exotic	Tree
Millingtonia hortensis	Bignoniaceae	Maha Wathusuddha	Exotic	Shrub
Azadiracta indica	Meliaceae	Kohoba	LC	Tree
Thespesia populnea	Fabaceae	Gansuriya	LC	Tree
Tephrosia purpurea	Fabaceae	Kathuru Pila	LC	Shrub
Ipomoea pes-caprae	Convolvulaceae	Bimthaburu	LC	Creeper
Carica papaya	Caricaceae	Gaslabu	LC	Tree
Acorus calamus	Cyperaceae	Thelakeeriya	LC	Herb
Cyanodan dactylon	Poaceae	Ruha	Native	Creeper
Nerium oleander	Apocyanceae	Kaneru	LC/Exotic	Tree
Calotrophis gigantean	Asclepiadceae	Wara	LC	Shrub
Tamarindus indicus	Mimosaceae	Siyabala	LC	Tree
Alstonia scholaris	Apocyanceae	Hawari Nuga	LC/Exotic	Tree
Cassia auriculata	Caesalpiniaceae	Ranawara	LC	Shrub
Cissus quadrangularis	Vitaceae	Heerassa	Native	Vein
Tectona grandis	Verbanaceae	Thekka	LC	Tree
Terminalia catapa	Terminaliaceae	Kottaba	NT	Tree
Syzygium cumini	Myrtaceae	Madan	LC	Tree
Ficus religiosa	Moraceae	Bo	Secret	Tree
Ficus benghalensis	Moraceae	Maha Nuga	LC	Tree
Cassurina equisitifolia	Casurinaceae	Kasa	LC/Exotic	Tree
Ervatamia divaricate	Apocyanceae	Wathusudha	LC/Exotic	Shrub
Emblica officinalis	Euphorbiaceae	Nelli	LC	Tree
Spinifix spirosis	Poaceae	Maharavana Revula	LC	Creeper
Clitoria ternatea	Fabceae	Katarodu	LC	Vein
Sesbania grandiflora	Fabaceae	Kathurumurunga	LC	Tree
Mirabilis jalapa	Nyctaginaceae	Hendrickka	LC	Herb
Ixora coccinea	Rubiaceae	Ratmal	LC/Exotic	Shrub
Albizia lebbeck	Fabaceae	Suriya mara	NT	Tree
Pedalium murex	Pedaliaceae	Aeth nerenchchi	LC/Exotic	Herb
Boerhavia diffusa	Nyctaginaceae	Pitasudu sarana	LC	Creeper
Cassia siamea	Fabaceae	Aramana	LC	Tree
Psidium gujava	Myrtaceae	Pera	LC	Shrub
Acacia nioltica	Myrtaceae	Maha nidikumba	LC/Invasive	Shrub
Catharanthes roseus	Apocyanaceae	Menimal	LC/Exotic	Shrub
Sesuvium	Aizoaceae	Maha Sarana	LC	Creeper

portulacastrum				
Pergularia daemia	Asclepiadaceae	Madahangu	LC/Invasive	Vine
Asparagus racemosu	Asparagaceae	Hathawariya	LC	Vine
Wedelia biflora	Asteraceae	Mudu Gam Palu	LC	Vine
Vitex trifolia	Lamiaceae	Wal Nika	LC/Exotic	Shrub
Cassine glauca	Celastraceae	Neralu	EN	Tree
Opuntia dilleni	Cactaceae	Pathok	LC/Exotic	Shrub
Gloriosa superba	Colchicaceae	Niyangala	LC	Vine
Coccinia grandis	Cucurbitaceae	Kowakka	LC/Invasive	Vine
Ipomoea pes-tigridis	Convolvulaceae	Divi Adiya	LC/Exotic	Vine
Launaea sarmentosa	Asteracea	Muudu Kalanduru	LC	Creeper
Flueggea leucopyrus	Phyllanthaceae	Katupila	LC	Shrub
Caesalpinia bonduc	Fabaceae	Kuburuwel	LC	Vine
Morinda coreia	Rubiaceae	Ahu	Native	Shrub
Premna obtusifolia	Verbenaceae	Maha Midi	Native	Shrub
Leucas zeylanica	Lamiaceae	Thuba	LC	Herb

3.2.1.3 Terrestrial fauna

The study area is the home of several species of mammals, reptiles and birds. Since the area has a medium–low diversity of vegetation cover the wildlife present in the area were of general varieties and were not endangered or rare species. Most wildlife species recorded during the survey were birds.

However, only one site on the sandy beach, just near the eastern side of the main breakwater has identified as a turtle nesting site. The turtles visiting the site were Olive Ridley. The nesting season is March to October. Navy personnel of the nearby camp were giving protection to the site; ensuring sea turtles have a safe place to nest. All sea turtles encountered in Sri Lanka are at risk of disappearance and are listed as endangered. Except sea turtles there were no rare or endangered species recorded during the survey. The fauna species recorded around KKS Port is given in Table 3.5.

Table 3.5: Terrestrial animals recorded in the study area and their conservation status

Family	Species	Sinhala name	Conservation status
Birds			
Cercotrichas	*Copsychus saularis*	Polchicha	LC
Corvidae	*Corvus splendens*	Kakka	LC
Sturnidae	*Acridotheres tristis*	Mayna	LC
Dicruridae	*Dicrurus macrocercus*	Kawuda	LC
Estrildidae	*Lonchra punctulata*	Wee kurulla	LC
Turdoides	*Turdoides affinis*	Demalichcha	LC
Passeridae	*Passer domesticus*	Ge kurulla	LC
Nectariniidae	*Nectarinia zeylonica*	Sutikka	LC
Strigidae	*Otus sunia*	Bassa	LC
Columbidae	*Columba livia*	Alu paraviya	LC
Charadriidae	*Vanellus malabaricus*	Kaha kirala	LC
Accipitridae	*Haliastur indus*	Bamunu ukussa	LC
Corvidae	*Corvus splendens*	Kakka	LC

Reptiles			
Colubridae	*Ptyas mucosa*	Garadiya	LC
Colubridae	*Ahaetulla nasuta*	Ehatulla	LC
Elapidae	*Bungarus caeruleus*	Mudu karawala	LC
Agamidae	*Calotes versicolor*	Katussa	LC
Elapidae	*Naja naja*	Naya	LC
Varanidae	*Varanus bengalensis*	Thalagoya	LC
Cheloniidae	*Lepidochelys olivcea*	Batu kesbewa	EN
Mammals			
Muridae	*Rattus rattus*	Kalumeeya	LC
Sciuridae	*Funambulus palmarum*	Lena	LC
Herpestidae	*Herpestes smithii*	Mugatiya	LC
Hystricidae	*Hystrix indica*	Iththewa	LC
Leporidae	*Lepus nigricollis*	Kelae hawa	LC

3.2.2 Marine environment

3.2.2.1 Harbour basin

Underwater visibility was generally poor within the harbor basin, but varied from site to site. On the outer coast (harbor approach channel) visibility was around 1.0m. However, at docking site's visibility was less than 0.5 m and a sharp increase in turbidity were observed with visibility reduced to below 10 cm where closer to the bottom. The seabed at all study sites was found to consist of fine, soft sediments, dominated by the fine mud and silt. Sediment type did not vary greatly between approach channel and the docking area.

Owing to the coastal development along harbour coastline, most of the natural habitats have been transformed into varied types of artificial seawall (Jetties and other structures). Natural inter-tidal habitat is rare in harbour except a few locations, closer to the Navy dock in which rocky shores with hard substratum were retained. The coastal communities were subjected to oil pollution from marine traffic, water runoff or sewage discharge from land based sources. Spot dive survey conducted close to seawalls inside the harbour recorded fouling organisms such as barnacles, periwinkles, mussels, polychaetes as well as some macro-algae (*Sargassum sp*), which were tolerant to pollution. Inter-tidal fauna of soft bottom areas were characterized by low ecological value species, mostly polychaetes and bivalves in low numbers. Crabs were recorded on the rubble-mount seawalls.

3.2.2.2 Intertidal zone

Beyond the harbor basin, the intertidal zone within the study area does not show significant habitat heterogeneity. The area was rocky, consisting rampart of bedrock-related dead Miocene limestone blocks (reef). They were fairly exposed during low tide. The reef (rampart) that is heavily etched with small drainage channels and low widely spaced ridges running parallel to the reef edge that resemble a series of long low and wide corrugations. The rock surface shows indentations, undercuts cracks where layers were broken, smooth depressions eroded by wave action, and tiny slots where chitons were borne down a few centimeters. Mixtures of loose rocks and stable boulders occur at the base and less commonly scattered atop the bedrock flats. Only a

few places were reasonably safe access where relatively soft sedimentary rocks may be tilted or broken off from the bedrock.

Western side of the Port **Eastern side of th Port**

Figure 3.17: Rocky intertidal zone

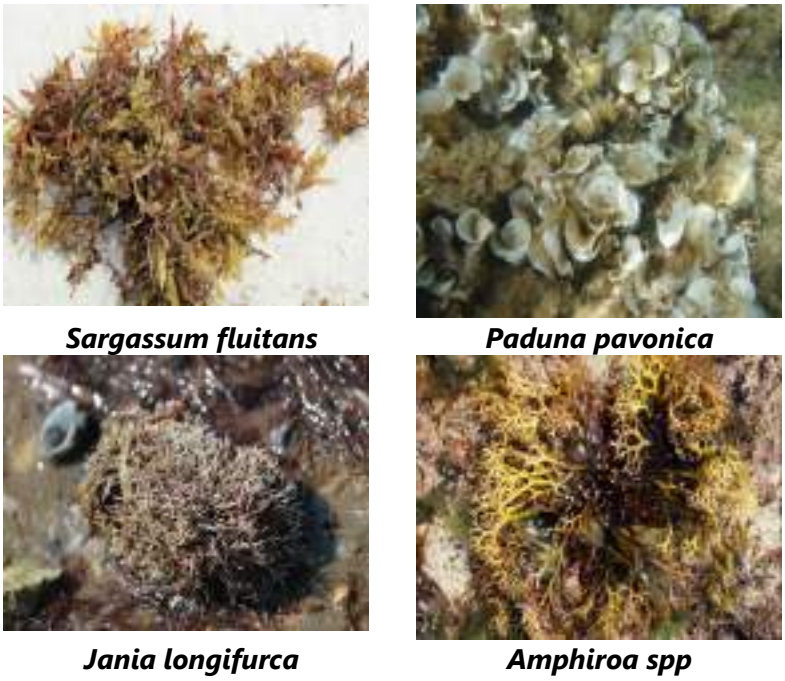
The gradient between marine and terrestrial condition was not sharp and thus no rapid changes in physical conditions or the species zonation was readily observable in the intertidal zone. Gradual sloping and limited tidal range leaves behind soft sediments; silt and mud in the near shore area. However, intertidal zone on the eastern side of the Port (Thalseven Resort end) was relatively less sediment. The distribution of species (gastropods and seaweeds) reflected the difference in the exposure on the two sides of the Port and it clearly demonstrates that wave action and water movement had a greater effect on the distribution of littoral species than the tidal amplitude.

Figure 3.18: Gastropods and Bivalve species reported from intertidal zone

The rocks of the upper tidal zone contain species that depend upon periods of submergence for their survival. The most active was the crab species, *Grapsus sp*. The littoral gastropods *Planaxis sulcatus, Cerithium litteratum* and *Cantharus cecillei* were tolerant of the more exposed conditions found in large numbers on the dry surfaces of upward facing rocks, while *Nerita* sp, *Tectarius muricatus* and *Littorina sp* were usually found in crevices and rock pools, coming out and moving over the rock surfaces when the rocks were wet or at high tide. Clams (*Tegillarca* sp), mussels (*Saxidomus sp; Mercenaria sp), Turritella sp*, *Umbonium sp* and *Murex sp* were more abundant in muddy substratum.

Seaweeds were limited to their distribution from the lower intertidal to the shallow sub-tidal zone and rarely found in upper intertidal sediment shore. A limited number of species were observed during the survey and were found only in the sheltered coves while others may be confined to

the rocky exposed along the shore or margins of the reef. In contrast to red and brown algae, green algae was not found in the upper intertidal.



Sargassum fluitans ***Paduna pavonica***

Jania longifurca ***Amphiroa spp***

Figure 3.19: Algae species recorded from intertidal zone

Rocky intertidal habitats were common on the shallow sea of KKS. All species recorded from the intertidal zone during the survey have extensive geographical ranges. Neither intertidal habitats nor the species were rare or restricted in their distribution.

3.2.2.3 Sub-tidal zone

Below the low tide line is the sub-tidal zone, the coastal life zone that remains underwater. Sub-tidal zone of the study area was shallow and rocky. The water was relatively clear and making possible the development of a great variety of benthic communities. However, the sub-tidal area outside the harbor basin remained dark and turbid. Only a few dead coral colonies were observed beside the harbour approach. The seabed was silt and mud. Seagrass were not observed in the area but reported in more towards offshore waters as well as distance further away from harbor approach. This may due to direct impacts involved of physical removal of vegetation during earlier dredging the harbour basin and the approach to remove sunken ships during the war time and also indirect impacts in adjacent un-dredged areas may occur as a result of increased turbidity and/or siltation associated with dredging activities.

Beyond harbor location the intertidal fringing reef rampart without forming a reef lagoon slopping into sub-tidal zone featuring a few isolated small encrusted live hard corals on boulders, soft corals, hydroids, seagrass and macroalgae, such as *Sargassum sp*, which extended over 1km into the Palk Bay. However the diversity improved when stretched > 2km from the harbour

location. In deeper depths seagrass forms meadows on the sea floor while isolated outcropping of coral patches that were in close proximity to each other were physically separated by seagrass and this goes up to about 50-60 m depth and function as shelters and breeding grounds for fish and other invertebrates and vertebrate. This suggested that in distance water coral amenable to settle and growth under conditions of improving water quality.

The coral colonies were dominated by the families Faviidae (*Goniastrea sp*, *Platygyra sp*, *Leptoria sp*, *Favia sp* and *Favites sp*) and family Poritidae (*Porites lutea* and *Porites lobatathe)* followed by plating and encrusting Acroporids (Table 3.6). Most notable features were the high abundance of soft coral mainly genus Scrcopjyton and Sinularia. All these reported species are sediment tolerate species, indicating that these reefs are exposed to stress from the high sediment load. *Halimeda sp*, *Caulerpa sp*., *Turbinaria sp*. and *Sargassum sp*. were the main algae in the reefs. The status of the coral reef in the area was quite varied. On the eastern side live coral cover made it to over 30% (hard coral and soft coral) in most transects while in the west on average it was less than 15%.

Enhalus acoroides

Caulerpa racemosa

Sarcophyton sp

Symphyllia recta

Caulerpa prolifera

Gogonian sp

Montipora aequituberculata

Diploria sp

Padina gymnospora

Gogonian sp

Favia pallida

Goniopora sp & Capnella sp

Favia speciosa

Porites porites

Cladiella sp

Sarcophton elegans

Leptoria Phrygia

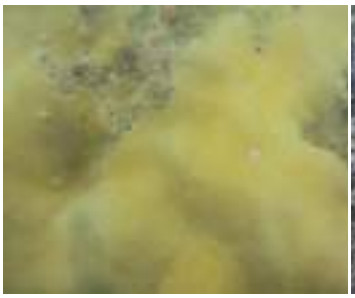
Favia rotundata & Goniastrea retiformis

Porites sp

Porites lobata

Scarcophyton sp

Goniopora sp



Favites flexuosa

Cladiella hartogi

Sinularia sp

Sinularia brassica

Lobophytum sp

Favites abdita

Sinularia compressa

Porites lutea

Porites sp

Halimeda growing on coral reefs

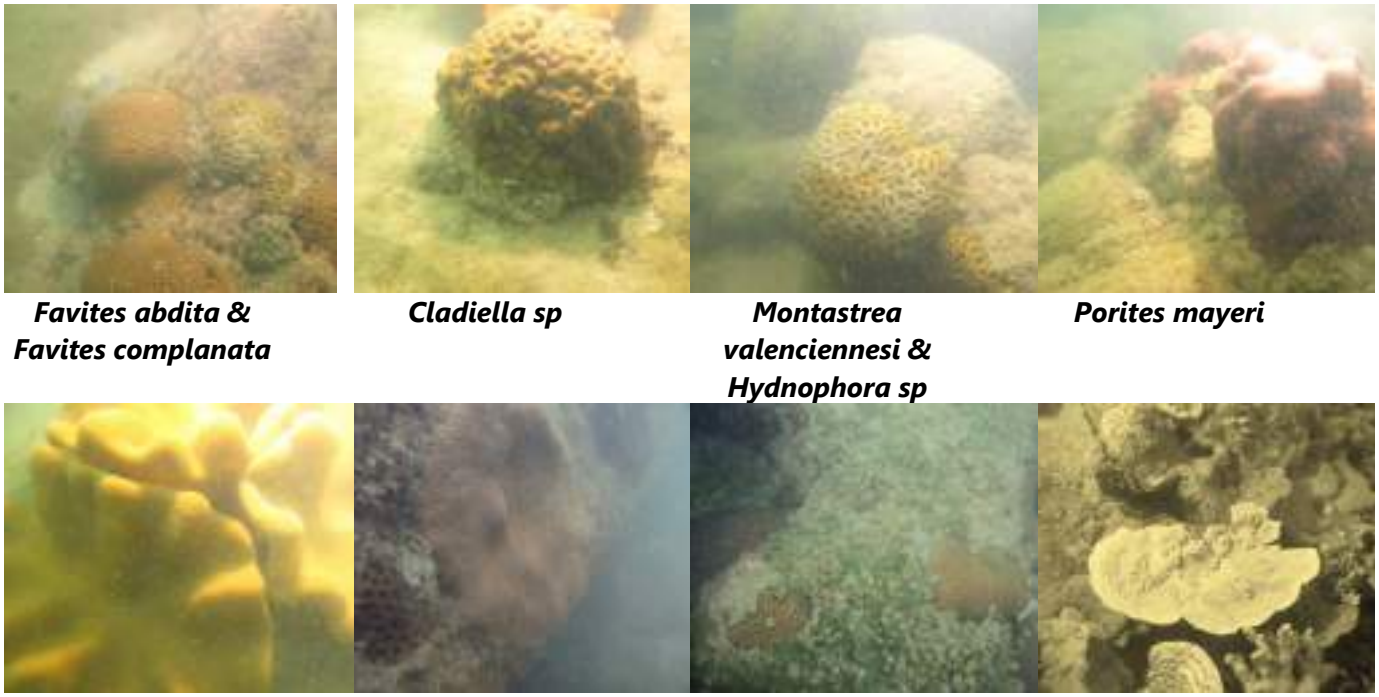


Figure 3.20: Stony corals and soft coral in sub-tidal reef environment

Table 3.6: Coral species reported in the study area

Hard coral		Soft coral	
Family	Species	Family	Species
Dendrophyllidae	*Turbinaria mesenterina* *Turbinaria peltata*	Alcyoniidae	*Cladiella hartogi* *Cladiella pachyclados* *Lobophytum crissum* *Lobophytum scrcophytoides* *Sarcophyton crassocaule* *Sarcophyton sp* *Sarcophyton glaucum* *Sarcophyton elegns* *Sinularia sp* *Sinularia brassica* *Sinulria capillosa* *Sinularia compressa* *Sinularia gibberosa*
Faviidae	*Favia pallida* *Favia speciosa* *Favia rotundata* *Favites abdita* *Favites chinensis* *Favites complanata* *Favites flexuosa* *Favites pentagona* *Montastrea valenciennesi* *Goniastrea retiformis* *Platygyra lamellina* *Platygyra sinensis* *Platygyra daedalea* *Platygyra pini* *Leptoria phrygia* *Leptastrea purpurea* *Echinopora lamellosa*		
Mussidae	*Symphyllia agaricia* *Symphyllia radians*	Briareidae	*Briareum excavatum*

	Symphyllia recta *Symphyllia sp* *Diploria strigosa* *Diploria sp*		
Poritidae	*Porites sp.* *Porites lutea* *Porites lobata* *Goniopora spp.*		

Sixty three species of reef fish were recorded during the survey (Table 3.7) and most abundant species in the area were belongs to family Siganidae and Caesionidae. Reef fish of high ornamental value and also commonly reported in healthy coral reefs were rarely encountered during the survey.

Table 3.7: Reef fish species recorded during the survey

Family	Species	Family	Species
Acanthuridae	*Acanthurus lineatus* *Acanthurus mata* *Acanthurus nigricauda* *Acanthurus tristis* *Naso annulatus*	Lutjanidae	*Lutjanus ehrenbergii* *Lutjanus fulviflamma* *Lutjanus fulvus* *Lutjanus vitta*
Apogonidae	*Apogon sp*	Monacanthidae	*Aluterus monocerus*
Balistidae	*Pseudobalistes fuscus* *Sufflamen fraenatus*	Mullidae	*Upeneus tragula*
Caesionidae	*Caesio caerulaurea* *Caesio cuning* *Caesio xanthonota* *Pterocaesio chrysozona* *Pterocaesio tessellate*	Mugilidae	*Liza sp*
Carangidae	*Caranx sexfasciatus* *Gnathanodon speciosus* *Ttrachinotus bailonii*	Nemipteridae	*Scolopsis vosmeri*
Centropomidae	*Psammoperca waigiensis*	Pomacentridae	*Abudefduf septemfasciatus* *Abudefduf sordidus* *Abudefduf vaigiensis* *Amblyglyphidodon leucogaster* *Chromis ternatensis* *Neopomacentrus asyzron* *Pomacentrus chrysurus* *Pomacentrus indicus*
Chaetodontidae	*Chaetodon plebeius* *Chetodon sp*	Pseudochromidae	*Pseudochromis sp*

Dasyatididae	*Dasyatis zugei* *Himantura imbricate*	Scaridae	*Scarus ghobban* *Scarus niger* *Scarus rubroviolaceus*
Diodontidae	*Diodon holocanthus*	Scorpaenidae	*Pterois volitans*
Gerridae	*Gerres filamentosus* *Gerres sp*	Serranidae	*Cephalopholis boenak* *Cephalopholis formosa* *Epinephelus areolatus* *Epinephelus faveatus*
Gobiidae	*Amblygobius sphinx*	Siganidae	*Siganus canaliculatus* *Siganus javus* *Siganus lineatus* *Siganus stellatus* *Siganus virgatus*
Haemulidae	*Plectorhinchus lineatus* *Plectorhinchus pictus*	Sphyraenidae	*Sphyraena jello*
Holocentridae	*Sargocentron diadema*	Tetraodontidae	*Arthron hispidus*
Lethrinidae	*Gymmnocranius sp* *Lethrinus lentjan* *Lethrinus harak*		

3.2.2.4 Pelagic zone and open sea

Schooling pelagic fish such as sardines, barracudas, carangids or any other fish schools were not encountered within the study area during the survey. However, fishing with small-mesh drift nets was observed in far deeper waters about 4-5 km away from the shore.

Marine mammals and sea turtles are limited distribution in and around the KKS coastal sea area. None of these animals were recorded during the pelagic survey. According to fishermen the occurrence of sea turtles is commonly reported in Point Pedro sea area while the dolphins are rarely observed in the seas around KKS or Point Pedro sea area.

3.2.2.5 Marine ecological sensitive receiver

There are no Marine Parks or Marine Reserves in the study area. The only marine ecological sensitive receiver is the established coral communities in the sub-tidal zone along the KKS coast of the Port area. The study area is not considered to be an important fishing ground or fish breeding or spawning ground. Further, the area is not the distribution range of dolphins. However, turtles were observed in the open sea area and also there is a nesting site near the Port premises; adjacent to the main breakwater.

3.2.3 Fisheries and fishery resources

3.2.3.1 Fish landing sites

There is no beach seine sites located along the coast of the study area. The fish landing centers are confined more away from the KKS Port as it located within the high security zone. As such the area is counted as no fishing zone. The study area comes under the KKS west Fisheries Inspector Division (FI Division). The nearest landing center towards the west is Valithoondal and towards the east is KKS and both landing centers are located over 1km away from the Port point. In the KKS west FI Division only the sea fishing is conducted as there are no internal water bodies (lagoons).

Within KKS west FI division there are 7 fishing villages (fish landing sites), namely KKs, Valithoondal, Senthankulam, Seenthilpanthal, Urania, Poietty and Mareesankudal. All are beach landing centers and neither landing site facility nor Port facility available to accommodate bigger boats. Therefore, fishing in the area is basically small-scale in nature. The closest fishery Port is at Myliddy which is still under rehabilitation and is located about 4 km wards east of the KKS Port.

3.2.3.2 Fishing population

The total fishing population in the KKS west FI Division in 2018 was 1934 and of them 439 were active fishermen (Table 3.8).

Table 3.8: Fishing population in the KKS west FI Division -2018

Fishing villages	No. of fisher families	No. of active fishermen	Population of fisheries sector
KKS	110	115	422
Valithoondal	56	60	220
Senthankulam	117	114	565
Seenthilpanthal	46	44	198
Urani	45	15	160
Poietty	39	41	150
Mareesankudal	54	50	219
Total	467	439	1934

Source: Department of Fisheries and Aquatic Resources

There are about 467 fishing families in the coastal belt of the KKS west FI Division. Although the number is relatively less compared to the total fishing families, 21356 in Jaffna District their importance cannot be underemphasized. This is often associated with high levels of dependence which touch on important issues of nutrition, food security, health, livelihoods and poverty alleviation.

3.2.3.3 Type of fishing crafts operating and gear used

A variant type of fishing craft, traditional to modern is being operated in the FI Division as shown in Table 3.9. Only one IMUL boat is registered in the area and is engaged in prawn trawl fishing. Since there is no Port facility in the area it is generally operated based on Karainagar fishery Port.

Table 3.9: Number of fishing crafts by type operate in KKS west FI Division - 2018

Fish landing site	IMUL	IDAY	OFRP	MTRB	NTRB	NBSB
KKS			13		8	
Valithoondal			3	5	1	
Senthankulam	1		43	5	22	
Seenthilpanthal			27		1	
Urani			16	1	9	
Poietty			10	1	4	
Mareesankudal			42		10	
Total			154	12	55	

Source: Source: Department of Fisheries and Aquatic Resources

IMUL-Multiday boats; IDAY- Inboard engine day fishing boats; OFRP- Outboard motor fiberglass reinforced boats; MTRB- Motorized traditional boats; NTRB- Non-motorized traditional boats

OFRP boats are powered generally by 15-25 HP outboard motors. Length of the boat hull varies from 18-22 feet. They operate proximity to the study area. These crafts generally being used a wide array of fishing gear separately or simultaneously in the fishing operation such as small mesh gillnets, trammel nets, bottom set gillnets, handline, bottom longline, fish trap etc. Generally 2-3 crew members, including skipper are onboard the OFRP boat. The operational cost of these boats mainly comprised of fuel expense. A range of 15-40liters of fuel is used per day, and on average about 35 kg fish being harvested per day. Except in very rough weather condition these boats operate year round.

Catamaran or log raft is the most commonly used non-motorized traditional fishing craft in the area. They only sail for short distance generally 2-3 kilometers. These crafts mainly used in the operation of small mesh gillnets, trammel nets, handline etc. Fishing are made only during non-monsoonal season; March to October when the sea is calm. Generally, one crew member; most of the time craft owner engaged in fishing operations. They harvest array of 2-20kg per day.

Fiberglass Reinforced Plastic boats (OFRP)

Non-motorized traditional craft

Figure 3.21: Fishing crafts engaged in fisheries in the study area

3.2.3.4 Fishing activities and fishing seasons

Fisheries take place in the coastal waters, especially targeting small pelagic fish and demersal reef fish. Small pelagic fish are those species that live in the water column of coastal sea, either close to the surface or in mid water. The dominant small pelagic groups are sardines and herrings (Clupeidae), scads (Carangidae), Indian mackerel (Scombridae), seer fish (Scombridae), and wide range of other free swimming types. Fishing takes place generally in coastal waters beyond sub-tidal coral ridge and mainly confined to the depths beyond 20m and extends up to about 40-50m depths depending on the target and sea condition. Small mesh gill net is the common fishing gear used in the area.

Demersal fisheries conducted mainly with traps targeting reef associated finfish, and invertebrates such as lobsters and crabs. As the shallow sea is generally rocky demersal finfish fisheries make a significant contribution to the fish production of the area. Fishing is conduct seasonally mainly non-monsoon season, April to September employing fish traps and set nets. Their main target is the large demersal fishes like skates, snappers (Lutjanidae), groupers (Serranidae), trevallies (Carangidae), sweetlips (Haemulidae). Fishermen change the fishing ground east-west direction according to the availability of resources. Thereby, they take the route via offshore waters to reach the fishing ground.

3.2.3.5 Fish catch and catch composition

Fish production recorded from KKS FI division in July 2018 is given in Table 3.10.

Table 3.10: Fish production reported in July 2018

Fish landing site	Fish production – July 2018 (MT)
KKS	8.5
Valithoondal	4.5
Senthankulam	37.5
Seenthilpanthal	15.5
Urani	10.5
Poietty	8.0
Mareesankudal	23.5
Total	108.0

Source: Source: Department of Fisheries and Aquatic Resources

Composition of the fish reported from KKS west FI Division in July 2018 is given in Table 3.11.

Table 3.11: Composition of the fish catch in July 2018

Landing site	Production (Kg)								
	Seer fish	Carangids	Sharks	Skate / Rays	Reef fish	Crabs	Sardine	Other	Total
KKS	1500	2500			2500		1500	500	8500
Valithoondal	100	1300			1700		1200	200	4500
Senthankulam	4500	9000	1250	1250	11500	1500	5500	3000	37500

Seenthilpanthal	1500	4200			4800	200	3300	1500	15500
Urani	500	3500			4500		1200	800	10500
Poietty	50	2500			4200	100	750	400	8000
Mareesankudal	2700	6500			7600	1500	3000	2200	23500
Total	10850	29500	1250	1250	36800	3300	16450	8600	108000

Source: Source: Department of Fisheries and Aquatic Resources

Of the total catch over 34% consisted reef fish followed by carangids (27%) and this shows the importance of reef fisheries in the area.

3.2.3.6 Dry fish production

Due to the shortage of ice, lack of storage facilities and limited byers in their villages, most fishermen have resorted to fish processing as an alternative for saving their catch from rapid spoilage. Preservation of fish is often an opportunity to use underutilized family labor and generation of employment in coastal areas. Salted dried fish processing is mostly done by women, children and unemployed youth who cannot go fishing. Quantity of fish used in dry fish production is given in Table 3.12.

Table 3.12: Quantity of fish used in dry fish production

Quantity (wet weight – Kg)	Carangids	Rock fish	Sardine	Other	Total
Fish used for dry	4500	3500	7500	1500	17000

Source: Source: Department of Fisheries and Aquatic Resources

3.2.3.7 Species composition of the fish catch in the KKS west FI Division

During the field survey a total of 48 fish species and 3 shrimp and 2 crab species were identified in commercial fish catches at Senthankulam, Seenthilpanthal and Urani (Table 3.13).

