Project Proponent NEW MANGALORE PORT

AUTHORITY



Prepared By



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ÚLTRA TECH

PREFACE

This EIA report is prepared as per scope of work prescribed by New Mangalore Port Authority and Standard Terms of Reference published by MoEF&CC for Port, Harbour and Jetty Project. EIA manual prepared by IL&FS Ecosmart Limited; Hyderabad is also followed while preparing this EIA report.

Disclaimer:

This report has been prepared with all reasonable skills, knowledge, care and diligence by M/s ULTRA TECH, Environmental Consultancy & Laboratory Thane, the NABET accredited and national level leading Environmental Consultancy Organization within the terms of the contract with the client (Project Proponent), incorporating their General Terms and Conditions of Business and taking account of the resources devoted to it by Business Agreement. The report was discussed with the project proponent in detail before releasing. This EIA report has been prepared using information received from Client, collecting primary data and compilation of secondary data from available resources. We are not responsible for the origin and authenticity of the information, drawings or design details provided by the Client.



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ULTRA TECH is thankful to New Mangalore Port Authority for providing opportunity to prepare Environment Impact Assessment Report for the proposed Development of Multipurpose Cargo Berth (Berth No.17) at New Mangalore Port Authority.

Thanks are due to Shri. A.V. Harinath, Chief Engineer (Civil), Shri. Shashikanth P. Kodi, Executive Engineer (Civil) and Dr. Roopashree Dhiraj, Deputy Manager-Environment from New Mangalore Port Authority for providing support during EIA preparation.

We sincerely feel this EIA report will be beneficial for New Mangalore Port Authority to mitigate environmental concerns related to propose Development of Multipurpose Cargo Berth (Berth No.17) at New Mangalore Port Authority, Karnataka.



Niranjan Shekhar Tamhane

Managing Director

ULTRA TECH

NABET Certificate No: NABET/EIA/2023/ RA 0194





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13.	Townships and Area development projects	39	8 (b)	В

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Signed for and on behalf of NABL



N. Venkateswaran Chief Executive Officer

Declaration by Experts contributing to the EIA for the Proposed Construction of Development of Multipurpose Cargo Berth (Berth No.17) at M/s. New Mangalore Port Authority.

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

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Name: Dr. Vikrant Kulkarni

Anni

Signature and Date:

Period of involvement: December 2021- February 2023

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Sr. No.	Functional Area	Name of Expert	Period of Involvement	Signature with date
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Declaration by the Head of the accredited consultant organization/ authorized person

I, Niranjan Shekhar Tamhane, hereby, confirm that the above mentioned experts prepared the EIA for Construction of Development of Multipurpose Cargo Berth (Berth No.17) at M/s. New Mangalore Port Authority. I also confirm that that EIA Coordinator (EC) has gone through the report.

It is certified that no unethical practices, plagiarism involved in carrying out the work and external data / text has not been used without proper acknowledgement while preparing this EIA report.

Signature

Name: Niranjan Shekhar Tamhane Designation: Managing Director Name of the EIA consultant organization: ULTRA TECH NABET Certificate No. & Issue Date: NABET/EIA/2023/RA0194





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1. INTRODUCTION

1.1. Introduction of New Mangalore Port Authority (NMPA)

New Mangalore Port is located on the West Coast of India and managed by New Mangalore Port Authority (NMPA) previously called as New Mangalore Port Trust (NMPT). The Port is a modern all-weather port situated at Panambur, Mangalore. The Mangalore Harbour Project started in 1962 and completed in May 1974. On 1st April 1980, the Port Trust Board was set up under the Major Port Trust Act, 1963 and the same was superseded on 18th February 2021, when Government of India by notification designated all the Major Port as Major Port Authority. Since then, NMPA has been functioning as the 9th Major Port and has fallen in line with other Major Port Trusts functioning in the country under the administrative control of Ministry of Ports, Shipping and Waterways (MoPSW).

New Mangalore Port is a deep-water port and the only major port of Karnataka. The port is approached through a 7.5 km long channel with water depths -15.4 m CD in the outer channel and -15.1 m CD in the inner channel. The Port has a total land area of approximately 822 ha. and water spread area of about 120 ha.

1.2. Background of the Project

Important part of the sea transport is the port infrastructure, which serves oceangoing and coasting activities such as loading and unloading of various goods and passengers as a connecting point for marine and land traffics. Activities in ports may decide a high or low economic growth in a region. The transportation sector is a strong factor in terms of economic and regional balanced development, as well as also having a great influence on national integration to the world economic activity in coastal areas. The higher the throughput of goods and passenger's year-on-year, the more infrastructures, provisions and associated services are required. These will bring varying degrees of benefits to the economy and to the country. Ports are also important for the support of economic activities in the hinterland since they act as a crucial connection between sea and land transport. As a supplier of jobs, ports do not only serve an economic but also a social function. In terms of load carried, seaway transportation is the cheapest and most effective transportation system compared to other systems. Industries require a safe and cheap means of exporting finished





goods and importing raw materials. Hence the majority of industries in the world are located in the coastal belts, in the vicinity of major ports. These industries in turn, influence the lives of the employees and indirect benefactors. This report seeks to study the role played by ports in the development of a nation.

The Earlier Berth No. 14 is the longest and deepest common-user berth among non-POL berths in the Port, with 350 metre length and 15.1 metre depth and hence, it is the most intensely used berth. All dry cargoes including coal, container, iron ore, fertilizer, gypsum, river sand, raw sugar, and breakbulk items like timber, machinery etc, and also edible oil use the berth when these cargoes come in bigger and deeper-drafted vessels. In 2017-18, among the multi-purpose berths, berth 14 handled the largest volume of traffic at 5.4 million tons (40 %) and received the highest berth occupancy (80%) among all the berths including crude and POL berth.

NMPA intends to develop the Berth No. 14 for handling container and clean cargo. It has therefore been decided to undertake Mechanization of the berth for providing equipment for handling containers through Public-Private Partnership (PPP) on Design, Build, Finance, Operate and Transfer (DBFOT) basis.

NMPA has handed over the existing multipurpose deep draft Berth No 14 for handling container through Mechanization to PPP operator and the Port will no longer have other deep draft berth general cargo to handle the large ships of 60,000 DWT and above. Therefore, Port has proposed to develop an additional deep draft general cargo berth in between berth No.8 and No.13, named as Berth No. 17. It is proposed to handle RO-RO/ Cruise ships bunkering cargo ships Iron ore fines/concentrate, fertilizers, river sand, bentonite, gypsum, machinery, steel coil etc. at the proposed new berth No. 17. The proposed handling capacity of the multipurpose Berth No. 17 would be 6.13 MTPA.

1.3. Purpose of the Report

As per Environmental Impact Assessment (EIA) Notification dated 14th September 2006, & it's amendments proposed project falls under category- 'A' of project activity 7(e) and requires prior Environmental/CRZ Clearance to be obtained from Ministry of Environment, Forest and Climate Change before the commencement of ground activity. The online application vide proposal (IA/KA/NCP/239741/2021) for prior EC (Form-1 and Pre-





Feasibility Report) for the proposed project was submitted to Expert Appraisal Committee (Infra - 1) on 25th November 2021 and the ministry issued the ToR on 6th January 2022 for Development of Multipurpose Cargo Berth (Berth No. 17) at New Mangalore Port by M/s New Mangalore Port Authority. A copy of the ToR along with its compliance is enclosed as **Annexure I**

1.4. Location of the project

New Mangalore Port is an artificially created lagoon type harbour with an approach channel. The Port is an all-weather port situated at Panambur, Mangalore (State of Karnataka in south India), on the west coast of India, 170 nautical miles south of Mormugao and 191 nautical miles north of Cochin Port. The project is located at New Mangalore Port Authority, Village Panambur, Tehsil Surathkal, Dakshina Kannada District, and Karnataka. The proposed location of the berth No. 17 has been identified as the existing waterfront in between berths No. 8 and berth No. 13. This is shown in the Figure 1.1. As can be seen, there is sufficient 3.5 Ha of back up area behind the berth for the storage of cargo.

1.5. Importance and Need of the Project

After converting the deep drafted berth No.14 into a container berth, the Port has no other deep draft berth to handle the displaced other cargo through large ships of 60,000 DWT and above. Therefore, Port has proposed to develop an additional deep draft general cargo berth between berths No.8 and No.13. The proposed berth location has a waterfront of around 390 m with sizable back up of around 3.5 Ha.

The purpose of the new deep drafted berth No.17 is to take over the deep drafted vessels presently calling at berth No.14 after it is dedicated to handle only containers. Hence it is necessary to review the pattern of traffic and ship sizes being handled at berth No. 14 for the past few years. It may be noted that the total traffic for each commodity is the volume of cargo handled by the ships on their port calls and not necessarily discharged at berth No.14 as some of the ships discharge their cargo at multiple berths.

The berth-14 is converted into an exclusive container terminal, the present container traffic will continue there. All coal (coal, steam coal, coking coal and coke) will be shifted to the berth No. 16 under license with Mangalore Coal Terminal Private Limited developed under PPP mode. This leaves Iron ore fines/concentrate, fertilisers, river sand, bentonite, gypsum,





machinery etc. to be handled at the proposed new berth No. 17. However, both berths No. 14 & No. 16 have been permitted to handle fertilisers, gypsum, limestone and dolomite to supplement their revenue till the time the traffic picks up to the expected level. But taking into consideration compatibility of cargo, ways of handling and transferring from berth to the storage yard, it is unlikely these could be handled at these two berths. Hence this proposed berth No.17 should be prepared to handle these cargoes also.

Container traffic at NMPA has grown from 94929 TEUs in 2016-17 to 150445 TEUs in 2020-21. The CAGR for Container Traffic for the past 5 years is an impressive 9.65%. Therefore, considering future prospects i.e., potential growth in container traffic and end of exclusivity to the upcoming JSW container terminal after 9 years, port may need to look at creating additional capacity for container handling. Hence, the upcoming berth may be designed to handle containers too. In such a case, the berth may be equipped to be operated using at least two RMQCs (Rail mounted Quay Cranes).

Anticipated benefits

By development of a new multipurpose cargo berth No. 17 there will be direct and indirect benefits to the country in general and the new Mangalore port and its hinterland in particular. Even on a pessimist approach the new terminal will be able to handle 340000TEU or 4 MTPA additional cargo. This will trigger development of major and minor industries, processing units, employment potential in the hinterland apart from sizeable income to the port exchequer from the EXIM trade.

1.6 Location and Overview of Environmental Setting of Project Area

The proposed location of the berth No. 17 has been identified as the existing waterfront in between berths No. 8 and berth No. 13. Site Coordinates are - Latitude -12°55'26.39"N; Longitude- 74°48'58.66"E. There is no displacement of community or destruction of any vegetation, etc. The satellite imagery of the proposed location is given in Figure 1.1.

Dakshina Kannada is a maritime district located in the south-western part of Karnataka adjoining the Arabian Sea. The geographical area is 4770 sq. km extending between 12°30'00'' & 13°11'00'' north latitude and 74°35'00'' & 75°33'30'' east longitude. Mangalore town is the district headquarters. Administratively the district is divided into five taluka's viz. Bantwal, Belthangady, Mangalore, Puttur and Sulya. Dakshina Kannada district





of Karnataka has a total population of 2,089,649 as per the Census 2011. Out of which 1,034,714 are males while 1,054,935 are females. In 2011 there were a total 439,733 families residing in Dakshina Kannada district. The Average Sex Ratio of Dakshina Kannada district is 1,020 (As per 2011 Census). The district is drained by Netravathi, Gurupur, Mulki, Kumaradhara, Payasvini and and Shambhavi rivers which originate in the Western Ghats and flow westwards to join the Arabian Sea.



Figure 1-1: Location of the proposed project





The detailed environmental settings around New Mangalore Port are depicted in Table 1.1.

Table 1-1: Environmental Sett	ings at and around the Project Site
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S. No.	Particular	Details			
1	Project Location	New Mangalore Port			
2	Site Coordinates	Latitude -12°55'26.39"N Longitude- 74°48'58.66"E			
3	Toposheet	48L/13, 48K/16			
5	Railway Station	Mangalore Railway Station - 7.4 km Surathkal Railway Station- 6 km Thokur Railway Station - 4.5 km			
6	Airport	Mangaluru International Airport - 7.0 km			
7	Sea Port	Project is located within the New Mangalore Port			
8	Village/Major Town	Mangalore City - Approx.4.00 km Kuloor - Approx.1.30 km			
9	Ecologically Sensitive Zones	Mangroves near Kasba Bengre – Approx. 3.56 km Mangroves near Baikampady – Approx. 3.35 km Gurpur River - Approx.0.65 km Baggundi Lake - Approx. 4.00 km Kavoor Lake - Approx.4.60 km Gujjar Kere Lake, Bolar - Approx.9.30 km Pilikula Nisarga Dhama, Vamanjoor Approx.8.50 km			
10	Historical/ Tourist Place	Sultan Bathery – 3.78 km Tippu Sultan Fort - 4.00 km			





	Shree Nandaneshwara Devasthana - 1.70 km			
		Panambur Beach - 2.00 km		
		Tannirbavi Beach – 3.35 km		
	Beach resorts	Samudra Darshan Beach House – Approx. 7 km		
11		Sharath Villa Beach Homestay – Approx. 6.26 km		
		Raj Sea Front Beach Resort – Approx. 4.58 km		
12	2 Coastal Areas rich in corals, mangroves, breeding ground of specific species Coastal Areas rich in corals, mangroves, breeding ground of specific species Coastal Areas rich in Mangroves are present within 10 km of the project Mangroves near Kasba Bengre – Approx. 3.35 km			
13	Biosphere reserves	None at the project site and none within 10 km of the		
		project site		
14	Defense installations, especially those of security importance and sensitive to pollution	Indian Coast Guard Station – Approx. 2.00 km		
	Water Bodies/ Reservoirs	Arabian Sea - Abutting		
		Gurupura River - Approx.0.65 km		
		Baggundi Lake - Approx. 4.00 km		
15		Kavoor Lake - Approx.4.60 km		
		Gujjar Kere Lake, Bolar - Approx. 9.30 km		
		Pilikula Nisarga Dhama, Vamanjoor - Approx.8.50 km		
		Netravathi River – Approx. 9.5 km		
16	Critically polluted areas as per MoEF notification	None within 5.0 km radius from the boundary of the project site		





18	Seismic Zones	Seismic Zone-III as per IS 1893 (Part I): 2002		
19	Corals, coral reefs and associated biodiversity	None within 10 km radius from the boundary of the project site		
20	Sand dunes	None within 10 km radius from the boundary of the project site		
21	Mud flats	None within 10 km radius from the boundary of the project site		
22	National parks, marine parks, sanctuaries, reserve forests, wild life habitats	None within 10 km radius from the boundary of the project site		
23	Salt mashes	None within 10 km radius from the boundary of the project site		
24	Turtle nesting grounds	Bengre coastal regions- Approx. 8 km		
25	Horse shoe crab habitats	None within 10 km radius from the boundary of the project site		
26	Sea grass beds	None within 10 km radius from the boundary of the project site		
27	Nesting grounds of birds	None within 10 km radius from the boundary of the project site		
28	Nearest Industries	KIOCL Limited – Approx. 0.62 km BASF, Katipalla – Approx. 6 km HPCL, Mangalore – Approx. 5.6 km MRPL- Approx. 1.97 km MCF- Approx. 1.30 km		

*All distances are measured as aerial distance





1.7 Objective of EIA Study

The objective of the Environmental Impact Assessment is to assess the likely impacts of proposed development of multi-purpose berth on the existing quality of land, marine water, noise, air quality, marine as well as terrestrial ecology and socio-economic environment during construction and operation phases. Mitigation measures in the form of an Environmental Management Plan (EMP) have also been outlined as a part of the EIA report.

The State Pollution Control Board (SPCB) accords No Objection Certificate (NOC), Consent for Establishment and Consent for Operation for the projects. As per the list of projects or activities requiring prior environmental clearance given in the EIA Notification issued by MoEF&CC on 14th September 2006 and amended till date, proposed project is listed on S. No. 7 (e) and requires Environmental Clearance from the MoEF&CC.

As the proposed development will be in a CRZ area, CRZ Clearance is mandatory under the CRZ Notification 2011.

Environmental Impact Assessment (EIA) study needs to be conducted as per the guidelines stipulated in the EIA notification of September 2006 and CRZ Notification of January 2011. Hence it is proposed to conduct an EIA study to assess the impacts likely to occur as a result of various activities associated with the project. A suitable Environmental Management Plan (EMP) will be prepared based on the impacts identified to mitigate the adverse impacts. An Environmental Monitoring Plan will also be suggested in this EIA report.

The HTL/LTL demarcation for the project site was conducted through Institute of National Centre for Sustainable Coastal Management (NCSCM).





Figure 1-2: Toposheet showing area within 10 km radius from the project site





1.8 Methodology for EIA Study

Detailed review of the feasibility report for the proposed project has been carried out. Detailed study area of 10 km radius is attached as **Annexure II** that marked using latitudes and longitudes of the project site. For all major environmental components, primary data was generated and compared with available historical/published information for assessment of various environmental components to develop EMP.

Land use pattern was mapped within 10 km radius from the proposed site using GIS II remote sensing maps followed by ground truth verification. Baseline monitoring program was undertaken for three seasons (December 2021 – February 2022; March – May 2022 and October-December 2022) to establish the background air quality, ground and marine water qualities, soil quality and noise levels in the study area. Meteorological data pertaining to Mangalore Port area was collected from IMD.

Ecology and biodiversity studies were carried out for terrestrial and marine components of the study area. Field Survey was undertaken to develop socio-economic profile of the study area and was compared with published census data for further refinement. Marine Ecology study was carried out by NIO, Goa.

A detailed review on the possible environmental pollutants such as liquid and solid wastes was undertaken. Impact Assessment of various environmental components have been carried out using standard EIA tools and techniques with appropriate input of primary and secondary baseline data to determine the significance of the impact. Various activities those are envisaged during construction and operation phases of the proposed project were evaluated for its significance. Based on the impact, suitable EMP was developed to mitigate the pollution. Risk assessment study, emergency response plan were also prepared for the proposed project. CRZ map was prepared by Institute of National Centre for Sustainable Coastal Management (NCSCM), Detailed Project Report for the proposed berth no. 17, CWPRS Reports, Oil Spill Contigency Plan, and Ship Tranquillity Study, Traffic Management and Decongestion Study by IIT Bombay etc was carried out for the proposed development.