Table 3.13: Species recorded in the commercial fish catch by gear

Fishing gear	Species
Small-mesh gillnets	*Caranx sansun* *Dussumieria acuta* *Hilsa kelee* *Escualosa thoracata* *Sardinella gibbosa* *Sardinella longiceps* *Sardinella albella* *Sardinella sp* *Nematalosa nasa* *Cypselurus sp* *Pellona sp* *Gerres abbreviates* *Gerres sp.*
Medium mesh gillnet	*Megalaspis cordyla* *Chirocentrus sp*

	Lactarius lactrius *Sphyraena sp* *Scomberomorus guttatus* *Rastrelliger kanagurta*
Bottom set gillnet, Trammel net	*Aris sp* *Alectis indicus* *Upeneus vittatus* *Therapon puta* *Siganus oramin* *Siganus sp* *Siganus javus* *Himantura uarnak* *Scomberoides sp* *Drepane punctate* *Plectorhinchus sp* *Penaeus merguiensis** *Penaeus semisulcatus** *Metapenaeus dobsoni** *Portunus pelagicus+* *Portunus sanguinolentus+*
Fishing traps and bottom set nets	*Lethrinus lentjan* *Lethrinus microdon* *Lethrinus olivaceus* *Lethrinus ornatus* *Lutjanus fulviflamma* *Lutjanus gibbus* *Lutjanus leminiscatus* *Lutjanus rivulatus* *Epinephelus undulosus* *Arius bilineatus* *Arius thalassinus* *Balistoides viridescens* *Canthidermis maculatus* *Carangoides chrysophrys* *Carangoides fulvoguttatus* *Carangoidesmalabaricus* *Caranx ignobilis* *Cephalopholis Formosa*

Shrimp- * Crabs - +

Source: Field survey

3.2.3.8 Income level of fishers

Monthly gross and net income estimated using data gather during field visits is presented in Table 3.14.

Table 3.14: Monthly gross and net revenue of fisheries by craft category

Craft type	Monthly Av. Fish catch/ boat (Kg)	Unit price (LKR)	Fisheries income (LKR) per month	Monthly Av operational cost (LKR)	Net Income	Net income per fishing day	No. crew members	Revenue sharing	Net income per boat owner	Net income per crew member
OFRP	540	150	81000	25000	56000	2240	2	2:1	1493.34	746.70
NTRB	280	150	42000	5000	37000	1480	1	1	1480	

Source: field survey

Fishermen engaged in fishing with traditional crafts have limited fishing days and fishing is confined only to non-monsoonal months; October to April.

3.3 Historical and Archeological significant sites

There are no places with historical, Archeological or cultural significant located within the port land. Nevertheless 7 religious locations are observed located within 600m radius. These places have been intensively used by the local community prior to civil war but, there were no any complaints or grievances due to the port operations. The details of these 7 locations are included in Table 3.15.

Table 3.15: Information on religious locations

Religious place	**Distance from the project boundary -m**	**Other remarks**
Thissa Viharaya	Adjacent	This is located within the premises of Navy camp, constructed and used by navy personnel.
Vayil Kovil	Adjacent	This was used by large number of community members prior to war but, at present it is dilapidated. Vacant land is available
Aiyanayar Kovil	500	Not actively utilized by community after the war, this might become much significant after resettlement of evacuated community members due to war
Krishnan Kovil	500	Popular place in the area
Amman Kovil	500	This is used by less number of community members
Veerappan Kovil	600	Presently neglected religious place
Pullayar Kovil	500	Presently neglected religious place

3.4 Social and Economic Aspects

3.4.1 Population

There are no households located within the land area demarcated for the project. The land area in the vicinity of KKS Port had being occupied by fairly large population but, this population left the area during War. Resettlement activities in the vicinity of port area have been initiated recently and the area is being used for relocation activities at present. The population in studied geographical units relevant to the project is shown in Table 3.16

Table 3.16: Population in project relevant geographical units

Studied area	Total population		Total families		Remarks
	past	present	past	present	The navy camp is located within the demarcated project area. The land within J233 GND is presently released for resettlement. The full resettlement has been not yet achieved.
500m distance from the land area	60	20	15	7	
J 233 GN division	2500	265	700	80	
DS division (Walikamam)	N/A	44160	N/A	12500	

Nearly 100% of the families in these project relevant geographical units are Tamils. About 87% of the population in Walikamam DS division is Hindus and the balance belongs to Christian. The Hindu population in J233 GN division is 67% and the rest is Christians. Nearly 50% of the population so far resettled in the area within 500m radius from the project boundary is Hindus and the balance 50% are Christians. According to the data related to population within 500m radius 60% are female and the 40% are male. In contrast to this 47% of the total population in J233 GN division is female and the others are male. This gender difference of population is similar in DS division where 52% of population is female.

3.4.2 Land use

Project area: about 15 Acres of land has been allocated for the use of KKS port. Three buildings belong to Navy are located within this land plot at present. About 5 acres including the existing jetty is being used by the Sri Lankan Navy. The rest of the area (about 10 acres) is bare land. Except Navy the present port is used to import about 6000 cement bags in every three days by Sri Lanka Port Authority.

500m distance of land towards land side: there are no houses located facing to the boundary of the port land. The Navy camp and another small army camp are located adjacent to the port boundary. Presently neglected land previously used for Cement Corporation is also located facing to the boundary of port land. About 75% of the land within 500m distance from the boundary of port belongs to cement corporation (previous). The private lands previously occupied by community members have been released now for resettlements but only 7 families have been so far resettled. Even these 7 families have not yet permanently established their residences.

1 km distance area towards sea from the port boundary: This sea area is mainly used by Sri Lankan Navy. About 20 -25 fishing boats from Urani and Mayiladi used to move across this sea area for fishing.

2 km distance along coast on left side of the KKs port: this is the coastal area where Navy camp is established. A large building previously constructed to be used as president bungalow is located little beyond this 2 km distance.

2 km distance along coast on right side of the KKs port: about 1 km distance of this 2km coastal belt has been allocated for the use of KKS port. About 6 boats are used to anchor in the coastal belt beyond 1 km distance from the Port boundary. The light house and a hotel managed by Army are also located beyond 1 km distance from the port boundary. Small fisheries Port known as Urani has been established about 3 km distance from the port boundary and Mayiladi fisheries Port can be found about 4km distance from the port land.

3.4.3 Nature of households and principle economic activities

According to the Grama Niladhari of J 233 there had been about 700 families resided within the Grama Niladhari division but these families had left the area during civil war period. The government started releasing private land in GN area since 2018 and at present entire land area has been released but only 80 families of 700 have come back to the area for resettlement. These families have been resettled in the past 2 – 3 months and therefore they are also in the process of seeking income generation activities. Many of the children in these recently resettled families have not come to their houses. Significant number of children in these families have either gone abroad or other provinces of the country. The parents who have come are reinitiating their agricultural activities.

About 100-150 families of 700 previously lived in GN area were involved in fisheries activities. Another 100-150 depended on various daily paid labor activities. The GN also mentioned about involvement of members of about 20 -25 families in regular employment in public sector. The balance of 700 families was involved in agriculture.

3.4.4 Existing infrastructure facilities

Roads: The main road from Jaffna to Kankesanturai is recently improved. Even most of the other roads connected to this main road in the project area are also recently improved.

Electricity: The entire project area, its vicinity and also the whole Kankesanturai area have access to electricity supply.

Drinking water: Availability of drinking water is the most significant problematic in Kankesanturai area. Ground water is available but, it is not suitable for drinking according to the local community members.

Institutions: Cement factory and its related cement corporation were the two main institutions functioned in the area prior to war. Since the area was under influence of civil war for long period of time there had been no opportunity to establish other industries or institutions. At present underutilized KKS port is the only institution in KKS area, except Navy camp.

3.4.5 Description of existing fishing activities in the area

There is no fishing activities performed within the underutilized Port area in the sea or in its vicinity up to about 1 km distance. However, following information was collected about the fishing activities in the KKS area even though they are not directly related to the port project.

Situation prior to civil war	Present situation
There were no "madal padu" (Beach seine fishing) up to about 2km distance from the port boundary.	There are no "Madal Fishing" activities performed within 2km distance from the port boundary
Fishermen used to move through the vicinity of port to launch deep sea area for fishing in their boats	The fishermen use to cross the vicinity of port area to launch their boats to the deep sea in their boats for fishing activities.
There was a boat landing site on right side of the port boundary on the coast prior to civil war. About 20 boats were operating from this boat landing site. About 50 fishermen operated from this boat landing site and they were organized in to a fishing association.	There is a boat landing site in a point in the coast on right side of the coast about >1km distance from the boundary of the port, 15 fishermen operate their 6 boats from this boat landing site.
About 100-150 families used to depend on fisheries activities in J 233 GN division	A fishing Port called Urani is located about 3km distance from the port boundary, another fishery Port called Mayiladi is also located about 4km distance from the port boundary.

3.4.6 Transportation, communication, power

Transportation: A regular public bus service is operated from Jaffna to Kankesanturai with 45m interval. About 5 buses run between KKS and Colombo every day. The rail transportation is also available from KKS to Colombo.

Communication: telephone lines are available in main roads from KKS to Jaffna and KKs to Palali. The people in KKs have access to facilities for mobile phones and internet.

Power: Almost all the roads including interior roads have been used to install 3 phase electricity lines. Therefore, communities getting resettled in the area have access to electricity facilities.

3.4.7 Housing/Sanitation, Water supply and Agriculture

Housing and sanitation: The settlements in J 233 and other GNDs in Walikamam DS area were well established with permanent houses and good sanitation system even though they had to depend on ground water. This system got destroyed during civil war and at present community members left the area during war have started coming back for resettlement. They have just started construction of their houses. Most of them have established temporary toilet systems until they fully reestablish their lost livelihood systems

Water: The people in KKS area did not have access to pipe water system even prior to civil war. They all depended on ground water extracted through shallow wells. The community members interviewed did not have complaints about quantity of water in shallow wells but, quality is rather

poor according to interviewed community members. They further mentioned that water in the wells are not at all suitable for drinking purposes. At present they use to drink bottle water and well water is used for other domestic and cultivation purposes.

Agriculture: KKS area was the most popular agriculture zone in Jaffna District of Northern province. The people in KKs used to produce large quantity of red onion, vegetables and banana prior to war. These agriculture systems got destroyed during war and at present most of the lands have become abandoned. The land in J 233 GN division has been recently released for the use of resettlement and agriculture and therefore, it can be expected agriculture development in near future with the area getting resettled with communities.

3.4.8 Other main economic activities

After construction of KKS port in 1985 there were several port related industrial activities emerged in the area. These activities included cement and food storage operated by Cement Corporation and Food Department. This system was destroyed by the war and area became virtually abandoned from livelihood activities.

The resettlement activities have just begun and only lesser number of families have moved to the area on temporary basis. Therefore, economic activities have not yet started by the community members. The responsible persons in the government agencies are of the view that industrial and other income generation activities would come to the area after rehabilitation of KKS port and other basic infrastructure facilities.

3.4.9 Existing beach access

There are 6 access roads within 2km distance on right side of the port to reach the beach. Similarly, 3 access roads are available on left side to visit the beach area.

3.5 Detail of Disaster

Tropical storms, cyclones and tsunamis are the principal hazards facing the coastal areas of Sri Lanka, resulting in storm surges, land inundation, flooding and extensive physical and structural damage. Figure 3.22 identifies the areas and level of vulnerability to natural disasters for the Northern Province; the site representative of a comparatively low vulnerability for wind, storm surge and tsunami impact.

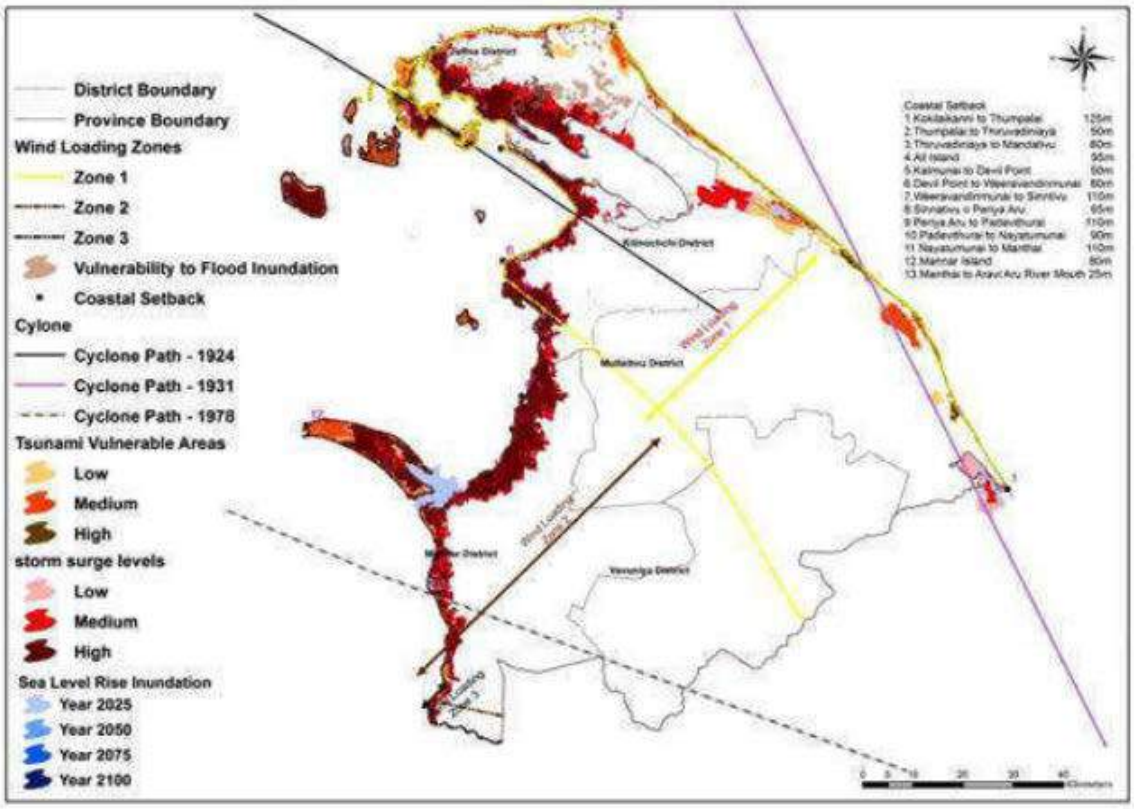


Figure 3.22: Vulnerability levels of natural disasters for the Northern Province.

(Source: CEA/DMC, 2014).

Volcanic activity within Sir Lanka is very rare with no reported cases during the past century whilst earthquakes within the island and in close proximity to the nation's coastal areas are rare.

Tsunamis: Tsunamis are caused by vertical displacement of seabed fault lines during earthquakes, or by other processes such as a volcanic eruption, volcanic collapse or submarine landslide. Tsunami-generating earthquakes tend to be shallow and of relatively-large magnitude (i.e. greater than Richter Magnitude 7), hence the occurrence of a large, shallow earthquake located beneath the ocean will more often than not produce a tsunami, providing there is vertical offset of the sea floor.

Sri Lanka has been impacted by tsunamis in the past, albeit they are rare events, with the most recent occurring on the 26th of December 2004 resulting from a large submarine earthquake (9.3 magnitude) in the Andaman-Sumatra subduction zone. This tsunami caused significant coastal infrastructure and damage to land along the entire eastern coastline of Sir Lanka, including the Northern Province districts of Mullaithivu and Jaffna and significant loss of life. Figure 3.22 is a computer generated model of the potential inundation of the coast line of Sir Lanka resulting from the tsunami.

4 ASSESSMENT OF ANTICIPATED ENVIRONMENTAL IMPACTS & PROPOSED MITIGATION MEASURES

4.1 Physical Resources

4.1.1 Impacts to the beach and shoreline

There will be no new breakwaters/groyne type structures built under this project and only the rehabilitation works will be carried out for the exiting breakwater. Additionally, there will be a construction of jetties at the inner side of the breakwater. Therefore following conclusions could be made.

Erosion or accretion impact for adjacent beaches lands due to change of current wave height regimes attributed to the rehabilitation of KKS Port structures is minimal

Erosion effects in either sides of the coastal stretch during construction period as well as in long term will not be occurred due to the breakwater rehabilitation

Coastal erosion/accretion and bathymetric changes (on either side of the port breakwaters) in the area is negligible

Neither the Port construction nor resulting shoreline changes would change the natural drainage pattern that currently exists in the project area.

Hydrological pattern such as currents and wave patterns, wave height and direction, nearshore current velocity, direction and tides will remains unchanged due to the project

Existing sediment transport patterns on both periods (short term and long term) will not be affected due to the port rehabilitation

Impacts due to the costal hazards event such as tsunamis, cyclones storm surges etc and sea level rise to the Port basin will be reduced in some extent as the strength and the crest height of the breakwater are increased. However, those impacts to the adjacent beach and the shore line is negligible due to this project

In other words overall impact to the beach and shoreline due to rehabilitation works in KKS port is minimal.

4.1.2 Impacts of sewage, waste oil spills, surface runoff, waste water disposal on the environment

All wastewater and sewage will be managed through properly constructed septic tanks and soakage pits during construction period. No effluent will be released into the environment without treatment.

- Adequate toilet facilities will be provided to the labor camps

As explained in section 2.5.3, wastewater during operation period will be treated prior to discharge into the environment.

4.1.3 Anticipated problems related to solid waste disposal

Proper collection/storage and disposal methods are proposed during the construction phase as improper collection, storage and disposal methods could lead to environmental pollution. Washing out waste to sea, blockage of natural drainage paths and spreading of dust could happen during the construction period, if waste is not properly managed. Bad smell, spreading of wastes particularly fish offal by scavenges could occur when the solid waste is not properly managed during the operation period.

Waste disposed in water courses and beaches could lead to water pollution and cause threats to marine and aquatic life. There are no impacts to the wildlife as the project area is a well built up area and no wildlife exists.

All construction waste should be segregated as recyclable and non-recyclable. All recyclable materials should be sold to the local recycle materials collectors in the area.

The non-recyclable debris (broken tiles pieces, rubbles, broken bricks and concrete and sand mixed with cement and other materials) should be used for refilling activities and if any leftover, should be disposed at the local authority collection system/disposal sites.

- All construction wastes will be properly stored with suitable cover like polythene sheets, tarpaulin, or jute to prevent the spreading of dust.
- If possible spray water to keep the waste wet during the dry season
- No open burning of solid waste is allowed as this could cause a nuisance to the people in the area.
- Adequate color bins will be provided to segregate the MSW in the labour Camps. National color code for segregated waste are blue, orange, red, brown and green for Paper and card boards, Polythene and plastic, Glass and bottle, Metal and Bio-degradable waste respectively. All recyclable waste will be stored separately and sold out for local recycle materials collectors in the area and all bio-degradable waste will be disposed through the Point Pedro Urban Council.
- All e-wastes, bulbs such as CFL and linear fluorescent bulbs, obsolete communication equipment etc. will be collected separately to be given to the e-Waste recyclers registered with the CEA.

4.1.4 Transportation, Handling and stock piling of materials

Metal Quarry

There are two potential metal quarries identified for the armors. All these quarries possess Industrial Mining License (IML) from GSMB and Environmental Protection License (EPL) from the CEA. Both licenses provide guidelines and conditions to operate the quarry without causing any environmental damages. Therefore, the construction contractor should ensure that the selected quarries possess valid IML and EPL for the operation.

Impacts on roads

A large quantity (around 260,000 m3) of armor has to be transported for the breakwater construction purpose. Major portion of the transportation route of materials to the site from the quarries are RDA or PRDA roads which are administrated by RDA. The armor will be transported either from Mullaithivu district using 6, 9 and 12T tracks. The existing RAD and PRDA roads are capable of bearing 12T tracks. Therefore, there will not be any risk to damage the roads

4.1.5 Proposed mitigatory measures for potential Physical impacts

Since there is no any significant physical impact has been identified under proposed rehabilitation works in KKS Port, mitigatory measures have not necessary to be proposed.

4.2 Ecological Resources (Land based and Marine)

4.2.1 Terrestrial environment

KKS Port was dormant for a large part of the last 30 years due to civil war. Except mooring and berthing facility no other associated infrastructure is remaining at the locality.

The proposed development project features the construction of a new pier and rehabilitating of existing docking facilities as well as associated Port facilities such as constructing roads, camps, office building, warehouses, maintenance facilities, logistics, road development, equipment and material storage area etc. The major impact on flora and fauna associated with the development will occur during the construction phase of the project. The major impacts at this stage will be the loss of vegetation and transformation and also disturbance to the environment at the site. The presence of a sizeable construction workforce at the site also poses several risks, as does the operation and presence of construction machinery and also residual impacts such as noise and dust.

4.2.1.1 Impacts on terrestrial habitat and biodiversity

(a) Construction phase

- **Habitat destruction and erosion**

The value of the area shows ecologically of low sensitive environment due to physical disturbance gone through over last 30 years. During the habitat survey, except the turtle nesting site no other protected or rare or notable species of flora or fauna were recorded on, or immediately adjacent to, the study area. The site largely supports anthropogenic habitats of low ecological and conservation value typically associated with disturbed ground and which provide limited opportunities for fauna. Any individual or groups of species that may be present on the site are likely to be transitory due to the nature of the habitats and the occurrence of better quality habitat-types within the wider surrounding area.

The construction phase will require construction or widening of access roads as well as the clearing of vegetation for service areas and buildings and temporary construction areas. Apart from direct loss of vegetation, this will also render the disturbed areas vulnerable to erosion.

The clearing and removal of trees and vegetation during building and road construction will result in the loss of a significant part of the existing vegetation and, as a consequence a loss of fauna, especially a reduction of arboreal habitat for epiphytes, lizards, tree frogs, birds and snakes, bats, monkey etc. However, land clearing will not directly responsible in threatening of native flora and fauna as there were no endangered or threatened species reported from the area except few female palmyra trees which comes under Falling Trees (Control) Act. About 31% of the plant species reported in the area were exotic or invasive.

As an implication of clearing vegetation it can lead to soil erosion and increased input of sediment into coastal waters.

- **Dust and noise pollution**

The project activities will generate a substantial amount of dust at the construction site and its surrounding area. The sources of dust will include excavation and leveling works, and transport vehicles delivering construction materials. Impact of dust on vegetation is twofold. The concentrated dust particles in the atmosphere surrounding the plant reduce and probably screen out effective light rays reaching the leaves. Absence of such light rays would interfere with the pigment formation process and result in chlorotic plants. The second effect of the dust particles can be due to the encrustation of dust particles on the broad leaf surfaces, which will effectively seal out light penetration into the leaves.

Noise pollution can have a dramatic effect on the animals that live in the area, perhaps even driving evolutionary change as species adapt to or avoid noisy environments.

Mitigation:

- The construction, material storage and temporary building sites must be selected taking environmental factors into consideration in a manner that will minimize, to the extent possible, impacts to biological resources and ecosystems.
- Turtle nesting site must be protected from wild animals and of all human activities during the nesting period. The Sri Lanka Navy should continue the protection rendered by them and ensure turtles safety. No other person would allow to enter the site and also maintain natural environment characteristics; no artificial light and maintain a silence zone.
- Impact mitigation should be seeking to retain and restore as much of the original and natural vegetation condition of the site.
- Site clearance should be carried out in a manner that retains the large trees while the building footprints are pegged out.
- Construction of the internal roads and placement of the building footprints should be carried out after identifying and locating all the mature and ecologically valuable trees (using qualified personnel) and aligning the roads and building footprints as much as possible so as to save these trees.

- Ensure that all plant/machinery used or construction activities and vehicles are well maintained and in proper running order and also ensure that no work is carried out between 1800 hrs and 0700 hrs.
- Where construction vehicles must traverse the site, they must remain on demarcated roads within the site. If vehicles must leave the road for construction purposes, they should utilize a single track and should not take multiple paths.
- Appropriate erosion control and water diversion structures should be constructed at the same time as the vegetation is cleared so that the loosened soil is not left vulnerable to erosion.
- Construction should complete within a limited time period
- Any slow-moving fauna, such as tortoises or snakes observed at the site during the construction or operational phase should be removed to a safe location.

(b) Impacts during operation

- **Loss of terrestrial habitat and biodiversity**

During the operational phase, human activity and disturbance levels in the foreshore area will be relatively low as compared to the construction phase. The impacts associated with this phase will likely to be related to maintenance activities and carry-over effects resulting from the construction phase and it may result in some damage to vegetation or disturbance to fauna present on site.

The potential impact includes the alien plant invasion. The large amount of disturbed and bare ground that is likely to be present at the site after construction will leave the site vulnerable to alien plant invasion. The presence of alien plants may prevent the natural recovery of the natural vegetation, reduce plant and animal diversity at the site as well as result in various other negative ecosystem consequences. Some alien invasion is inevitable and regular alien clearing activities will be required to limit the extent of this problem. Once the natural vegetation has returned to the disturbed areas, the site will be less vulnerable to alien plant invasion, however, the roadsides and lay-down areas adjacent to the Port will likely to be remained foci of alien plant invasion.

Mitigation:

- Regular monitoring of turtle nesting site and continue patrolling the site
- Regular monitoring of alien plants at the site should carry out
- When alien plants are detected, these should be controlled and cleared using the recommended control measures for each species to ensure that the problem will not be exacerbated or does not re-occur.
- Clearing methods employed at the site should themselves aim to keep disturbance to a minimum (i.e. avoid clearing of vegetation through grading).
- Use of Port roads should be strictly controlled and access to the area in general should be regulated
- In order to reduce collisions of vehicles with fauna, and also to control dust emissions, the speed limits should apply to all roads and vehicles using the site; a maximum of 40 km/h is recommended.

- All cleared areas which do not need to remain clear of vegetation should be rehabilitated or seeded with local species if natural recovery does not take place within a year of being cleared.
- Planting of trees and other vegetation along the roads and operational areas as noise and dust barriers that fit in with the surrounding environment.

4.2.2 Marine environment

The KKS Port development project is planned to repair and rehabilitate the existing breakwaters, piers and roads, including dredging and wreck removal and also construction of a new pier for commercial cargo handling. Although the dredging and removal of wrecks have already been completed at present construction of a new pier for accommodating larger vessels within the inner Port and deepening of the entrance channel and turning area will need additional dredging. Main activities identified under the construction phase that would impact marine environment are; dredging of Port basin; pile driving, rock filling and reclamation while constructing the new pier.

The KKS sea area is a well-known for the uniqueness of its ecological quality. Thus, it is clearly seen that the neighborhood of the project is in this unique ecological zone having a characteristic biological make up. Fringing coral reef is located along the coast of KKS and it is relatively broad and more often extended beyond 2 km into the Palk Bay. The shoreward margin of the reef is touching the limestone shoreline whilst the seaward edge is at a depth of about >20 m. The reef is characterized by presence of stony corals and soft corals. The study revealed that the reef on the eastern side of the Port is in a better condition than the western side may due to lack of influence of wind driven Port born segmentation. The live coral percentage increased towards deeper depths and it was estimated about 30% in some areas. The KKS Port area presently holds higher coral cover because the area is within the high security zone and is often protected passively by the KKS Naval base. However, beyond the security zone, reefs are prone to anthropological disturbance from tourism and local fishing activities

4.2.2.1 Impacts on marine ecology

(a) Construction phase

- **Habitat destruction**

The proposed project envisaged that, except rehabilitation of existing Port structures no any other expansion of the Port basin or the construction of new breakwaters. Thus, neither current patter changes nor physical loss of marine habitat such as damage to intertidal or the sub-tidal area will be expected. However, the construction of a new pier will contain dredging of seabed within the Port basin. Dredging necessarily removes benthic organism from the seabed and increases its depth. With the exception of some mobile surface animals that may survive a dredging event through avoidance, the activity will completely remove all life from the sea floor for a period of time. The recovery rate of the benthic communities will depend on the particular nature of the ecosystem: some ecosystems dominated by opportunistic species may recover in

only a few months, whereas those populated by slow growing, sensitive species may take years, or may never recover.

The construction of new pier is planned at the location (at the entrance of the main breakwater) where the sea bottom mainly consists of a sandy- mud soft bottom field with excessive sedimentation. During the marine ecological survey, it was observed that the productivity of the Port area is quite low and the presence of fish larvae occasionally. The seabed is free of either corals or sea-grasses. Hence, no major impacts will be anticipated on marine ecology due to construction and operation of the proposed project.

Mitigation

The dredging area is lack of productive ecosystems such as coral reefs and seagrass beds and thus dredging would not directly affect productivity of the area and also the benthic communities will quickly re-colonize of the area. Hence mitigation measures are not proposed.

- **Water quality deterioration**

Dredging operations will disturb the seabed, resulting in re-suspension of seabed sediments, generation of a sediment plume and increased turbidity levels in the water column. Losses of fine sediments during dredging works and as a result of overspill of dredger bucket will also contribute to the creation of sediment plumes at the dredging site. In addition to dredging operations, the disposal at sea of the dredged material will generate a sediment plume at the disposal site. Generally, there are limited opportunities to dispose of dredged material for beneficial reuse, such as beach re-nourishment or in reclamation, land disposal is typically too costly and or impracticable which means that marine disposed of locally is often the option of choice. When dredged material is disposed of in the marine environment, it can smother the benthic fauna in the immediate disposal area, as well as lead to disperse over a wider area by the action of waves and currents until eventually resettling on the seabed. Other construction activities such as the rehabilitation of breakwaters and piers will also cause seabed disturbance and re-suspension of sediments. However, the impacts on water quality arising from these operations will be deemed as being of smaller magnitude than those arising from capital dredging operations and disposal, which will disturb the greatest extent and volume of seabed sediments. This impact may occur in a continuous manner over which the dredging operations will take place.

Increase of suspended sediment in the water reduces sunlight penetrating the water column due to increase turbidity and reduces the food production ability of the photosynthesizing plants, as well as behaviour changing of animals due to changes in the physical environment. Increase the suspended solids concentration, will also decrease in dissolved oxygen (DO) level and the increase in nutrient levels in the water column. The high concentration of suspended solid may cause clogging of gills or filaments of the marine organisms, increase energy consumption to expel the sediments by the filter feeding animals.

The high concentration or deposition rate of suspended solid will also form a blanket that smothers the corals and reduce the ability of the associated photosynthesising zooxanthellae to

undertake photosynthesis; coral bleaching will occur or even die if the corals cannot tolerate the stresses. Sediment disturbance will also affect coral recruitment and will impact on other (non-coral) reef-dwelling organisms. Shellfish, which have delicate feeding and breathing apparatus, will affect by increases in sedimentation. Similarly, sediment can become trapped in the gills of young fish causing increased fatalities, and smothering of spawning or nursery areas of fish can result in the death of eggs and larvae. This could potentially reduce the level of recruitment for harvestable fisheries. Further, smothering of intertidal areas may result in decreased availability of food for the birds and fish that feed there.