1.9 Structure of EIA Report

The present EIA Study Report is organized into eleven chapters and all relevant aspects as per MoEF&CC guidelines and EIA Notification 2006 and its subsequent amendments thereon, has been addressed in this report.

Chapter 1: Introduction

This Chapter describes the details about the introduction of proponent, objectives of EIA study and EIA methodology adopted for undertaking this EIA study.

Chapter 2: Project Description

This Chapter explains need of the project, existing activity, land details, project cost and project completion schedule.

Chapter 3: Description of Environment

This Chapter describes about the existing baseline environmental conditions of the study area. Various environmental components such as air quality, water quality, noise levels, meteorological data, ecological and biological aspects, marine environment and socio-economic profile Geological and Hydrogeological conditions, Summary of NIO Report have been presented.

Chapter 4: Anticipated Environmental Impact and Mitigation Measures

This Chapter presents cumulative (positive and negative) environmental impacts arising during the construction and operational phases of the proposed activities.

Chapter 5: Analysis of Alternatives (Technology & Site)

This Chapter presents analysis of alternate sites and technologies considered and the justification for selecting the proposed project site.

Chapter 6: Environmental Monitoring Programme





This Chapter describes the proposed Environment Monitoring Programme to be implemented during construction and operation stages of the proposed project. It also describes post project monitoring plan to be conducted under various stages and reporting procedures.

Chapter 7: Additional Studies

This Chapter presents the additional studies conducted such as summary of CRZ mapping by NCSCM, Hydrodynamic Modelling and Mathematical Model Studies for Ship Mooring Analysis carried out by CWPRS, Preliminary Risk Analysis, Disaster Management Plan, Oil Spill Contigency Plan, Shoreline Changes and Public Hearing etc.

Chapter 8: Project Benefits

This Chapter presents project benefits arising from proposed development

Chapter 9: Environmental Management Plan

This Chapter presents Environmental Management Plan (EMP) which includes the administrative and technical setup, summary matrix of EMP, the cost involved to implement the EMP, both during the construction and operational phases.

Chapter 10: Summary and Conclusions

This Chapter presents Summary of the full EIA Report.

Chapter 11: Disclosure of Consultants Engaged

This Chapter presents names of the consultants engaged with their brief resume and nature of consultancy rendered.





Photographs of the Project Site and Vicinity







2 **PROJECT DESCRIPTION**

2.1 History of Mangalore and Mangalore Port

Mangalore, officially known as Mangaluru, is a major port city of the Indian state of Karnataka. It is located between the Arabian Sea and the Western Ghats about 352 km (219 mi) west of Bangalore, the state capital, 20 km north of Karnataka–Kerala border, 297 km south of Goa. The city developed as a port in the Arabian Sea during ancient times, and has since become a major port of India that handles 75 percent of India's coffee and cashew exports. It is also the country's seventh largest container port. Mangalore has been rsuled by several major powers, including the Kadambas, Alupas, Vijayanagar Empire, Keladi Nayaks, and the Portuguese. The city was a source of contention between the British and the Kingdom of Mysore rulers Hyder Ali and Tipu Sultan, and was eventually annexed by the British in 1799. Mangalore remained part of the Madras Presidency until India's independence in 1947 and was unified with Mysore State (now called Karnataka) in 1956. Mangalore is the state's only city to have all four modes of transport—air, road, rail and sea. The population of the urban agglomeration was 2,089,649 according to the 2011 national census of India. It is known for being one of the locations of the Indian strategic petroleum reserves.

Mangalore has a long history dating back to the early Christian era. Mangalore is mentioned in the manuscripts of the Great Library of Alexandria, Egypt. Roman history describes Mangalore as a Port on the mouth of the river Netras (Netravati) as the old port was located at the confluence of Gur purand Netravati River. Greek drama also alludes to Mangalore described as Mangala. Ptolemy, the astronomer and famous explorer of the 2nd century makes a mention of Mangalore in his travelogue. During the time of Vijayanagara Empire, Arab traders had established a flourishing trade in silk and spices between Mangalore and West Asia and even now are known as the Gateway of Karnataka.

Situated at the convergence of Gurupur and Nethravathi rivers, the Old Port(Bunder) had its own constraints to meet the growing demand for sea trade. The need for a new port was felt and the New Mangalore Port was born. The Mangalore Harbour Project was set up in the year 1962. The maritime works on the project commenced in 1968. The New Mangalore Port, the





only Major Port of Karnataka was declared as the 9th Major Port on 4th May 1974 and was formally inaugurated by the then Prime Minister of India, Smt. Indira Gandhi on 11th January 1975. The provisions of the Major Port Trust Act 1963 were applied to NMPA with effect from 01.04.1980. Since then, the Port has been functioning as a center of activities for Importers and Exporters of this region.

Over the years the Port has grown from a humble beginning of handling less than a lakh tonnes of traffic to the present level of handling 39.15 million tonnes during the last financial year 2019-20. The major commodities exported through the Port are POL Products, iron ore pellets, containerized cargo, etc. The major commodities imported through the Port are POL Crude for MRPL, Cement, coal, fertilizer, edible oil, liquid chemicals, containerized cargo etc. The Port provides all the facilities for handling the cargo of mega industries like MRPL-ONGC, OMPL, KIOCL, TOTAL GAZ, MCF, HPCL, IOC, UPCL, etc.

2.2 Green Port Initiatives at New Mangalore Port

New Mangalore Port – during last five decades of its service has witnessed exponential growth in terms of trade & commerce without compromising key and critical elements of environment. "MARITIME INDIA VISION 2030" the ambitious project of Ministry of Ports, Shipping & Waterways, with the aim of overhauling the Indian maritime has emphasized on Green Port Initiatives under which it plans development of green sustainable ports with an aim to increase the share of renewable energy to over 60 per cent by 2030. In line with this New Mangalore Port has successfully implemented various initiatives to ensure improved environmental performance.

The Port has created a green belt around its vicinity and has earmarked 33% of its land area exclusively for greenery. For the last 5 years 1 lakh saplings were planted and the process is still going on. Being ISO 14001 certified, NMP had its Plan & vision in place and strives relentlessly to achieve the best results. The collective vision of Management had addressed the issue of "drinking water" and "sewage system" in the Port. The Port has developed Sewage Treatment Plant with a capacity of 1.20 MLD inside the Port area. This STP is enabled to receive domestic sewage of township and inside the Port as well. The treated water is used for watering the green belt and also for water sprinkling in operational areas. The Port has installed Slop Reception





facility for the vessels visiting to the Port and ensures hazardous wastes are disposed through authorized recyclers only. The Port has also developed an Oil Spill Response plan to monitor and control oil spills. Oil pollution drills are conducted regularly in compliance with NOSDCP and NMP is the first port to record the approval of its OSCP in 2017 by ICG complying with Tier-I OSR facility. To meet the water requirement, the Port has envisaged comprehensive plan to harvest the rain water. In this direction, 3 large water bodies have been created inside the Port area, in the catchment areas covering 64,217 sq. m with a capacity of 1, 10,340 Cubic meter of water. Due to creation of water bodies, the water requirement. The detail of various sources of water supply system at NMPA is provided in Table 2.1 below.

Sl. No.	Particulars of source	Size/capacity	Construction period
1	RCHW pump house open well	11 m dia. x 6 m Depth	-
2	Stadium Well	25 mx10 mx7 m	2006-07, 2015-16 (Extension)
3	Timber yard well	10 m Dia. x11 Depth	2017-18 (Reconstruction)
4	Thimmappayya well	47 m x17 m x 6.5 m	2001-02, 2010 (extension)
5	New UGR open well	9 m Dia. x 8 m Depth	-
6	Marshalling yard pond	6000 sq. m (6000 KL)	2011-12
7	Thimmappayya well pond	25028 sq. m (1,25,140 KL)	2013-14
8	Pond between Customs house and MCF	3900 sq. m (3900 KL)	2012-13
Sl. No.	Particulars of source	Capacity (in KL)	
1	RCHW pump house open well	570	-
2	Stadium Well	1750	-
3	Timber yard well	860	
4	Thimmappayya well	5200	_

Table 2-1 Details of various sources in water supply system (RWH) at NMPA





New UGR open well 510		510	-			
Marshalling yard pond	6000		-			
Thimmappayya well pond	125140		-			
Pond between Customs house and MCF	3900		-			
Total capacity from internal sources (in KL)		3930.00	-			
7 UGRs with a total storage capacity 4015 KL						
8 ESRs with a tot	al capacity	2930 KL				
Supply 1	Nil					
Average daily consumption 1800 KL to 2000 KL NMPA – is Self-sourcing for Water Consumption						
	New UGR open well Marshalling yard pond Thimmappayya well pond Pond between Customs house and MCF al capacity from internal sources (in KL) 7 UGRs with a total storag 8 ESRs with a tot Supply f Average daily con NMPA – is Self-se	New UGR open well Marshalling yard pond Thimmappayya well pond 1 Pond between Customs house and 1 MCF 14 al capacity from internal sources (in KL) 14 7 UGRs with a total storage capacity 8 ESRs with a total capacity 8 ESRs with a total capacity Supply from MCC Average daily consumption 1 NMPA – is Self-sourcing for 1	New UGR open well510Marshalling yard pond6000Thimmappayya well pond125140Pond between Customs house and MCF3900al capacity from internal sources (in KL)143930.007 UGRs with a total storage capacity4015 KL8 ESRs with a total storage capacity2930 KLSupply from MCCNilAverage daily consumption 1800 KL to 2000 I NMPA – is Self-sourcing for Water Consumption			

The Port has installed 5.2 MW solar plants in addition to roof top solar panels at the top of buildings and storage sheds at a total expenditure of Rs. 33.75 crores. The Port has generated total solar energy of 34.95 million KWH up to December 2021 & has achieved the coveted credit of meeting 100% of its power requirement from the solar panels. Due to this nearly 29,709 tonnes of carbon foot print has been reduced (up to December 2021) and helped in saving approximately Rs. 23 Crores in electricity bills for the port in 5 years.

The Port has also switched over to LED lighting which are more environment –friendly coupled with power saving. Over the years the port has mechanized almost 90% of its operations so as to mitigate dust pollution in the operational areas as per the Green Port initiatives under MIV 2030. Handling of coal, IOP, cement, etc. are now fully mechanized. The port is also not lagging behind in usage of e-vehicles. All the port vehicles will be changed to electrical vehicles in phases. Two electric buses will be hired for transportation in operational areas inside the harbor in view of adopting multi-clean fueled vehicles.

As part of the future plans the Port will be constructing an exclusive in-house facility to manage solid waste generated in the residential area & Port premises. The plastic waste generated in the Port will be segregated & disposed through an authorized recycler as per Central Pollution





Control Board guidelines. In view of re-using the materials generated through Dredging in Port waters the work feasibility study has been entrusted to NTCPWC, IIT (Chennai). The Port is also exploring the possibilities of setting up of a LNG Terminal which will facilitate LNG bunkering of vessels calling at NMP.

Apart from this the Port has implemented ISO 14001 & MARPOL and is in process for implementing OHSHAS 18001 which is an International Occupational Health & Safety Management Certification.

2.3 Rail and Road Connectivity

Road Connectivity

The Port is connected with 3 National Highways. The main road networks connecting the hinterland to New Mangalore Port are as follows:

NH-66 connecting Kochi – Mangalore – Goa – Mumbai

The National Highway NH 66 stretches from Kochi to Mumbai linking many important cities and towns in its route. The south bound cargo utilizes this route. NH 66 is a four lane road and part of the stretch is two lane road which are being widened to 4 lanes with a provision to expand to six lanes to accommodate future expansions.

NH-75 connecting Bangalore – Hassan - Mangalore

The NH 75 connects directly Mangalore to Bangalore via Hassan. This road serves the requirement of eastern and southern Karnataka. National Highway 75 is getting widened and upgraded to the 60 m wide, 4-lane highway.

NH-50 connecting Mangalore – Shimoga – Chitradurga – Bijapur – Sholapur

NH 50 aligned north-east connects Mangalore to Sholapur. The north bound traffic utilizes this route. This NH 50 has a total length of 691 km out of which 43 km of NH is in Maharashtra and 648 km of NH is in Karnataka. Though road is marked as a national highway, it is narrow along many stretches causing frequent mishaps. This highway is a 2 lane highway which is undergoing up gradation to 4 lanes. The road connectivity to New Mangalore Port is as shown in Figure 2.1.




Figure 2-1: Road Connectivity to New Mangalore Port

Rail Connectivity

New Mangalore Port is connected to the Indian Railway Network through Southern Railway, South Western Railway and Konkan Railway. The Railway Marshalling Yard at Panambur, inside the New Mangalore Port, is a part of the Southern Railway. This is connected to the Konkan rail network at Thokur providing access to Mumbai via Coastal Karnataka and Goa and to the South Western railway at Kankanady providing access to the Karnataka heartland and Bangalore and Mysore via Hassan and to Kerala through the southern railway. The rail connectivity to New Mangalore Port is as shown in Figure 2.2.







Figure 2-2: Rail Connectivity to New Mangalore Port

2.4 Existing berths and other details

New Mangalore Port is an artificially created lagoon type harbour with an approach channel. The Port is an all-weather port situated at Panambur, Mangalore (State of Karnataka in south India), on the west coast of India, 170 nautical miles south of Mormugao and 191 nautical miles north of Cochin Port.

The port is approached through a 7.5 km long channel with water depths -15.4 m CD in the outer channel and -15.1 m CD in the inner channel. The Port has a total land area of approximately 822 ha and water spread area of about 120 ha. Detailed Layout plan is attached as **Annexure III**.







Figure 2-3: Overall Layout of NMPA Port

The Port has 3 dock basins.

- Eastern dock basin
- Western dock basin
- Oil dock basin

The eastern dock comprises of 7 multipurpose berths and western dock with 2 berths. A deep draft multipurpose berth exists between eastern and western dock area. The southern arm comprises of 5 jetties to handle liquid bulk and POL. There is also an offshore Single Buoy Mooring for handling VLCCs.

2.4.1 Berths at Eastern Dock Basin (Berths 1 to 7)

The eastern dock arm has 7 berths. Out of these, Berth No. 1 is a shallow berth with a draft of 7 m and is used to handle general cargo. General cargo is also handled in Berths No.2 & No.3 with draft of 10.5 m. Berth No. 4 handles general cargo and in addition is reserved for handling phosphoric acid and liquid ammonia of MCF as this berth is connected by pipelines to the respective tankages nearby. This berth also handled passenger vessels, since a part of the transit





shed has been remodelled as a passenger station with all modern amenities for handling cruise passengers. Berth No. 5 handles general cargo, palm oil, edible oil. This berth is reserved for handling bulk cement of Ambuja Cements and Uniteck Cements since this berth is connected by pipelines to their respective cement silos nearby. Berths No. 6 & No. 7 handles bulk cargos. These berths cater to ships with draft of 9.5 m.



Figure 2-4: Layout of Eastern Dock Basin (Berth No. 1 to 7)

Berth No. 14

This is a deep draft multipurpose berth handling dry bulk and general cargoes. The berth has a length of 350 m with the dredged depth of -15.1 m CD to cater ships of 14 m draft. About 7 acres of land just behind has been designated for storage for this berth. The cargo is handled through mobile harbour cranes. This berth is the only deep draft berth with majority of the cargo being coal handled at this berth.







Figure 2-5: Deep Drafted Berths No. 14

2.4.2 Berths at Western Dock Basin

Berth No. 15

Berth No.15 is a captive berth for Udupi Power Corporation Limited. It is a fully mechanized berth which includes grab unloaders, conveyor belt system connected to stackyard and rail loading silo at the western side marshalling yard.



Figure 2-6: Captive Berth No. 15 of Udipi Power Corporation Ltd





Berth No. 8

This berth is designated for handling Iron ore for Kudremukh iron ore plant and has a capacity of 6.6 MTPA for importing iron ore and exporting pallets. The overall length of the berth is 300 m and has a depth of 12.5 m capable of handling vessels upto 60,000 dwt. Behind this berth, an area has been allotted to KIOCL for locating their stackyard, palletisation plant etc.



Figure 2-7 Berth No. 8 allotted to KIOCL with back-up area

2.4.3 Berths at Oil Dock Basin (Berths No. 9 to No. 13)

All these berths are dedicated oil berths for handling Crude oil, POL products and LPG. These are transported through pipelines to MRPL Refinery and the tankages of other oil firms.







Figure 2-8: Berths No. 9 to No. 13 in Oil Dock Basin with Tank-farms

Berth No. 16

For improving the capacity, the port has taken up the project of mechanisation of Berth No.16 with a capacity to handle all coal other than that of UPCL. The concession for mechanisation and operation of this berth has been awarded to the consortium of M/s. Chettinad Builders Private Limited (JSW Infrastructure purchased ownership of terminal during 2020) on revenue sharing basis. The terminal was inaugurated by May 2019 and the cargo handling capacity is 6.73MTPA. Details of Cargo handled at New Mangalore Port.

2.5 Present Proposal for Development of Additional Deep Draft General Cargo Berth No 17

The Chief Engineer (Civil) i/c, New Mangalore Port Authority, Panambur, Mangalore has requested the National Technology Centre for Ports, Waterways and Coasts, Department of Ocean Engineering, Indian Institute of Technology Madras to prepare Detailed project report (DPR) for the proposed development of additional deep draft general cargo berth which has to handle coastal cargo also as well as Ro-Ro vessels and provisions given for container vessels (Berth No.17) in New Mangalore Port. Port also has the plan for deepening the channel, turning circle to handle cape size vessels. NMPA has informed NTCPWC, IIT Madras vide letter No.17/1/DPR-B.NO.17/EE (MW)/2020-21/TS on dated 21.08.2021 in Proposed Berth No.17.





NTCPWC, IIT Madras included in the DPR for provision of container handling in futures which is restricted to 6500TEU vessel with LOA of 300m.



Figure 2-9 Location of Proposed Berth No.17

2.6 Aim and objectives of the traffic study

The aim of the study was to assess the traffic potential of the proposed berth 17 for determining its economic viability.

Objectives

- a) To identify the cargoes that have the propensity to go to berth 17
- b) To determine how much quantity of each identified cargo, based on the present level of traffic, would need berth 17 and how much total volume of cargo the berth could get in its first year of operation
- c) To estimate how much traffic berth 17 could get in the near term, (2029-30), medium term (2039-40) and long term (2049-50)

2.6.1 Performance of Port

The operational performance of the Port in the last three years is as follows.





Details of operational performance	2021-22	2020-21	2019-20
1. No. of vessels handled			
a) Dry Bulk (Total)	232	238	298
i. Conventional + Semi Mech.	68	74	147
ii. Mechanical	164	164	151
b) Break Bulk	124	98	50
c) Liquid Bulk	770	722	762
d) Container	167	179	241
e) Overall	1293	1237	1351
2. Avg. Pre-berthing detention (Total In days)			
a) Dry Bulk (Total)	0.57	0.36	0.63
i) Conventional + Semi Mech.	0.19	0.18	0.91
ii) Mechanical	0.73	0.45	0.37
b) Break Bulk	0.21	0.22	0.13
c) Liquid Bulk	1.77	1.65	1.95
d) Container	0.07	0.02	0.05
e) Overall	1.19	1.05	1.26
3. Ave. Turn-Round Time (In hrs)			
Total (in hrs) (As per Readiness) *			
a) Dry Bulk (Total)	56.79	56.82	59.90
i) Conventional + Semi Mech.	95.64	94.64	78.97
ii) Mechanical	40.44	39.27	41.32
b) Break Bulk	24.59	31.01	56.66
c) Liquid Bulk	46.86	46.13	44.03
d) Container	42.60	39.13	31.96
e) Overall	46.18	46.01	45.84
4. % of Idle time at berth			
a) Dry Bulk (Total)	22.30	19.72	21.49
i) Conventional + Semi Mech.	24.05	21.37	24.08
ii) Mechanical	20.50	17.74	16.56
b) Break Bulk	36.64	38.03	26.17
c) Liquid Bulk	18.91	17.12	18.31

Table 2-2 Performance of port in the last three years





Details of operational performance	2021-22	2020-21	2019-20
d) Container	9.78	6.88	8.72
e) Overall	19.39	17.95	18.43
5. Av. Output per berth day (In Tonnes) *			
a) Dry Bulk (Total)	18,396	16,567	15,836

Details of operational performance	2021-22	2020-21	2019-20
3.1 PERFORMANCE OF PORT	10,946	10,736	11,987
The operational performance of the Port in the last three years are as follows.	25,840	23,576	23,146
b) Break Bulk	3,190	2,560	2,550
c) Liquid Bulk	18,465	18,477	18,780
d) Container	8,199	8,162	7,583
e) Overall	16,465	15,690	15,774
6. Avg. Dwell Time of Containers (in days)			
a) Import	8.85	12.53	8.77
b) Export	9.35	8.72	5.59
c) Overall	9.06	10.63	7.18

In order to understand the distribution of cargo between two groups of berths viz. shallow drafter Berth No. 1 to 7 and deep drafter berths No.8 & 14, the berth wise cargo traffic handled by these two groups in the last 4 years is brought out in the following table.

Table 2-3 berth	wise cargo	traffic	handled in	the la	nst 4	vears (i	in T	onnes)
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COMMODITIES	2018-19	2019-20	2020-21	2021-22		
I UNLOADED						
LIQUID BULK						
Crude	17244768	13748386	14049430	13973421		
LPG	2209009	2552076	2782958	2663000		
POL	884338	1185567	1021697	1098147		
Edible Oil	745391	733696	730584	773598		



Authority



COMMODITIES	2018-19	2019-20	2020-21	2021-22	
Others	355708	449990	543655	605330	
SUB TOTAL (A)	21439214	18669715	19128324	19113496	
	DRY B	ULK			
Fertilizer	364703	518150	778787	407853	
FRM (Dry)- Phosphate	82201	75691	61980	120000	
Cement	366828	355904	366069	253087	
Coal	6462684	5067724	3338454	3928238	
Other Dry bulk cargo-ore	2692840	2704466	2344970	2176363	
Others	1385566	1858099	371434	832919	
Containers	-	-	1489033	1409562	
SUB TOTAL (B)	11354822	10580034	8750727	9128022	
TOTAL OF $(A) + (B)$	32794036	29249749	27879051	28241518	
II LOADED					
	LIQUID	BULK			
Crude	-	114159	114385	523486	
POL	5507014	5012228	3923073	5478462	
OMPL	1011158	821410	791431	928378	
POL Bunker/Pipeline	-	239061	225537	257466	
Others	-	-	32924	14748	
SUB TOTAL (C)	6518172	6186858	5087350	7202540	
	DRY B	ULK			
Ore	2277160	2436098	2383558	2137656	
Coal	114275	74541	55089	87129	
Food Grains	554	550	-	916	
Other Cargo	803823	789315	120953	435895	
Container	-	-	801891	900339	
Misc cargo –railway	-	407848	172028	289619	
SUB TOTAL (D)	3195812	3708352	3533519	3851554	
TOTAL OF (C)+ (D)	9713984	9895210	8620869	11054094	
GRAND TOTAL (I+II)	42508020	39144959	36499920	39295612	





From the above table, extract of category wise cargo handled in the last 4 years is is brought in the following table.

(In Tonnes)						
Category	2018-19	2019-20	2020-21	2021-22		
a) Dry Bulk (Total)	1,24,38,809	1,17,06,327	95,42,243	1,00,65,220		
Conventional Semi Mechanical	75,96,612	59,47,352	34,54,162	32,41,306		
Mechanical	48,42,197	57,58,975	60,88,081	68,23,914		
b) Break Bulk	1,92,273	2,93,983	4,40,549	5,92,163		
c) Liquid Bulk	2,79,57,386	2,48,67,178	2,42,26,204	2,63,28,328		
d) Containers (In Tons)	19,19,552	22,77,471	22,90,924	23,09,901		
- (In TEUs)	1,31,613	1,53,351	1,50,445	1,52,484		
GRAND TOTAL	4,25,08,020	3,91,44,959	3,64,99,920	3,92,95,612		

NMPA carried out the TEFR for development of additional Deep Drought General Cargo Berth No17. The relevant details related to the present study are reproduced in the following sections.

• The purpose of the new deep drafted berth No.17 is to take over the deep drafted vessels presently calling at berth No.14 after it is dedicated to handle only containers. Hence it is necessary to review the pattern of traffic and ship sizes being handled at berth No. 14 for the past few years. From the records, it may be noted that the total traffic for each commodity is the volume of cargo handled by the ships on their port calls and not necessarily discharged at berth No.14 as some of the ships discharge their cargo at multiple berths.

An analysis of the above traffic data provides the following information:

- -Iron ore fines and concentrate traffic has been picking up in the last couple of years
- -Coal/steam coal/coking coal/coke traffic has also been picking up.
- -Container vessel calls with deeper draft have also been increasing.
- -During the past couple of years, traffic in imported sand has started.





- Iron ore fines and concentrate traffic has been picking up in the last couple of years Coal/steam coal/coking coal/coke traffic has also been picking up. • Container vessel calls with deeper draft have also been increasing. • During the past couple of years, traffic in imported sand has started.
- This leaves Iron ore fines/concentrate, fertilizers, river sand, bentonite, gypsum, machinery etc. to be handled at the proposed new berth No. 17. However, both berths No. 14 & No. 16 have been permitted to handle fertilisers, gypsum, limestone and dolomite to supplement their revenue till the time the traffic picks up to the expected level. But taking into consideration compatibility of cargo, ways of handling and transferring from berth to the storage yard, it is unlikely these could be handled at these two berths. Hence this proposed berth No. 17 should be prepared to handle these cargoes also.
- An analysis of ship card data for the past few years indicate that the largest iron ore vessel handled at berth No. 14 was of 106,590 dwt with a parcel size of 70,085 T at 14 m draft.
- The LOA of the vessel was 254 m. The largest parcel size handled was 82,500 T from a ship of size 95,766 dwt.
- As regards the largest coal carrier, it was 110,909 dwt but it carried lesser parcel size of 21,000 T at 11.90 m draft. The LOA of the vessel was 240 m. The largest coal parcel was 83,954 T carried by a ship of 108,709 dwt at a draft of 14 m. The LOA of the vessel was 230 m.

2.6.2 Traffic Analysis

New Mangalore Port's container traffic has been increasing successively in the last 10 years, concomitantly; there also has been an increase in the number of bigger and deeper-drafted container vessels calling at the Port. The Port has therefore decided to develop a dedicated container terminal at berth14 under PPP mode.

Berth 14 is the longest and deepest common-user berth among non-POL berths in the Port, with 350 metre length and 15.1 metre depth and hence, it is the most intensely used berth. All dry cargoes including coal, container, iron ore, fertilizer, gypsum, river sand, raw sugar, and





breakbulk items like timber, machinery etc, and also edible oil use the berth when these cargoes come in bigger and deeper-drafted vessels. In 2017-18, among the multi-purpose berths, berth 14 handled the largest volume of traffic at 5.4 million tons (40 %) and received the highest berth occupancy (80%) among all the berths including crude and POL berths.

The next deepest berth in the port at present is No. 8, with 13.5 metre depth. But it is a captive berth of KIOCL, which uses the berth for their iron ore pellet exports. Though the berth does handle other cargoes, KOICL's vessels get priority over other vessels.

Thus, port-privatization of berth 14 the Port will have no common-user berth to handle deepdrafted dry cargo vessels and edible oil vessels. The Port has therefore decided to develop another deep-drafted berth in the Port. The new berth is intended to handle in general all cargoes (except POL) brought in deep-drafted and big sized vessels, and in particular cargoes displaced from 14. The new berth, numbered 17, will come up between berth 8 and berth 13. At a length of 310 metre and depth of -15.4 metre CD. berth 17 will have the capability to handle up to mini capesize vessels (80k to 120k DWT) and even regular cape size (120k to 180k DWT) vessels if it is not fully laden.

NMPA through IPA, assessed the traffic potential of the proposed berth 17 for determining its economic viability, now based on the available traffic potential, NTCPWC to assess the economic viability of the project.

Considering the past traffic trend of the identified potential cargoes, the feedbacks and inputs received from port officials, port users and trade bodies, and the developments in the national and international scenes pertaining the identified potential cargoes to forecast the volume of traffic berth 17 can garner in the near term, by FY '30, medium term, by FY '40, and far term, by FY '50.

2.6.3 Berth Analysis

Following table shows essential details of the port's 15 +1 berths including their basic parameters, characteristics, the cargoes they handle and the topside facilities they have.





Table 2-4: Berth Analysis

Berth	Type of Berth	Maximum Draught Available (Mtrs.)	Quay Length (Mtrs.)	DWT (MT)	Top side facilities	
B 1	Gen.cargo	7.00	125	4,000	-	
B2	Gen.cargo	10.50	198	30,000	-	
B3	Gen.cargo	10.30	198	30,000	-	
B4	Gen.cargo/ Liq.Ammonia/ Phos. Acid	9.50	198	30,000	Pipelines for liquid cargo	
B5	Gen.cargo/ Bulk cement/ Edible Oil	9.50	198	30,000	Pipelines for edible oil and hoses for bulk cement	
B6	Gen.cargo	9.50	198	30,000	-	
B7	Gen.cargo	9.50	198	30,000	-	
B14	Gen.cargo	14.00	350	90,000	-	
B8	Coal/Iron Ore(KIOCL)	12.50	300	60,000	Ship Loader with conveyor system	
B9	LPG	10.50	330	45,000	-	
B10	Crude/POL Products	14.00	320	85,000	-	
B11	Crude/POL Products	14.00	320	50,000	-	
B12	POL /LPG/Edible Oil	12.50	320	50,000	-	
B13	POL /LPG/Liq.Cargo	14.00	350	85,000	-	
B15	Bulk Coal Handling (UPCL)	14.00	350	90,000	Ship unloader with	
B 16	Bulk coal(Chettinad)	14.00	325	90,000	conveyor system	
SPM	POL Crude	21.00	-	3,00,00	-	
	The overall usable of					

It can be seen that 75% to 80% of the traffic is accounted by liquid bulk, coal and iron ore. Existing berths No.1 to 7 is relatively shallow drafted and can cater to small sized ships only.





Excluding the berths in the oil dock basin, the other deep drafted berths are only berths No. 8, 14 and 15. Berth No. 15 is under captive use of Udupi Power Corporation Ltd. Berth No. 8 is mainly for the use of. Kudremukh Iron Ore Company Ltd. being adjacent to their plant. The two deep drafted berths handled almost twice the volume of traffic handled by the seven shallow drafted berths.

2.6.4 Cargo Analysis

The extract shows the category-wise and commodity- wise traffic handled in the past 4 years are shown below.

Category	2018-19	2019-20	2020-21	2021-22
a) Dry Bulk (Total)	1,24,38,809	1,17,06,327	95,42,243	1,00,65,220
Conventional +Semi Mechanical	75,96,612	2 59,47,352 34,54,1		32,41,306
Mechanical	48,42,197	57,58,975	60,88,081	68,23,914
b) Break Bulk	1,92,273	2,93,983	4,40,549	5,92,163
c) Liquid Bulk	2,79,57,386	2,48,67,178	2,42,26,204	2,63,28,328
d) Containers (In Tons)	19,19,552	22,77,471	22,90,924	23,09,901
- (In TEUs)	1,31,613	1,53,351	1,50,445	1,52,484
GRAND TOTAL	4,25,08,020	3,91,44,959	3,64,99,920	3,92,95,612

Table 2-5 Cargo wise traffic handled in the last 4 years (in Tonnes)

2.6.5 Traffic Projections for Berth No.17

The traffic for berth No.17 is projected for 3 terms, near, medium and far. Near term, from 2021-22 (expected launch year of the berth) to 2029-30, medium term, from 2030-31 to 2039-40 and far term, from 2040-41 to 2049-50.

The extract of projections was made for 2 scenarios, bullish and balanced or moderate, based on the following factors are reproduced below.

Bullish scenario:

In this scenario a somewhat optimistic growth has been assumed for all the identified potential cargoes, based on the following factors.





- Iron ore pellet export which was at its lowest point in 2015-16 at 0.4 million tons has jumped to 2.5 million tons in 2017-18, a whopping increase of 600% in 2 years. This may be a harbinger of happy times for iron ore pellet export and so in turn for iron ore import. The rebound in Chinese economy and its steel industry switching from sintering technology to IOP technology will vastly improve India's prospect for iron ore export. Already, China is the largest buyer of Indian IOP. In 2017-18, 81% of our IOP exports went to China. The above developments in China will not only enhance the proportion of our export but also will increase the volume in absolute terms. However, KIOCL has a capacity constraint for IOP production. Their present capacity is 3.5 million tons which they can ramp up to maximum 4.5million tons per annum if there is a corresponding demand. Besides, IOP, they have a facility for making another product use in manufacture of water pipes. For this product they would have to import 0.6 million tons of iron lumps. Thus, KIOCL's limit for iron ore import will be about 5 million tons. Accordingly, their iron ore import traffic is forecast only up to 2040 as they would have almost reached this quantity by then.
- Fertilizer import does not appear to be as rosy as iron ore import. However, we can expect a moderate to marginal growth over the next 30 years.
- Import of rock phosphate by Mangalore Chemicals and Fertilizers, a major importer of the material, may keep rising if they expand the production of NPK, which is the main purpose for which they are importing rock. Other fertilizer manufacturers also may start production of NPK thereby increasing the traffic further.
- There are bright prospects for river sand because of the ban on domestic sand mining and the boom in the construction industry.
- Gypsum import also will continue to grow like river sand due to the active and thriving construction industry
- Raw sugar and wheat, like all agro produces/products, are moody cargoes. They may soar or sink depending on the year-to-year monsoon intensity and the size of domestic harvests. So, on the positive side, we can consider a moderate growth for them.





• Edible oil import has been growing steadily over the years and this pace is expected to continue in the future as well.

Based on the above growth factors, the traffic for the bullish scenario for the 3 terms has been worked taking the predicted 2021-22 traffic as the base. A CAGR of 4% up to 2030 and 2% thereafter up to 2040 has been considered. For the last segment no growth is considered because the berth would have reached its rated capacity by 2040.

Timeline	FY 30	FY 40	FY 50
Cargo	@ CAGR 4%	@ CAGR 2%	@ CAGR nil
IOF/IOC	3.87	4.72	4.72
Fertilizer	0.55	0.67	0.67
Rock phosphate	0.62	0.76	0.76
Gypsum	0.34	0.41	0.41
River sand	0.41	0.50	0.50
Raw sugar	0.29	0.35	0.35
Wheat	0.15	0.18	0.18
Edible oil	0.25	0.30	0.30
Total	6.48	7.89	7.89

Table 2-6 Bullish projections (in million tons)

Balanced or moderate Scenario

- There is a possibility growth may soften across the cargoes identified for Berth No.17, due to following reasons/developments.
- Iron ore pellet export was muted for almost a decade up to 2015-16. It started picking up in 2016-17 and hit a high in 2017-18. The expectations are with China's economy bouncing back and their steel industry reviving along with it there will be an increased demand from them for iron ore pellet. However, there have been some developments in the recent past which may put a brake on China's growth. There is an ongoing trade war between the US and China, with US slapping a huge,30% tariff on China's steel. This will to some extent affect their steel production and in turn may lower their demand for





iron ore pellet. Iran, which was a major buyer of pellet from KIOCL is starting its own iron ore pellet plants in their country. Further, the United States has reimposed sanction on Iran. India has a temporary relaxation for importing oil from Iran. It is not known whether the US will extend this exemption for India's export as well. United Kingdom is another country to which KIOCL is selling its IOP. UK is now on the verge of splitting from the European Union and what effect this will have on British Economy is not known. Doomsayers predict the divorce will send Britain into deep recession till 2025. This may have collateral damage for India's IOP export. Essar is a major competitor for KIOCL They have huge pellet plants in Paradip and Vizag with a total production capacity of 20 million tons per annum. Oman is another competitor for KOICL. Vale of Brazil, who is the world's biggest producer of iron ore pellet and raw materials essential for the manufacture of steel have set up several iron ore pellet plants in Oman. They are able to sell their pellets competitively because their plants use power from natural gas which is available cheaply and abundantly in Oman.

- As for as fertilizer import is concerned India wants to become self-sufficient in fertilizer and wants to stop import altogether, though it is not known when or whether it will happen. One indication is many urea plants have come up in the country and urea import has been declining year after year. In 2015-16 the country imported about 8.5 million tons which came down to 5.5 million tons in 2016-17 and it further came down to 4.6 million tons in 2017-18. Though a lot will depend on the intensity of monsoon across the country from year to year, declining trend in urea import is irrefutable, though other imports like MOP, DAP may continue to expand but at a slower pace.
- The import of rock phosphate may turn sluggish if demand for the product falls or if MCF faces stiff competition or if connectivity problems choke despatch of the material.
- Gypsum and river sand are materials predominantly used in the construction industry. The estate and property sector is presently on a growth trajectory.
- There is a probability construction activity will slow down in the future due to surplus accommodations or high prices. Second factor is the duty on river sand import. Sand is a low value commodity and if duty on it is raised, its import may become uneconomical to





traders and merchants. Thirdly, it is understood, there is a lobby working to scuttle sand import. This lobby comprises dealers in a type of sand called M-sand which is generated in quarries during the cutting, grinding or crushing of stones. This is used as an alternative for river sand. Fearing river sand import will affect their business merchants of M-sand allegedly are working against the import of river sand. That is the reason, it is learnt, for months together the sand imported in NMPA and other ports has been lying in the ports uncleared.