Generally, bottom sediment of the Port is contaminated; dredged material is subject to some contamination. A variety of harmful substances, including heavy metals, oil, and pesticides, can be effectively 'locked into' the seabed sediments in ports and Ports. These contaminants can often be of historic origin and from distant sources. The dredging and disposal processes can release these contaminants into the water column, making them available to be taken up by animals and plants, may accumulate and transfer up the food chain to fish and sea mammals. The likelihood of this occurring depends upon the type and degree of sediment contamination. However, indirect impact due to changes in water quality is temporary and reversible. The level of SS and DO would return to normal shortly after the construction phase. The contaminants and nutrients would be diluted by a large volume of seawater. The effect would be transient.

Mitigation:

- Choose a suitable time to dredging. Dredging should be undertaken during non- monsoon period and only the mid days within a phase of the new and the full moon days. During these days, the tidal amplitude is the lowest in the particular moon phase. As the water movement is the least, siltation on marine biota can be minimized.
- Choose an advance technology for dredging.
- Selection of disposal sites, disposal methods and requirements for capping are key issues in undertaking disposal at sea. The disposal sites are chosen to ensure that the impacts are isolated to these locations and the plumes are generally localised (Figure 4.1). Thereby disposal should make more in deeper water somewhere > 3 km away from the shore and also fishing activities are minimal. However, grabbing of benthic substratum entails lesser disturbance of mud particles as compared to its disposal at some place away from its original source.It is recommended to dispose the dredged material to the same dumping site used in earlier dredging operation (Figure 4.1).
- Silt curtains, settlement ponds, temporary retaining walls, temporary dry docking and new technologies should be installed and well-maintained to prevent any silt runoff from entering coral reef area. Compliance with these consent conditions should be managed by Port authorities.

Noise impact

Marine mammals and fish are more sensitive to sound. Noise can travel long distances underwater, blanketing large areas, and potentially preventing marine animals from hearing their prey or predators, finding their way, or connecting with mates, group members, or their young once. The project will involve short-term impacts during construction and long-term impacts during operation due to increased noise levels.

However, the review of available literature on fish and marine mammal presence in and around KKS Port and ground-truthed with records of fish schools and marine mammals of the study area, revealed that fish schools could potentially be present, nearer to shore but mammals are not even seldom visitors to the study area and hence predicted to have infrequent interaction with the Project area. As such noise interactions are unlikely to lead to impacts to individuals and even less likely to affect the species at the population level.

Mitigation:

- Restriction of anthropogenic underwater noise to a acceptable level (e.g., limitation of impulsive noise during construction)
- Exclusion of noise generating activities during night time.
- Spatio-temporal exclusion or limitation of noise causing activities
- Usage of alternative techniques with lower sound emissions

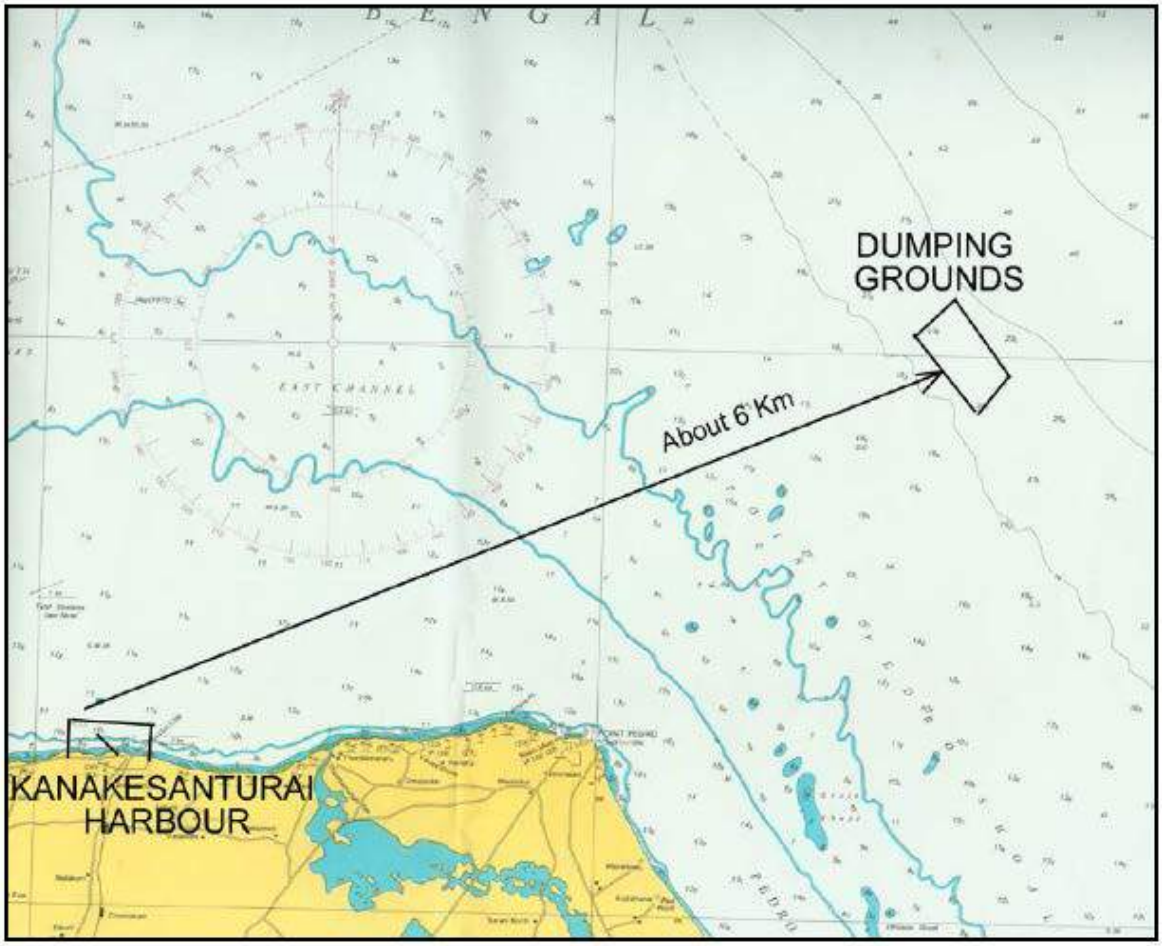


Figure 4.1: Proposed Dumping Grounds.

(b) Operation phase

- **Habitat destruction**

Maintenance dredging usually not involves frequent removal of seabed material and also the amount removed differs considerably depending on the site. The impact of maintenance dredging of the seabed is usually less severe than capital works, because the activity is taking place in an area which has already been disturbed, and the organisms that have recolonised the area are likely to be more resilient. Hence dredging is not expected to lead to significant adverse impacts. Thereby mitigation measures are, not proposed.

- **Water quality deterioration**

Certain elements during the operational phase of the project such as maintenance dredging and vessel and Port operations can also result in impacts on water and sediment quality. Possible discharge from ships that could be sources of water pollution are bilge water, ballast water, oily wastes, sewage, garbage and other residues in ships. Oil spills, lubricants, fuels and other oily liquids may be other sources of water pollution. Once the oil or an oily compound is discharged into water, it is spread on the surface by winds and currents, forming a thin layer. On the surface of the seas, oils can be polymerized gradually by biodegradation and eventually form dense particles which sink.

Run off from raw material storage, spills from bulk cargo handling and windblown dust are possible sources of contamination of water. Toxic or harmful substances may be included in runoff and other raw materials. Organic materials in runoff are decomposed to the inorganic form, spending dissolved oxygen and increasing the nutrient level in the water.

Mitigation

- The MARPOL Convention 1973/78 will be strictly adhered to, all vessels working within the Port and hence there is no chance of oil spills, garbage discharge, etc.
- Information will be available for shipment captains to identify solid waste reception facilities and acceptable handling procedures at the Port. Discharge of solid waste from vessels should be prohibited while the Port is in accordance with MARPOL and national regulations.
- A collection and disposal system should be developed for ship-generated garbage from ships alongside and at anchor.
- Plan for minimizing impacts on local flora and fauna, and screen for the presence of rare, threatened or endangered species that are indigenous to the project location
- Develop a management plan to improve marine water quality in the port area

4.3 Impact to fisheries

(a) Construction phase

No significant direct impact to the fisheries or fisheries resources would be expected during construction phase as the fishing activities are conducted more in deeper waters of the Port area and no important spawning or nursery grounds were identified within or in the vicinity of the proposed marine work area. Indirect impacts of fishery resources due to deterioration of water quality could be minimized by following the proposed mitigation measures (Section 4.2.2.1).

(b) Operation phase

No direct or indirect impact to the fisheries resources would be expected during operation phase. However, the risk of collision of fishing boats under operation with ships and also the damage of fishing gear by sailing over the upper part of fishing gear may occur, as the fishermen are unfamiliar with the shipping lanes, navigational signals etc.

Mitigation:

- Fishing vessels should display the proper lights or signals during the night
- Drifting gear used should mark with luminous buoys during night
- Educate fishermen on navigational signals and shipping lanes

4.4 Impacts due to changes of land use

Proposed rehabilitation works will be carried out along the existing breakwater and hence existing land use pattern surrounding area will remain unchanged. Socio-Economic Aspects

4.4.1 An assessment of direct and indirect impacts of the project on other development projects within the area

There are no other major development projects implemented within 2km radius of the proposed project except ongoing resettlement activities in recently cleared private lands. Some interior roads are being rehabilitated. The proposed project will not create negative impacts on these miner development activities in the area.

The ongoing resettlement activities may get accelerated due to improved port if it is rehabilitated as proposed. The local communities who left the area may get motivated to come back seeking income generation opportunities under the port. This impact can be defined as long term sustainable positive impacts.

The local community and agency stakeholders including district secretary and Divisional secretary assumed KKS cement industry presently neglected may be reinitiated due to the improved port.

4.4.2 Impact on fishing industry and fishing community and the methodologies of operating of fisheries activities in alternative places

The construction activities of the port will be confined to the sea area that is being already used for port related activities. Therefore, the fishermen presently moving through the vicinity of port area to launch their boats for deep sea fishing will not have any negative impacts.

Improved port with adequate business will motivate population left the area to come back and get in to fisheries activities. This trend will be beneficial to Port operators as well as communities in the area.

If the sea area in the vicinity of port boundary is declared as security zone by Navy or other security forces it will create disturbances to the fishermen launching their boats across vicinity of Port area.

4.4.3 Impact to present beach users in the area

KKS port is not a new development project it is an existing port which will be improved within the area used for the present limited port operations. Except Navy other community members are not using the coast near the port. It was the practice of community members even before the civil war. Therefore, community members are not interested or have specific purpose to reach the sea coast near the Port.

At present community members reach the sea coast through existing access roads on left and right sides of the Port area. Any of these access roads will not get disturbed during construction or operation phases of the Port.

4.4.4 Impacts in relocation and loss of livelihood

There will be no requirement to acquire private land for the proposed port rehabilitation project. Some activities will take place in part of the cement cooperation land. It is a public land presently unutilized. The project also will not create any negative impact on the livelihood activities of the local community members.

Improved Port and its relevant industries will attract people who left the area to come back and get resettled. They might have opportunities for income generation activities directly and indirectly during construction and operation phases of the project. Income generation opportunities during operation would create long term impact on the local community. According to the local community the Port prior to civil war had created employment for about 1000 people in the KKS area. Apart from direct employment there had been employment opportunities generated by cement cooperation and Food Department. Similar opportunities are expected by local people during post rehabilitation phase of KKS port. However, they are of the view that priority in employment should be given to local community members residing in J 233 GND and Walikamam DS area.

4.4.5 Details of generate more employment to the local community in the vicinity

The proposed Port rehabilitation project will generate employment opportunities through its activities to be implemented during construction and operation phases. The activities that could generate employment opportunities are mentioned below.

- During construction period of the project – opportunities for local community members to work as skill and un-skilled workers.
- There can be opportunities for capable local community members to provide construction material required for the project during its construction period.
- Employment opportunities for local personals to work as skill and un-skilled workers during operation phase of the port (long term income generation activities)
- Opportunities for employment in industries that would emerge during operation phase of the project.
- Opportunities for local persons to provide food and logging for the workers during construction and operation phases of the project.

4.4.5.1 Proposed mitigatory measures for potential social impacts

The proposed project will not create significant negative impacts due to its construction and operation activities. This is because it is a project design to improve the existing infrastructure in the present Port. The land to be used is government property. This port was operated prior to civil war without significant negative impacts. Therefore, measures required are mainly related to create harmony among port operators, Navy and local communities.

The project developer and Navy should not disturb the present movement of fishermen in their boats launching to other areas of the sea for fishing. The project developer should convince the contractors about the need of providing priority in employment and other income generation opportunities for the local community members during construction and operation phases of the project. A communication system should be worked out to establish close interactions among Navy, Port operators and local community members to resolve issues if emerged during construction and operation phases.

4.5 Impacts on Archeological cultural Resources

There are no historical, archeological and cultural places located within or adjacent area of the port. There had been one Hindu Kovil existed prior to civil war. This Kovil is damaged during war but the land of this religious place has not been used for any other proposes and therefore this land can be used to reconstruct the Kovil if local community members are interested. This Kovil is not much significant historical or archeological place.

4.6 Any other impacts not listed here but may be significant.

Possible conflicts if local community members are not given opportunities to get involved in income generation activities during construction and operation phases of the project. There can be some conflicts between Navy and fisheries communities using sea area close to the port for launching their fishing vessels

5 ENVIRONMENTAL MANAGEMENT PLAN

The EMP is used as a tool for the management of the environmental performance of the project and it is developed and implemented as an important component of project activity. The EMP guides the implementation of Mitigatory Measures and Monitoring throughout the implementation of the project and contributes to the overall process of Project Monitoring and Auditing. The EMP therefore presents a consolidation of the recommendations given in the EIA Report, including specific recommendations for environmental mitigation, monitoring and management. In particular it specifies the mechanisms for the implementation of the mitigatory measures and for monitoring.

This EMP is developed as a part of project preparation activity. However, prior to commencement of the construction activities it has to be updated fully in consultation with the Environmental Monitoring Committee (EMC) and the Contractor. Discussions with the Contractor(s) are critical because the EMP is part of the relevant contract.

5.1 Implementation of Mitigatory Measures

With respect to Mitigatory Measures (as described in Chapter 4 and summarized in Table 5.1), the EMP sets out the mechanisms for the implementation of such measures for which prior agreement has to be reached between the Contractor and the Project Proponent (PP). The agreement is required in view of the EMP being part of the contract. Therefore the EMP will be used as means by which the Contractor (and any Sub Contractors) will implement the recommended mitigation measures and achieve the environmental performance standards defined and recommended in Sri Lankan environmental legislation, in the EIA and in the Contract. The primary reason for adopting the EMP approach is to make all parties including the Contractor aware of environmental responsibilities and to be proactive in his commitment to achieve the standards specified.

5.2 Implementation of Monitoring Procedures

With respect to Monitoring Procedures, the EMP has set out the relevant mechanisms and institutional arrangements to achieve the objectives of Environmental Monitoring through the Environmental Monitoring Program. As the EMP will form part of the contract there will be provisions to ensure that the Contractor fulfils his obligations regarding the implementation of mitigation measures. It is recommended that the Coast Conservation and Coastal Resources Management Department appoints specialist(s) from the EMC to independently verify that the measures are implemented correctly and efficiently as part of third party verification. This arrangement will fully satisfy the requirement of Compliance Monitoring.

5.2.1 Institutional Arrangements for Environmental Monitoring

It is recommended that an Environmental Monitoring Committee (EMC) be appointed to oversee the implementation of the Monitoring Plan. A well-structured programme will ensure both Compliance and Impact Confirmation Monitoring to high degree of efficiency.

All relevant line agencies, local government bodies and interested parties shall take part in the monitoring activities. An Environmental Monitoring Committee consisting of the members from the following agencies shall be set up by the Coast Conservation and Coastal Resources Management.

- Coast Conservation and Coastal Resources Management Department (in the Chair)
- Central Environmental Authority
- National Aquatic Resources Research and Development Agency
- Marine Environment Protection Authority
- Department of Fisheries
- Sri Lanka Navy
- Office of the District Secretary
- Office of the Divisional Secretary
- Local Authority / Pradesiya Sabah of the area
- Department of Archaeology
- Project proponent; Sri Lanka Ports Authority

The EMC should also include representatives from the Contractor(s).

The EMC shall have regular meetings in order to review the monitoring results. In areas of potential conflict, the EMC will have responsibility to resolve such issues.

It is recognized that Compliance Monitoring and Impact Confirmation Monitoring are required to ensure that the project includes the satisfactory implementation of the EIA recommendations and to confirm that no potential adverse impacts have been excluded from the assessment process. The EIA team believes that the wider participation of all stakeholders is important to achieve this objective. For this purpose it is important to develop and implement a formal mechanism for such participation and dissemination of information to the general public. If necessary, technical assistance should be provided for adequate understanding of project interactions with the environmental components and mitigatory actions.

Arising from such activity, the EMC in consultation with the Contractor(s) should develop a mechanism to manage, investigate, respond and act upon, any issues raised by the public during construction.

5.2.2 Environmental Monitoring Programme (EMoP)

Table 5.2 shows the summery of the Environmental Monitoring Plan.

Table 5.1: Summary of Anticipated Significant Impacts and Proposed Mitigation Measures

No	Impact	Proposed Mitigation Measures		
		Pre-construction phase	Construction Phase	Operation Phase
1	Water quality degradation arising from dredging and disposal of dredged material	• Sampling and analysis of sediment quality before dredging • Careful selection of disposal area	• Use modern dredging techniques (Tailor Suction Hopper Dredger is recommended) • Proper maintenance of dredging equipment to avoid leakages • Careful schedule (timing) of construction activities with consideration of local hydrographic and seasonal conditions. • Monitor prescribed environmental parameters	Undertake mitigation measures proposed in construction stage during maintenance dredging works.
2	Disturbance to fishing activities cause by ship traffic	• Sampling and analysis of catch rates before construction • Analysis of fishing gear losses and sea accidents	• Mitigation measures not proposed because significant impact would not expected	• Display proper light signals onboard the fishing vessel during the night • Drifting gear should mark with luminous buoys during night • Educate fishermen on navigational signals and shipping lanes
3	Air Quality degradation: Increased Air emissions (SO2, NOx, HC ect.,) due to vehicle movements.	Proper emission tested vehicles (licensed) shall be used for the operations.		
			Periodical sampling and analysis of air quality around the construction site.	Periodical sampling and analysis of air quality around the facility.
	Air Quality degradation: Increase in dust (PM10, PM2.5) during construction and haulage trucks during	Propose less dust generating construction methods.	• Sprinkle water on roads to reduce dust • Monitor environmental parameters prescribed in this report • Provide suitable Personal Protective Equipment	Periodical sampling and analysis of air quality around the facility.

	operation.			
4	Noise and Vibration are produced by most construction activities. Noise can affect quality of life; vibration can cause structural damage. The major noise generating sources are movement of vehicles, construction equipment, operation of vessels/boats/ships and operation of Standby Generators.	Baseline survey: Monitor structural condition of at risk buildings & structures near construction sites.	Noise levels at the boundaries of the Project site will be maintained during construction phase to the levels stipulated in Schedule III of the National Environmental (Noise Control) Regulations No. 1 of 1996 by applying appropriate mitigatory measures. In order to control vibration impacts due to blasting activities, it is recommended that all blasting work will be carried out in controlled manner and explosive loads will be based on investigation of effects of vibration on nearby structures and limits decided thereby.	If generators are to be used these shall be housed in a building with ventilation to avoid noise especially to the nearby sensitive receptors.
5	Waste/ Garbage disposal		Solid wastes generated in labour camps will be collected separately using correctly marked containers (eg. Organic waste, Plastic, Paper, and Glass etc.) and disposed off in an acceptable manner to designated places for such disposals.	Solid wastes generated in during operation will be collected separately using correctly marked containers (eg. Organic waste, Plastic, Paper, and Glass etc.) and disposed off in an acceptable manner to designated places for such disposals.
6	Waste / Sewarage disposal		• Adequate number of toilets will be provided at worksites; • All toilets will have septic tanks / soakage pits of adequate capacity so that it can function properly for the entire duration of construction phase. • Training of construction employees on Project sanitation practices.	

Table 5.2: Environmental Monitoring Programme (EMoP)

No	Parameter To Be Monitored	Monitoring Location	Frequency of Monitoring		Relevant Standard
			Baseline	Impact	
1. Air Quality	Ambient Air Quality: Hourly Levels of TPS, NO2, SO2 and CO in ppm. 24 hourly average of PM10 in mg/m3	Near Sensitive Receptors.	One at beginning of the project.	Monthly during construction. Annually for two years after commissioning.	
2. Noise	**Noise** - 03 times during a day (Morning, Evening & Night). dB (A)	Near Sensitive Receptors.	One at beginning of the project	Monthly during construction. Annually for two years after commissioning	Schedule III of the National Environmental (Noise Control) Regulations No. 1 of 1996
3. Vibration	**Ground Vibration** Period of 24 hours in stops of 15 minutes;	Near Sensitive Receptors.	One at beginning of the project	Monthly during construction. Annually for two years after commissioning	
4. Water Quality	**Water Quality –** Concentration levels of suspended sediments; Dissolved oxygen concentration	Selected locations around construction site;	One at beginning of the project	Monthly during construction. Annually for two years after commissioning	
	Bacteriological Parameters – Total Coliform & Faecal Coliforms			End of the construction period	
	NO_3^--N , NO_2^-N, PO_4^{3-}-P , SiO_4^{4-}-Si , Chlorophyll-a, oil			Annually	
	Fecal Coliform Survey			Monthly	

6 CONCLUSION AND RECOMMENDATIONS

Only the Breakwater and Pier rehabilitation and construction of a new jetty at the rear side of the breakwater will be done under this project. Therefore, no significant impacts have been identified for the existing physical environment. Further, the proposed modification will enhance the port operational activities up to the international level. Hence, the project can be considered as a viable project in a physical environmental perspective.

Except the turtle nesting site no other site of conservation importance was identified in the Study Area. Overall the terrestrial habitats in the area have very low ecological value. No faunal or floral species of conservation importance or uncommon were recorded. Further, no nursery breeding, foraging or roosting sites were recorded in the Project footprint and thus only minor impact is expected.

Although no construction would take place within the turtle nesting site or the surrounding habitat it can be subject to indirect impacts such as lighting, and noise both during construction and operation phases. Thus, implementation of the proposed mitigation measures would utmost important.

In the marine environment the impact caused by the construction of a new pier may be magnified by the filling and construction works carried out in adjacent areas at the same time and releasing a great amount of suspended matter. For this reason, it is important to take all the mitigation measures to prevent transporting of suspended solids further away from the Port as much as possible.

All impact mitigation and control measures proposed herein are reliable and effective and should be taken during the construction and operation period and thereby the proposed project will just have insignificant impact on biological environment. To sum up, the construction of the proposed project is viable from the perspective of environmental protection.

The proposed project is not a new construction. Therefore, it activities will be confined to the existing port. There will be no private land acquisition, evacuation of people or negative impacts on livelihood activities. Project will generate tangible benefits to the local community. Rehabilitation of KKS port is one of the priority development needs in Jaffna according to the District Secretary and all other representatives of government agencies. Therefore, this project can be defined as socially feasible economic Endeavour proposed for Jaffna district.

Annex I

Terms of Reference (TOR)

SECTION 6 - Terms of Reference (TOR)

INTRODUCTION

The Government of Sri Lanka has decided to rehabilitate the Port of KKS. The Project consists of rehabilitation of the existing 1400 m long breakwater in the same location and in same orientation and to construct two jetties along the breakwater. The proposed development activities are needed to implement with precautionary measures to minimize the environmental impact and pollution. Accordingly, an EIA study for rehabilitation of port of KKS is planned to be carried out.

TERMS OF REFERENCE FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED REHABILITATION OF PORT OF KANKASANTHURAI IN JAFFNA DISTRICT

(Under the Coast Conservation & Coastal Resource Management Act No 57 of 1981)

Project Title	-	Proposed Rehabilitation of Port of Kankasanthurai in Jaffna District
Project Proponent	-	Sri Lanka Ports Authority No 19 Chaithya Road Colombo 01
Project Location	-	Port of Kankasanthurai, Jaffna
Project Approving Agency	-	Coast Conservation & Coastal Resource Management Department

Validity

This Terms of Reference is valid only for one and half year period from the date of issues. The Environmental Impact Assessment report should be submitted within the validity period.

Out Line of the EIA Report

- Executive summary

Chapter 1 Introduction
Chapter 2 Description of the project
Chapter 3 Description of the existing Environment of the study area
Chapter 4 Assessment of anticipated environmental impacts
Chapter 5 Proposed Mitigatory measures
Chapter 6 Environmental Monitoring Plan
Chapter 7 Evaluation of Environmental Cost Benefits
Chapter 8 Conclusion and recommendation

Annexure

- Terms of Reference
- Reference
- Persons responsible for the study including their work allocations (report should be authenticated by preparers)
- List of work plan, budget time schedules complete set of relevant maps, tables charts, lay out plans and other details.
- List of consultants, acceptance with the signatures
- And any other supporting annexures required for the main report

Language of the Report

The Final report shall be delivered in all the three languages as English, Sinhala and Tamil as stated in the section 8 of the TOR deliverables and reporting.

Executive Summary

This should be a brief and non-technical summary of the vital features of the report including proposal in a very brief description of its nature, size and location of the project and its importance to the country, description of environment including physical, ecological resources, environment impacts and proposed mitigatory measures. Further summary should also mention about how this project fits into overall national industrial development plan and its expected contribution to national economy.

01 INTRODUCTION

This chapter should include following

1. **Main objectives of the proposed project**

2. **Justification of the project**
   This section should be present the case for justification for implementation of the proposal. Comparison of the social and economical status of the community before the project and after the project should be presented with clear indicators of growth and benefits. Complementary benefits to fisheries as well as national economy created by the project has to be analyze more

3. **Objectives of the EIA report**

4. **Aim and scope of the EIA study**
   The purpose of calling for an EIA report, concerns of project approving agencies and the scope within which EIA report which is expected to assess the environmental impacts should be elaborated in this section for the benefit of general public and other readers. Any limitations or any constraints experienced in complying with the Terms of Reference to this EIA should be stated in this section
   It should be noted that the study area proposed for the EIA study should cover the project site, an area extending up to 500m periphery from the boundary of the port and 02 km on either sides on coastal belt and 1 km toward sea from the boundary of the project site.

5. Brief outline of the Methodologies and Technologies adopted in EIA report preparation

6. Main Beneficiaries
7. Policy legal and administrative frame work with reference to the project
8. Compatibility with other development projects/programs/plans in the area, specially with the government development plan of the area including
9. Conformity to Coastal Resources Management Plan
10. Contingency plan of Marine Environmental Protection Authority and any other conservation/development plant

11. **Approvals and permits required to implement the proposed project**
State all the approvals required for implementing the project and any permits required to be obtained. Furthermore, any initial clearances or consents given by any authority should also be stated here (please include copies of approvals in the annexure. Clearance obtained or should be obtained from relevant agencies including Ministry of Defense, Geological Survey and Mines Bureau, Marine Environmental Protection Authority; Land Commissioner General's Department should be mentioned here.

12 Environmental requirements of donor agencies.

02 DESCRIPTION OF THE PROJECT

This Section should describe details of the proposed project under following section.
The project description should include information about the project at a degree of detail comparable to that obtained for feasibility level reports with necessary maps/charts.

2.1 The details of the existing port

2.2 A location map of reasonable scale (1:10,000 scale is preferred) indicating the project site, accessibility to the site, surrounding developments, land use and infrastructure facilities

2.3 Description of the project including major components, size and magnitude of each component with permanent and temporary structures including
Details of Breakwaters, quay wall, jetties, port basin, entrance canal with justification of geometric features (levels, beam widen etc.)
- Summary of designed features
- Details of shore line facilities such as loading and unloading areas, Storage, refueling details of other infrastructure facilities
- Details of Dredging and Reclamation

2.4 **Detailed drawings (drawings** to be provided) indicating all project components indicating breakwaters, jetties, quay walls, port basin, entrance canal, proposed dredging areas and dumping sites, access roads to the site, reservation etc. in order to get a clear picture of the project (Sale

2.5 Details of Construction and Operational Activities under following aspects

2.5.1 Details of the methodologies to be adopted during the construction.
This section is expected to give details of all major construction activities planed including the following:

- The Details on pre-construction including land clearing, excavations, dredging, earth moving, filling, construction of access, other facilities and equipments to be used.
  Sources of construction materials and transportation. Traffic Management plan Description of sources of construction materials (eg. Armor rocks) and mode of transportation, location of stock piling capacity of access, frequency of transportation. Traffic Management plan.
- Techniques and equipment to be used.
- Method of material / equipment transport and installations
- Other construction activities, including temporary structures and drainage network/plan etc.
- Construction activities related to resettlement sites if any and infrastructure developments (if any)
- Waste treatment sites. Disposal of construction debris and solid waste.
- Details of staffing, labour requirement during construction.
- Occupational health and safety.
- Time schedule for the development and construction.

2.5.2 Infrastructure facilities required / provided

(i) Details of Infrastructure facilities provided by the project

(ii) Electricity requirements / Electricity Supply during construction and operation stages separately

- Source
- Availability
- Alternative source

Proofing document from the Ceylon Electricity Board regarding the supply of electricity for the development.

(iii) Details of Access / parking facilities

- Availability of access roads
- Details of any access road to be built/improved (existing condition and anticipated improvement)
- Beach Access

(iv) Communication

(v) Infrastructure facilities provided by the project to the community and other benefits to the local community

2.5.3 Water Requirement (Constructional and Operational Phase)

Water requirements / Water Supply system

- Amount (m^3 / d) / source of water required for the project
  -Construction stage
  -Operation stage
- If extraction of surface water is envisaged, submit the approval obtained from the relevant Divisional Secretariat Office / Department of Irrigation
- If extraction of ground water is envisaged, provide a report from the Water Resources Board / National Water Supply & Drainage Board. This report should include the availability, quality of ground water and safe extraction limits

2.5.4 Waste water (Constructional and operational Phase)

- Type of effluents
- Quantity and quality of waste water to be generated
- Arrangements for disposal of sewage (both during construction and operation)
- Proposed method of treatment and disposal of waste water
- Provide a conceptual plans of waste water treatment methodology with details
- Final point of discharge of treated waste water methodology according to the National standards

2.5.5 Solid Waste

- Type and quantities of solid waste generated
- Proposed method of disposal of solid waste
- Locations identified for temporary collection
- Proposed sites of disposal
- Sludge disposal method
- Disposal of construction waste
- If solid waste is disposed through the local authority system, provide the agreement between the relevant Local Authority and the project proponent
- Any attempts for reduce, recycle or reuse of solid waste

2.5.6 Requirement of labour during construction and operation period

- Availability of labour, labour requirement
- Proposed employment of local people during construction and operation

2.6 Operatinn and Maintenance

Description of the methodologies to be adopted during operation and long term maintenance of major components including

- Replacement of water and sources
- Proposed methods to be adopted on sewage and solid waste discharges
- Waste Oil reception facilities to be employed
- Details pertaining to maintenance dredging

2.7 Details of land ownership of the project (state / private / other specify)

- If state owned, letter of consent of the release of the land from the relevant stage agency
- If private owned, letter of consent of the release of the land, present status of acquisition procedure and approvals

2.8 Financial Commitments

Financial commitments to proposed project should be mentioned and fund availability for migratory measures and compensation should be stated. Improvements to the social infrastructure in the vicinity if proposed their financial commitments too are expected to be indicated in this section.