- As noted earlier, raw sugar and wheat are seasonal and capricious cargoes. They may swing to extremes like negligible or sizeable import.
- Edible oil being low-value commodity is highly duty-sensitive. From time to time, the government imposes high duty on edible oil imports to protect the domestic vegetable oil industry. This may have an impact on edible oil import traffic in some years.

For the balanced scenario forecast, the traffic estimated for 2021-22 was taken as the base and a modest CAGR of 2% for the next 8 years, up to FY 2030, and CAGR of 1% for the next 10 years, up to 2040 and no growth fo the next ten years have been considered.

Timeline	FY 30	FY 40	FY 50
Cargo	@ 2% CAGR	@ 1% CAGR	@ nil CAGR
IOF/IOC	3.32	3.67	3.67
Fertilizer	0.47	0.52	0.52
Rock Phosphate	0.53	0.59	0.59
Gypsum	0.29	0.32	0.32
River sand	0.35	0.39	0.39
Raw sugar	0.25	0.28	0.28
Wheat	0.13	0.14	0.14
Edible oil	0.21	0.23	0.23
Total	5.55	6.14	6.14

 Table 2-7 Balanced projection (in million tons)





2.6.6 Conclusion of Traffic Study

The Conclusion of the traffic study is "Of the two projections, the balanced projection is more realistic. It may therefore may be taken for all considerations including financial evaluation".

2.7 **Project Siting and Bathymetry**

The proposed location of the berth No. 17 has been identified as the existing waterfront in between berths No. 8 and berth No. 13. This is shown in the Figure 2.10 hereunder. As can be seen, there is sufficient 3.5 Ha back up area behind the berth for the storage of cargo.



Figure 2-10: Proposed Location of Berth No. 17

There is a straight stretch of waterfront set back by about 40 m from the western end of berth No.8 and contained within the limit of the pump house near berth No.13. It is possible to construct a berth of at least 300 m along this waterfront. The new berth could be in alignment with the existing berth No. 8 and with the same open-piled configuration.





The existing shoreline with pitched revetment will ensure that the waves would get absorbed instead of getting reflected. This will ensure tranquility being maintained in the harbour basin. The port also agreed with this suggestion as it will have an added benefit of providing flexibility in berthing of longer vessels either at berth No.8 or at berth No. 17.

Presently the waterfront at the proposed berth No. 17 is provided with extended stone pitching to protect the shore slope. Giving due consideration to this aspect, the new berth No. 17 is located in line with the berthing face of berth No. 8. Since this berth is located offshore, it is proposed to have three approaches. The location and alignment of the new berth is shown in the Figure 2-11



Figure 2-11 Proposed alignment and approach to Berth no. 17

It can be seen that on the western side of the new berth No. 17, there is the existing berth No. 13 which handles crude oil and LPG. It is generally accepted that for LPG the distance may be at least 150 m to the other installations on safety considerations. In this particular case, the edge of berth No. 17 is more than 250 m from the transfer point of the berth No. 13. Hence there is no issue on safety.





2.8 Structural model for berthing structure

2.8.1 General arrangement

The proposed General Cargo berth is for 348.2m long with two Approaches connected to the land. The dimensions of berthing structure is 348.2m long and 26.05m wide for handling deep draft general Cargos and Approach jetty dimensions of 34m x 10m with 2 side berthing is used to connect the land. 2,00,000 DWT vessel is considered for the design of proposed Berth No.17 with dimensions of 303m (LOA) x 47m (Beam) x 18.2m (Draft) and Dredging depth is considered for (-)20.0m CD in front of proposed berth for future handling. Overall layout of proposed structures is shown in Fig.5.2 and the length 348.2m of berthing structure is divided into 3 Units with expansion joints of 100mm. Detailed Layout is attached as **Annexure IV**.



Figure 2-12 Overall Layout of Proposed Structures

2.8.2 Arrangement of Berthing jetty and approach jetty

2.8.2.1 Berthing Jetty

The structural system of proposed General cargo berth (Berth No.17) consists of 5 rows of RCC Bored cast in-situ pile with diameter of 1400mm (A-1 to 51 and E-1 to 51) and 1200mm (B1,





C1, D1 to B51, C51, and D51). The deck level of proposed berth is (+) 4.66m. The dimensions of the jetty structure (Unit -1/2/3) is 26.05m width and 116m in length. Service trench is provided on lee side of berthing structures, which will be the provision of water and electrical components throughout the jetty structures. The centre-to-centre distance for Bollard and Fender arrangements is 14m. The wearing coat is considered as 100mm. The provision is given for crane anchoring in storm condition. The centre-to-centre distance for crane rail is 22m. The dredging depth is (-) 20.0m CD in front of berthing structures. Geotextile mattress and Geo bags (Anchoring) is considered for stability of dredging depth in front of berthing structures (Refer: clause – 5.9). Behind the berth natural slope will be adopted active to land side. The founding depth of pile berthing jetty for 1.4m and 1.2m diameter are (-) 34m CD and (-)32m CD respectively. While driving the 1.4m dia. pile and 1.2m dia. pile for hard rock stratum, a minimum of 3D (3 times the diameter of the pile) should be embedded into them, respectively.

2.8.2.2 Approach Jetty

The structural system of approach jetty 1(AJ-1) and 2 (AJ-2) (10m x 34m) consist of 2 rows of RCC Bored cast in-situ pile with diameter of 1000mm. The deck level of approach jetty is (+) 4.66m. The typical general arrangement drawings of approach jetty (AJ-1 & AJ-2) and sections are shown in Fig.5.6, Fig.5.7 and Fig.5.8. Service trench is provided on one side which is to transfer the water facility and electrical duct to the land side. The centre to centre pile spacing in longitudinal direction and transverse direction are 5m and 7.35m. The founding depth of pile approach jetty is (-) 31m CD. While driving the pile (1000mm diameter pile) for hard rock stratum, Minimum 3D (3 time the diameter of pile) should be embedded into it.

2.8.2.3 Analysis Model

The finite element model of berthing jetty is considered as a three-dimensional frame which includes the pile and beam. The structure is modelled as two units (26.05mx116m) and (10mx34m). The piles are supported by fixity (Rock). The pile is modelled as beam elements with appropriate properties of reinforced concrete. Static analysis was carried out in this model.







Figure 2-13 Structural model for berthing jetty

Storage area:

During the initial stages of operation of this new berth No.17, it will be handling only the displaced cargo from the berth No. 14. Of the dry bulk cargo handled there, it is understood that iron ore fines/concentrates, limestone, gypsum, fertilisers etc. all move directly to their respective destination and are not stored within the port. Only sand is being stored.

It can be seen in the satellite picture of the proposed berth with the backup area that the eastern side of the backup area is already developed and sand is being stored there. The western area is to be developed.

Since during the initial stages, there will not be any additional revenue generation, it is suggested that the status quo could be maintained and new storage area could be developed later as and when the necessity arises.

Accessibility:

As shown in the Figure 2-14: Back Up Area with the Road Leading to Silver Jubilee Gate, the existing newly laid roadway to Silver Jubilee Gate will serve as the berth access road maintaining the status quo.









2.9 Cargo Handling

During the initial stages of operation of berth No. 17, it will be handling only the displaced cargo from berth No. 14 after that berth's conversion into a container terminal, i.e. primarily iron ore fines/concentrates and other dry bulk like fertilisers, limestone, gypsum etc. For handling this dry bulk cargo at this berth, it is suggested that the two Mobile Harbour Cranes presently operating at berth No.14 could be shifted to this berth as all the other berths are relatively less drafted, only small geared vessels will call at these berths and these cranes will be under-utilized. The details of these existing MHCs are presented hereunder.







Figure 2-15: MHCs Operating at Berth No. 14

At a later stage, when KIOCL enhances its capacity and imports larger quantities of iron ore fines/concentrates, they indicated that they would like to have a mechanised system for handling with grab unloaders and conveyor system. These topside facilities are likely to be installed and operated at the cost of KIOCL. During the discussion with the IPA team, KIOCL indicated that they may refer this to their consultant MECON. In such a case, it has to be specified to KIOCL that the conveyor leading from the berth to their storage should be located at the rear edge of the deck structure so that a clear space of at least 25 m is available on the berth for the operation of the two MHCs for handling the other cargo when KIOCL ships are not berthed.

A typical baby cape bulk carrier of 120,000 dwt will have 7 holds and their disposition is shown in the figure 5.7 hereunder. When it is berthed, there will be sufficient space at the other end of the berth for parking the MHCs which will not be in operation. The grab unloaders can operate freely accessing all the holds. Similarly when other dry bulk cargo vessels arrive, the grab unloaders could be parked at the other end of the berth while the MHCs can operated freely.





Figure 2-16: Areas for Parking of equipment

2.10 Revetment

A revetment has also been proposed along the berth 17 to protect the dredging slope. The proposed revetment is made of geotextile mattress which is used as a protection to dredging slope in front of berthing structure. The geotextile mattress has to be laid from (-) 20m water depth with distance of 2.75m from front face of the jetty, i.e. behind the 1st row of piles in sea side along the berthing structure and it will continue with the natural slope up to (+)2.0m top level of the mattress. Geo textile mattress is anchored with placing of geo textile bags upto the soil top level (+) 2m as per general arrangement of revetment drawings. Geo bags placement height is 1m with side slope of 1:1 on both sides. The proposed cross-sections of revetment are shown in Figure 2-17.







Geo textile bags

Geo textile bags or Geotextile Sand Containers (GSC) which is a low cost, soft and reversible solution for shore protection structures and for the reinforcement of existing coastal barriers and structures. The proposed geo-textile bag is of 0.3 m diameter and it is placed at top level of (+) 2m CD with height of 1m to anchor the geotextile mattress on land side. Geo-textile bags are with 70 % volume fill condition (0.175 m - height). Single bag with dimension of 0.35 m x 0.75 m x 0.175 m (width x length x height) is adopted and it will have 50 kg (Min.) filling in it. The minimum density of sand filling must be 1600kg/ m³. The volume of geo bags after filling should be 70% of sand, which is 0.64m3. The perimeter of single bag is 0.85 m.

Geo bags are designed to withstand stresses developed while filling (placing) and under the marine loadings expected on the structure. The aperture opening should be selected such that soil is retained and water is drained out during filling. The geo-bags placed underwater are little affected by UV radiations. In the intertidal zone, the geo-bags are covered very soon by algae





which provide sufficient UV protection. Geo-bags are generally manufactured using polypropylene or polyester fabric. The dimension of the designed geotextile container at 70% volume fills condition. It is inferred that a minimum length of 0.75m should be maintained for the geotextile bags. Hence, the section with dimensions 0.75 m x 3.5 m x 0.175 m (length x width x height) is adopted for the geotextile container having 50 kg to 60 kg filling in it.

Geo textile mattress

A geotextile sand mattress is employed to provide a slope stability of proposed structures. The GSM for the upper and lower layers are 650 and 400 g/m^2 respectively, while the tensile strength for the same is equal to or above 40 and 75 kN/m respectively. Fig.5.21 shows the typical image slope protection example of jetty structure by using geo textile mattress. The geotextile Mattress is made of 2 layers - a flat bottom layer and top layer consisting of 200mm thickness with filling of sand. The geotextile mattress filled with slurry pockets is blanketed over the arrangement of dredging slope as per cross sections.



Figure 2-18 Typical image slope protection example of jetty structure by using geo textile mattress





Sequence of slope protection:

- Initially Geo textile mattress shall be placed over the sloped portion naturally formed below the berthing structure when dredging in front of Berth No.17 is carried out as shown in the general arrangement drawings.
- Geo textile mattress is should be placed up to slope ending top level of (+) 2.0 with anchored of geo textile containers, which will help to anchor the geo textile mattress.
- While placing the geotextile mattress, it will sink to natural slope after filling the sand by using slurry pocket on mattress, ensure the proper stitching between Geotextile mattresses and geotextile mattress may be spread around the pile.
- Geo textile mattress anchor the level is (+) 2m and mattress with height of 1m from the anchor level as shown Figure 2.18.

2.11 Dredging Requirements

Dredging is the removal of sediments and debris from the bottom of lakes, rivers, harbors, and other water bodies. It is a routine necessity in waterways around the world because sedimentation—the natural process of sand and silt washing downstream—gradually fills channels and harbors.

Dredging often is focused on maintaining or increasing the depth of navigation channels, anchorages, or berthing areas to ensure the safe passage of boats and ships. Vessels require a certain amount of water in order to float and not touch bottom. This water depth continues to increase over time as larger and larger ships are deployed. Since massive ships carry the bulk of the goods imported into the country, dredging plays a vital role in the port economy.

To provide a required draft for safe navigation of vessels, where depth is not available naturally, dredging work is carried out. The dredging requirement for the proposed project can be classified as capital dredging. It will be carried out in four phases:

• **Excavation**: This process involves the dislodgement and removal of sediments (soils) and/or rocks from the sea bed





- Vertical transport: Raising the excavated materials to the surface by hydraulic or mechanical methods
- **Horizontal transport**: Transporting materials from the area of dredging to the site of utilization (reclamation), disposal or intermediate treatment.
- **Placement or use of the material dredged:** The dredged material shall be disposed in the designated dumping locations or can be used for reclamation depending upon the suitability of the material.

Ministry of Ports, Shipping and Waterways issued the Dredging Guidelines for Major Ports in June 2021 and requested Major ports to be followed by Major Ports to follow these guidelines for ensure implementation of dredging projects for cost effectiveness and delivery of projects as per schedule, this document shall be reference guidelines but is not exhaustive.

2.11.1 Capital dredging Quantity Estimation

It is proposed to deepen the area in front of proposed Berth no. 17. Dredging activity shall be carried in front of proposed berth no. 17 and its approach up to (-) 15.10 m.

The depth in front and approach of the proposed berth no. 17 is considered as - 15.1m CD and the dredging quantity was calculated by using Hypack software. The dredging quantity is assessed as 146594 cubic meter, approx.1, 50,000 cubic meter.









2.11.2 Maintenance Dredging

Average cost of dredging for the previous 3 years is collected from the Port which worked out to be Rs. 39.03 crores per annum. The total Berth length of all the existing berths on date is considered to be 3953. Average Maintenance dredging cost per meter length is applied to B-17.

2.11.3 Dredged disposal Site Details

The Radiotracer Investigation for Bed-load movement at New Mangalore Port, Mangalore Report found that four tracking direction were studied. As a result of this investigation, it was concluded that the proposed dumping ground north of the channel site was suitable for dredging disposal. This is due to the fact that the sediment would be moving away from the shipping channel. This highlights the importance of conducting thorough research before settling on a suitable dredging disposal option. Through an effective research process, it is possible to ensure that the dredging disposal process is efficient and safe.





2.12 **Resource Requirements**

2.12.1 Land Use and Land Ownership

The 30 Acres (Approximate) of Port land which will be utilized for the storage of the cargo generated by the proposed project. The entire area is within Port estate and has been declared as Port (As per The Major Port Authorities Act, 2021). The land use plan is as per the Port Master Plan. 2.5 Acres of water area will be used for Construction of Berth adjacent to existing berth No. 8.

2.12.2 Water Demand



Construction Phase:

The water requirement during the construction phase will be around 100 KLD of water. This water can be sourced from the port itself, if there is a shortfall, it can be met with water from water tankers and water suppliers. Water has to be stored in a sump. The major impacts on marine water quality are envisaged due to the civil works activities like driving of piles, construction of berth, approach way, movement of construction equipment's etc., that will have a high potential to disperse the fine grained sediments in the water, thus increasing the particular load which in turn can adversely influence the photosynthetic activity further affecting the marine life. However this rise in turbidity will be only during the construction phase. The runoff





from the site containing construction materials, debris, and construction waste and excavated earthen materials may have adverse impacts on the water environment especially on nearby marine water resources. Further the dispersion of fine sediment runoff in the water during the confection activities can increase the particulate load in the neighbouring aquatic habitat, which in turn can increase turbidity in and consequently affect the rate of the photosynthetic activity of the aquatic life. Proper mitigation measures shall be implemented to avoid such runoff as well as spillage of construction materials so that the materials in runoff cannot enter in to the water bodies.

Operational Phase:

During operation phase, no impact is envisaged on surface and groundwater resources. For domestic purpose water requirement will be 10 KLD for flushing. This water can be sourced from the port itself, if there is a shortfall, it can be met with water from water tankers and water suppliers. The net quantity of domestic wastewater generated will be also being taken care of port itself. Hence no significant impact on water quality is expected during the operation phase. Beside the sewage, as mention earlier there will not be any considerable impact on environmental quality as no toxic or serious pollutants are anticipated.

2.12.3 Electrical Power Requirement

The proposed Multipurpose cargo berth is situated under the New Mangalore Port Authority conservancy which has an existing terminal is well equipped with proper power backups. The power supply requirement would be in the range of 4 to 5 MVA, which will be obtained from Mangalore MESCOM or the constructing agencies will use their own power generators.

2.12.4 Manpower requirement

During Construction Phase:

The expected labour force required during construction phase is to the tune of about 100 to 150 persons. Although the workforce requirement will be temporary in nature, it will be met from the local population as far as possible hence there will be positive impact.





During Operational Phase:

The operation phase of the proposed development will also provide opportunities for employment mostly in the skilled and semi-skilled categories directly and indirectly to the tune of 1000 Nos. This will enhance the income of the people associated with subcontracting business.

2.13 Resettlement and Rehabilitation

The proposed activity does not involve any resettlement and rehabilitation process as the project is located in New Mangalore Port limits where none of the settlement is present.

2.14 Project Cost and Schedule

The total capital cost of the project is estimated at Rs.213.91 Crores. The summary break-up of the estimate is given in Table 2.8.

Sl. No.	Description of work	Amount Rs.
1	Berthing jetty	163,17,72,000
2	Approach jetty	81600000
	Civil construction cost total	1713372000
	Contingency (3%) - Miscellaneous items	51401160
	Detailed Engineering & Project Supervision @ 2%	34267440
	Total	1799040600
	GST @ 18%	323827308
Ν	Aiscellaneous Cost @ 5% of project cost as per TAMP	16191365.4
	Grand Total (in crore)	213.91

Table 2-8: Break-up of Project Cost

Project implementation schedule:

The project implementation period for the Proposed Construction of work is estimated to be 24 months after the CRZ & Environmental Clearance.




3 BASELINE ENVIRONMENT

The EIA determines the environmental consequences of the project prior to construction; assesses the impact on environment due to construction, on existing baseline environment; and also, importantly on land use and socio-economic parameters; and suggests measures to eliminate or minimize negative impacts on the environment. Thus, the baseline study is an integral part of an EIA, as it helps to identify the environmental concerns already existing in that area. The entire baseline data has been collected through actual physical surveys and observations, literature surveys, interaction with locals, government agencies and departments.

This chapter describes the existing environmental settings in the study area. The purpose of describing the environmental settings of the study area is:

- To understand the project need and environmental characteristics of the area.
- To assess the existing environmental quality, as well as the environmental impacts due to the proposed development surrounding the project area.
- To identify environmentally significant factors or geographical areas that could preclude any future development.

The establishment of baseline data for different environmental components in the designated study area and at the project site has been conducted by field monitoring / investigation for baseline data generation. The data generation was carried out covering Ambient Air Quality, Noise Levels, Water Quality, Land Use, Soil Quality, Ecology, Hydrology and Socio-economic features. Besides, additional data/information regarding water availability, meteorology, ecology, demographic pattern, and socio-economic conditions were also collected from secondary sources.

3.1 Details of Study Area and Study Period

Baseline environmental status has been established for various environmental attributes within a study area of 10 km radius from the project site. The major environmental disciplines covered in the EIA report includes ambient air quality, water quality, marine water quality, sediment quality, noise, soil, ecology (terrestrial and aquatic/marine), land use, geology, hydrology and





demographic & socio-economic conditions. The baseline data has been collected as per MOEF&CC/CPCB guidelines for three seasons – December 2021 to February 2022; March 2022 to May 2022 and October 2022 to December 2022.

It is necessary to evaluate the impacts of the project activities, so that the surrounding area and communities are least affected from the negative impacts. For studying the environmental sensitivity in a radius of 10 km, secondary data was also obtained which is mentioned as Table no. 3.2 and the sampling locations of the study area are indicated below in Table 3.1.

Sr. No.	Attributes	Parameters	Frequency	No of Locations
1	Ambient Air Quality	PM ₁₀ , PM _{2.5} , NO _X , SO ₂ CO and other relevant parameters	24 hourly samples, twice a week for 12 weeks	8 locations
2	Noise Levels	L _{day} , L _{night} , L _{eq}	Once in season. Hourly reading for 24 hrs	8 locations
3	Fresh Water	As per IS:10500	Once in season	2 locations
4	Ground Water	As per IS: 10500:2012	Once in season	5 locations
5	Marine water and Sediment	Physical and chemical parameters as per TOR	Once in season	7 locations
6	Soil Quality Soil profile with chemical constituents		Once in season	5 locations
7	GIS Land use and land classification		Based on secondary data and satellite imagery	10 km Study area
8	Ecology Terrestrial and aquatic flora and fauna in the study area		Primary survey through field studies during study period	10 km Study area
9	Socioeconomic aspects Based on data published in census handbooks and field studyss		Primary survey through field studies during study period	10 km Study area

 Table 3-1: Baseline Monitoring Plan for the EIA of construction of Berth 17





Sr. No.	Parameter	Details	Source
1	Oceanography Studies	Tide, Current, Bathymetry, Hydrogeology	Previous EIA, DPR
2	Marine Ecology Studies	Mangroves, Fishery, Endangered marine mammals, corals, Birds	CSIR-NIO, Goa
3	Social Studies	Census, Demography	Census 2011
4	Ecology	Forest Working Plan, List of Flora & Fauna	Forest Department, Mangalore

3.2 Geomorphology and Soil Types in Dakshina Kannada District

3.2.1 Physiography

The beaches of the Dakshina Kannada coast are low open sandy beaches which are 25 to 100 m in width. The material of the beach is mainly detrital sand and the mean size of it varies from place to place. The beach material is well sorted sand. The particles are found to be within sub rounded and angular range of roundness. The shell fragments are angular and calcareous. The beaches are interrupted by natural features, river mouths and manmade features such as breakwaters at Mangalore and Panambur. Beaches are also bordered by casuarina, coconut and beach plantations which have been grown on dunes, raised berms and barrier spits.

3.2.2 Coastal Dynamics

Strong winds are observed from Southwest and West direction during monsoon period. Rest of the year, winds is mainly from North and East in the forenoons and Westerly or North-westerly in the afternoons. The coast is subjected to very strong sea breeze during the non-monsoon months. The sea breeze in the afternoons predominates over the land breezes in the early mornings. The average wind velocity during non-monsoon season varies from 0 to 18 kmph and 8 to 26 kmph during monsoon season.





Severe waves are experienced only in the monsoon months with wave period ranging from 9 to 10 seconds. During the non-monsoon months, the maximum wave heights are less than 1 m with wide variation in wave period including the presence of long period swell waves. Predominant wave directions during the monsoon months are Southwest, West and Northwest. These deep water wave directions when approaches the coast, due to wave refraction their crest become parallel to the shoreline and hence there will be onshore and offshore sediment transport along the coast.

3.2.3 Sea Bed and Coastal Sediments

The sediment distribution in the sea bed is generally a reflection of the bathymetry of the area and the related energy domain on the sea bed. Sea bed adjoining to Dakshina Kannada coast contains medium to coarse sand with minor amounts of silt and clay up to the -5 m contour. These are the areas where waves break, the clay and silt fractions are brought into suspension to be moved offshore. Beyond the -5m contour, sea bed is composed of silt and clay. The outer shelf region comprises of fine to medium sand with clay and neritic shell fragments. Nearer to the river mouths, a widening of the sand zone along the flow direction of the rivers is invariably observed.

3.2.4 Geomorphology and Geology

Dakshina Kannada district which is a coastal district of Karnataka, spreads along the west coast of India covering coastal tract of about 40 km. Dakshina Kannada district is divided into three regions, low land, mid land and high land. The coast line is generally straight and followed the Dharwar rocks trending NNW-SSE. The rocks weathered fractured and jointed granitic gneisses and laterite varies from 10 m to 30 m. The thickness of coastal alluvium varies from 7 to 29 m. There are spits and beach ridges available in coastal tract. The Netravati river flow towards Mangalore where it joins Gurupur River and both the Rivers from common esture discharging into the sea. Gneissic rocks Archaean age cover a major part of this region as basement rocks. These are elsewhere overlain by oligomictic quartz conglomerate belonging to Dharwar super group. The recent alluvium and colluvial deposits occur along the river bed and sea coast. The exposure of crystalline rock found as isolated hills along the shore and off shore. The black clay





marine sediments with a thickness of 0.30 m to > 1m occur as lenses along the coast and in the deltaic islands. Its occurrence as marked at a depth ranges of 5 to 6 mbgl. The groundwater below the black clay horizons of coastal sediments found with high salinity, which marks the index bed for saline water and fresh water interface.

Geomorphologically Dakshina Kannada District can be divided broadly into three well-defined physiographic units viz. i) Coastal plain ii) Upland pedi plain area iii) Eastern hilly area forming part of the Western Ghats. The Coastal plain is a narrow, thickly populated and intensely cultivated area adjoining the coast. There is considerable extent of barren land along the coast partly because it is sandy, rocky, and marshy. The area near sea is covered with coconut gardens.

The Upland pediplain area interspersed with low hills between the Western Ghats and the coast, which is moderately cultivated with a considerable extent of fallow land, which can be put to agricultural use. The Eastern hilly area in the eastern part of the district is hilly with thick forest cover, which forms part of the Western Ghats. The hills of the area range in elevation from 1200 to 1500m a.m.s.l. and are capped with laterite, which form plateau usually of oval or elongated configuration. The hill ranges are dissected by numerous streams and rivulets. The prominent peaks in the area are Balihalli (1240m), Amadikul betta (1298m) Attiberi Gudda (1522m), Banganabagile Gudda (1513m) etc.

Geologically Dakshina Kannada coast is of recent origin. The major rock type is the granite gneiss which is popularly known as peninsular gneiss. Laterities are abundant in the coastal regions. The exposed laterites develop a hard crust and are devoid of vegetation as they do not retain any moisture. The area between the shoreline and Western Ghats can be broadly divided into three regions, namely the low land, the mid land and the high land. The soil in the district is mostly lateritic type, found distributed in the Pediplain area characterised by high iron and aluminium content. Lateritic soil is mostly red in color and yellow loamy, pale to bright red colours are also seen. Lateritic soil is suitable for Paddy, Sugarcane, Arecanut and Plantation crops, viz. crops like Cardamom & plantains. Loamy red soils are distributed in the lower reaches of valleys. Red lateritic soil is the most dominant soil type in the area. The texture of the soil varies from fine to coarse. The soil in valleys and intermediate slopes is rich in loam whereas





in upper slopes it is much coarse in nature. The soil responds well to irrigation and other soil management practices. Silty and loamy soils are of transported origin and are found mostly along river banks and in valley plains. They have good infiltration capacity and are well-suited for agriculture due to their fertility.

3.3 Hydrogeology

Weathered and fractured gneiss, granite and schist are the major water bearing formations. Alluvial formation of limited thickness and aerial extent is found along the courses of major rivers. Groundwater occurs under phreatic (water table) condition in weathered zones of gneiss, schist and granite and under semi-confined to confined conditions in joints and fractures of these rocks at deeper levels. Weathered and fractured gneiss is the predominant aquifer found in the district followed by schistose and granitic aquifers, which occur as isolated patches in some taluks.

The depth to water level during pre-monsoon ranges from 1.85 mbgl (Nelyadi) to 15.17 mbgl (Bellare). During post-monsoon ranges from 1.65 mbgl (Nelyadi) to 9.40 mbgl (Bellare).

The seasonal fluctuation data reveals that 36.5% of the wells show rise while, 63.5% of the wells show a fall in water level. The rise in water level ranges from 015 m to 16.0 m while, the fall ranges from 0.65 m to 4.62 m. Analysis of the long-term water level trend in the last 10 years (1997-2006) reveals that 58% of the wells show a rise in water level ranging from 0.014 m to 0.12 m, whereas, the remaining wells (42%) show a fall in the range of 0.01m to 0.19 m. This means, little more than half of the total wells for which data have been analysed show a rise in the water level in the last decade.

Borewells drilled under Groundwater Exploration Programme of CGWB ranged between 16 and 200m. These wells have yielded from less than an lps to 19.9 lps. Though the Transmissivity ranged from 3 to 476 m2/day, it generally ranges from 3 to 20 m2/day. Good yield can be encountered by scientifically pin-pointing the bore well site.





3.4 Seismicity of the Study Area

Based on occurrence of earthquakes the latest version of seismic zoning map of India given in the earthquake resistant design code of India [IS 1893 (Part 1) 2002] assigns four levels of seismicity for India in terms of zone factors. In other words, the earthquake zoning map of India divides India into 4 seismic zones (Zone 2, 3, 4 and 5), shown in Figure 3 3 unlike its previous version, which consisted of five or six zones for the country. According to the present zoning map, Zone 5 expects the highest level of seismicity whereas Zone 2 is associated with the lowest level of seismicity. Seismic Zone IV is the highest risk zone where earthquakes having intensity of IX+ on Modified Mercalli Intensity (MMI) scale can take place. Earthquakes of intensities between VIII to IX can be experienced in seismic Zone IV, whereas earthquakes can occur between VI and VIII intensity in seismic Zone III. The seismic hazard map of India was updated in 2000 by the Bureau of Indian Standards (BIS).

The state of Karnataka constitutes a part of one of the most prominent and largest Precambrian shield areas of the world, and is tectonically termed as intraplate region or shield region. The convergent movement of Indian plate towards Eurasian plate at the rate of 5 cm/year induces moderate to high deformations in the interior of the Indian plate. Mangalore is one of the well-connected coastal cities on the western margin of the Peninsular India. Due to continuous seafloor spreading, the region is subjected to moderate seismic activity from time to time and is categorized under seismic zone III.

3.5 Drainage

A drainage system is the pattern formed by the streams, rivers, and lakes in a particular drainage basin. Drainage basins can be described by the order of streams within them. Streams that have no tributaries (or streams flowing into it) are termed first order streams. When the first order streams join together, they become second order steam. Two second order streams join to form third order stream and so on for forth and further orders. Here the Drainage layer, which was generated after scanning the thematic manuscripts, was edited for line the errors. Two different layers were made separately for line drainage. Drainage order was given to all the drain lines in the layers. Strahler method of ordering was used for giving order to drainage. The area shows an





undulating topography. The drainage of the area is dendritic type of drainage pattern (Figures 3.2).



Figure 3-1: Earthquake Zone Map of India with project area





Figure 3-2: 10 km Radius Drainage Map around Project Site





3.6 Land Use Land Cover of Study Area

3.6.1 Introduction

Remote Sensing data is a classic source of information on natural resources for a region and provides a record of the continuum of resource status because of its repetitive coverage. Remote Sensing is a powerful and accurate means of collecting data. The study of satellite imagery gives an excellent opportunity to monitor the quantitative extent of vegetation cover as well as qualitative changes due to changes in environment. This aspect is very significant in understanding the dynamics of the earth surface features and phenomenon such as various ecosystems.

3.6.2 Methodology

Following stapes area adopted for the land use and land cover classification study:

- 1. Creation of input database.
- 2. Data Analysis and Data Processing.
- 3. Preparation of final output.

Input Data

Toposheet:

Topographycal sheet (SOI) scale 1:50,000 No., 48 K/16 amd 48L/13 were studied for spatial features, ground control points, latitude, longitude and geo-registration of the satellite imageries.



Authority





Figure 3-3 Project Site on Google Image





Figure 3-4: 10 Km. Radius Area from Project Site on Toposheet





Satellite Image

The Satellite data or Satellite Image downloaded from Copernicus Open Access Hub portal (Download <u>URL: https://scihub.copernicus.eu/dhus/odata/v1/Products('a173094f-124a-4b57-9c7e-ead2a44a9e04')/\$value)</u> into the system and a land-use map was prepared. The first step involved was the preparation of standard FCC Image (using Sentinel-2 band 2, 3, 4 and 8) and done supervised classified LULC Map of the study area, which was followed by the ground truthing of the image and identification of Ground Control Points (GCP) for the geo-registration of the images.

The Satellite image used for this study details as follow:

- Filename: S2A_MSIL2A_20221217T052231_N0509_R062_T43PDQ_2022 1217T082753.SAFE
- **Satellite name:** Sentinel-2
- Satellite number: A
- Sensing Date: 2022-12-17T05:22:31.0





Figure 3-5: Satellite Image Map





Data Processing / Analysis

Image Restoration

Image restoration aims to correct the distorted or degraded image data to create a more faithful representation of the original scene. This typically involves the initial processing of raw image data to correct for geometric distortions and to calibrate the data radio-metrically. Image rectification and restoration procedures are often termed as processing operations because they normally precede manipulation and analysis of the image data to extract specific information.

Radiometric Correction

First order correction was done by dark pixel subtraction technique (Lillesand and Keifer, 1979). This technique assumes that there is a high probability that there are at least a few pixels within an image, which should be black (0% reflectance). However, because of atmospheric scattering, the image system records a non- zero DN value at the supposedly dark shadowed pixel location. This represents the DN value that must be subtracted from the particular spectral band to remove the first order scattering component.

Geometric Correction

Raw digital images usually contain geometric distortions so significant that they cannot be used as maps. The source of these distortions range from variation in the altitude, and velocity of sensor platform, to factors such as panoramic distortion, earth curvature, atmospheric refraction, relief displacement and non-linearity in the sweep of a sensor's IFOV. The intent of geometric correction is to compensate for the distortion introduced by these factors, so that the corrected image will have the geometric integrity of a map.

Images were registered geometrically using toposheet of Survey of India (SOI) on 1:50000 scale. The common uniformly distributed Ground Control Points (GCP's) were marked with root mean square error of one third of a pixel and the image was re-sampled by nearest neighbour method. The data set was then co-registered for further analysis.





Ground Truthing:

Reconnaissance visit was undertaken for broad understanding of the study area. It was vital for obtaining and visualizing the information pertaining to the existing field conditions, assessment of the accessibility of the area, pattern and distribution of vegetation and its composition.

Ground truthing is the process of establishing the correlation between the surface objects and the objects detected, identified, recognized and deduced from the satellite imagery. The occurrence of a particular vegetation type on the ground was correlated with its tonal appearance on satellite images for identification.

Final Outputs

Land-use classifications:

A hybrid Level-2 land use classification has been done using Supervised Classification Method. The bands 8, 4, 3 were found to be most appropriate. Finally 9 classes were derived and the image was classified. The classified land use pattern is given in Table 1 and represented in Figure no. 3-6. The False Color Composite of the area is presented in Figure no.3-5.





Figure 3-6: Map of LULC Classification (10 Km. Radius)





S.N.	Classes	Area in Ha.	Area in Sq.Km.	Area in %
1	Builtup Land	1856.7	18.6	5.8
2	Agriculture	808.0	8.1	2.5
3	Fallow Land	328.0	3.3	1.0
4	Open Land	3367.7	33.7	10.4
5	Beach Sand	104.8	1.0	0.3
6	Barren Land	534.8	5.3	1.7
7	Vegetation	9589.5	95.9	29.7
8	Mangrove Vegetation	434.3	4.3	1.3
9	Waterbody	15236.4	152.4	47.2
	Total Area	32260.2	322.6	100.0





Interpretation on Land use classification

Built up Land:

It is defined as an area of human habitat developed due to non-agriculture use. The built-up land in 10 km radius from project site comprises of villages, towns, panchayat and revenue villages that include buildings, Industries, factories, transport, communications, utilities in association with water and vegetation. Out of total area, 18.6 sq. Km area comes under built up land class.





This is 5.8 % of total study area. Mangalore city and surrounding area are of study area area comes under this class.

Vegetation:

The vegetation class use is a function of land productivity and land utilization practices over a period of time. It is an area within the notified forest boundary bearing an association of predominantly of trees and other vegetation types capable of producing timber and other forest produces. These lands are generally occupying the topographically high regions and along to river. This land use/land cover class in the study area coved 95.9 sq. km. area comes under vegetation class this is 29.7% of study area. 4.3 sq.km area found under mangrove vegetation class this is 1.3% of study area.