2.9 Future expansion

Any future additions, expansion envisaged, if so give details.

2.10 Evaluation of Alternatives

This section should briefly state the basic environmental, engineering and economic parameters and criteria used in the investigation and evaluation of site alternatives. Compare alternatives in terms of potential environmental impacts, mitigatory measures, capital and operating costs, reliability, etc. the probable adverse impacts for each alternative site should be summarized. State the criteria for elimination of other alternatives and selection of the proposed site.

The following Alternatives shall be described

- No action alternative
- Alternative site's
- Alternative scales, design, technology and construction techniques.

Comparison of the alternatives considered and recommendations should be given.

03 DESCRIPTION OF THE EXISTING ENVIRONMENT OF STUDY AREA:

This Chapter should provide information on physical features, ecological, socio economic, archaeological and cultural aspects of environment likely to be affected by the proposed project during the construction or operational phases

The information should be presented in a comprehensive format using tables, maps and diagrams. The methods used to collect data should be clearly stated under each category. Any technical terms used should be defined. The existing environment should be described under the following. following details should be provided for the study area.

Study area

a) Project site

b) Area beyond the project site where there is potential for environmental impacts due to the project

The boundary for describing existing environment (physical and ecologically) should cover the **project site, an area extending up to 500m periphery from the boundary of the port and 02 km on either sides on coastal belt and 1 km toward sea from the boundary of the project site.** Assemble evaluate and present baseline data on following environmental characteristics of the study area.

3.1 Physical Features

3.1.1 Topography and Drainage/Geology/Soil

Information of the project site should be provided to the extent to understand the topographical aspects of the area and most recent topographical map clearly indicating drainage channels, water bodies, marshy area, lime stone rocky area, adjacent land areas at a suitable scale.

3.1.2 Geology / Soil

- General geology and bathymetry of the area and unique geological features of the area
- Soil types / soil profile and distribution
- **Present land use of the area**
  - Present land use of the study are (provide land use map indicating, water bodies, marshy area, lime stone rocky area, drainage canals, access roads, archeological/cultural important area)
  - Zoning (if any)
  - Other development projects envisaged in the area.

3.1.3 Hydrology

- Surface water bodies and surface drainage pattern of the area
- Quality and present uses of surface water
- Ground water levels, quality and present uses of ground water
- Whether the area is subjected for flooding and level of flooding
- Areas inundated by such floods (if any)

3.1.4 Coastal Features (Environment)

- Coastal bathymetry and sediment transportation
- Coastal features including beach profile
- Beach and near shore sea bed characteristics
- Relevant oceanographic information including near shore wave height and direction, near shore current velocity, tidal and current characteristics
- Coastal erosion possibilities and coastal erosion records of last ten years
- Prior action which is taken to cope with any severe erosion
- Coastal structures, coastal protection system
- Coastal water quality
- Details of coastal hazard events in the past Tsunamis, cyclones, storm surges etc. in the region

3.2 Noise Inventory of existing noise sources and noise levels, noise standards

3.3 Ecological Environment

i. Land Based Ecological Environment

- Detail of existing natural habitats/ecosystems/coastal vegetation
- List of rare, threatened, endemic flora and fauna within the project site and surrounding area
- Classification and mapping of all habitats
- A report on their ecological statuses within the area
- Distribution pattern of vegetation along the coastal area

ii. Aquatic Ecological Environment

Details of the coastal environment including coastal and marine habitats, such as coral reef, sand stone reef/lime stone rocks, sea grass beds, fishing grounds, breeding grounds, fishing activities and interactions with coastal protection structures.
Affected fishing grounds due to propose project should be addressed.

3.4 Historical and Archeological significant sites

- Describe any land marks or evidence of historic, religious, archeological, scientific or cultural importance known to be within the project area and the study site.
- States of their conservation programs (if any)
- Approval obtained from the Archeological Department.

3.5 Social and Economic Aspects

The section will cover all the areas that may have impacts by the projects and it is activities.

- Brief socio-economic profile of the area
- Nature of households and principle economic activities
- Existing infrastructure facilities
- Description of existing fishing activities in the area including type of fishing activities, no of fishermen, number of fishing crafts etc.
- Transportation, communication, power
- Housing, sanitation, water supply, agriculture
- Other main economic activities
- Existing beach access

3.6 Detail of Disaster

Presently experienced disasters and their frequency

3.7 Existing Environmental Issues and Social Conflicts

4. ASSESSMENT OF ANTICIPATED ENVIRONMENTAL IMPACTS

This chapter should show the overall effects of the project on the individual environmental components. Impacts should include the direct and indirect, long and short-term positive and negative effects. Significance of impacts should be assessed using appropriate techniques. When describing the impacts, indicate which are irreversible or unavoidable and which can be mitigated to the extent possible. Impacts should be discussed in the order of severity.

Impacts shall include project – environment interactions (impacts of the project activities on the environment) and environment – project interactions (impacts of the environment on project activities).

Special attention should be given to following aspects:

4.1 Physical Resources

Impacts to the beach and shoreline

- Erosion of adjacent beaches lands due to change of current wave height regimes attributed to the port structures.
- Erosion effects in either sides of the coastal stretch during construction period as well as in long term.
- Coastal erosion / accretion and bathymetric changes (on either sides of the port breakwaters) in the area.
- Changes in drainage patterns.
- Changes in hydrological pattern such as currents and wave patterns, wave height and direction, near shore current velocity, direction and tides.
- Changes Sediment transport patterns on both periods (short term and long term)
- Impacts on sewage or waste water, solid disposal, waste oil spills, surface runoff on coastal environmental and coastal waters.
- Impacts on water quality
- Impacts due to coastal hazard events -- tsunami, cyclones, storm surges etc. in the area and sea level rise.

4.2 Transportation of materials

Impacts on buildings, roads and other properties during transportation of material from the source location to the construction site.

4.3 Handling and stock piling of materials

- Impacts of material handling stock piling at the site or in the vicinity

4.4 Impacts of sewage, waste oil spills, surface runoff, waste water disposal on the environment

4.5 Anticipated problems related to solid waste disposal

4.6 Ecological Resources (Land based and Marine)

Impacts on fauna and flora and their distribution

- Impacts on vegetation in the coastal belt and special habitats/ecosystems including coral reef in the study area
- Impacts to any rare, threatened, endemic flora and fauna in the study area

4.7 Impacts related to noise, vibration, dust, and air quality generation.

4.8 Impacts due to changes of land use

4.9 Socio-Economic Aspects

- An assessment of direct and indirect impacts of the project on other development project within the area
- Impact on fishing industry and fishing community (during construction and operation) and the methodologies of operating of fisheries activities in alternative places.
  Impacts to present beach users in the area
- Impacts in relocation and loss of livelihood
- Details on generate more employment to the local community in the vicinity

4.10 Impacts on Archeological Cultural Resources
Potential impacts which may effect to the qualities and value of any archaeological cultural resources should be discussed.

4.11 Any other impacts not listed here but may be significant.

5. PROPOSED MITIGATION MEASURES

This chapter should set out the proposed measures to minimize the impacts identified in Chapter 4 to acceptable levels including conformity to Sri Lankan standards. In Chapter 5 mitigation measures should be given in the same order the impacts appeared in the Chapter 4. Alternative methods of mitigation should be discussed and the effectiveness of the proposed measures that are to be provided should be stated. Mitigation methods should be defined in specific practical terms. A rationale should also be presented for selection of chosen mitigatory measures.

6. ENVIRONMENTAL MANAGEMENT PLAN

An Environmental Management Plan (EMP) should be submitted including the followings:

i) A summary of the anticipated significant adverse environmental impacts together with the mitigation measures for each anticipated significant adverse environmental impacts.

ii) Monitoring plan including.
   a) Parameters to be monitored
   b) Proposed locations of sampling points
   c) Frequency of monitoring
   d) Responsible agency - agencies
   e) Facilities available with such agencies
   f) Availability of funds, expertise and facilities

iii) Implementation arrangement including:
   a) Implementation schedule of the impact mitigation plan showing, lining and co-ordination with overall project implementation.
   b) Institutional framework, namely who is responsible for carrying out the mitigation and monitoring.
   c) Capital and recurrent costs to implement mitigation and monitoring measures described above. Identify the availability of source of funds to implement the mitigation measures.

7. CONCLUSION AND RECOMMENDATIONS

The environmental acceptability of the proposed project and key findings and recommendations of the assessment should be given. Any programme to improve general environmental conditions can also be stated here.

8. REPORTS AND DELIVERABLES

The deliverables of the report with the content and Time frame are as follows:

Name of Report	Contents	Time Frame	Language
Inception Report and the presentation for the same	Work plan, review of the TOR and identify missing information and forward the draft plan of study	Three Weeks after conformation	English
Draft Final Report and the presentation for the same	Report on total of TOR including SLPA and stakeholders comments for the inception report	eight weeks after submission of the Inception report incorporating SLPA and stakeholders comments	English
Final Report and the presentation for the same	Report on total of TOR including SLPA,CC&CRM &stake holders comments for the Draft Final Report	four weeks after submission draft final report incorporating SLPA and stakeholders comments	Enlish
Final Report in Sinhala and Tamil language	Report on total of TOR including SLPA,CC&CRM & stake holders comments for the Final Report (In English) shall be translated to Sinhala and Tamil Language	Two weeks after submission Final report in English	Sinhala and Tamil
Final Report	Report incorporating SLPA, CC &CRM and stakeholders and Public comments		English, Sinhala and Tamil

SECTION 7 - Standard Form of Contract

This CONTRACT (hereinafter called the "Contract") is made the [day] day of the month of [month], [year], between, on the one hand, [name of client] (hereinafter called the "Client") and, on the other hand, [name of Consultant] (hereinafter called the "Consultant").

[Note: If the Consultant consist of more than one entity, the above should be partially amended to read as follows: "...(hereinafter called the "Client") and, on the other hand, a joint venture/consortium/association consisting of the following entities, each of which will be jointly and severally liable to the Client for all the Consultant's obligations under this Contract, namely, [name of Consultant] and [name of Consultant] (hereinafter called the "Consultant")."

WHEREAS

(a) the Client has requested the Consultant to provide certain consulting services as defined in this Contract (hereinafter called the "Services");

(b) the Consultant, having represented to the Client that it has the requiredprofessional skills, and personnel and technical resources, has agreed toprovide the Services on the terms and conditions set forth in this Contract;

NOW THEREFORE the parties hereto hereby agree as follows.

1. The following documents attached hereto shall be deemed to form an integral part of this Contract:

(a) The General Conditions of Contract;
(b) The Special Conditions of Contract;
(c) The following Appendices:

Appendix A: Description of Services
Appendix B: Reporting Requirements
Appendix C: Consultant & Key Personnel Expectances
Appendix D: Breakdown of Contract Price
Appendix E: Services and Facilities provided by the Client
Appendix F: The Layout of the KKS Harbour

The mutual rights and obligations of the Client and the Consultant shall be as set forth in the Contract, in particular:

(a) The Consultants shall carry out the Services in accordance with the provisions of the Contract; and
(b) The Client shall make payments todte Consultants inaccordance with the provisions of the Contract.

Annex II

Detail Designs of Marine Structures

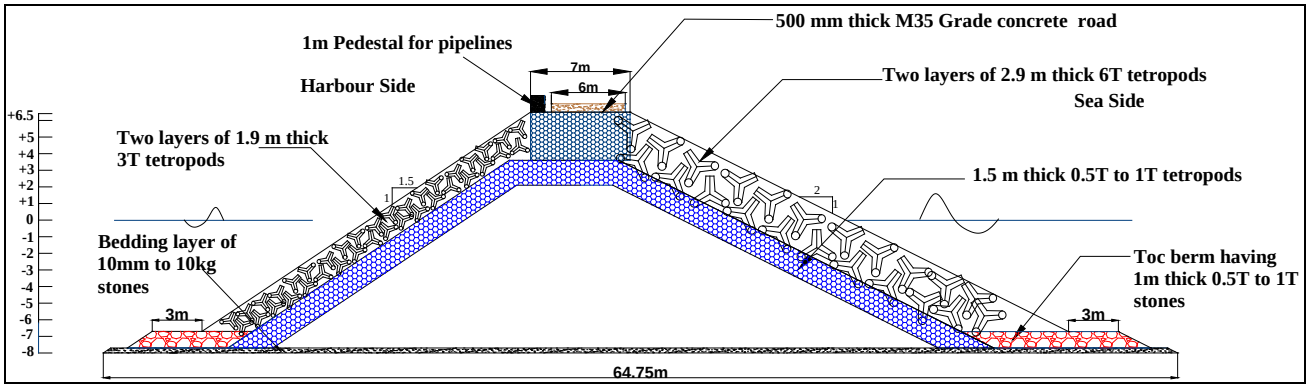


Fig 5.1 Typical breakwater trunk section for water depth of 5m to 8m

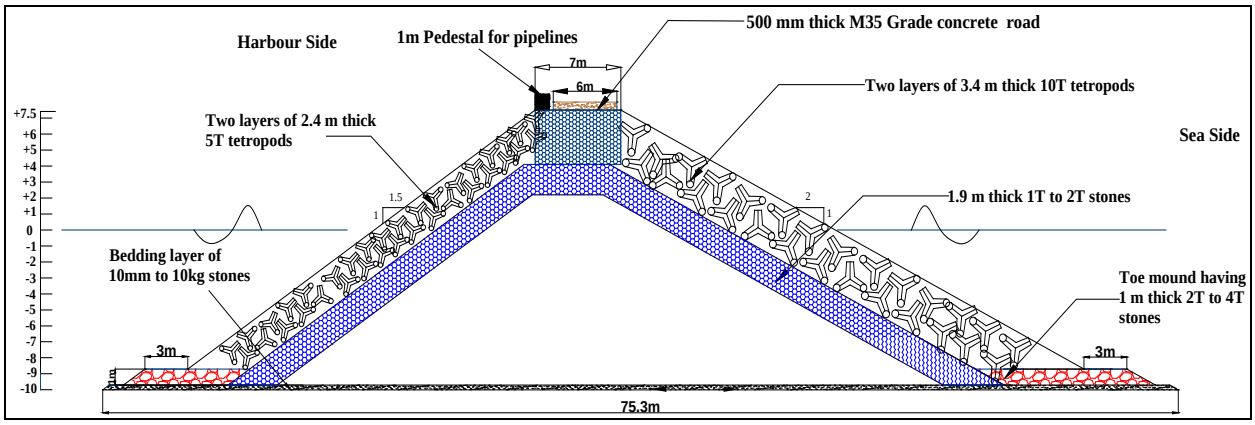


Fig 5.2 Typical breakwater trunk section for water depth of 8m to 10m

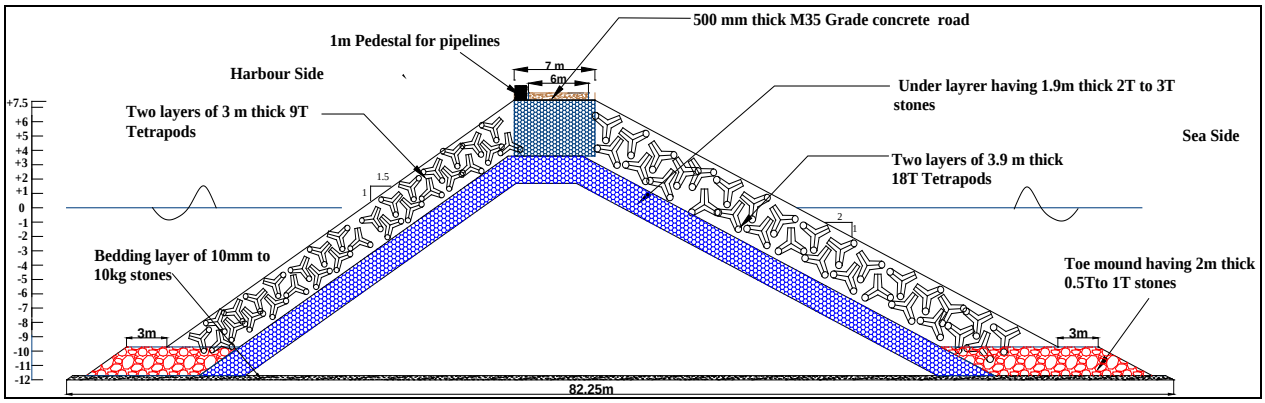


Fig 5.3 Typical breakwater trunk section for water depth of 10m to 12m

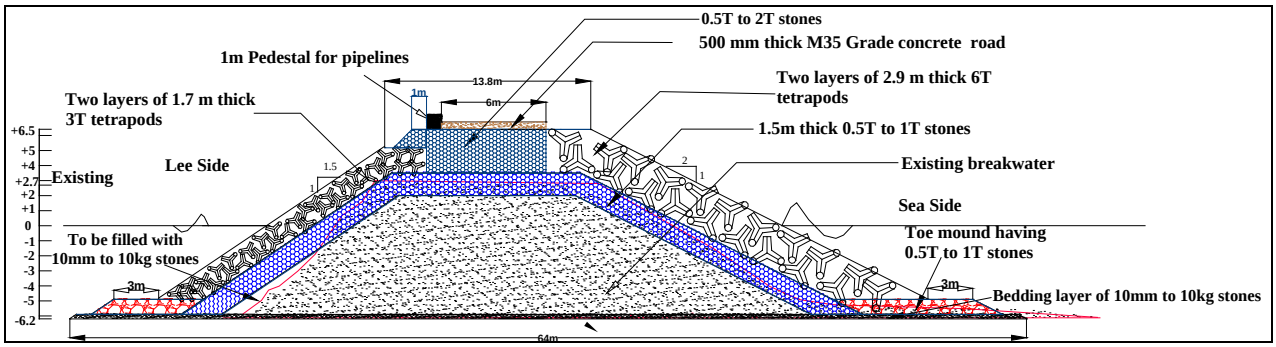


Fig 5.4 Cross section at 0 m chainage

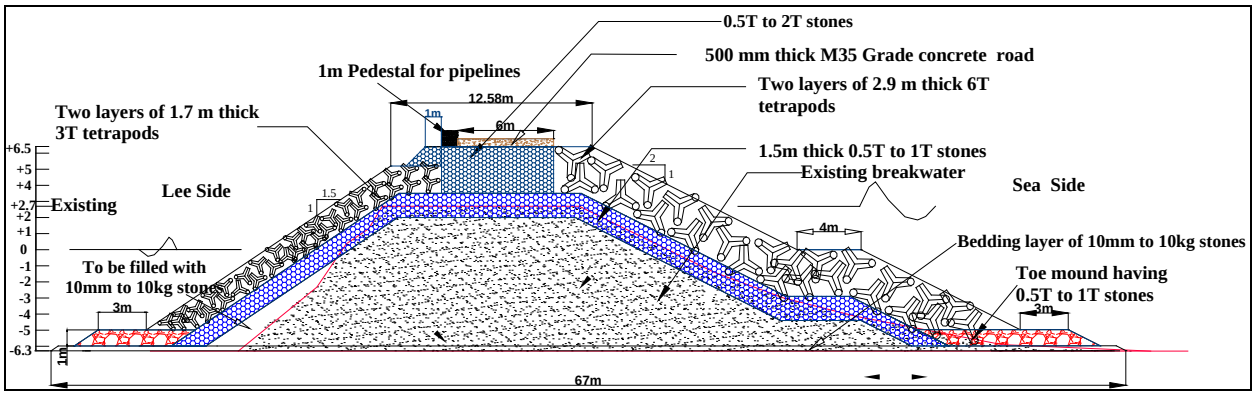


Fig 5.5 Cross section at 10 m chainage

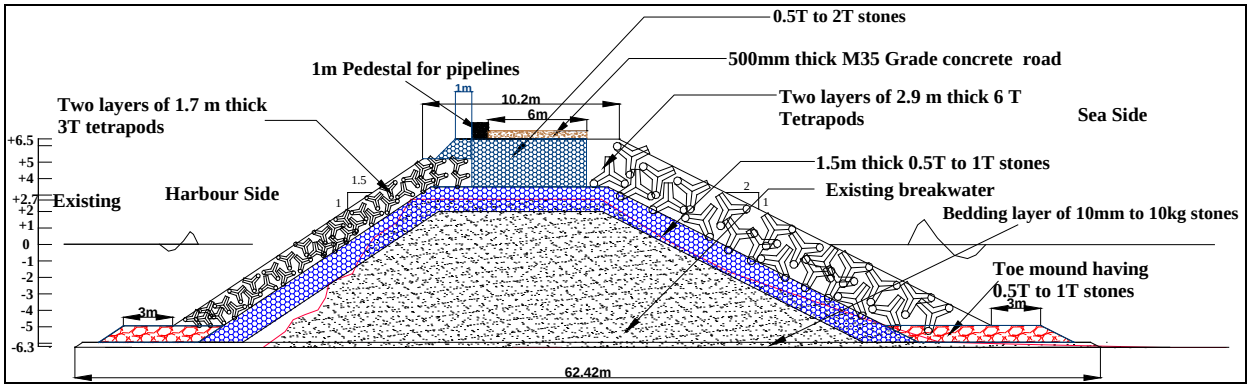


Fig 5.6 Cross section at 20 m chainage

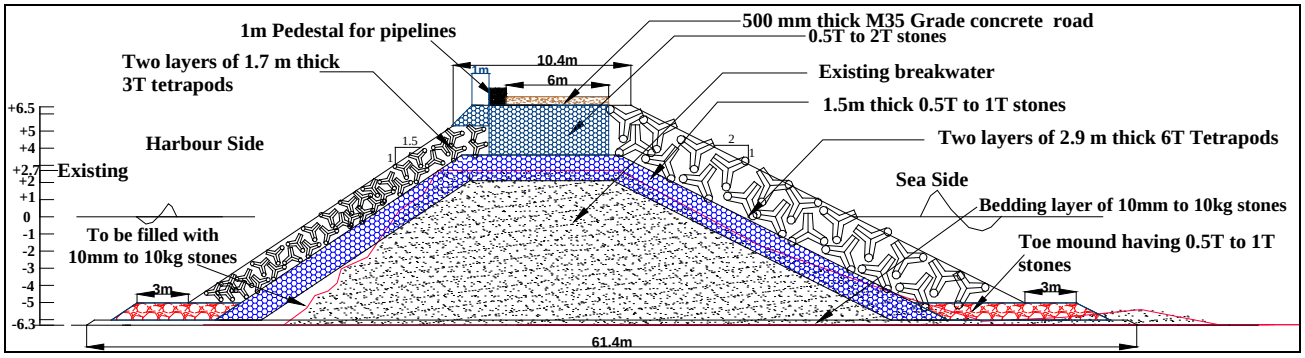


Fig 5.7 Cross section at 30 m chainage

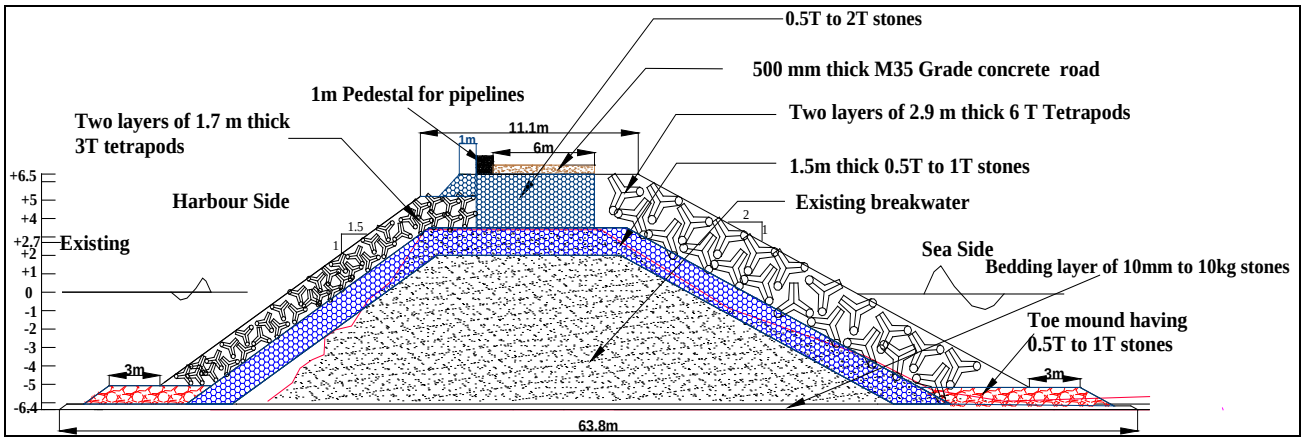


Fig 5.8 Cross section at 40 m chainage

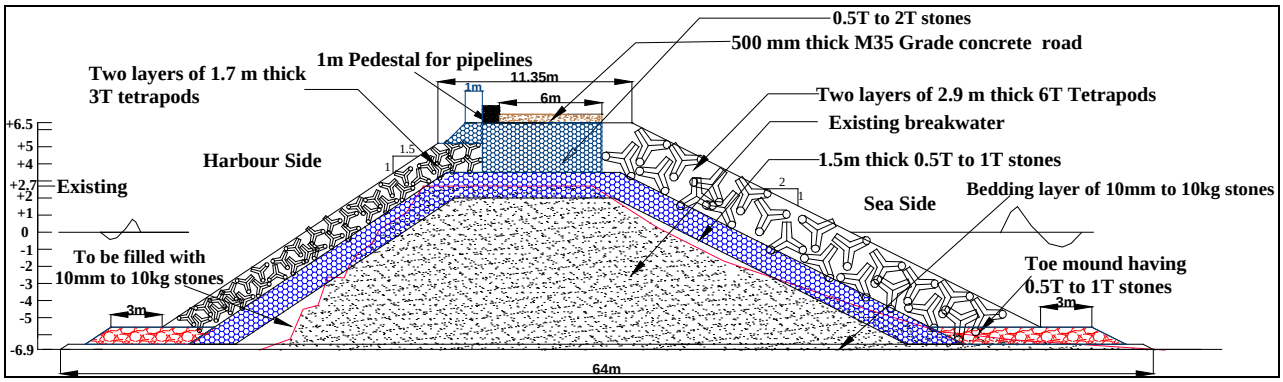


Fig 5.9 Cross section at 50 m chainage

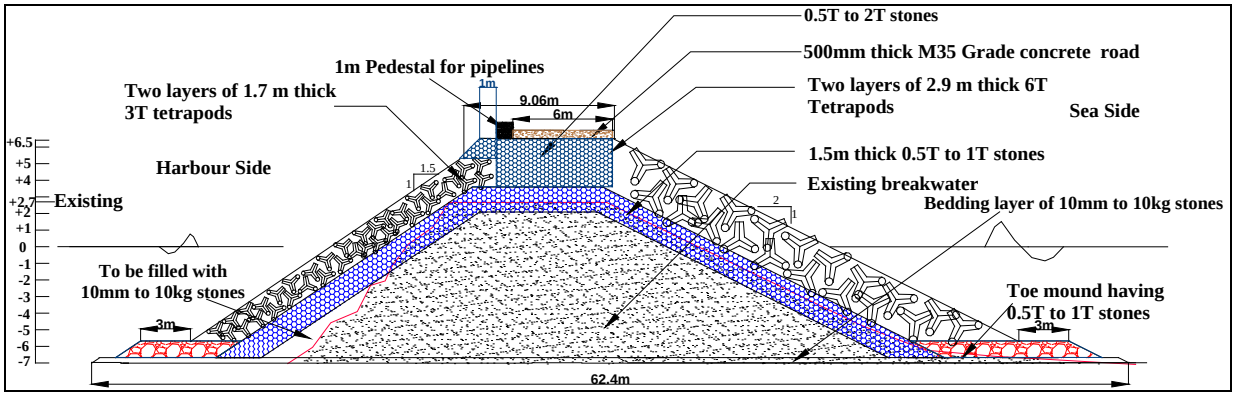


Fig 5.10 Cross section at 60 m chainage

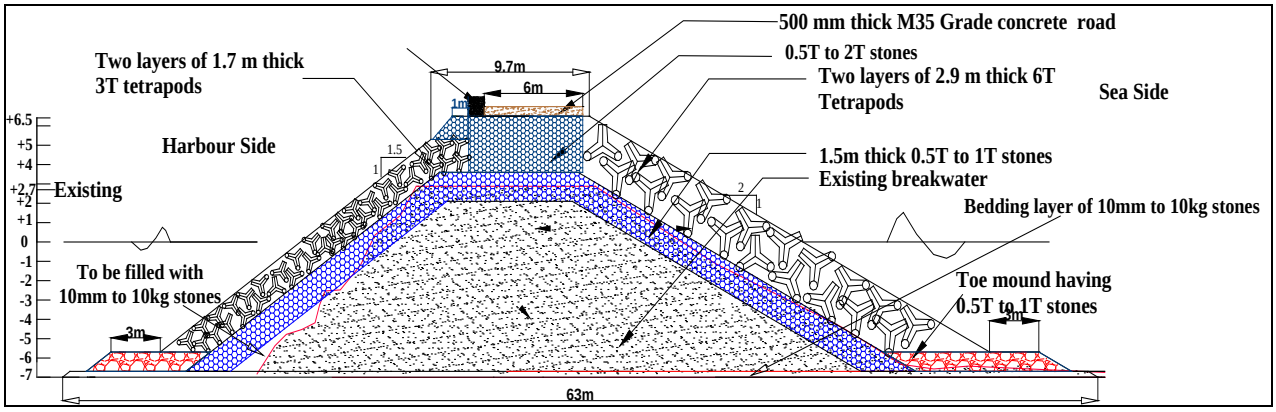


Fig 5.11 Cross section at 70 m chainage

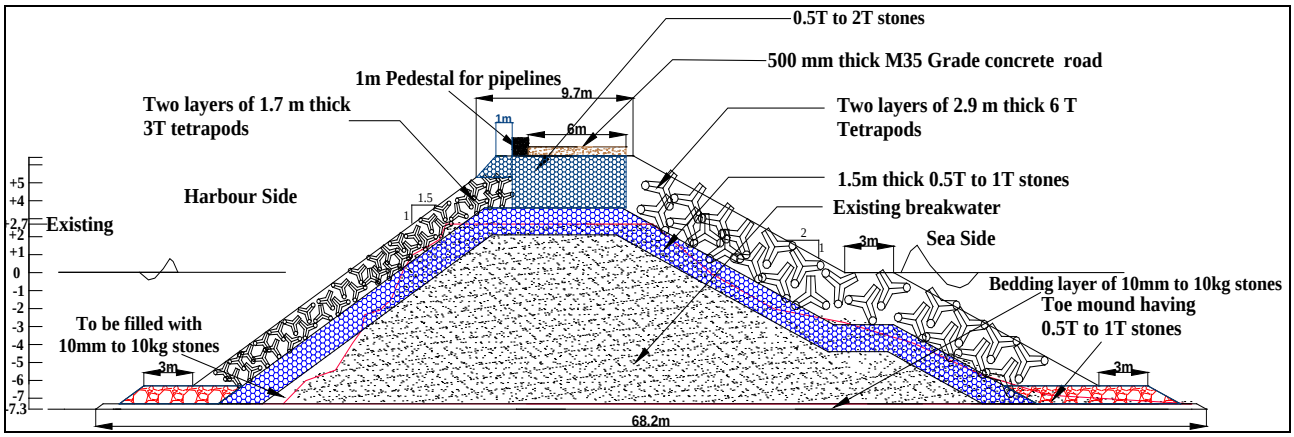


Fig 5.12 Cross section at 80 m chainage

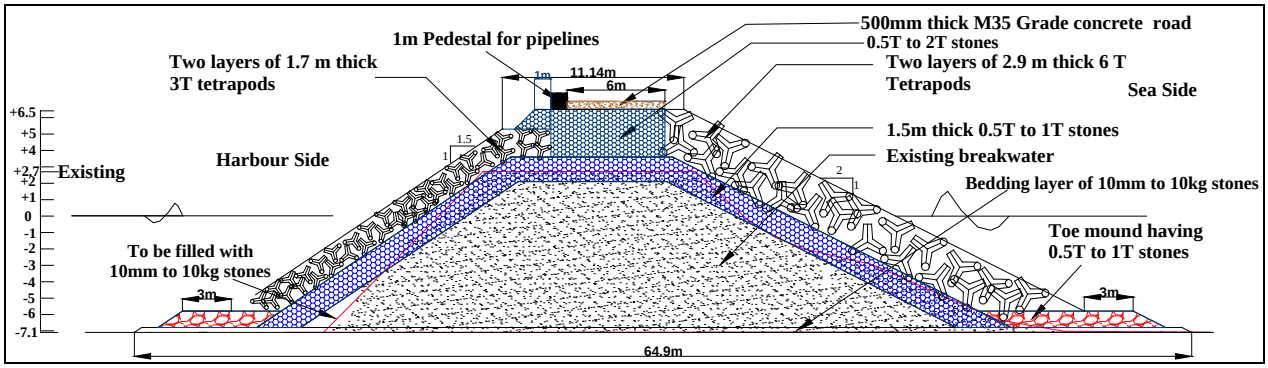


Fig 5.13 Cross section at 90 m chainage

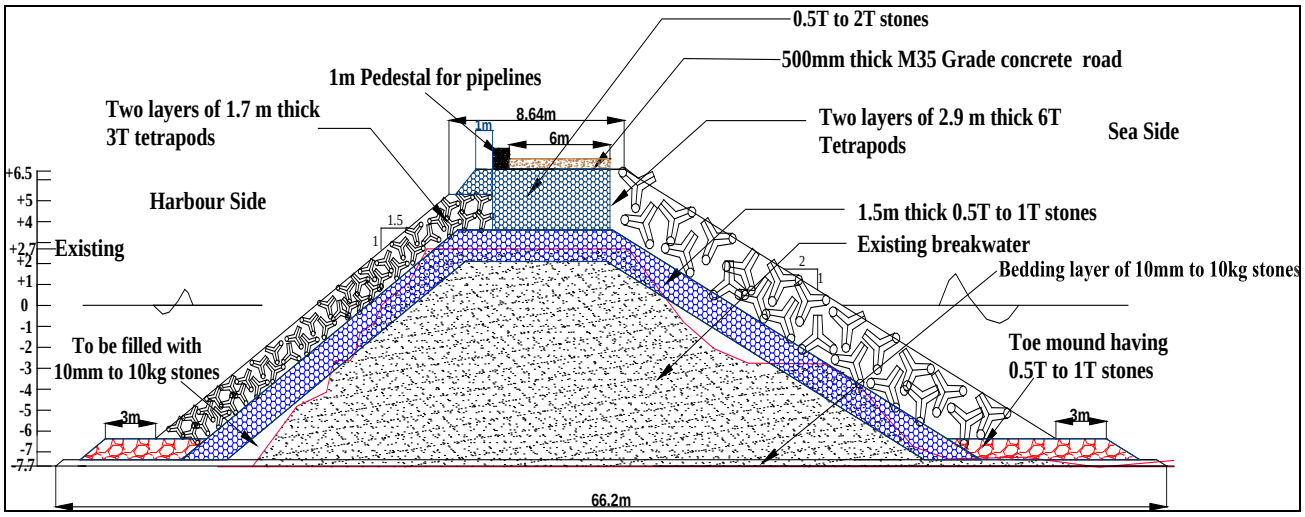


Fig.5.14 Cross section at 100 m chainage

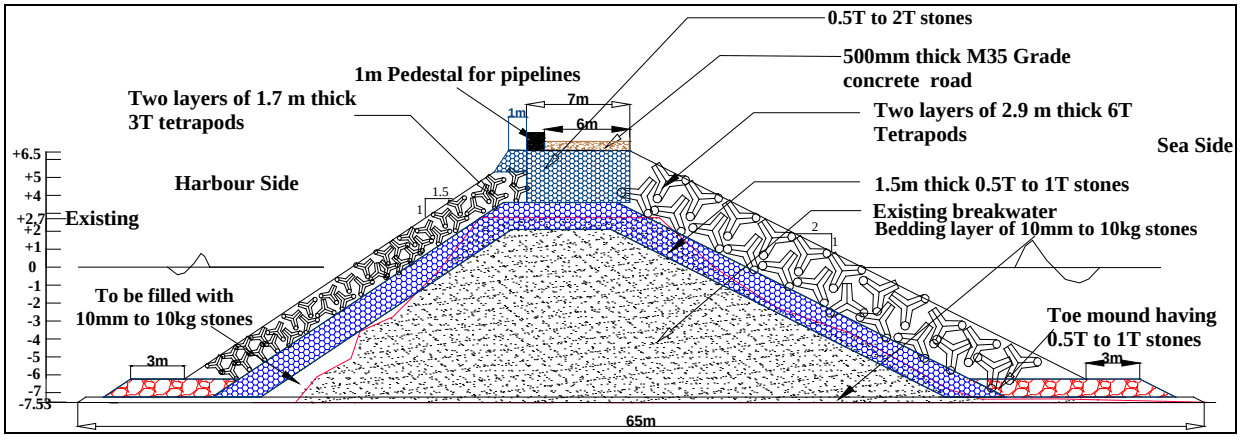


Fig 5.15 Cross section at 110 m chainage

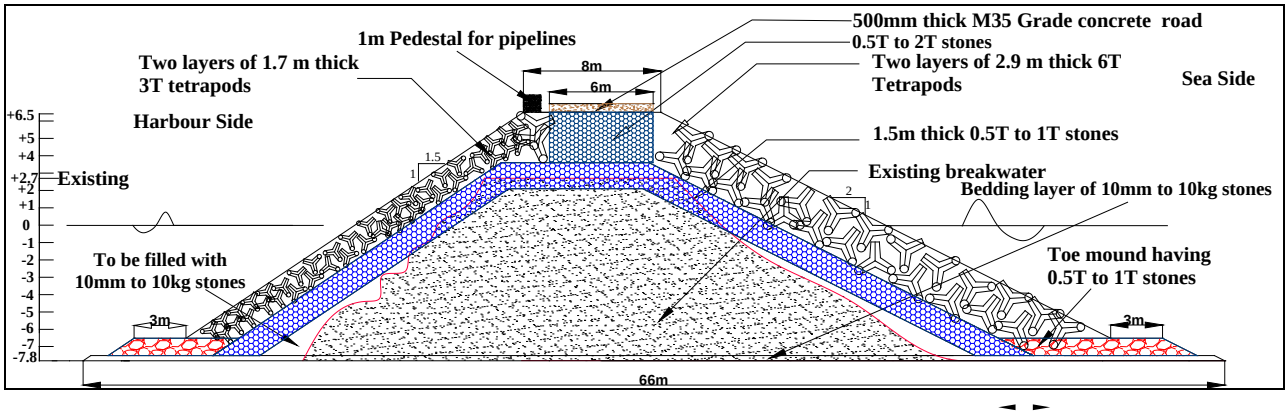


Fig 5.16 Cross section at 120 m chainage

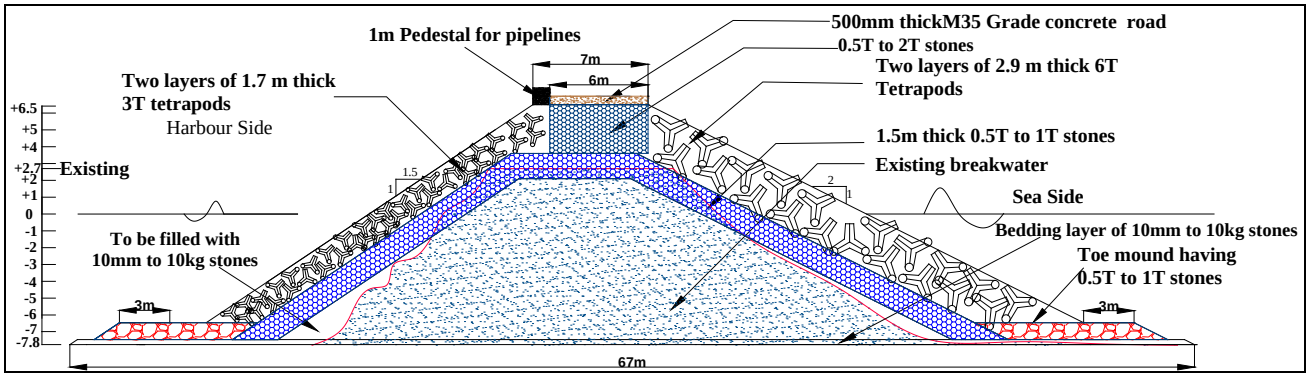


Fig 5.17 Cross section at 130 m chainage

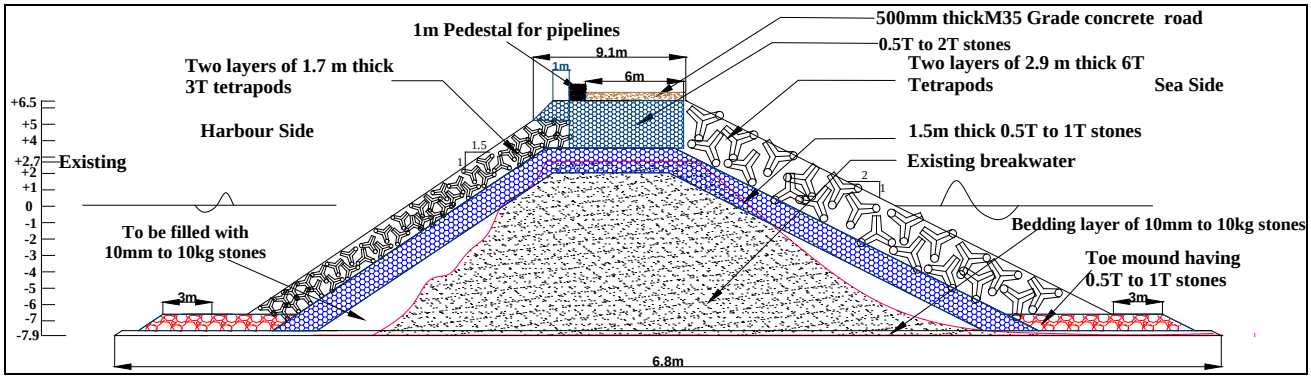


Fig 5.18 Cross section at 140 m chainage

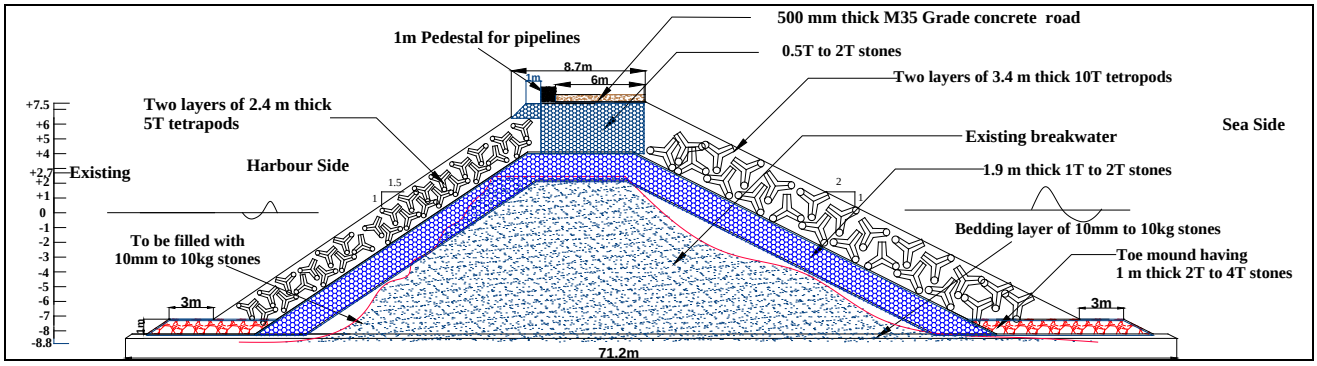


Fig 5.19 Cross section at 150 m chainage

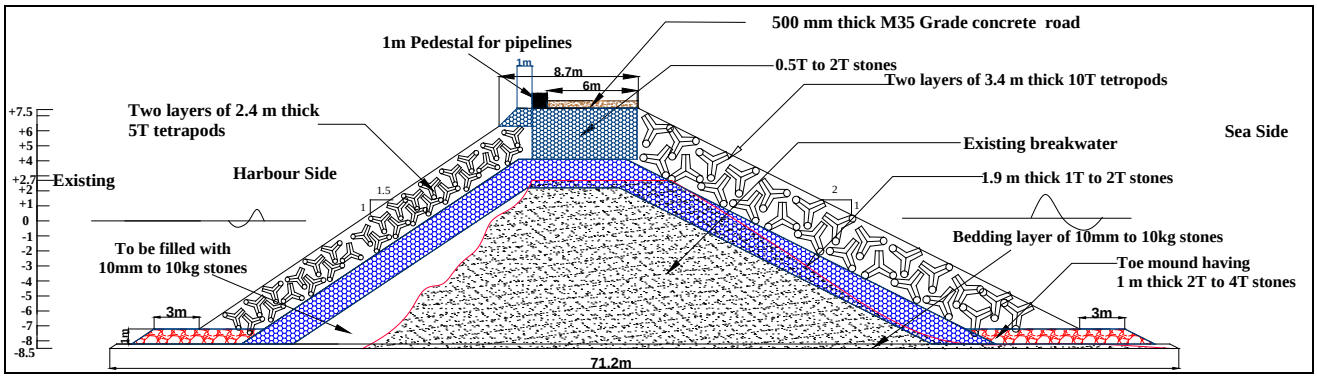


Fig 5.20 Cross section at 160 m chainage

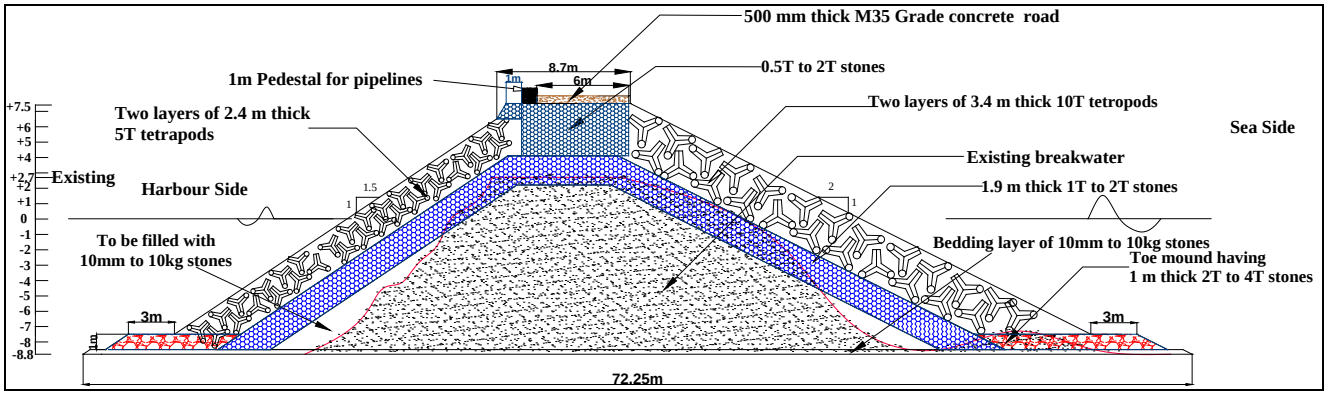


Fig 5.21 Cross section at 170 m chainage

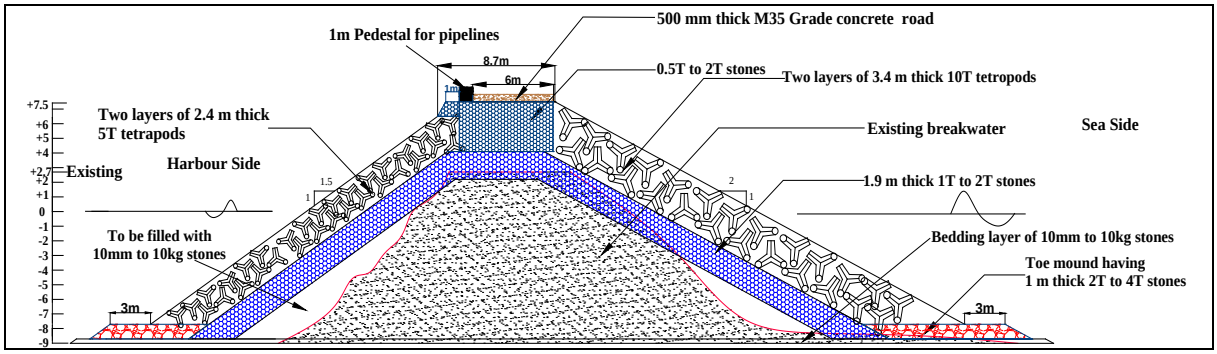


Fig 5.22 Cross section at 180 m chainage