Water Bodies:

This category comprises areas with surface water, either impounded in the form of ponds, lakes, Ocean and reservoirs or flowing as streams, rivers, canals etc. These are seen clearly on the satellite image in blue to dark blue or cyan colour depending on the depth of water. These areas were identified and mapped as water bodies; this unit is spatially distributed in 152.4 sq. km area which is 47.2% of total area. Arabian Sea, Gurupur River and its tributaries area in study area.

Open Land and Barren Land:

Open land described as degraded land which can be brought under vegetative cover with reasonable effort and which is currently under-utilized and land which is deteriorating due to lack of appropriate water and soil management or on account of natural causes. Wastelands can result from inherent/imposed constraints such as, by location, environment, chemical and physical properties of the soil or financial or management constraints. 33.7 sq.km area funder under open land (10.4%)., 3.3 sq. km. area found under Agriculture fallow land, 5.3sq km area found under barren Land, and 1.0 sq.km. area found under Sandy beach area.

3.7 Meteorology

Under the Köppen climate classification, Mangalore has a tropical monsoon climate and is under the direct influence of the Arabian Sea branch of the southwest monsoon. It receives about 95





percent of its total annual rainfall between May to September but remains extremely dry from December to March. Humidity is approximately 75 percent on average and peaks during June, July and August. The maximum average humidity is 93 percent in July and average minimum humidity is 56 percent in January. Mangalore experiences moderate to gusty winds during day time and gentle winds at night. The driest and least humid months are from December to February. During this time of year temperatures during the day stay below 34 °C (93 °F) and drop to about 19 °C (66 °F) at night. The lowest temperature recorded at Panambur is 15.6 °C (60 °F) on 8 January 1992 and at Bajpe it is 15.9 °C (61 °F) on 19 November 1974. According to the India Meteorological Department (IMD), the temperature in Mangalore has never reached 40 °C (104 °F). The summer gives way to the monsoon season, when the city experiences the highest precipitation of all urban centres in India due to the influence of the Western Ghats. The rains subside in September but there is occasional rainfall in October. The highest rainfall recorded in a 24-hour period is 330.8 mm (13 in) on 22 June 2003. In 1994, Mangalore recorded its highest annual rainfall at 5,018.52 mm (198 in)

The average rainfall of the district 3789.9 mm and is received mainly during the southwest monsoon season extending from June to September. About 85% of the annual rainfall occurs during the monsoon months. Post -monsoon season yields about 8% and the balance of annual rainfall from December to March. This district on the West Coast of India experiences a typical maritime climate. The district is marked by heavy rainfall, high humidity and oppressive weather in hot season. Generally, the weather is hot and humid throughout the year. In the eastern part of the district i.e., along the Western Ghats, the weather is comparatively cooler than in the western coastal areas.





Month	Tempe (°C)	erature daily	Rela Hum (%	tive idity 6)	Rainfall	Predo W Dire	ominant /ind ection	Calm Period		Cloud Amount s Octas	Win d
	Max	Min	Max	Min	(IIIII)	08:30	17:30	08:30	17:30		Speed
January	31.7	21.7	70	65	0.2	E, SE	W, NW	0	0	2.6	9.1
February	31.7	22.7	73	68	3.6	E, SE	W, NW	3	0	2.4	9.2
March	31.9	24.4	74	70	2.5	E, NE	W, NW	3	0	2.5	8.9
April	32.8	25.7	72	71	35.0	E, NE	W, NW	5	0	3.4	9.1
May	32.3	25.4	76	73	199.5	E, NE	W, NW	6	0	4.9	9.8
June	29.9	23.7	87	82	955.8	E, SE	W, SW	7	3	6.7	8.3
July	28.6	23.1	90	86	1160.3	E, SE	W, SW	6	4	7.5	8.7
August	28.5	23.1	89	85	792.6	E, SE	W, SW	6	0	7.2	8.6
September	29.2	23.1	86	83	331.5	E, SE	W, SW	4	0	6.1	7.8
October	30.4	23.4	83	80	184.0	E, SE	W, SW	4	1	5.2	7.6
November	31.7	23.0	74	71	75.2	E, SE	W, SW	1	0	3.5	7.8
December	32.0	22.4	69	67	33.9	E, SE	W, NW	1	1	3.2	8.4

Table 3-4: Long Term Meteorological Data of Mangalore (30 years average)



Figure 3-8: Wind Rose of Mangalore – observations during the study period





3.8 Met-oceanographic data

Winds

Wind in Mangalore during monsoon months of June, July and August are predominantly from southwest and west with a maximum intensity of 5 on the Beaufort scale.

Cyclones

While the average frequency of cyclonic storms in the Arabian Sea is about one per year, there have been years when two or three such storms have occurred. There have also been years without any storms. The maximum wind speed so far recorded has not exceeded 62 kmph (16.9 m/s), except once during 1965 when the maximum speed recorded was 97 kmph (26.9 m/s).

Waves

The predominant direction of waves at open sea in the vicinity of Mangalore Port during the monsoon months of June, July and August is W and SW whereas the predominant direction during the fair weather months is NW and N. Analysis of the data collected from ships in and around Mangalore revealed that 0.4% of the waves have a height of 4.9 meters above. The wave heights in the non-monsoon months are much less. Inside the harbour, generally calm conditions prevail throughout the year as is well protected from outside waves by long breakwater on either side of the outer approach channel.

Tides

The tides at Mangalore are semi-diurnal in nature with tidal levels, relative to the Chart Datum (CD) as follows:

	Level t CD (m)
Highest High Water Spring (HHWS)	+1.68
Mean Highest High Water (MHHW)	+1.48
Mean Lowest High Water (MLHW)	+1.26
Mean Sea Level (MSL)	+0.95





Mean Lowest Low Water (MLLW)	+0.26
Lowest Low Water Spring (LLWS)	+0.03

Currents

The magnitude of the current outside the lagoon area during the monsoon season is about 1 to 1.5 knots has been experienced by pilots. However, the currents within the harbor are insignificant.

The bathymetry of the area in front of the proposed berth No. 17 is shown in figure 3.9. It can be seen that the location of the turning circle is away from the berthing face. Even when the largest ship with 45 m beam is berthed at the new berth, there will be sufficient distance from the ship to the edge of turning circle.



Figure 3-9 Bathymetry in front of the proposed location





3.9 Ambient Air Quality

The ambient air quality with respect to the study area of 10 km radius around the proposed project site forms the baseline information. The various sources of air pollution in the region are traffic and urban and industrial activities. This will also be useful for assessing the conformity to standards of the ambient air quality during the Proposed Construction of Berth 17 at NMPA. The study area mostly represents industrial environment. Ambient air quality monitoring was conducted as per MOEF&CC/CPCB guidelines. This section describes the selection of sampling locations, methodology adopted for sampling, analytical techniques and frequency of sampling.

Methodology Adopted for the Study:

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

- Meteorological conditions on synoptic basis
- Topography of the study area
- Representatives of regional background air quality for obtaining baseline status; and
- Representatives of likely impact areas.

 PM_{10} , $PM_{2.5}$, Sulphur dioxide (SO₂), Oxides of Nitrogen (NOx), Carbon Monoxide (CO), will be the major pollutants associated with project. The baseline status of the ambient air quality has been established through field monitoring data on PM_{10} , $PM_{2.5}$, Carbon Monoxide (CO), Sulphur dioxide (SO2), Oxides of nitrogen (NOx) at 8 locations of the study area, The locations for air quality monitoring were scientifically selected.

Meteorological conditions on synoptic scale

The methodology for conducting the baseline environmental survey and selection of sampling locations is in line with the guidelines given in the EIA manual of the MoEF&CC, representative of regional background air quality for obtaining baseline status and representative of likely impact areas.





Sampling and Analytical Techniques

Respirable Dust Samplers APM-451 of Envirotech instruments were used for monitoring Respirable fraction (<10 microns) and gaseous pollutants like SO₂, NOx. Table 3.5 shows the techniques for sampling and analysis for these parameters.

Parameters	Technique	Technical Protocol	Detectable Limit, µg/m ³
PM_{10}	Respirable Dust Sampler (Gravimetric method)	EPA/625/R-96/010a Compendium Method IO-2.1:1999	10.0 μ g/m ³
PM _{2.5}	Particulate Sampler	CPCB Guidelines the Measurement of Ambient Air Pollutants, Volume-I	10 µg/m ³
Sulphur Dioxide	West and Gaeke	IS-5182 (Part-II)	$5.0 \ \mu g/m^3$
Nitrogen Oxide	Jacob & Hochheiser	IS-5182 (Part-II) 2006	2 mg/Nm
Carbon Monoxide (CO) mg/m ³	FID technique (Gas chromatography)	IS 5182 (Part 10): 1999	0.2 mg/m^3

Table 3-5: Techniques Used For Ambient Air Quality Monitoring

 PM_{10} has been estimated by gravimetric method. Modified West and Gaeke method has been adopted for estimation of SO_2 and Jacobs-Hochheiser method has been adopted for the estimation of NOx. Calibration charts have been prepared for all gaseous pollutants. The location of the monitoring stations with reference to the project site is given in Table 3.6. Map showing sampling locations is given in Figure 3.10.

 Table 3-6: Air Monitoring locations

S.No	Location Name	Lat/Long	Direction	Distance
1	Near Project Site	12°55'31.05"N 74°49'4.65"E	-	-
2	Near Panambur Beach Parking	12°56'16.93"N 74°48'19.20"E	NW	2.00 km





3	Kulai Near Bhrama Shree Narayana Guru Samaja seva sangha	12°57'48.0"N 74°48'27.3"E	Ν	4.30 km
4	New Mangalore Industrial Area Near Ruchi Soya Industries	12°56'47.06"N 74°49'58.76"E	NE	2.90 km
5	Karambar Near Rakshita Canteen	12°57'16.46"N 74°52'21.27"E	NE	6.75 km
6	Bondel Near Business school Manel Srinivas Nayak Institute of Management – Business School	12°55'30.06"N 74°52'11.09"E	E	5.60 km
7	Derebail Near Sri Durgha Parameshwari Prasanna Temple	12°54'26.25"N 74°50'54.57"E	SE	3.90 km
8	Urwa Near Church of Our Lady of Immaculate Conception	12°53'21.68"N 74°50'1.85"E	SE	4.25 km





Figure 3-10: Ambient Air Sampling location





Observations from the Ambient Air Quality Monitoring Results:

Winter Season (December 2021 – February 2022)

PM10: The maximum value for PM10 is observed at AAQM 01 as 89 μ g/m³, with the minimum value observed at AAQM 06 & 08 as 51 μ g/m³ during the study period. Which is as per prescribed limit NAAQ as 100 μ g/m³.

PM 2.5: The maximum value for PM2.5 is observed at AAQM 01 as 43 μ g/m3, with the minimum value observed at AAQM 08 as 16 μ g/m3 during the study period. Which is as per prescribed limit NAAQ as 60 μ g/m³

SO2: The maximum value for SO2 is observed at AAQM 01 as 15 μ g/m3, with the minimum value observed at AAQM 06, AAQM 07 & AAQM 08 as 7 μ g/m3 during the study period. Which is as per prescribed limit NAAQ as 80 μ g/m³

NOx: The maximum value for NOx is observed at AAQM 01 as 26 μ g/m3, with the minimum value observed at AAQM 05 as 12 μ g/m 3 during the study period. Which is as per prescribed limit NAAQ as 80 μ g/m³

CO: The maximum value for CO is observed at AAQM 01 as 1.7 mg/m3 with the minimum value observed at project site AAQM 05 as 0.8 mg/m3 during the study period.

Summer Season (2022):

PM10: The maximum value for PM10 is observed at AAQM 01 as 94 μ g/m³, with the minimum value observed at AAQM 06 as 51 μ g/m³ during the study period. Which is as per prescribed limit NAAQ as 100 μ g/m³

PM 2.5: The maximum value for PM2.5 is observed at AAQM 01 as 43 μ g/m3, with the minimum value observed at AAQM 05 as 19 μ g/m3 during the study period. Which is as per prescribed limit NAAQ as 60 μ g/m³

SO2: The maximum value for SO2 is observed at AAQM 01 as 16 μ g/m3, with the minimum value observed at AAQM 03, AAQM 05, AAQM 06, AAQM 7 & AAQM 08 as 7 μ g/m3 during the study period. Which is as per prescribed limit NAAQ as 80 μ g/m³





NOx: The maximum value for NOX is observed at AAQM 01 as 30 μ g/m3, with the minimum value observed at AAQM 03 as 10 μ g/m 3 during the study period. Which is within the prescribed limits stated under NAAQ as 80 μ g/m³.

CO: The maximum value for CO is observed at AAQM 01 & 08 as 1.5 mg/m3 with the minimum value observed at project site AAQM 05 as 0.8 mg/m3 during the study period. Which is within the prescribed limits stated under NAAQ as 4 μ g/m³.

Post-Monsoon (2022)

PM10: The maximum value for PM10 is observed at AAQM 01 as 92 μ g/m³, with the minimum value observed at AAQM 08 as 51 μ g/m³ during the study period. Which is as per prescribed limits stated under NAAQ as 100 μ g/m³

PM 2.5: The maximum value for PM2.5 is observed at AAQM 01 as 46 μ g/m3, with the minimum value observed at AAQM 06 & 07 as 20 μ g/m3 during the study period. Which is as per prescribed limits stated under NAAQ as 60 μ g/m³

SO2: The maximum value for SO2 is observed at AAQM 01 as 19 μ g/m3, with the minimum value observed at AAQM 06 & AAQM 07 as 7 μ g/m3 during the study period. Which is as per prescribed limit NAAQ as 80 μ g/m³

NOx: The maximum value for NOX is observed at AAQM 01 as 28 μ g/m3, with the minimum value observed at AAQM 06 & AAQM 07 as 12 μ g/m 3 during the study period. Which is as per prescribed limits stated under NAAQ as 80 μ g/m³

CO: The maximum value for CO is observed at AAQM 01, AAQM 06 & AAQM 07 as 1.3 mg/m3 with the minimum value observed at project site AAQM 08 as 0.5 mg/m3 during the study period. Which is as per prescribed limits stated under NAAQ as $4 \mu g/m^3$

The results of the monitored data, indicate that the ambient air quality of the region is in conformity with respect to residential norms of the National Ambient Air Quality Standards of CPCB with present level of activities. Ambient air quality monitoring results attached as **Appendix I** of EIA report. The ambient air quality results are as summarized in Table 3-6.





Table 3-7: Results of AAQ Monitoring – December 2021 – February 2022

PM ₁₀ (μg/m ³)								
Locations	AAQ M 01	AAQM 02	AAQ M 03	AAQ M 04	AAQ M 05	AAQ M 06	AAQ M 07	AAQ M 08
Average	83	73	73	81	65	56	57	56
Min	78	68	67	69	59	51	53	51
Max	89	80	80	86	69	60	65	60
98 Percentile	89	79	80	85	69	60	63	60
Standard	100	100	100	100	100	100	100	100
			PM	_{2.5} (µg/m ³)				
Locations	AAQ M 01	AAQ M 02	AAQ M 03	AAQ M 04	AAQ M 05	AAQ M 06	AAQ M 07	AAQ M 08
Average	39	31	31	37	25	23	23	21
Min	36	26	26	35	23	20	20	16
Max	43	38	36	40	28	28	26	25
98 Percentile	43	37	36	40	28	27	26	25
Standard	60	60	60	60	60	60	60	60
$SO_2 (\mu g/m^3)$								
Locations	AAQ M	AAQ M	AAQ M	AAQ M	AAQ M	AAQ M	AAQ M	AAQ M





	01	02	03	04	05	06	07	08					
Average	13	12	10	11	8	9	9	8					
Min	11	10	8	8	6	7	7	7					
Max	15	14	13	14	11	11	10	10					
98 Percentile	15	14	13	14	11	11	10	10					
Standard	80	80	80	80	80	80	80	80					
			N	Ox (µg/m ³)									
Locations	AAQ M 01	AAQ M 02	AAQ M 03	AAQ M 04	AAQ M 05	AAQ M 06	AAQ M 07	AAQ M 08					
Average	24	21	18	15	14	16	15	17					
Min	21	18	16	13	12	13	13	15					
Max	26	25	20	18	16	20	18	20					
98 Percentile	26	24	20	18	16	20	18	20					
Standard	80	80	80	80	80	80	80	80					
	CO (mg/m ³)												
Locations	AAQ M 01	AAQ M 02	AAQ M 03	AAQ M 04	AAQ M 05	AAQ M 06	AAQ M 07	AAQ M 08					
Average	1.5	1.2	1.2	1.7	1.0	1.2	1.3	1.3					
Min	1.3	1.1	1.1	1.5	0.8	1.1	1.1	1.1					





Max	1.7	1.2	1.3	1.8	1.2	1.3	1.5	1.5
98 Percentile	2	1	1	2	1	1	1	1
Standard	4	4	4	4	4	4	4	4

Table 3-8: Results of AAQ Monitoring – March 2022 – May 2022

PM ₁₀ (μg/m ³)										
Locations	AAQ M 01	AAQM 02	AAQ M 03	AAQ M 04	AAQ M 05	AAQ M 06	AAQ M 07	AAQ M 08		
Average	89	75	75	81	67	57	61	58		
Min	81	71	71	73	58	51	56	53		
Max	94	90	79	85	74	63	70	64		
98 Percentile	94	84.94	79	84.54	73.54	62.54	69.54	62.62		
Standard	100	100	100	sss100	100	100	100	100		
			PM	_{2.5} (µg/m³)						
Locations	AAQ M 01	AAQ M 02	AAQ M 03	AAQ M 04	AAQ M 05	AAQ M 06	AAQ M 07	AAQ M 08		
Average	38	32	28	34	22	24	24	24		
Min	34	26	24	30	19	20	20	21		
Max	43	36	33	36	26	26	26	26		





98 Percentile	43	36	32.54	36	25.54	26	26	26		
Standard	60	60	60	60	60	60	60	60		
SO ₂ (μg/m ³)										
	AAQ	AAQ	AAQ	AAQ	AAQ	AAQ	AAQ	AAQ		
Locations	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ		
	01	02	03	04	05	06	07	08		
Average	14	11	9	10	9	9	8	8		
Min	12	8	7	8	7	7	7	7		
Max	16	15	10	14	10	11	10	10		
98										
Percentile	16	14.54	10	13.08	10	10.54	10	10		
Standard	80	80	80	80	80	80	80	80		
	·		NO	Dx (µg/m ³))					
	AAQ	AAQ	AAQ	AAQ	AAQ	AAQ	AAQ	AAQ		
Locations	М	М	М	Μ	М	М	М	Μ		
	01	02	03	04	05	06	07	08		
Average	26	19	18	18	13	16	14	20		
Min	23	15	10	16	12	12	12	17		
Max	30	23	21	21	16	20	16	24		
98										
Percentile	29.08	22.54	20.54	21	15.54	20	16	23.54		
Standard	80	80	80	80	80	80	80	80		
			CO) (mg/m ³)						





Locations	AAQ M 01	AAQ M 02	AAQ M 03	AAQ M 04	AAQ M 05	AAQ M 06	AAQ M 07	AAQ M 08
Average	1.3	1.1	1.2	1.4	1.0	1.2	1.2	1.3
Min	1.1	1.0	1.1	1.3	0.8	1.0	1.0	1.1
Max	1.5	1.1	1.3	1.4	1.3	1.3	1.3	1.5
98 Percentile	1.49	1.29	1.29	1.39	1.28	1.29	1.29	1.49
Standard	4	4	4	4	4	4	4	4

Table 3-9: Results of AAQ Monitoring –October to December 2022

PM ₁₀ (μg/m ³)										
Locations	AAQ M 01	AAQM 02	AAQ M 03	AAQ M 04	AAQ M 05	AAQ M 06	AAQ M 07	AAQ M 08		
Average	82	73	76	78	65	61	61	57		
Min	72	68	69	71	57	52	56	51		
Max	92	82	82	83	72	67	70	65		
98 Percentile	91	80	82	83	72	67	70	65		
Standard	100	100	100	100	100	100	100	100		
PM _{2.5} (μg/m ³)										
Locations	AAQ M	AAQ M	AAQ M	AAQ M	AAQ M	AAQ M	AAQ M	AAQ M		





	01	02	03	04	05	06	07	08
Average	38	31	33	38	32	24	24	27
Min	32	26	29	33	26	20	20	22
Max	46	35	39	43	39	26	26	35
98 Percentile	45	35	39	43	39	26	26	34
Standard	60	60	60	60	60	60	60	60
	·		SO	ο ₂ (μg/m ³)				
Locations	AAQ M 01	AAQ M 02	AAQ M 03	AAQ M 04	AAQ M 05	AAQ M 06	AAQ M 07	AAQ M 08
Average	15	12	11	13	11	9	8	12
Min	11	8	9	9	8	7	7	8
Max	19	15	14	16	14	11	10	16
98 Percentile	19	15	14	16	14	11	10	16
Standard	80	80	80	80	80	80	80	80
			N	Dx (µg/m ³)				
Locations	AAQ M 01	AAQ M 02	AAQ M 03	AAQ M 04	AAQ M 05	AAQ M 06	AAQ M 07	AAQ M 08
Average	23	19	19	20	19	16	14	19
Min	19	15	15	17	16	12	12	15





Max	28	23	22	24	22	20	16	24		
98 Percentile	28	23	22	24	22	20	16	24		
Standard	80	80	80	80	80	80	80	80		
CO (mg/m ³)										
Locations	AAQ M 01	AAQ M 02	AAQ M 03	AAQ M 04	AAQ M 05	AAQ M 06	AAQ M 07	AAQ M 08		
Average	1.1	1	1.0	1.0	0.9	1.2	1.2	0.8		
Min	0.8	0.6	0.7	0.8	0.7	1.0	1.0	0.5		
Max	1.3	1.2	1.2	1.2	1.2	1.3	1.3	1.0		
98 Percentile	1	1	1	1	1	1	1	1		
Standard	4	4	4	4	4	4	4	4		

3.10 Noise Level

Objective

The main objective of monitoring of ambient noise levels was to establish the baseline noise levels in different zones i.e. Residential, Industrial, Commercial and Silence zones in the surrounding areas and to assess the total noise level in the environment of the study area.

Methodology

Identification of Sampling Locations:

A preliminary reconnaissance survey was undertaken to identify the major noise sources in the area. The sampling location in the area was identified considering location of industry,




commercial shopping complex activities and residential areas with various traffic activities and sensitive areas like hospital, court, temple and schools near the railway track for railway noise. The noise monitoring was conducted at 8 locations in the study area during monitoring period. The noise monitoring locations are given in Table 3.10 and shown in Figure 3.14.

1. Equivalent sound pressure level (Leq)

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

2. Instrument used for Monitoring

Noise levels were measured using an Integrating Sound Level Meter manufactured by Cygnet (Model No. 2031). It had an indicating mode of Lp and Leq. Keeping the mode in Lp for few minutes and setting the corresponding range and the weighting network in "A" weighing set, the sound level meter was run for one hour time and Leq was measured at all locations.

There are different types of fields for measuring the ambient noise level, categorized as free field, near field and far field.

3. Free Field

The free field is defined as a region where sound wave propagates without obstruction from source to the receiver. In such case, the inverse square law can be applied so that the sound pressure level decreases by 6dB (A) as the distance is doubled.

4. Near Field

The near field is defined as that region close to the source where the inverse square law does not apply. Usually this region is located within a few wavelengths from the source.

5. Far Field

The far field is defined as that region which is at a distance of more than 1-meter from the source.





Method of Monitoring and Parameters Measured

Noise monitoring was carried out continuously for 24-hours with one hour interval. During each hour parameters like L10, L50, L90 and Leq were directly computed by the instrument based on the sound pressure levels. Monitoring was carried out at 'A' weighing and in fast response mode.

The important parameters to be measured are Leq, Lday, and Lnight.

Leq: Latest noise monitoring equipment have the facility for measurement of Leq directly.

However, Leq can also be calculated using the following equation:

Leq (hourly) = L50 + (L10 - L90)2 / 60

Where,

L10 (Ten Percentile Exceeding Level) is the level of sound exceeding 10% of the total time of measurement.

L50 (Fifty Percentile Exceeding Level) is the level of sound exceeding 50% of the total time of measurement.

L90 (Ninety Percentile Exceeding Level) is the level of sound exceeding 90% of the total time of measurement.

Lday: This represents Leq of daytime. Lday is calculated as Logarithmic average using the hourly Leq's for day time hours from 6.00a.m to 10.00p.m

Lnight: This represents Leq of night time. Lnight is calculated as Logarithmic average using the hourly Leq's for nighttime hours from 10.00 p.m to 6.00 a.m

The noise levels were monitored at project site on hourly basis during the study period. A digital noise level meter of manufactured by Lutron was used to record the noise levels. Leq day and Leq night noise levels were derived and reported accordingly. Day time was considered as 10.00 hrs to 22.00 hrs and night time as 22.00 hrs to 06.00 hrs. Reading values of day time and night time equivalent noise levels at project site are presented in Table 3.11, 3.12 and 3.13. Laboratory monitoring results are attached as **Appendix II**.





Table 3-10: Noise monitoring locations

S. No	Location Name	Latitude/ Longitude	Direction	Distance	Zone
1	Near Project Site	12°55'31.05"N 74°49'4.65"E	-	_	Industrial
2	Near Panambur Beach Parking	12°56'16.93"N 74°48'19.20"E	NW	2.00 km	Commercial
3	Kulai Near Bhrama Shree Narayana Guru Samaja seva sangha	12°57'47.84"N 74°48'27.20"E	N	4.30 km	Residential
4	New Mangalore, Industrial Area, Near Ruchi Soya Industries	12°56'46.46"N 74°49'58.75"E	NE	2.90 km	Industrial
5	Karambar Near Rakshita Canteen	12°57'17.78"N 74°52'21.14"E	NE	6.75 km	Commercial
6	Bondel Near Business school Manel Srinivas Nayak Institute of Management	12°55'29.84"N 74°52'11.41"E	Е	5.60 km	Silent
7	Derebail Near Sri Durgha Parameshwari Prasanna Temple	12°54'25.59"N 74°50'53.76"E	SE	3.90 km	Residential
8	Urwa Near Church of Our Lady of Immaculate Conception	12°53'22.53"N 74°50'3.06"E	SE	4.25 kms	Residential





Figure 3-11: Noise Monitoring Locations





Sampling		Parameter						
Location	L10	L50	L90	Leq(d)	Leq(n)	Zone		
ANQM-1	71.3	63.8	54.6	68.6	60.2	Industrial		
ANQM-2	62.3	54.9	45.7	59.1	48.6	Commercial		
ANQM-3	54.6	49.1	42.8	52.4	43.5	Residential		
ANQM-4	61.9	54.9	47.9	59.3	51.0	Industrial		
ANQM-5	62.8	55.5	46.8	59.7	51.0	Commercial		
ANQM-6	51.9	43.8	37.8	49.3	38.4	Silent		
ANQM-7	50.5	47.4	38.5	49.0	39.5	Residential		
ANQM-8	54.3	47.6	42.0	52.0	42.6	Residential		

Table 3-11: Noise	Level Recorded in	n Study Area –	December 202	21 to February	2022
	Level Recolucu II	i Diudy Mica	December 202	I to I col uni j	

 Table 3-12: Noise Level Recorded in Study Area – March to May 2022

Sampling		Parameter							
				Г <u> </u>		_			
Location	L10	L50	L90	Leq(d)	Leq(n)	Zone			
ANQM-1	71.1	63.4	54.2	68.4	59.8	Industrial			
ANQM-2	62.1	54.7	45.3	58.9	48.2	Commercial			
ANQM-3	54.4	48.9	42.4	52.2	43.1	Residential			
ANQM-4	61.7	54.7	47.5	59.1	50.6	Industrial			
ANQM-5	62.6	55.2	46.4	59.5	50.6	Commercial			
ANQM-6	51.7	43.6	37.4	49.1	38.0	Silent			
ANQM-7	50.5	47.0	42.0	48.9	42.9	Residential			
ANQM-8	54.1	47.4	41.6	51.8	42.2	Residential			





Sampling		Parameter						
Location	L10	L50	L90	Leq(d)	Leq(n)	Zone		
ANQM-1	65.4	57.8	51.0	63.3	53.5	Industrial		
ANQM-2	62.7	56.7	46.2	60.0	50.1	Commercial		
ANQM-3	55.1	50.0	42.7	52.9	43.5	Residential		
ANQM-4	63.2	56.9	49.7	60.9	52.4	Industrial		
ANQM-5	63.5	56.2	49.9	61.4	51.6	Commercial		
ANQM-6	51.3	43.5	38.1	48.9	39.0	Silent		
ANQM-7	53.7	50.2	42.1	53.0	43.1	Residential		
ANQM-8	54.1	47.4	41.6	51.8	42.2	Residential		

 Table 3-13: Noise Level Recorded in Study Area – October to December 2022

Noise Standards

Ambient air quality standard in respect of noise have been stipulated by Govt. of India vide Gazette notification dated, 14.2.2000. Table 3.14 describes ambient noise standards.

Area Code	Category of Area	Limits in dB(A), Leq	
		** Day time	#Night time
А	Industrial Area	75	70
В	Commercial Area	65	55
С	Residential Area	55	45
D	Silence Zone @	50	40

 Table 3-14: Ambient Noise Standards

** Day Time: 6.00 a.m to 10.00 p.m. #Night Time: 10.00 p.m to 6.00 a.m

^(a) Silence zone is defined as an area up to 100 m around premises such as hospitals, educational institutions and courts. The silence zones are to be declared by the competent authority. Use of horns, loudspeakers and bursting of crackers shall be banned in these zones.





Figure 3-12 Graphical Noise level in Study area December 2021- February 2022



Figure 3-13: Graphical Noise level in Study area March-May 2022







Noise level observations and inferences:

Winter Season (December 2021 – February 2022):

In Pre – Monsoon season the Noise level of the study area for Industrial Zone varied from 59.3 - 68.6 dB during day time & 51.0-60.2 during night time which are within limits of the specified standards stated in table no. 3.11

The Noise level of the study area for Residential Zone varied from 49.0-52.4 dB during day time & 39.5 - 43.5 dB in night time which are within the limit of the specified standards stated in table no. 3.11

The Noise level of the study area for Commercial Zone varied from 59.1-59.7 dB during day time & 48.6-51.0 dB in night time which are within the limit of the specified standards stated in table no. 3.11

The Noise level of the study area for Silent Zone varied from 49.3 dB during day time & 38.4 dB in night time which are within the limit of the specified standards stated in table no. 3.11





Summer Season (March- May 2022):

In Pre – Monsoon season the Noise level of the study area for Industrial Zone varied from 59.1 - 68.4 dB during day time & 50.6-59.8 dB during night time which is within limits of the specified standards stated in table no. 3.12

The Noise level of the study area for Residential Zone varied from 48.9-52.2 dB during day time & 42.2-43.1 dB in night time which is within the limit of the specified standards stated in table no. 3.12

The Noise level of the study area for Commercial Zone varied from 58.9-59.5 dB during day time & 48.2-50.6 dB in night time which is within the limit of the specified standards stated in table no. 3.12

The Noise level of the study area for Silent Zone varied from 49.1 dB during day time & 38.0 dB in night time which is within the limit of the specified standards stated in table no. 3.12

Post-Monsoon Season (October-December 2022):

In Pre – Monsoon season the Noise level of the study area for Industrial Zone varied from 60.9-63.3 dB during day time & 52.4-53.5 dB during night time which are within limits of the specified standards stated in table no. 3.13

The Noise level of the study area for Residential Zone varied from 51.8-53 dB during day time & 42.2-43.5 dB in night time which is within the limit of the specified standards stated in table no. 3.13

The Noise level of the study area for Commercial Zone varied from 60-61.4 dB during day time & 50.1-51.6 dB in night time which is within the limit of the specified standards stated in table no. 3.13

The Noise level of the study area for Silent Zone varied from 48.9 dB during day time & 39.0 dB in night time which is within the limit of the specified standards stated in table no. 3.13





3.11 Water Environment

Selected water quality parameters of surface water, ground water and marine water resources within 10 km radius of the study area have been studied for assessing the hydrological environment to evaluate anticipated impact of the proposed project. Understanding the water quality is essential in the preparation of Environmental Impact Assessment report.

The purpose of this study is to:

- Assess the water quality characteristics for critical parameters.
- Evaluate the impacts on agricultural productivity, habitat conditions, recreational resources and aesthetics in the vicinity.
- Predict the likely impacts on water quality due to the project and related activities.

Selection of Sampling Locations

The assessment of present status of water quality within the study area was conducted by collecting water from ground water sources and surface water sources during monitoring period. The sampling locations were identified on the basis of their importance. 7 Marine water samples, 5ss ground water and 2 surface water samples were collected during monitoring period.

Details of surface water sampling locations, direction from the plant site are presented in Table 3.15 and Shown in Figure 3.14.

Sr. No.	Location	Latitude	Longitude	Direction	Distance
1	Baggundi Lake	12°57'45.9"N	74°48'40.6"E	N	4.00 km
2	Kavoor Lake	12°55'11.4"N	74°51'34.9"E	SE	4.60 km

Table 3-15: Surface Water Sampling Locations

Details of ground water sampling locations, their distance and direction from the plant site are presented in and shown in Table 3.16.





Table 3-16: Ground Water Sampling Locations

Sr. No	Location Name	Latitude	Longitude	Direction	Distance	Source
1	Near Panambur Beach Parking	12°56'17.25"N	74°48'19.83"E	NW	2.00 km	Bore Well
2	Kulai Near Bhrama Shree Narayana Guru Samaja seva sangha	12°57'48.20"N	74°48'27.36"E	Ν	4.30 km	Bore Well
3	Karambur Near Rakshita Canteen	12°57'47.65"N	74°48'29.14"E	NEs	6.80 km	Bore Well
4	Bondel Near Business school Manel Srinivas Nayak Institute of Management	12°57'15.85"N	74°52'21.77"E	N	5.70 km	Bore Well
5	Derebil Near Sri Durgha Parameshwari Prasanna Temple	12°54'26.41"N	74°50'54.06"E	SE	3.40 km	Bore Well





Figure 3-15 Surface & Ground water Sampling Location





Details of marine water sampling location, their distance and direction from the plant site are presented in Table 3.13.

Sr. No.	Location	Latitude	Longitude	Direction	Distance
1	Near Project Site	12°55'31.50"N	74°49'2.34"E	-	-
2	Mangalore Port Control office	12°55'38.29"N	74°48'54.37"E	N	0.30 km
3	On break water – NMPA	12°55'46.2"N	74°47'53.1"E	NW	2.00 km
4	Tannirbhavi Beach view point	12°54'53.5"N	74°48'21.0"E	SW	1.40 km
5	Panambur Beach	12°56'53.33"N	74°47'21.59"E	NW	3.90 km
6	Gurpur River Creek Water Up Stream	12°55'33.34"N	74°49'34.19"E	Е	0.90 km
7	Gurpur River Creek Water Down Stream	12°55'37.08"N	74°49'39.50"E	Е	1.00 km

Table 3-17: Marine Water and sediment Sampling Locations





Figure 3-16: Marine Water and Marine Sediment Sampling





Methodology

Water samples were collected from all the sampling locations and analyzed for relevant physical, chemical and bacteriological parameters. Collection and analysis of the samples was carried out as per established standard methods and procedures, prescribed by CPCB, relevant IS Codes and Standard Methods of Examination of Water. This report presents data for the monitoring Period.

Analyses of the parameters like temperature, pH, dissolved oxygen and alkalinity were carried out at the sampling stations immediately after collection of samples with the help of Field Analysis Kits. For analysis of other parameters, the samples were preserved and brought to laboratory. The metallic constituents like arsenic, mercury, lead, cadmium, chromium, copper, zinc, selenium, iron and manganese were analyzed with Atomic Absorption Spectroscope.

3.11.1 Surface Water Quality

The analysis data for the monitoring of surface water is presented in Table 3.14. Detailed Surface water quality monitoring results are attached as **Appendix III** of EIA report.

Observations and inferences:

Winter Season (December 2021- February 2022):

The analysis data for the monitoring period of surface water is presented above mentioned table.

- The analysis results indicate that the pH is 7.3-7.4.
- DO was observed between 4.9-5 mg/l TDS was observed between 402-418 mg/l.
- The chlorides and Sulphates were found as 56-60 mg/L and 50 mg/L respectively.
- Total Coliform Bacteria were observed to be 500-900 MPN/100 ml

The surface water quality of in accordance with water quality standards falls under Class D

Summer Season (March-May 2022):

The analysis data for the monitoring period of surface water is presented above mentioned table.

• The analysis results indicate that the pH is 7.5-7.6.