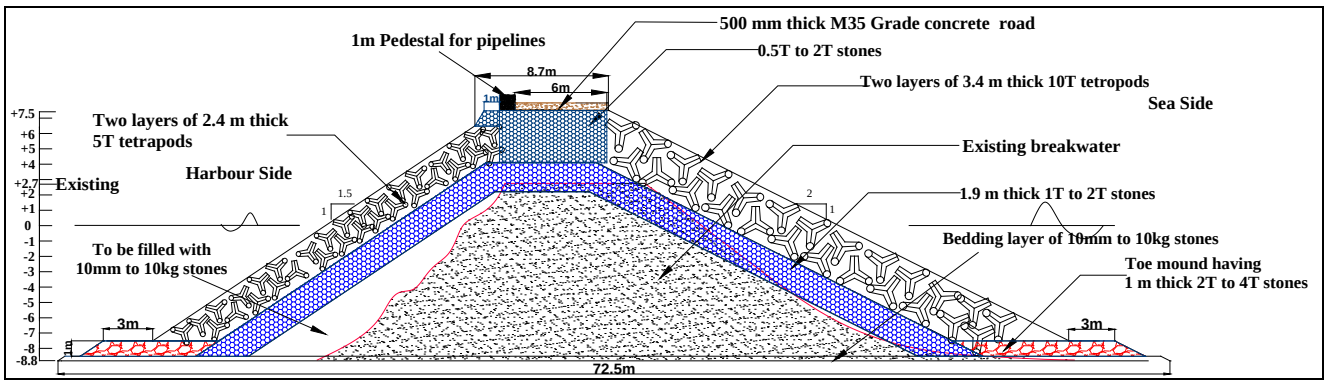


Fig 5.23 Cross section at 190 m chainage

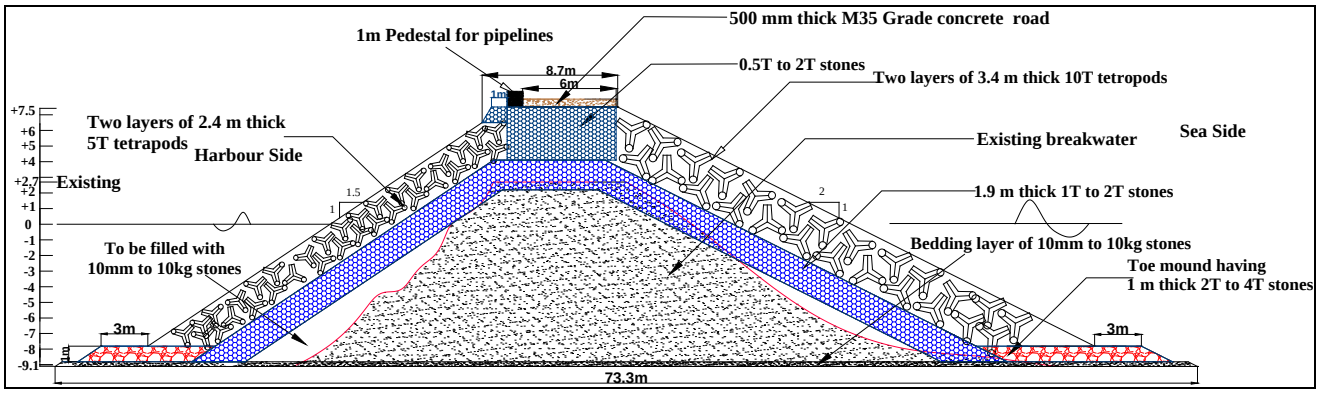


Fig 5.24 Cross section at 200 m chainage

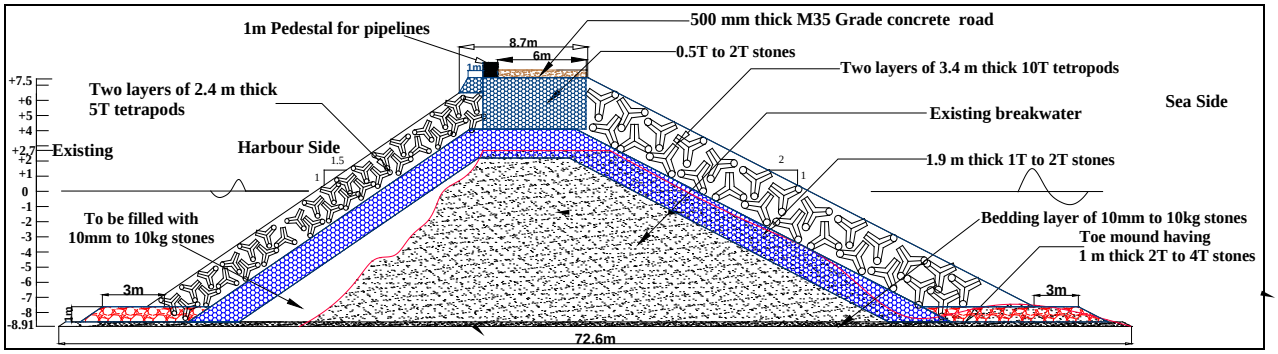


Fig 5.25 Cross section at 210 m chainage

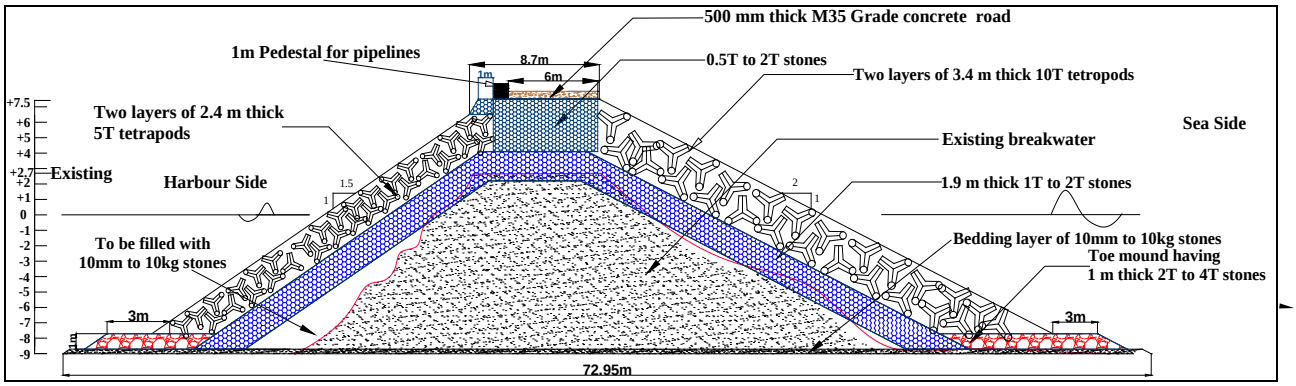


Fig 5.26 Cross section at 220 m chainage

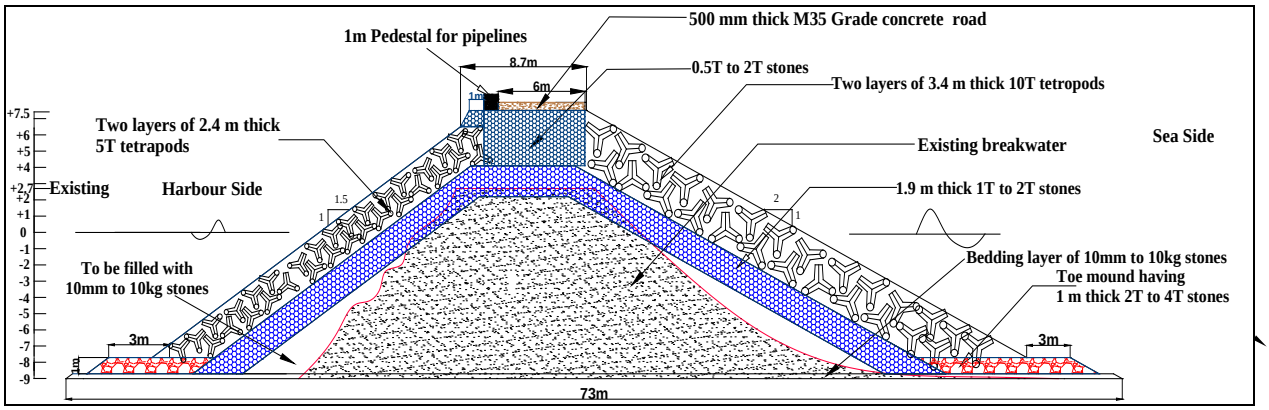


Fig 5.27 Cross section at 230 m chainage

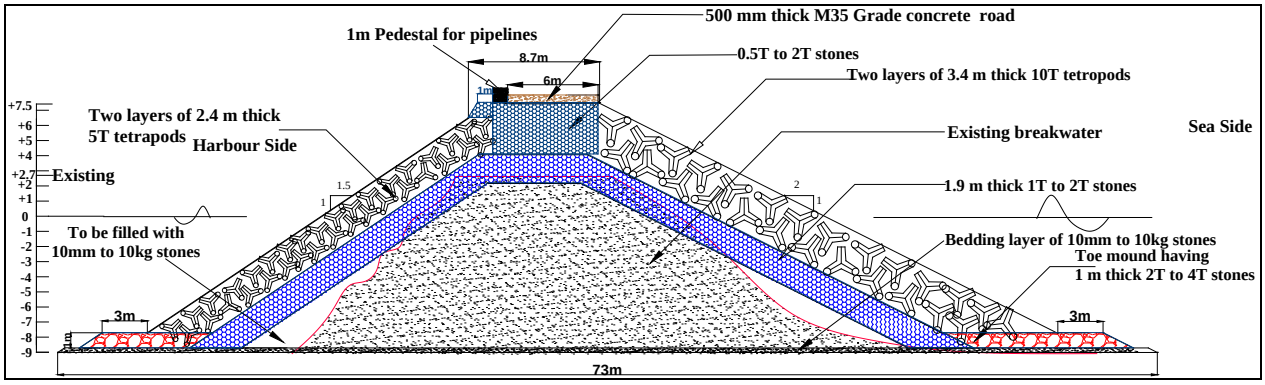


Fig 5.28 Cross section at 240 m chainage

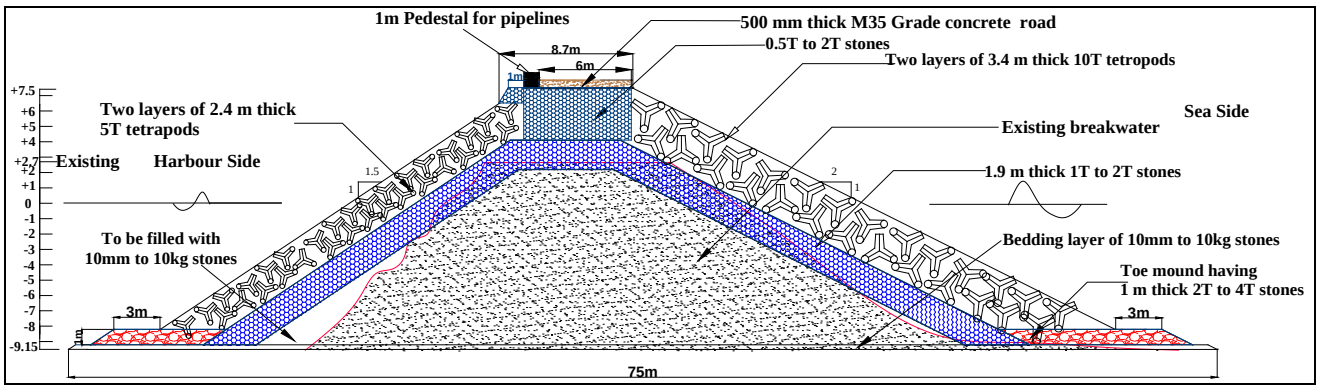


Fig 5.29 Cross section at 250 m chainage

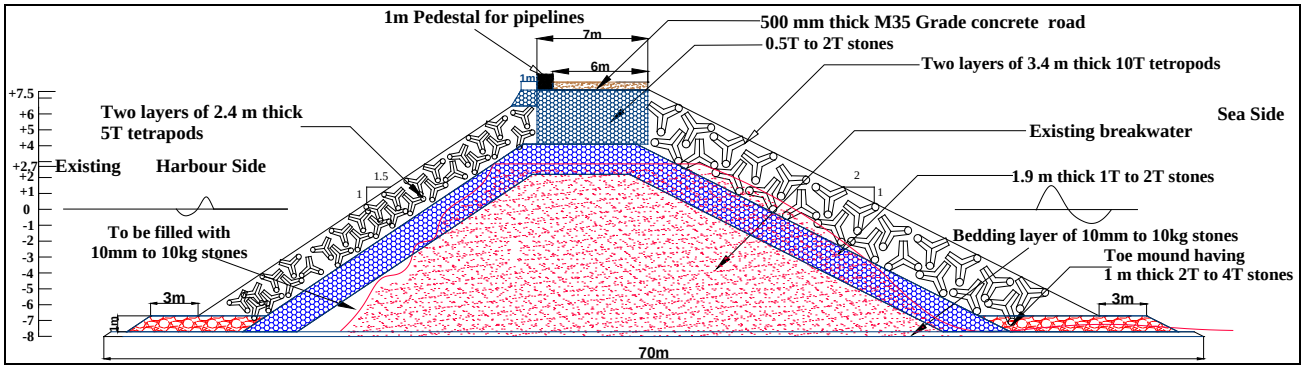


Fig 5.30 Cross section at 260 m chainage

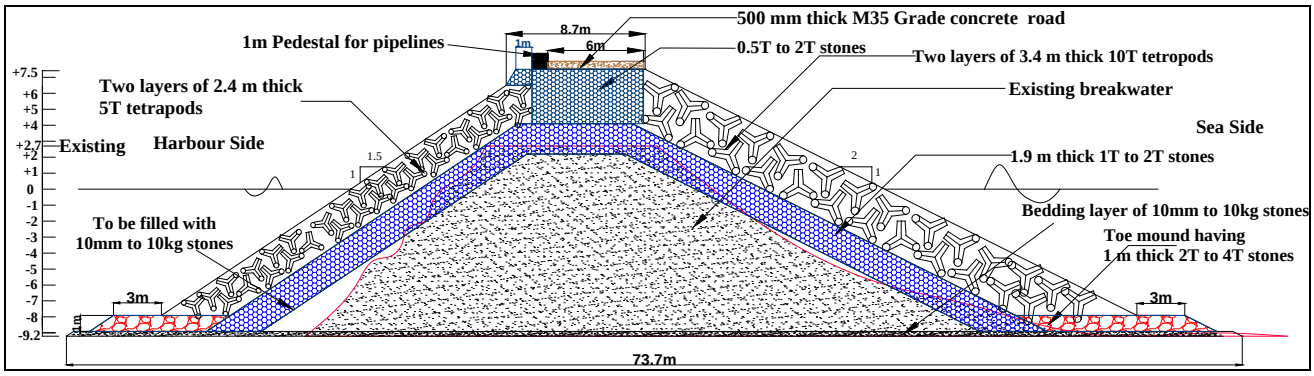


Fig 5.31 Cross section at 270 m chainage

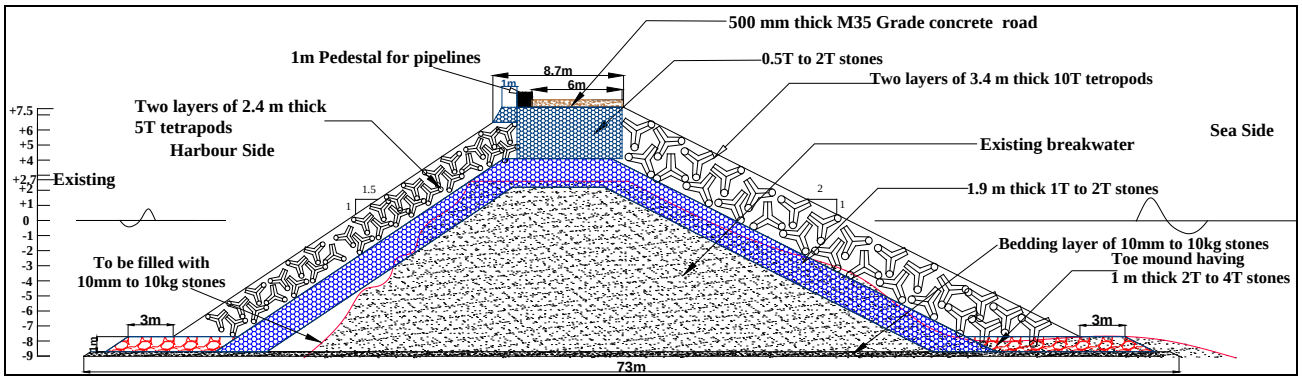


Fig 5.32 Cross section at 280 m chainage

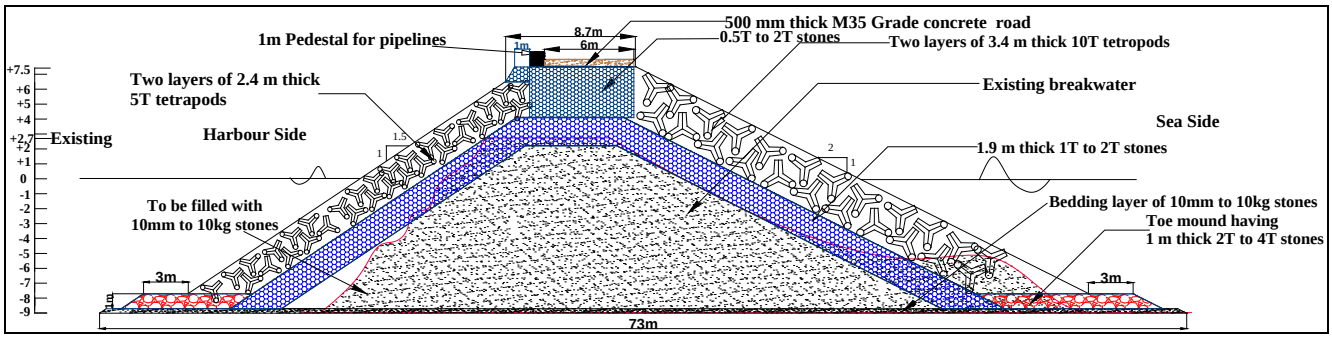


Fig 5.33 Cross section at 290 m chainage

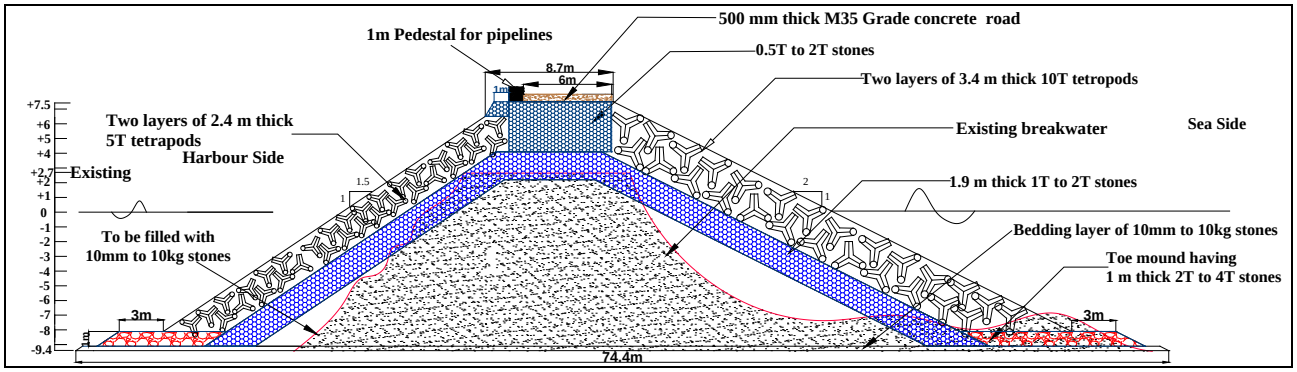


Fig 5.34 Cross section at 300 m chainage

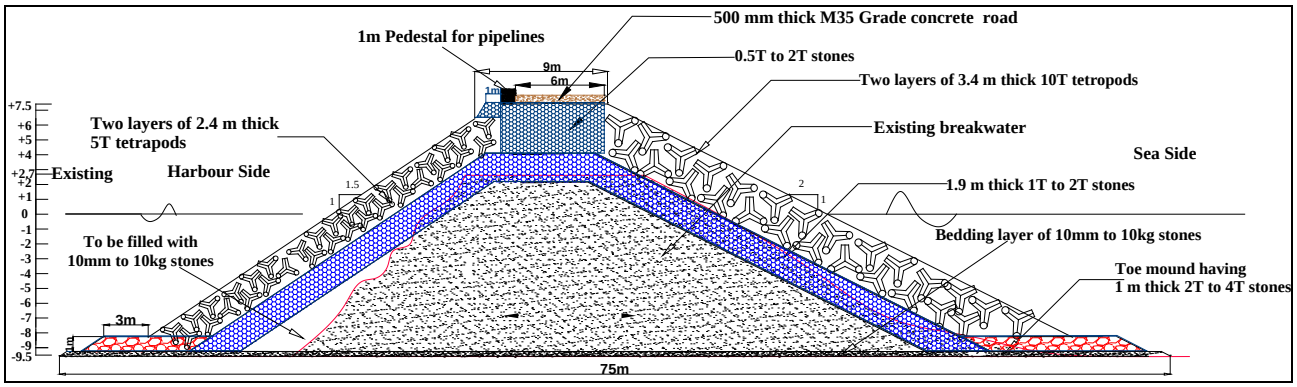


Fig 5.35 Cross section at 310 m chainage

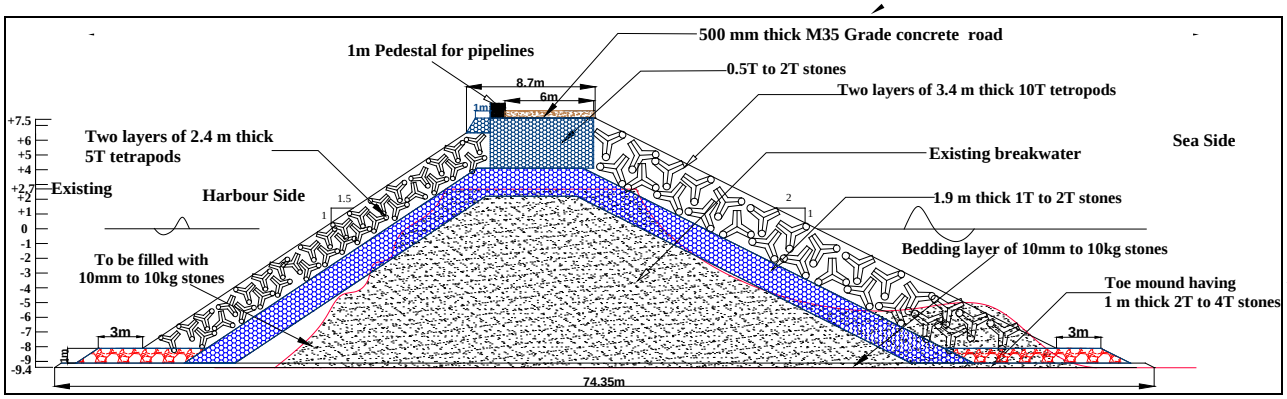


Fig 5.36 Cross section at 320 m chainage

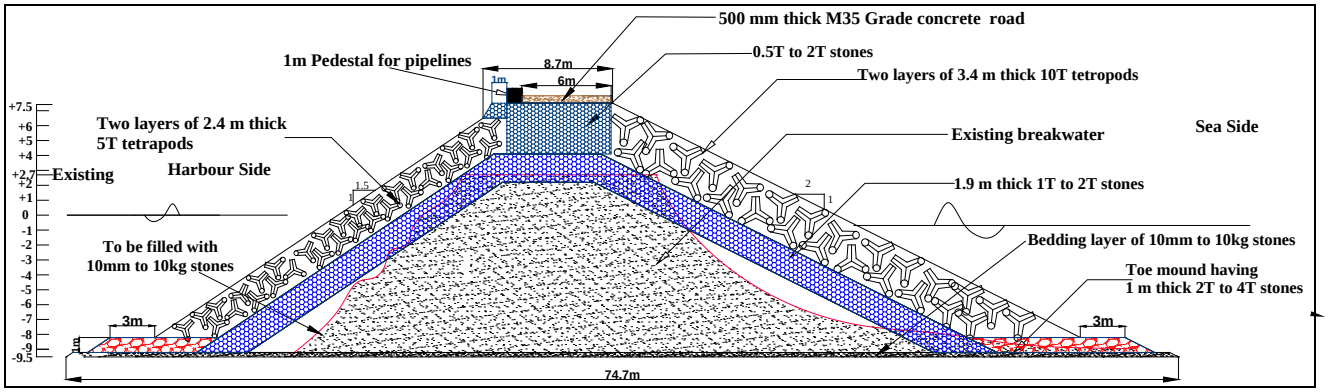


Fig 5.37 Cross section at 330 m chainage

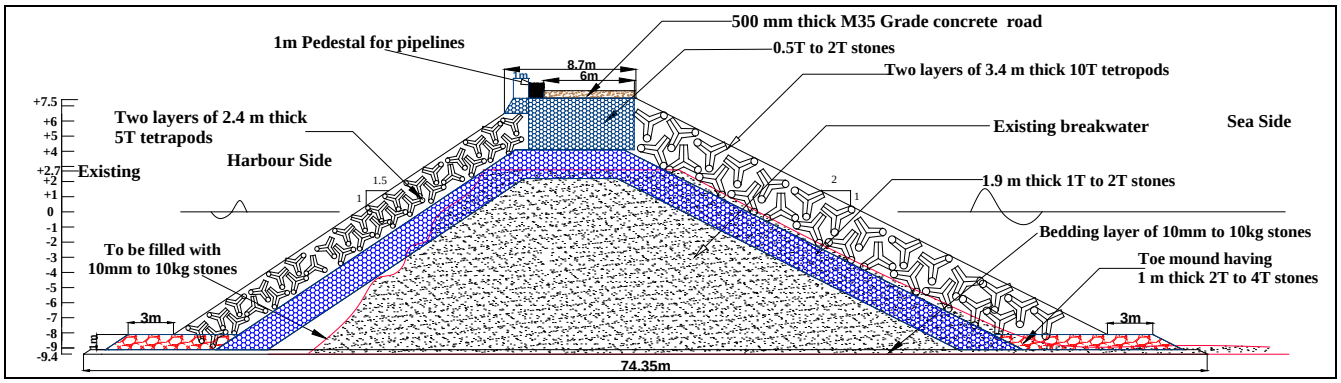


Fig 5.38 Cross section at 340 m chainage

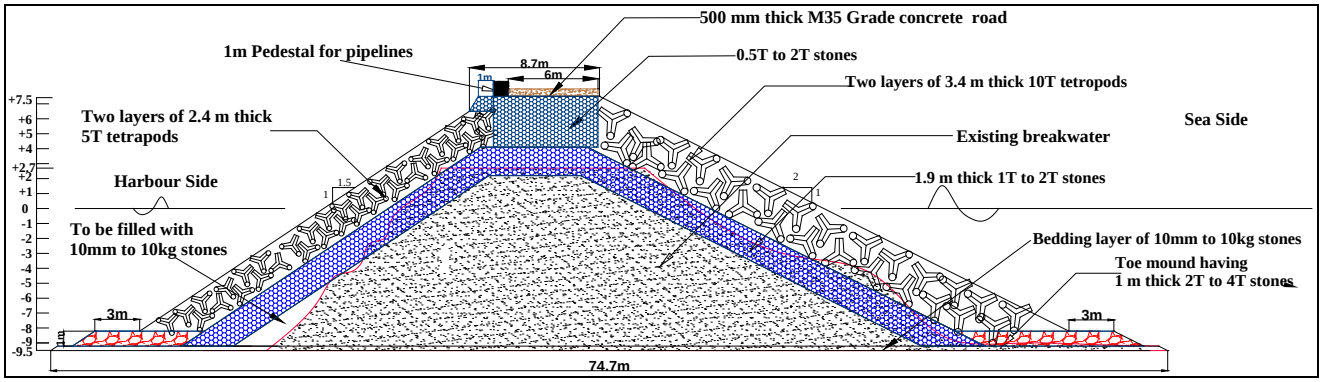


Fig 5.39 Cross section at 350 m chainage

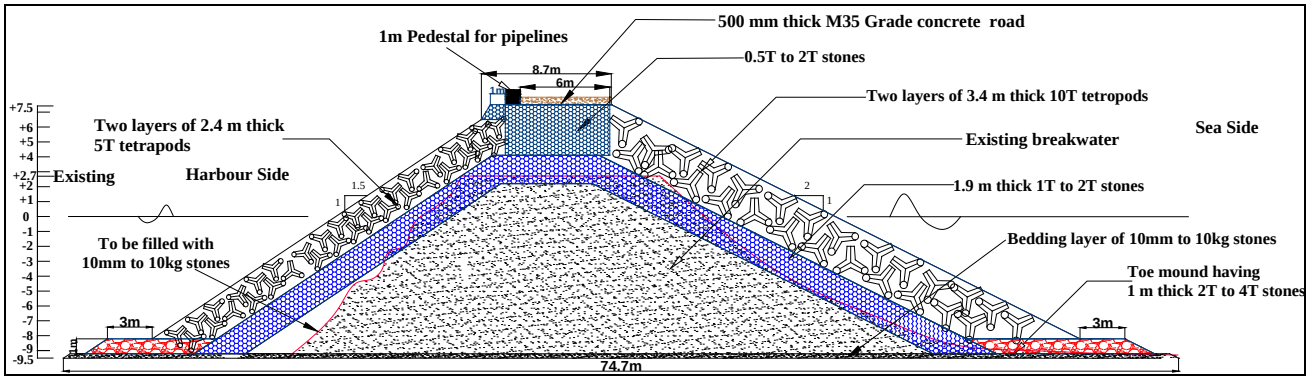


Fig 5.40 Cross section at 360 m chainage

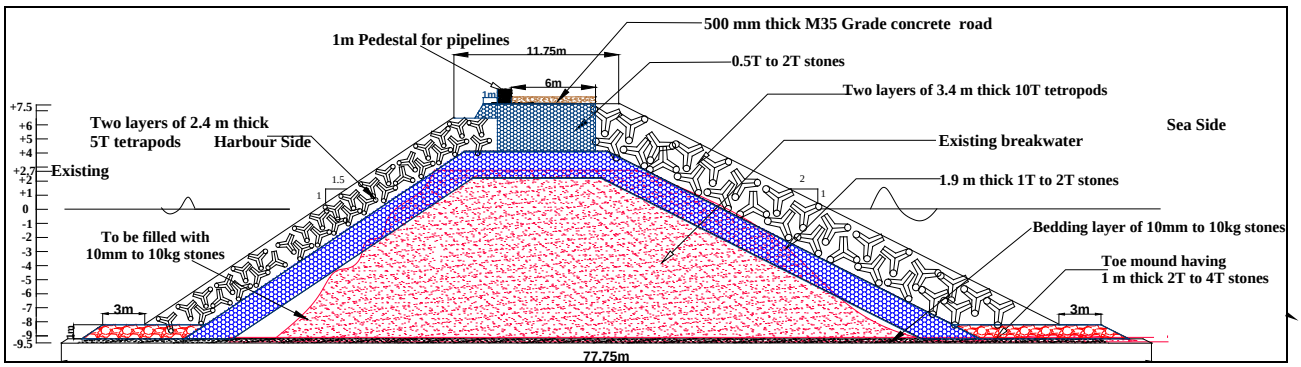


Fig 5.41 Cross section at 370 m chainage

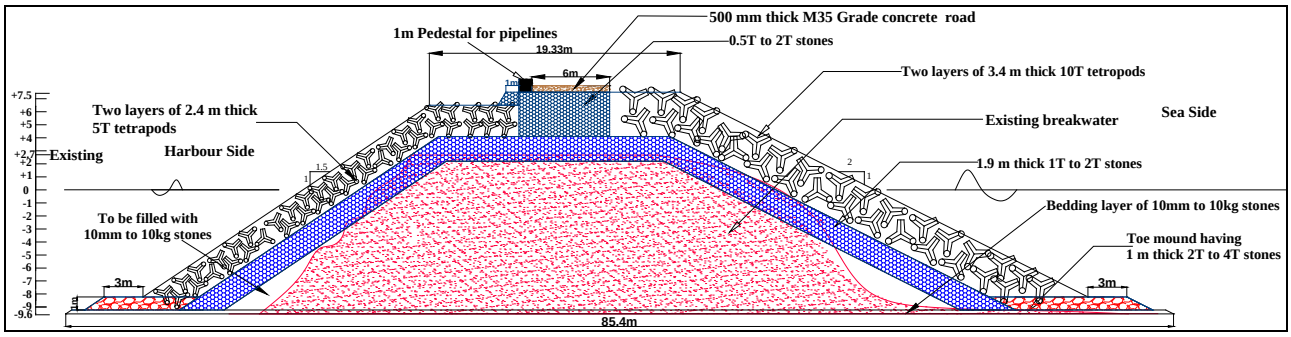


Fig 5.42 Cross section at 380 m chainage

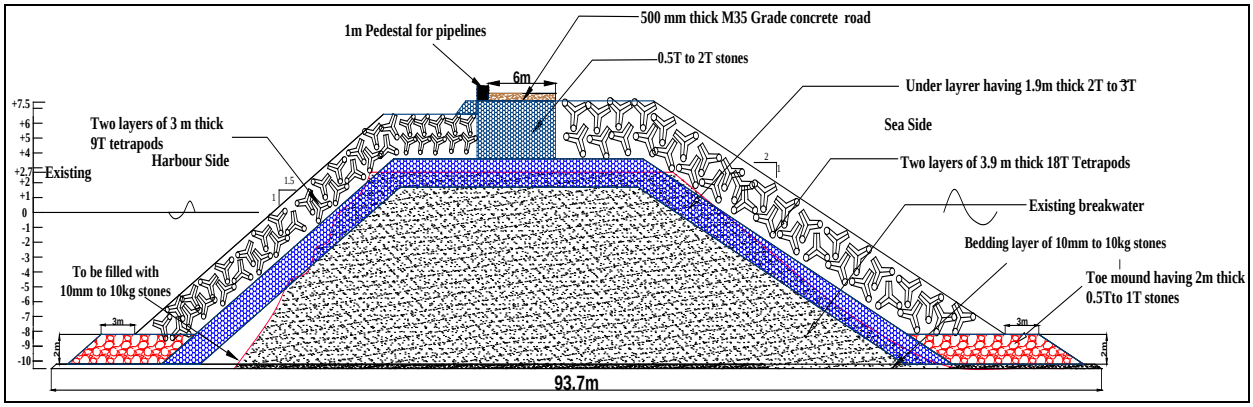


Fig 5.43 Cross section at 390 m chainage

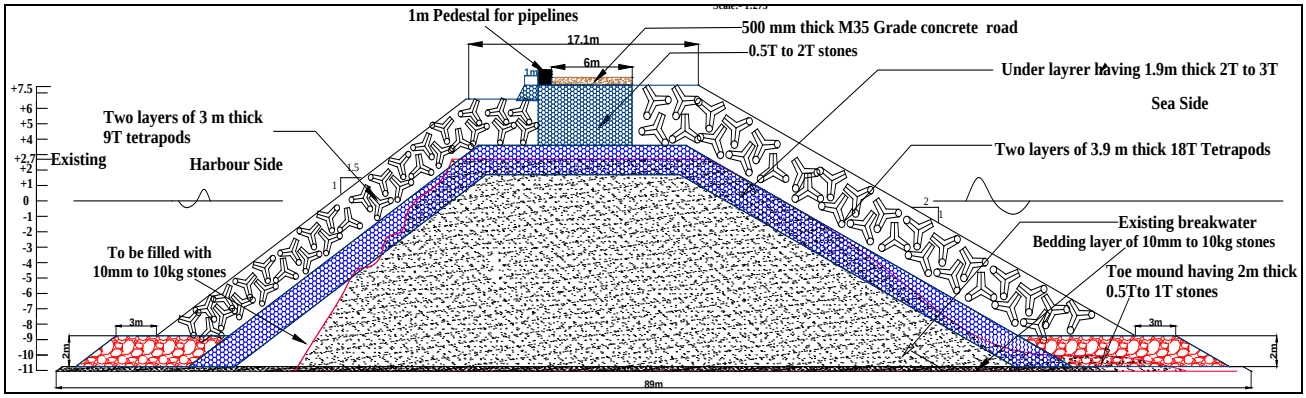


Fig 5.44 Cross section at 400 m chainage

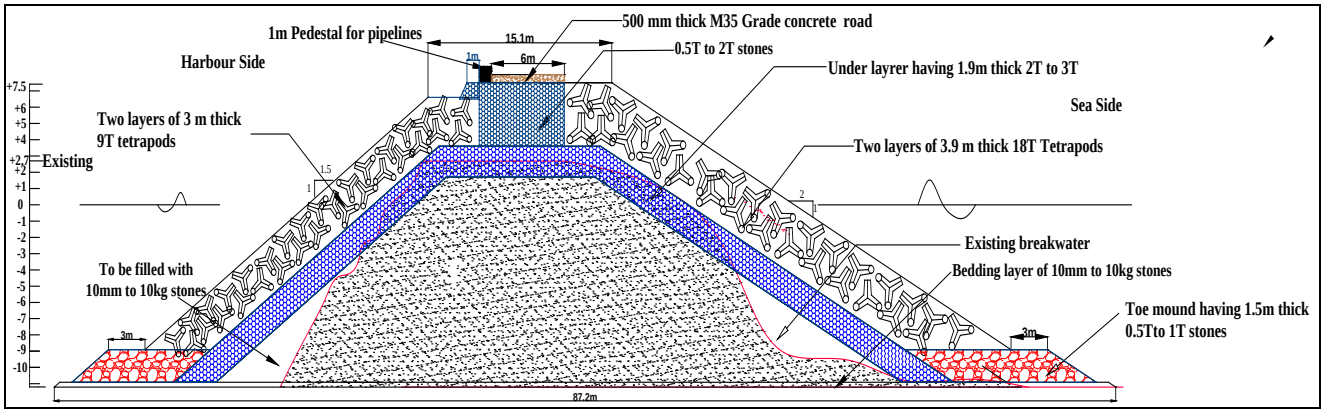


Fig 5.45 Cross section at 410 m chainage

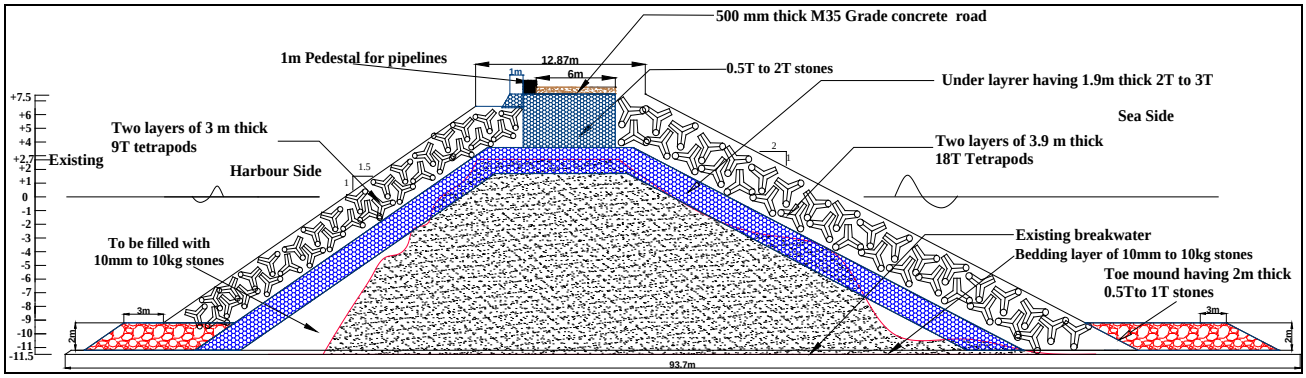


Fig 5.46 Cross section at 420 m chainage

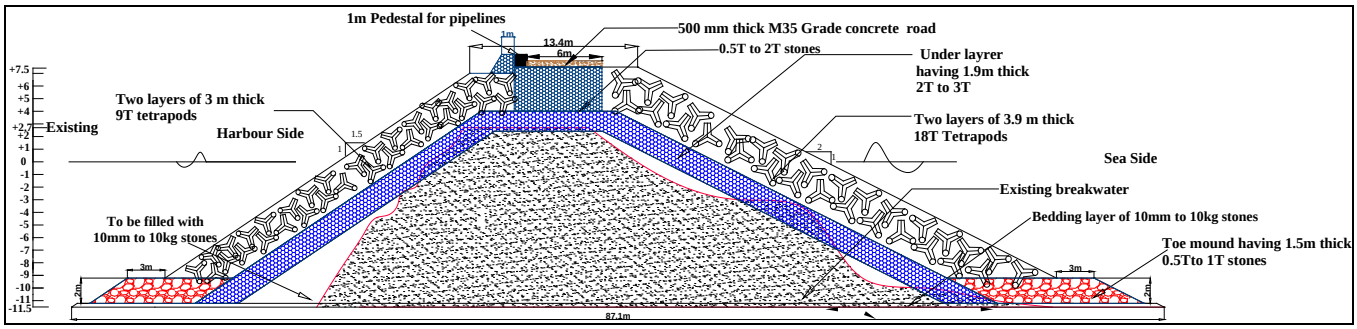


Fig 5.47 Cross section at 430 m chainage

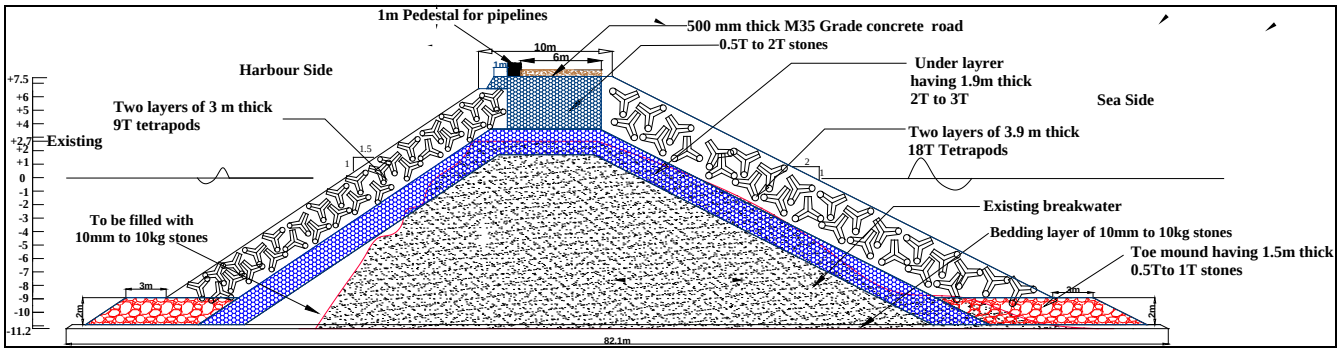


Fig 5.48 Cross section at 440 m chainage

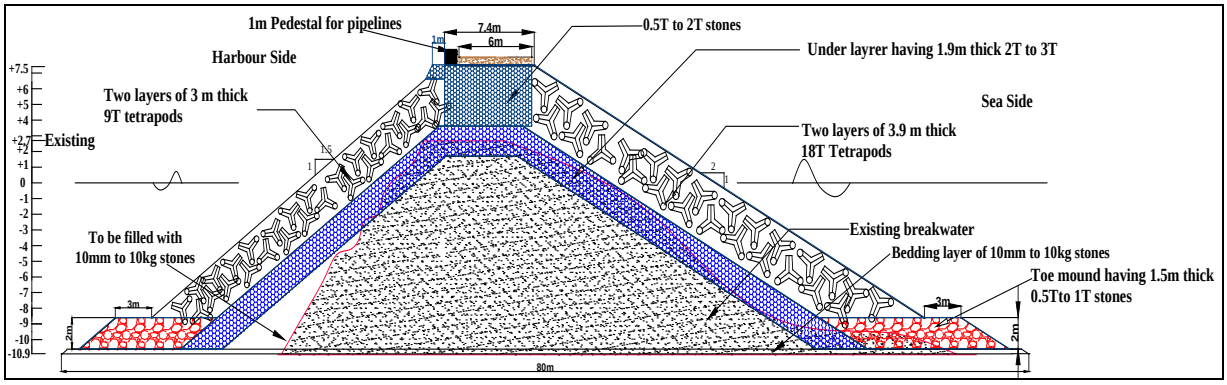


Fig 5.49 Cross section at 450 m chainage

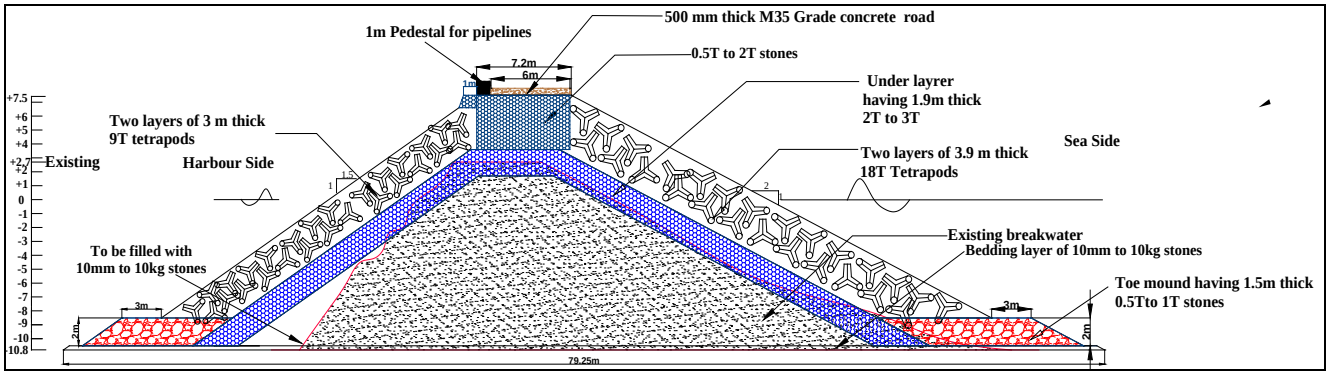


Fig 5.50 Cross section at 460 m chainage

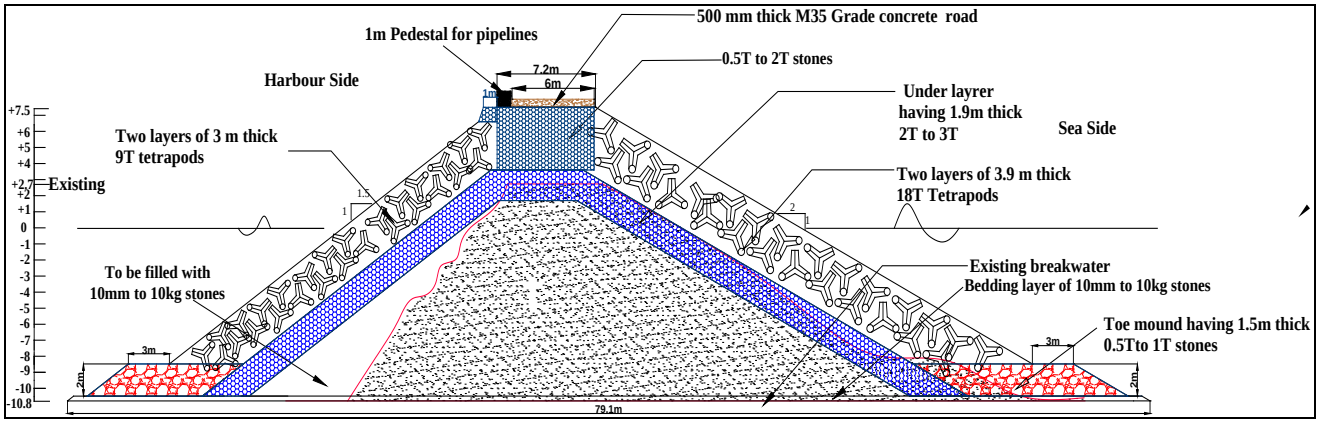


Fig 5.51 Cross section at 470 m chainage

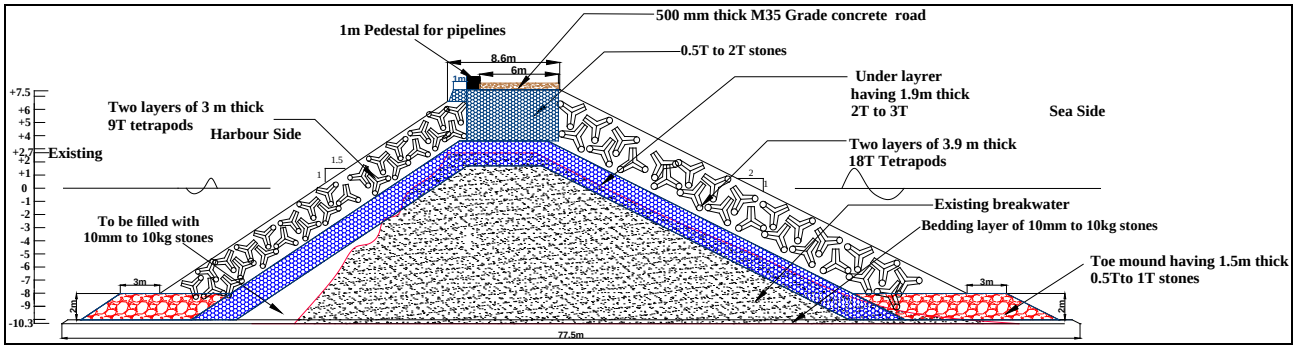


Fig 5.52 Cross section at 480 m chainage

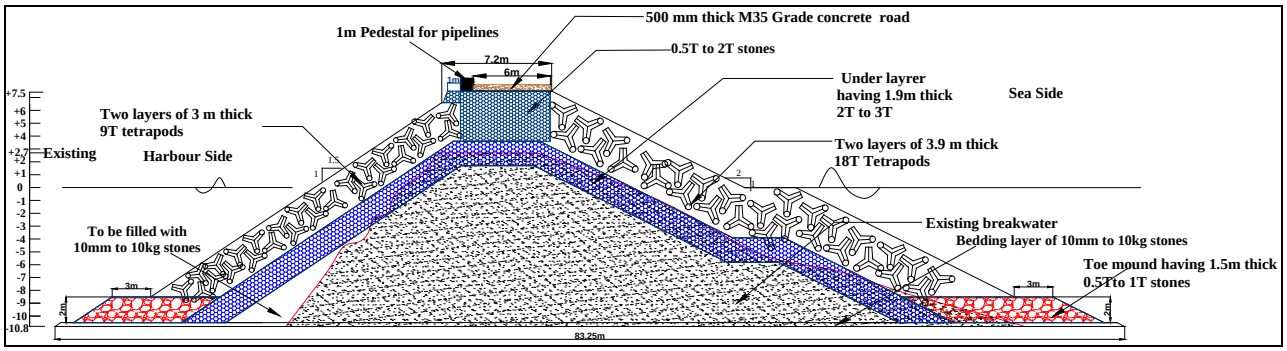


Fig 5.53 Cross section at 490 m chainage

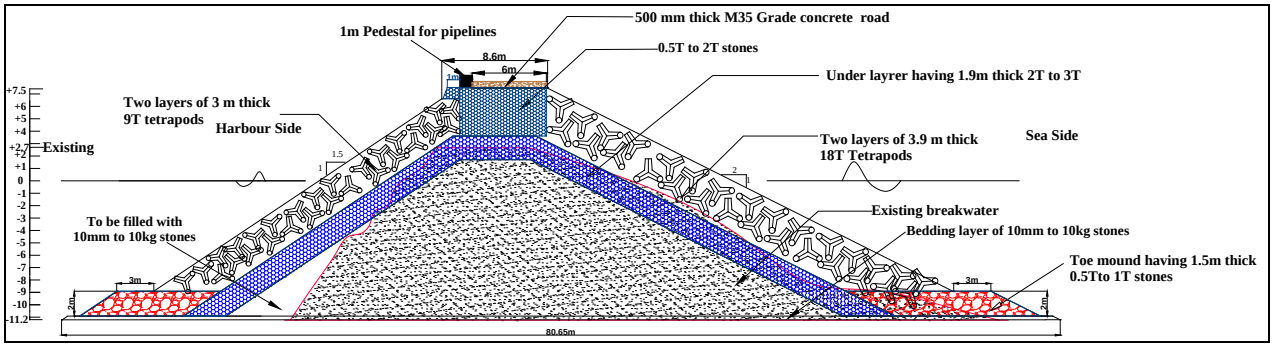


Fig 5.54 Cross section at 500 m chainage

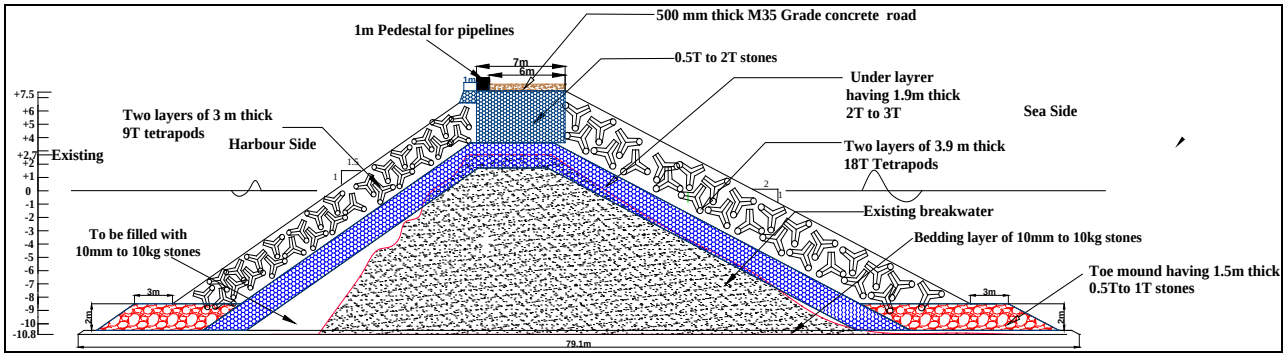


Fig 5.55 Cross section at 510 m chainage

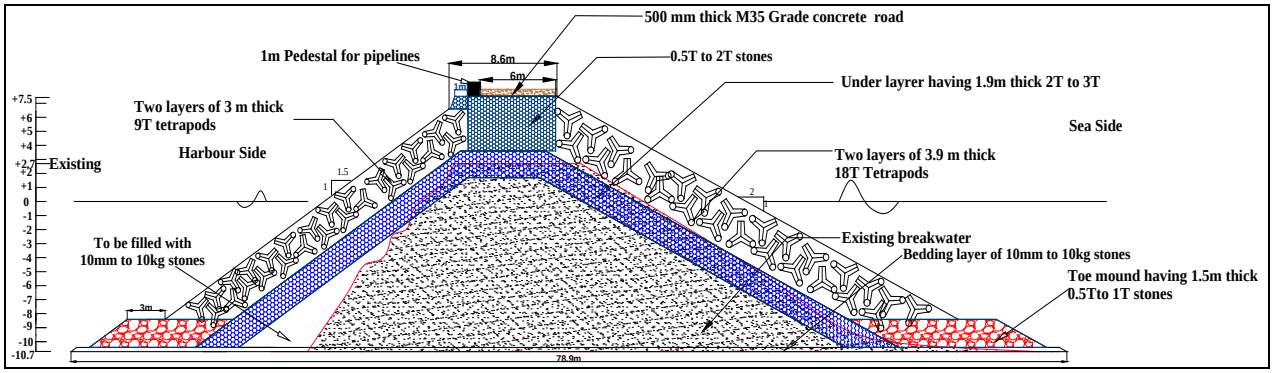


Fig 5.56 Cross section at 520 m chainage

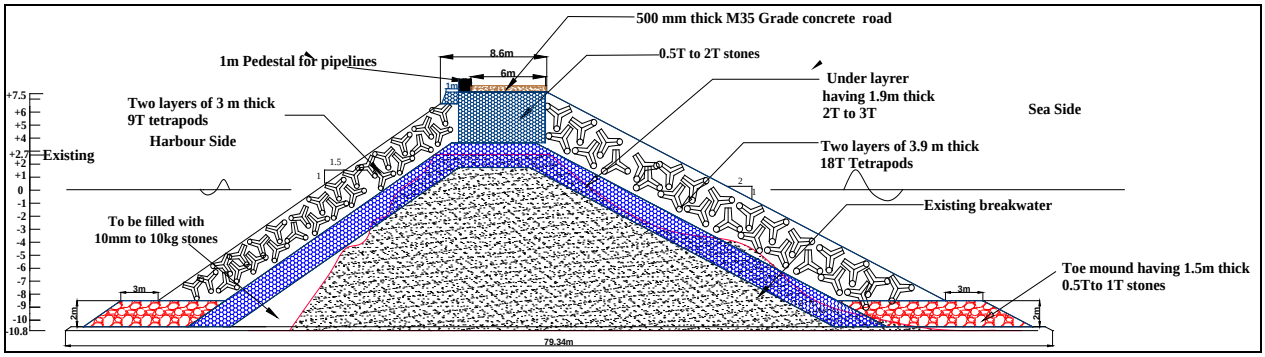


Fig 5.57 Cross section at 530 m chainage

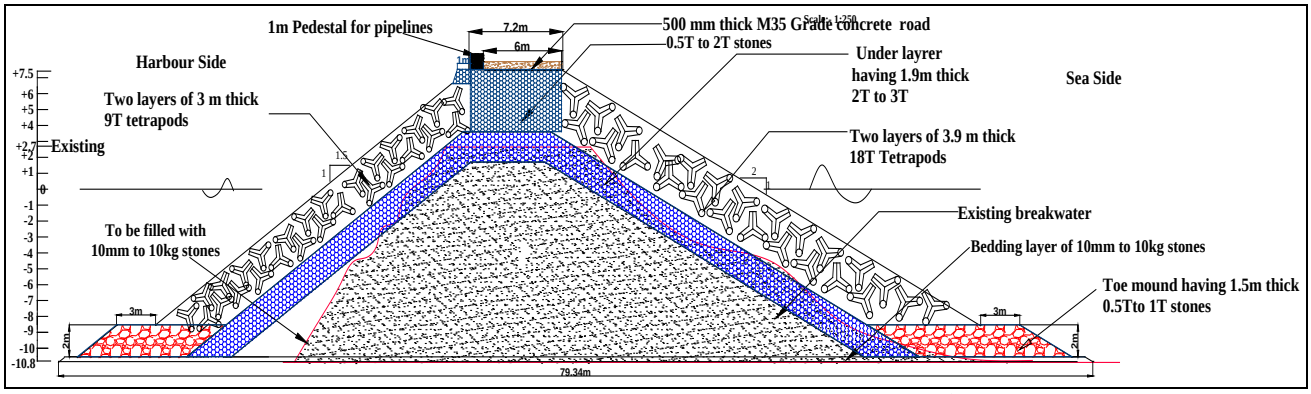


Fig 5.58 Cross section at 540 m chainage

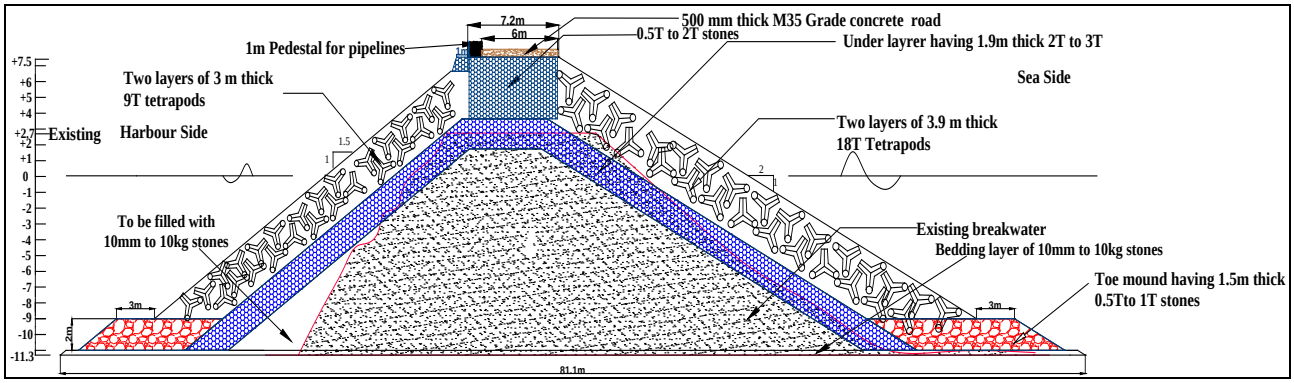


Fig 5.59 Cross section at 550 m chainage

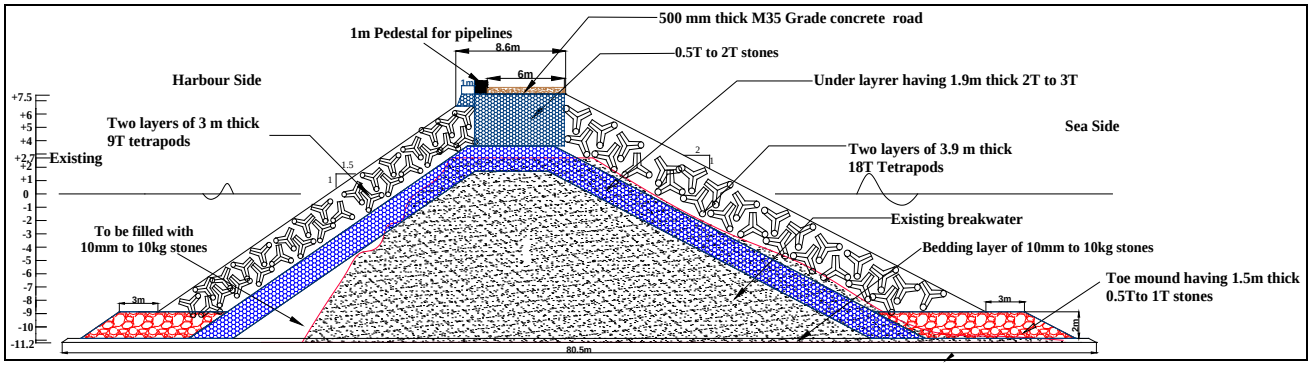


Fig 5.60 Cross section at 560 m chainage

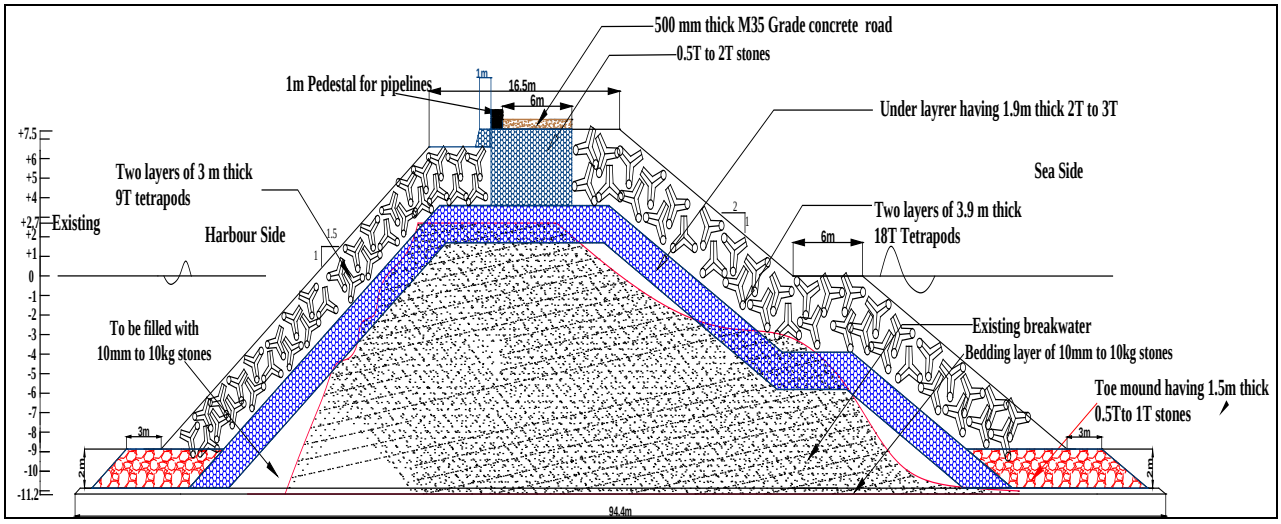


Fig 5.61 Cross section at 570 m chainage

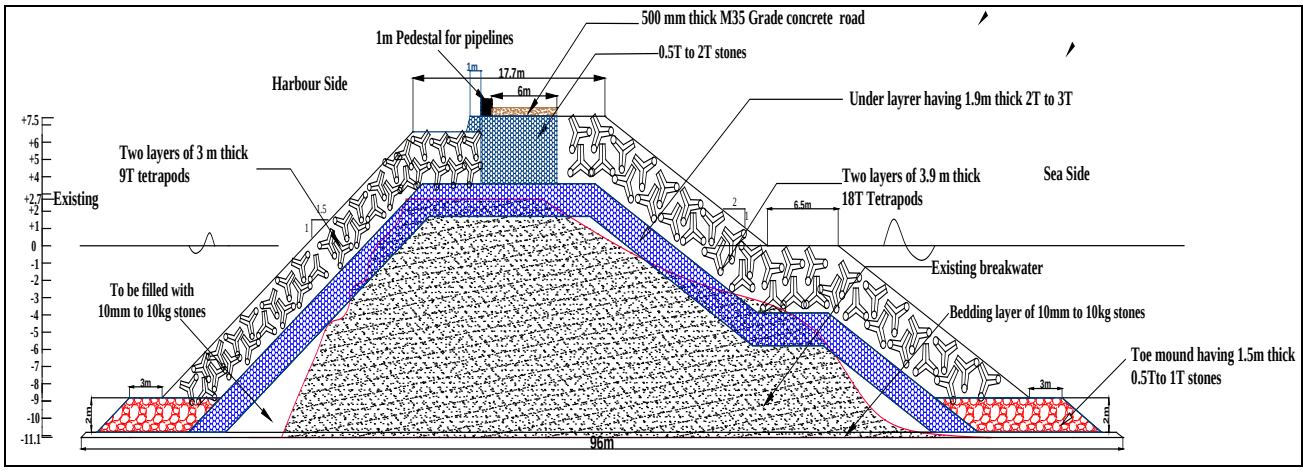


Fig 5.62 Cross section at 580 m chainage

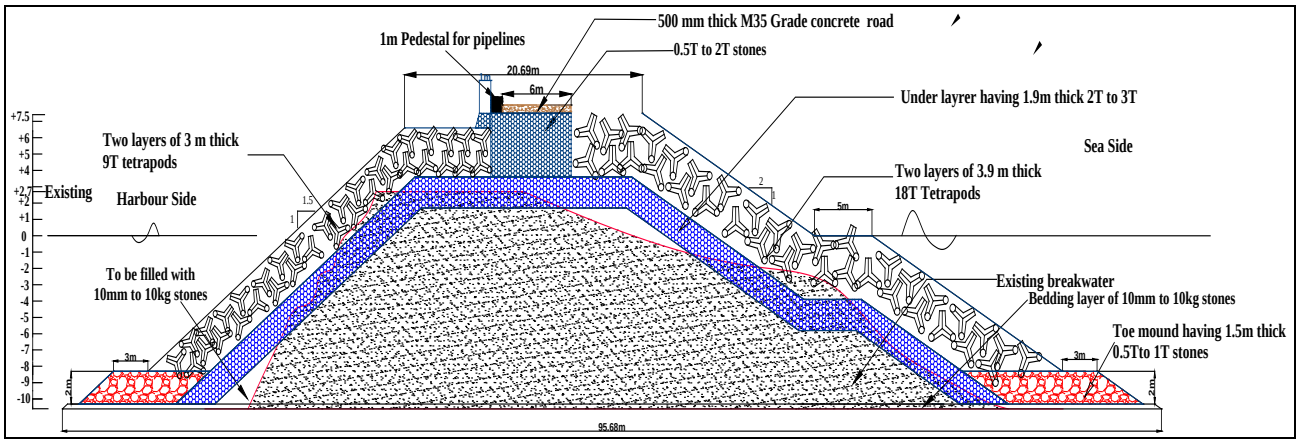


Fig 5.63 Cross section at 590 m chainage

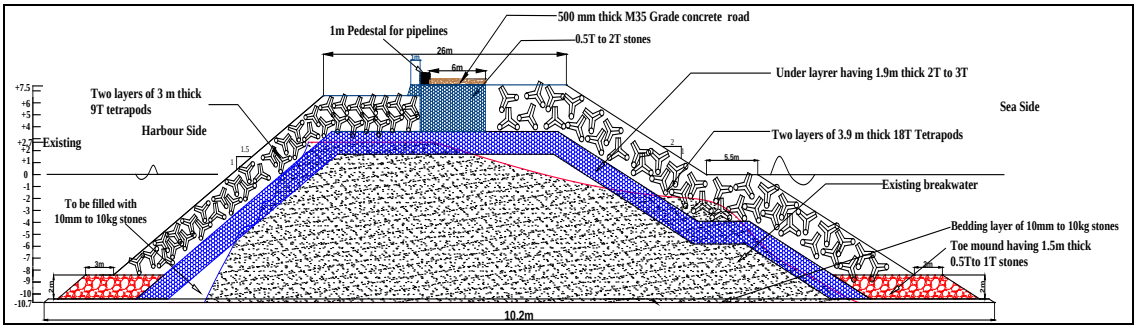


Fig 5.64 Cross section at 600 m chainage

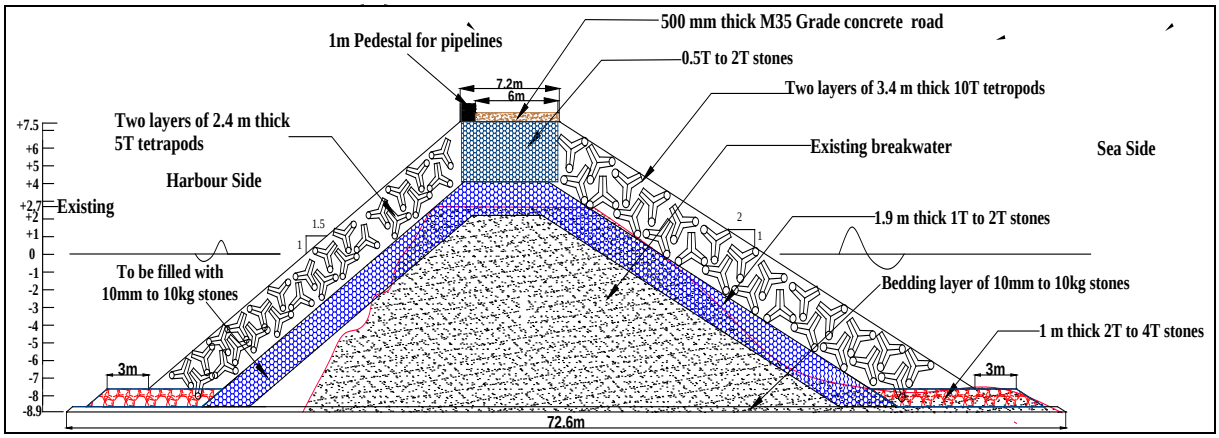


Fig 5.65 Cross section at 650 m chainage

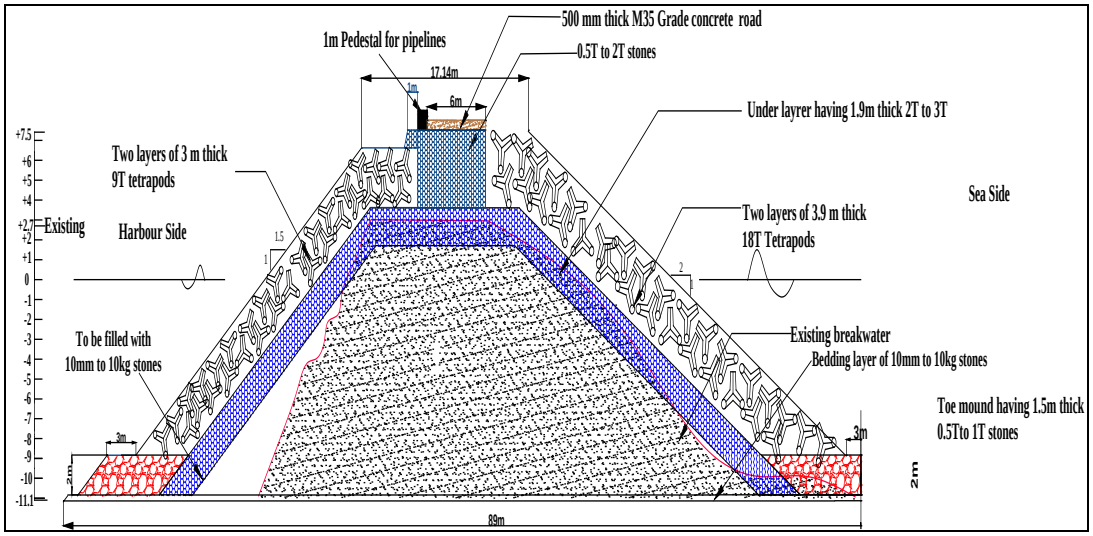


Fig 5.66 Cross section at 700 m chainage

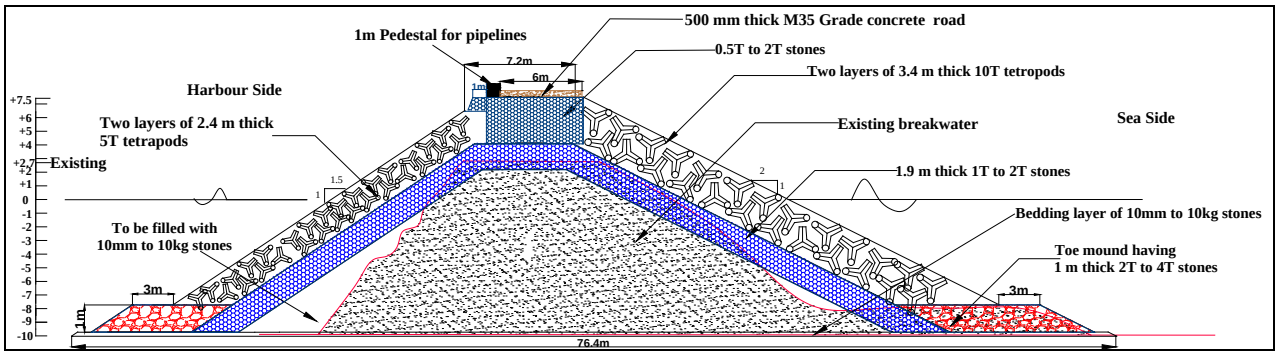


Fig 5.67 Cross section at 750 m chainage

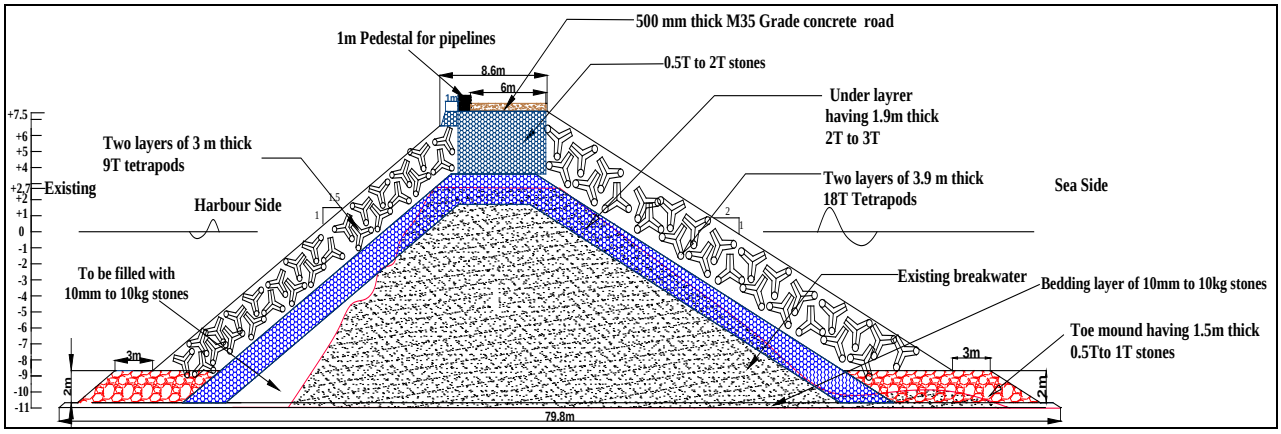


Fig 5.68 Cross section at 800 m chainage

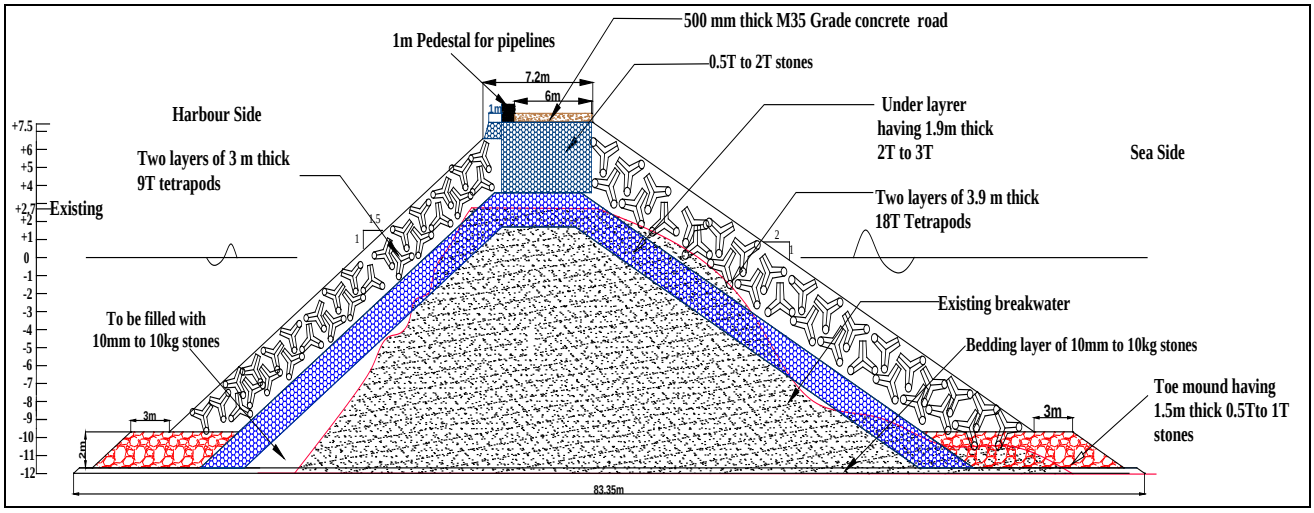


Fig 5.69 Cross section at 850 m chainage

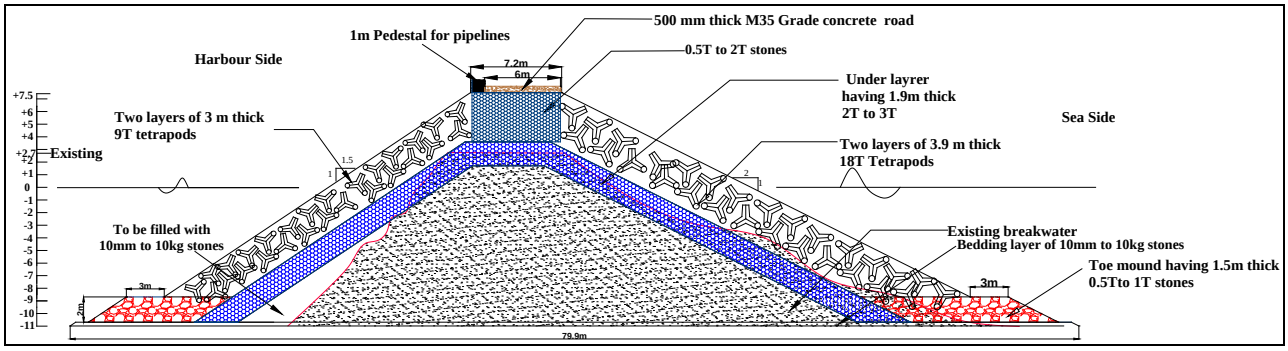


Fig 5.70 Cross section at 900 m chainage

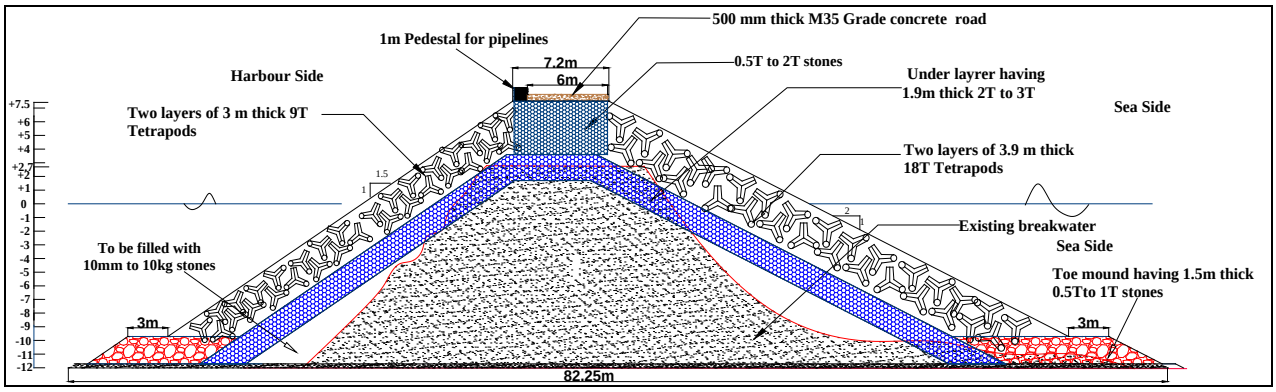


Fig 5.71 Cross section at 950 m chainage

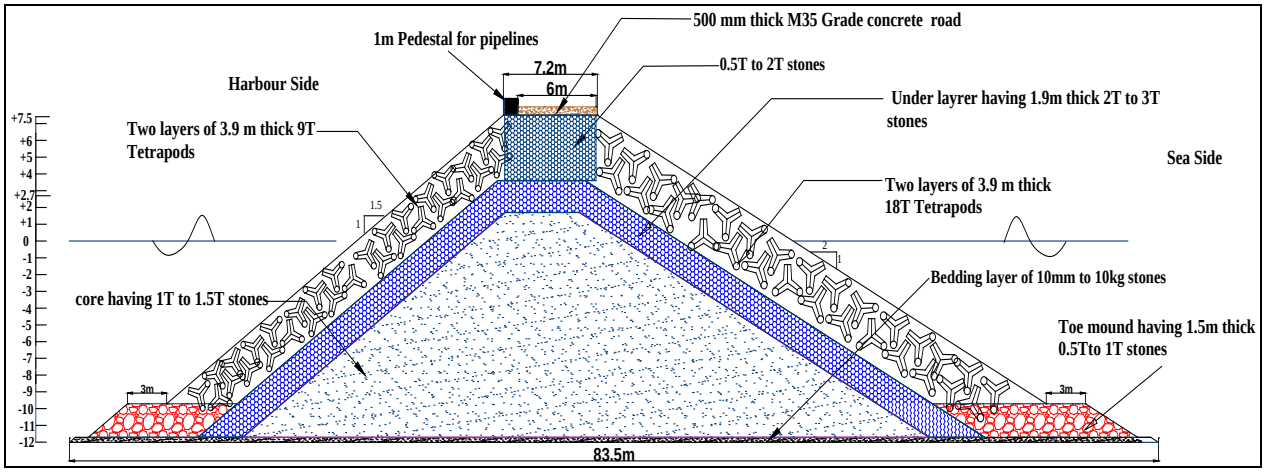


Fig 5.72 Cross section for 950 m to 1400m chainage

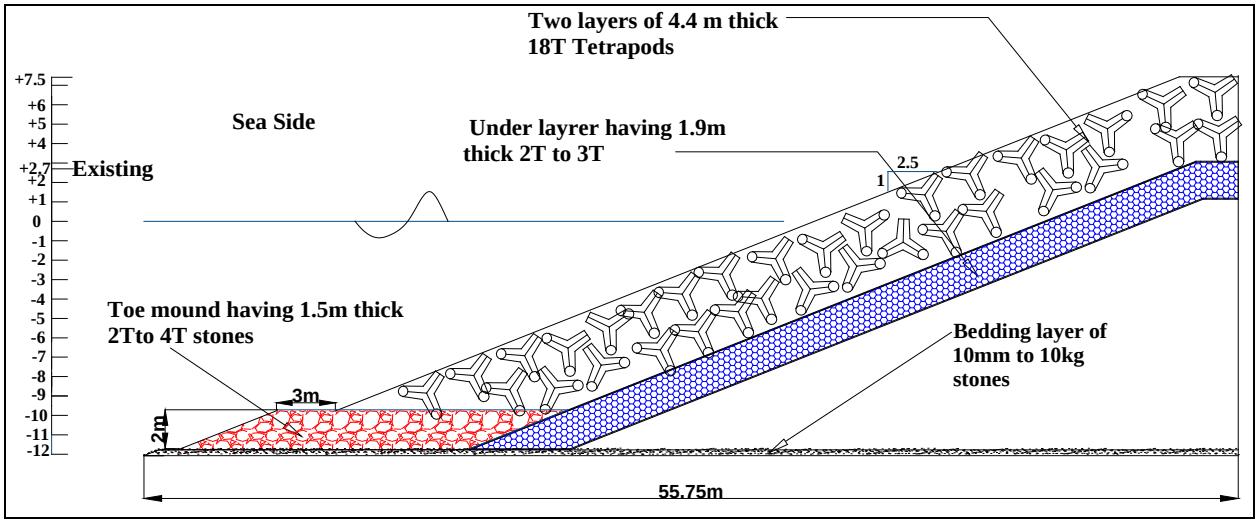


Fig 5.73 Head section at 1400 m chainage

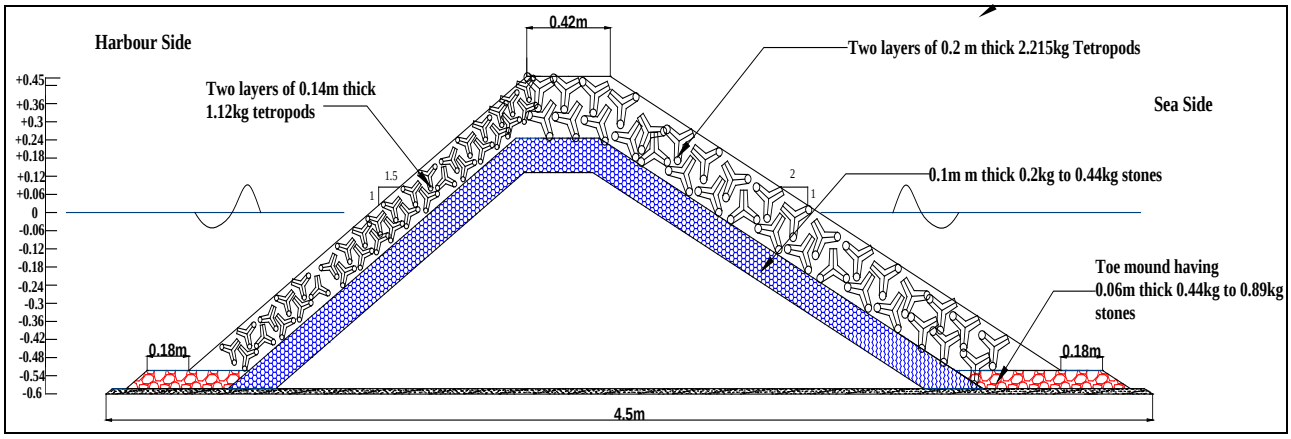


Fig 6.1 Details of prototype and model for the flume studies

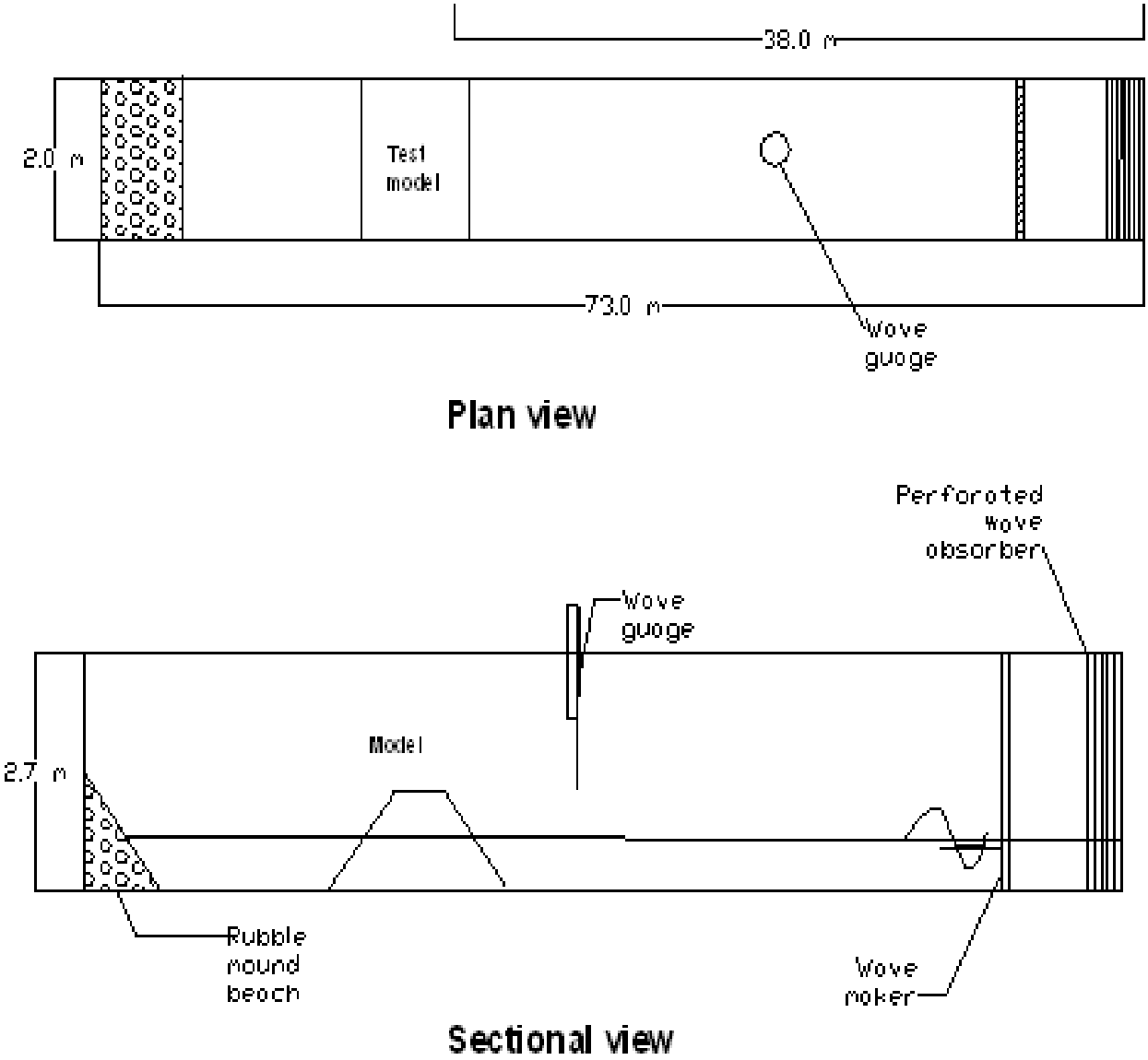


Fig 6.2 View of breakwater model in the wave flume

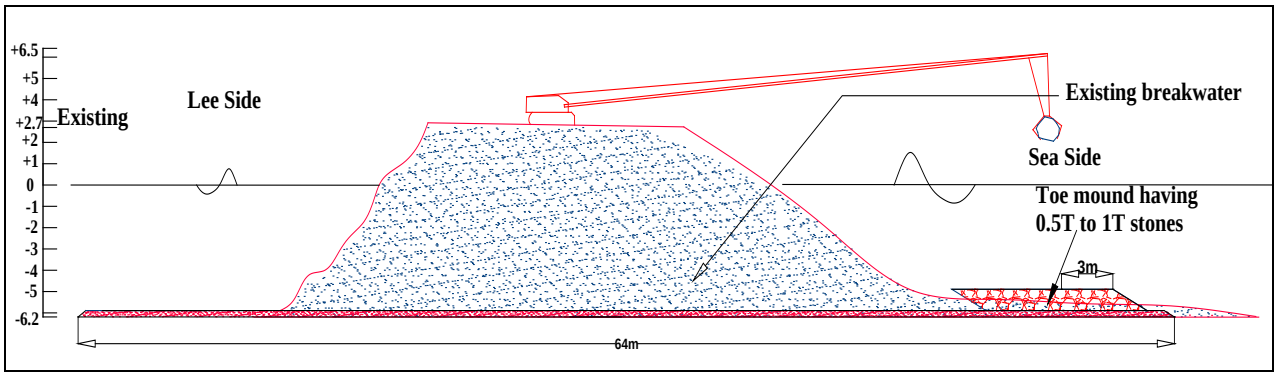


Fig 7.1 Construction of Toe mound

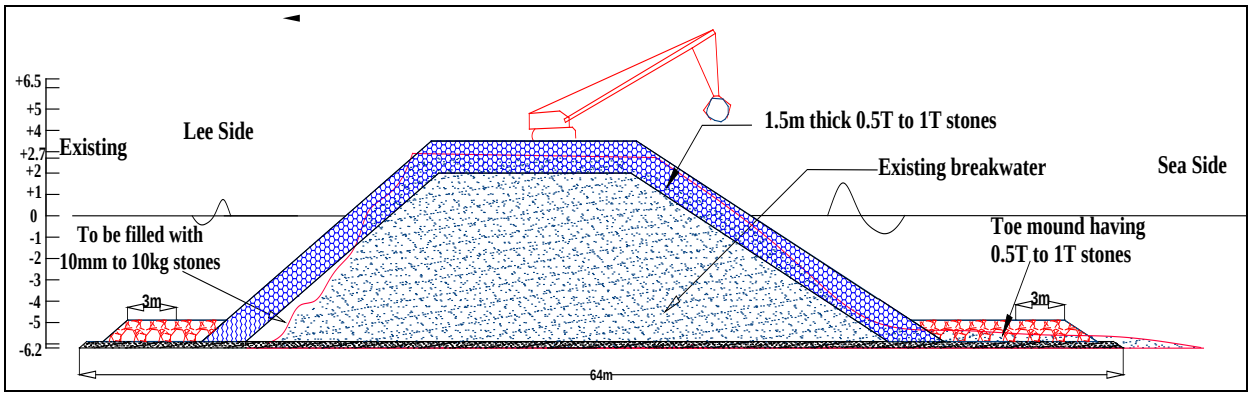


Fig 7.2 Construction of Underlayer

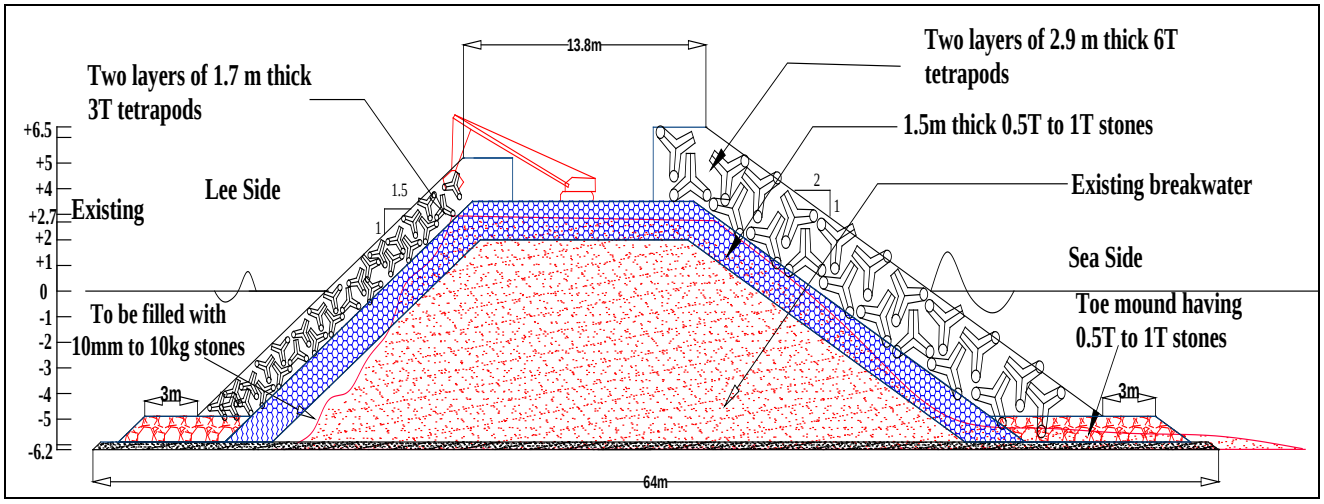


Fig 7.3 Construction of Armour layer

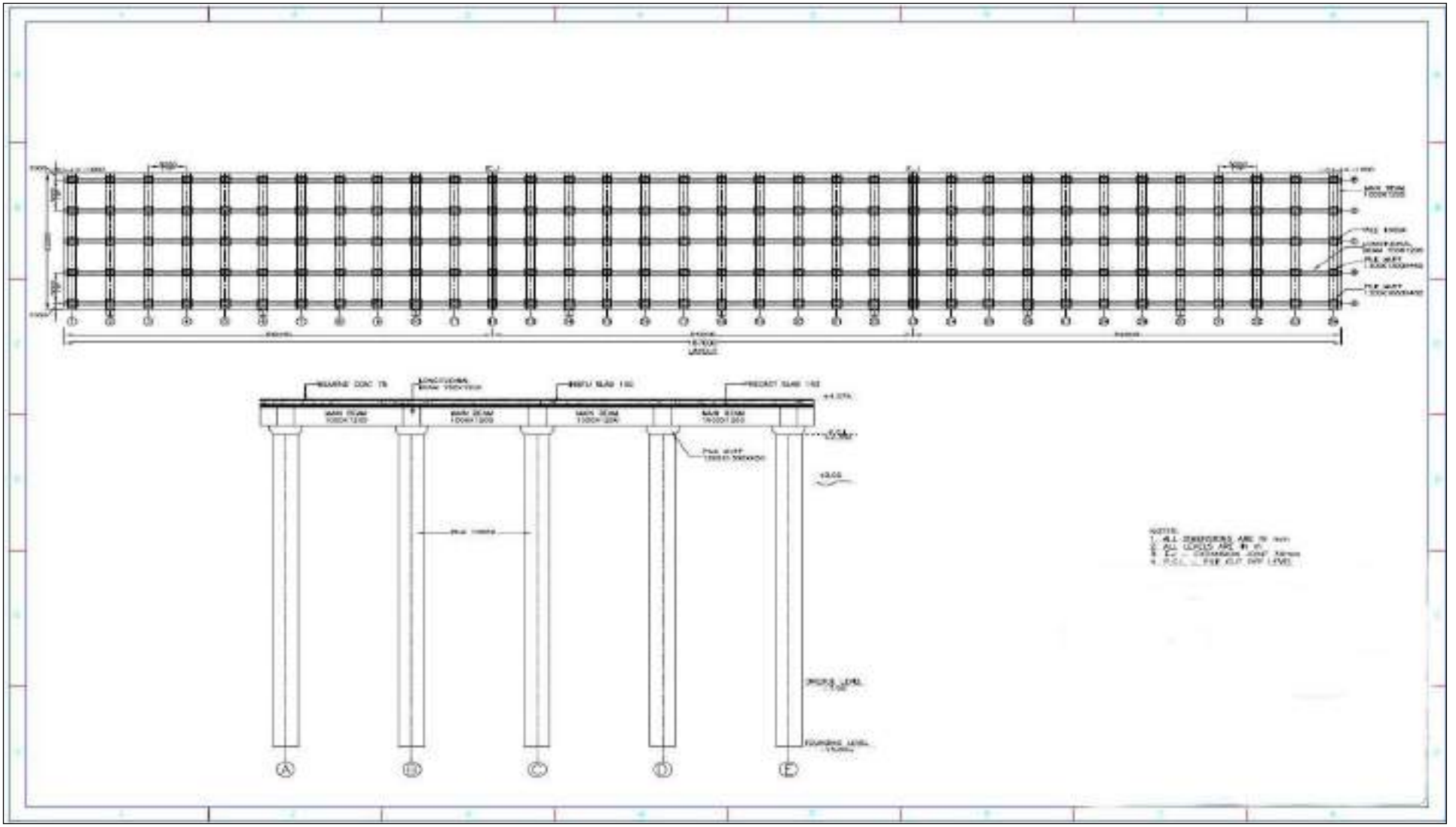


Fig. 8.1: Design of Pier No. 3 (New Commercial berth)

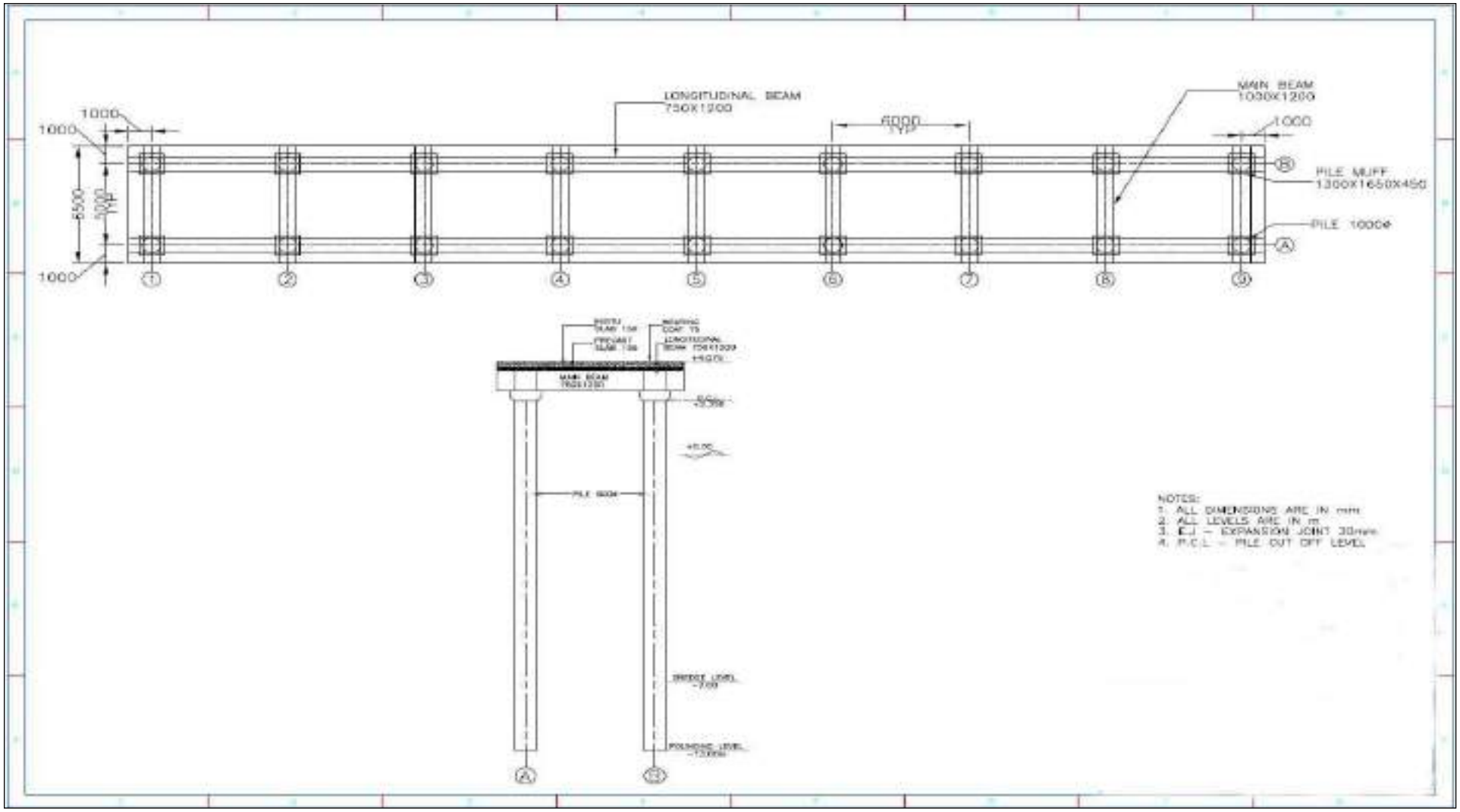


Fig. 8.2: Design of Pier No. 1

Annex III

Persons consulted

Annex III – Persons consulted

Index no	Date consulted	Name	Address	Opportunity
1	30/07/2018	K. Siva Sri	DS office, Walikamam North	Divisional secretariat
2		N. Raveendran	233, KKS west GN office, KKS	Grama NIladhari
3	01/08/2018	S. Dewasuriya	KKS port office	Works manager
4		Nawarathne	KKS port office	Operator
5		J. Sudaharan	Fisheries department, Jaffna	Assistant director
6	02/08/2018	S. Kamalanadan	Kovil road, Kankasanthurai	Member of Pradeshiya sabha
7		P. Aranthawarasa	Kovil road, Kankasanthuray	Fisherman
8		T. Thewarasan	Keeramale road, Kankasanthurai	Ex DS Walikkalam
9		K. Neranjan	Post master, Palali , Sub [post office for army	Post master
10		S. Sivapadan	Elawatti east, Elawatti	Community leader
11	03/08/2018	P.Manoharan	Elawatti east, Elawatti	fisherman
12		M. Gnaeshwari	Kanakasabewatta, Keeramale	House made
13		K.Kannan	Kanakasabewatta, Keeramale	fisherman
14		S.Sinnathambi	Kanakasabewatta, Keeramale	fisherman
15		K. Shandani	Keeramale road, Kankasanthurai	fisherman