- DO was observed between 4.7-4.9 mg/l TDS was observed between 438-478 mg/l.
- The chlorides and Sulphate were found between 60-71 mg/L and 53-56 mg/L respectively.
- Total Coliform Bacteria were observed to be 500-900 MPN/100 ml

The surface water quality of in accordance with water quality standards falls under Class D

Post-Monsoon Season (October- November- December 2022):

The analysis data for the monitoring period of surface water is presented above mentioned table.

- The analysis results indicate that the pH is 7.4-7.5.
- DO was observed to be 4.9-5 mg/l TDS was observed as 438-444 mg/l.
- The Chlorides and Sulphate were found between 56-64 mg/L and 52-53 mg/L respectively.
- Total Coliform Bacteria were observed to be 500-900 MPN/100 ml

The surface water quality of in accordance with water quality standards falls under Class D



Multipurpose Cargo Berth (Berth No.17) at New Mangalore Port

Authority



Table 3-18: Surface Water Quality Results - December 2021 to February 2022

Sr. No.	Test Parameter	Test Method	SW1	SW2	Unit
1	Colour	APHA 2120 C :2017, 23 rd Ed.	BDL[DL=1]	BDL[DL=1]	Hazen
2	Odor*	IS 3025 (Part 05) : 1983	Agreeable	Agreeable	-
3	Temperature	IS 3025 (Part 09) : 1984	26.9	27.1	⁰ C
4	Turbidity	IS 3025 (Part 10) : 1984	3.7	3.9	NTU
5	рН	IS 3025 (Part 11) :1983	7.4	7.3	-
6	Electrical Conductivity	IS 3025 (Part 14) : 1984	643	618	µS/cm
7	Total Dissolved Solids	IS 3025 (Part 16) : 1984	418	402	mg/L
8	Total suspended solids	IS 3025 (Part 17) : 1984	4	6	mg/L
9	Total Hardness as CaCO ₃	IS 3025 (Part 21) : 2009	292	280	mg/L
10	Ammonical Nitrogen as NH ₃ - N	APHA 4500-NH ₃ C :2017, 23 rd Ed.	BDL[DL=0.1]	BDL[DL=0.1]	mg/L
11	Nitrates as NO ₃ ⁻ -N	IS 3025 (Part 34) : 1988	0.6	0.5	mg/L
12	Nitrite as NO_2^- -N	IS 3025 (Part 34) : 1988	0.01	0.006	mg/L
13	Phosphates as PO_4^{3-}	APHA 4500 P	0.14	0.11	mg/L



Multipurpose Cargo Berth (Berth No.17) at New Mangalore Port



Sr. No.	Test Parameter	Test Method	SW1	SW2	Unit
		E:2017, 23 rd Ed.			
14	Biochemical Oxygen Demand (27 ⁰ C, 3Days)	IS 3025 (Part 44) : 1993	5.6	5	mg/L
15	Chemical Oxygen Demand	IS 3025 (Part 58) : 2006	36	32	mg/L
16	Dissolved Oxygen	IS 3025 (Part 38) : 1989	4.9	5	mg/L
17	Potassium as K	APHA 3500K:2017, 23 rd Ed.	1.2	1.4	mg/L
18	Sodium as Na	APHA 3500Na:2017, 23 rd Ed.	36	34	mg/L
19	Calcium as Ca	IS 3025 (Part 40) : 1991	59	57	mg/L
20	Magnesium as Mg	IS 3025 (Part 46) : 1994	35	34	mg/L
21	Carbonates (CO_3^{-2}) as $CaCO_3^*$	IS 3025 (Part 51) : 2001	BDL[DL=1]	BDL[DL=1]	mg/L
22	Bicarbonates as (HCO ₃ ⁻) as CaCO ₃ *	IS 3025 (Part 51) : 2001	276	266	mg/L
23	Chlorides as Cl ⁻	IS 3025 (Part 32) : 1988	60	56	mg/L
24	Sulphates as SO ₄ ²⁻	APHA 4500- SO ₄ ²⁻ E:2017, 23 rd Ed.	50	50	mg/L
25	Fluoride as F	APHA 4500-F ⁻ B- D:2017, 23 rd Ed.	0.6	0.5	mg/L



Multipurpose Cargo Berth (Berth No.17) at New Mangalore Port



Sr. No.	Test Parameter	Test Method	SW1	SW2	Unit
26	Boron as B	APHA 4500-B B:2017, 23 rd Ed.	0.3	0.4	mg/L
27	Iron as Fe	IS 3025 (Part 53) : 2003	BDL[DL=0.06]	BDL[DL=0.06]	mg/L
28	Zinc as Zn	IS 3025 (Part 49) : 1994	BDL[DL=0.02]	BDL[DL=0.02]	mg/L
29	Total Coliform Bacteria*	IS 1622 : 1981	900	500	MPN/100 ml
30	Fecal coliform*	IS 1622 : 1981	50	40	MPN/100 ml
31	E. Coli*	IS 1622 : 1981	Present	Present	-

 Table 3-19: Surface Water Quality Results – March to May 2022

Sr. No.	Test Parameter	Test Method	SW1	SW2	Unit
1	Colour	APHA 2120 C :2017, 23 rd Ed.	BDL[DL=1]BDL[DL=1]AgreeableAgreeable		Hazen
2	Odor*	IS 3025 (Part 05) : 1983	Agreeable	Agreeable	-
3	Temperature	IS 3025 (Part 09) : 1984	29.1	AgreeableAgreeable29.128.53.94.3	
4	Turbidity	IS 3025 (Part 10) : 1984	3.9 4.3		NTU
5	pН	IS 3025 (Part 11) :1983	7.5	7.6	-
6	Electrical Conductivity	IS 3025 (Part 14) : 1984	735	690	μS/cm
7	Total Dissolved Solids	IS 3025 (Part 16) : 1984	478	438	mg/L
8	Total suspended	IS 3025 (Part 17): 1984	3	4	mg/L



Multipurpose Cargo Berth (Berth No.17) at New Mangalore Port



Sr. No.	Test Parameter	Test Method	SW1	SW2	Unit
	solids				
9	Total Hardness as CaCO ₃	IS 3025 (Part 21) : 2009	326	292	mg/L
10	Ammonical Nitrogen as NH ₃ -N	APHA 4500-NH ₃ C :2017, 23 rd Ed.	BDL[DL=0.1]	BDL[DL=0.1]	mg/L
11	Nitrates as NO ₃ ⁻ -N	IS 3025 (Part 34) : 1988	0.7	0.6	mg/L
12	Nitrite as NO_2^- -N	IS 3025 (Part 34) : 1988	5 (Part 34) : 1988 0.014 0.01 A 4500 P E:2017, 23^{rd} Ed. 0.16 0.13		mg/L
13	Phosphates as PO ₄ ³⁻	APHA 4500 P E:2017, 23 rd Ed.	0.16	0.13	mg/L
14	Biochemical Oxygen Demand (27 ⁰ C, 3Days)	IS 3025 (Part 44) : 1993	6.2	5.6	mg/L
15	Chemical Oxygen Demand	IS 3025 (Part 58) : 2006	40	36	mg/L
16	Dissolved Oxygen	IS 3025 (Part 38) : 1989	4.7	4.9	mg/L
17	Potassium as K	APHA 3500K:2017, 23 rd Ed.	1.4	1.6	mg/L
18	Sodium as Na	APHA 3500Na:2017, 23 rd Ed.	43	36	mg/L
19	Calcium as Ca	IS 3025 (Part 40) : 1991	67	61	mg/L
20	Magnesium as Mg	IS 3025 (Part 46) : 1994	39	34	mg/L
21	Carbonates (CO ₃ ⁻²) as CaCO ₃ *	IS 3025 (Part 51) : 2001	BDL[DL=1]	BDL[DL=1]	mg/L
22	Bicarbonates as (HCO ₃ ⁻) as CaCO ₃ *	IS 3025 (Part 51) : 2001	304	276	mg/L



Multipurpose Cargo Berth (Berth No.17) at New Mangalore Port



Sr. No.	Test Parameter	Test Method	SW1	SW2	Unit
23	Chlorides as Cl ⁻	IS 3025 (Part 32) : 1988	71	60	mg/L
24	Sulphates as SO_4^{2-}	APHA 4500- SO ₄ ²⁻ E:2017, 23 rd Ed.	56	53	mg/L
25	Fluoride as F	APHA 4500-F ⁻ B- D:2017, 23 rd Ed.	30 33 0.7 0.6 0.4 0.5		mg/L
26	Boron as B	APHA 4500-B B:2017, 23 rd Ed.	-B B:2017, Ed. 0.4		mg/L
27	Iron as Fe	IS 3025 (Part 53) : 2003	BDL[DL=0.06]	BDL[DL=0.06]	mg/L
28	Zinc as Zn	IS 3025 (Part 49) : 1994	BDL[DL=0.02]	BDL[DL=0.02]	mg/L
29	Total Coliform Bacteria*	IS 1622 : 1981	900	500	MPN/100 ml
30	Fecal coliform*	IS 1622 : 1981	20	40	MPN/100 ml
31	E. Coli*	IS 1622 : 1981	Present	Present	-

 Table 3-20: Surface Water Quality Results – October to December 2022

Sr. No.	Test Parameter	Test Method	SW1	SW2	Unit
1	Colour	APHA 2120 C :2017, 23 rd Ed.	BDL[DL=1]	BDL[DL=1]	Hazen
2	Odor*	IS 3025 (Part 05) : 1983	Agreeable	Agreeable	-
3	Temperature	IS 3025 (Part 09) : 1984	28.8	28.6	^{0}C
4	Turbidity	IS 3025 (Part 10) : 1984	3.6	4.1	NTU



Multipurpose Cargo Berth (Berth No.17) at New Mangalore Port



Sr. No.	Test Parameter	Test Method	SW1	SW2	Unit
5	рН	IS 3025 (Part 11) :1983	7.4	7.5	-
6	Electrical Conductivity	IS 3025 (Part 14) : 1984	710	658	μS/cm
7	Total Dissolved Solids	IS 3025 (Part 16) : 1984	444	438	mg/L
8	Total suspended solids	IS 3025 (Part 17) : 1984	2	4	mg/L
9	Total Hardness as CaCO ₃	IS 3025 (Part 21) : 2009	318	284	mg/L
10	Ammonical Nitrogen as NH ₃ -N	APHA 4500-NH ₃ C :2017, 23 rd Ed.	BDL[DL=0.1]	BDL[DL=0.1]	mg/L
11	Nitrates as NO ₃ ⁻ -N	IS 3025 (Part 34) : 1988	0.6	0.5	mg/L
12	Nitrite as NO_2^- -N	IS 3025 (Part 34) : 1988	0.01	0.006	mg/L
13	Phosphates as PO ₄ ³⁻	APHA 4500 P E:2017, 23 rd Ed.	0.14	0.11	mg/L
14	Biochemical Oxygen Demand (27 ⁰ C, 3Days)	IS 3025 (Part 44) : 1993	5.4	5.3	mg/L
15	Chemical Oxygen Demand	IS 3025 (Part 58) : 2006	32	28	mg/L
16	Dissolved Oxygen	IS 3025 (Part 38) : 1989	4.9	5	mg/L
17	Potassium as K	APHA 3500K:2017, 23 rd Ed.	1.2	1.4	mg/L
18	Sodium as Na	APHA 3500Na:2017, 23 rd	38	34	mg/L



Multipurpose Cargo Berth (Berth No.17) at New Mangalore Port



Sr. No.	Test Parameter	Test Method	SW1	SW2	Unit
		Ed.			
19	Calcium as Ca	IS 3025 (Part 40) : 1991	63	59	mg/L
20	Magnesium as Mg	IS 3025 (Part 46) : 1994	39	34	mg/L
21	Carbonates (CO_3^{-2}) as $CaCO_3^*$	IS 3025 (Part 51) : 2001	BDL[DL=1]	BDL[DL=1]	mg/L
22	Bicarbonates as (HCO ₃ ⁻) as CaCO ₃ *	IS 3025 (Part 51) : 2001	298	270	mg/L
23	Chlorides as Cl ⁻	IS 3025 (Part 32) : 1988	64	56	mg/L
24	Sulphates as SO ₄ ²⁻	APHA 4500- SO ₄ ²⁻ E:2017, 23 rd Ed.	53	52	mg/L
25	Fluoride as F	APHA 4500-F ⁻ B- D:2017, 23 rd Ed.	0.6	0.5	mg/L
26	Boron as B	APHA 4500-B B:2017, 23 rd Ed.	0.3	0.4	mg/L
27	Iron as Fe	IS 3025 (Part 53) : 2003	BDL[DL=0.06]	BDL[DL=0.06]	mg/L
28	Zinc as Zn	IS 3025 (Part 49) : 1994	BDL[DL=0.02]	BDL[DL=0.02]	mg/L
29	Total Coliform Bacteria*	IS 1622 : 1981	900	500	MPN/100 ml
30	Fecal coliform*	IS 1622 : 1981	20	40	MPN/100 ml
31	E. Coli*	IS 1622 : 1981	Present	Present	-





Table 3-21: Surface Water Quality Standards as per CPCB

Designated use	Class	Criteria
Drinking water source		Total Coliforms MPN/100ml shall be 50 or less
without conventional	٨	pH between 6.5 and 8.5
treatment but after	A	Dissolved Oxygen 6mg/l or more
disinfection		Biochemical Oxygen Demand 5 days 20 ⁰ C 2mg/l or less
		Total Coliforms Organism MPN/100ml shall be 500 or less
Outdoor bathing	D	pH between 6.5 and 8.5
(organized)	В	Dissolved Oxygen 5mg/l or more
		Biochemical Oxygen Demand 5 days 20C 3mg/l or less
Drinking water source		Total Coliforms MPN/100ml shall be 5000 or less
after conventional	С	pH between 6 to 9
treatment and		Dissolved Oxygen 4mg/l or more
disinfection		Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Propagation of wild		pH between 6.5 to 8.5
life and fisheries	D	Dissolved Oxygen 4mg/l or more
ine and fisheries		Free Ammonia (as N) 1.2 mg/l or less
Imigation industrial		pH between 6.0 to 8.5
accling controlled	Б	Electrical Conductivity at 25C micro mhos/cm Max.2250
waste disposel	E	Sodium absorption Ratio Max. 26
waste disposai		Boron Max. 2mg/l
	Below E	Not meeting A,B,C,D,E





3.11.2 Ground Water Quality

Ground water monitoring was carried out at 5 locations. Detailed results of Ground water quality analysis have been given in Table 3.15 and attached as **Appendix IV**.

Observations:

Winter Season (December 2021 to February 2022)

The analysis results indicate that the pH is in the range of 7.5-7.7.

Total Hardness was observed in the range of 292-426 mg/L.

TDS was observed to be in the range of 428-692 mg/L

Turbidity was observed to be in the range of 0.3-0.7 NTU

Electric Conductivity was in the range of 680-1065 μ S/cm

The Chlorides and Sulphates were found as 58-135 and 62-90 mg/L respectively

Sodium and Potassium were found as 35-81 and 1.2-3.1 mg/L respectively

Calcium and Magnesium were found as 59-90 and 35-49 mg/L respectively

Fluoride and Boron were observed to be 0.3-0.5 and 0.1-0.3 mg/L respectively

Total Coliform Bacteria were observed to be 2-6 MPN/100 ml

Summer Season (March-May 2022)

The analysis results indicate that the pH is in the range of 7.7-7.8.

Total Hardness was observed in the range of 312-436 mg/L.

TDS was observed to be in the range of 462-695 mg/L

Turbidity was observed to be in the range of 0.6-0.9 NTU

Electric Conductivity was in the range of 735-1090 $\mu S/cm$

The Chlorides and Sulphates were found as 63-145 and 68-94 mg/L respectively





Sodium and Potassium were found as 38-87 and 1.5-3.1 mg/L respectively

Calcium and Magnesium were found as 66-93 and 36-50 mg/L respectively

Fluoride and Boron were observed to be 0.4-0.6 and 0.2-0.4 mg/L respectively

Total Coliform Bacteria were observed to be 2-5 MPN/100 ml

Post-Monsoon Season (October-November-December 2022)

The analysis results indicate that the pH is in the range of 7.4-7.6.

Total Hardness was observed in the range of 304-424 mg/L.

TDS was observed to be in the range of 442-688 mg/L

Turbidity was observed to be in the range of 0.4-0.8 NTU

Electric Conductivity was in the range of 711-1048 μ S/cm

The Chlorides and Sulphates were found as 57-133 and 63-90 mg/L respectively

Sodium and Potassium were found as 34-80 and 1.3-2.8 mg/L respectively

Calcium and Magnesium were found as 63-91 and 36-48 mg/L respectively

Fluoride and Boron were observed to be 0.3-0.5 and 0.1-0.3 mg/L respectively

 Table 3-22: Ground Water Quality Results – December 2021 to February 2022

Sr. No.	Test Parameter	GW1	GW2	GW3	GW4	GW5	Unit
1	Color	BDL[D L=1]	BDL[D L=1]	BDL[D L=1]	BDL[D L=1]	BDL[D L=1]	Hazen
2	Odor*	Agreeab le	Agreeab le	Agreeab le	Agreeab le	Agreeab le	-
3	Temperature	26.8	26.1	26.1	25.8	27.6	⁰ C
4	Turbidity	0.7	0.5	0.6	0.3	0.5	NTU
5	pН	7.7	7.5	7.6	7.6	7.7	-
6	Electrical Conductivity	1065	720	758	680	704	µS/cm





Sr. No.	Test Parameter	GW1	GW2	GW3	GW4	GW5	Unit
7	Total Dissolved Solids	692	468	488	428	458	mg/L
8	Total Suspended Solids	3	2	4	3	1	mg/L
9	Total Hardness as CaCO ₃	426	306	322	292	306	mg/L
10	Ammonical Nitrogen as NH ₃ - N	BDL[D L=0.1]	BDL[D L=0.1]	BDL[D L=0.1]	BDL[D L=0.1]	-	mg/L
11	Nitrates as NO_3^- - N	0.8	0.8	0.9	0.7	0.7	mg/L
12	Nitrite as NO_2^- -N	0.016	0.01	0.014	0.006	0.01	mg/L
13	Phosphates as PO_4^{3-}	BDL[D L=0.01]	BDL[D L=0.01]	BDL[D L=0.01]	BDL[D L=0.01]		mg/L
14	Potassium as K	3.1	1.7	1.4	1.2	1.6	mg/L
15	Sodium as Na	81	40	43	35	39	mg/L
16	Calcium as Ca	90	63	67	59	64	mg/L
17	Magnesium as Mg	49	36	38	35	35	mg/L
18	Carbonates (CO ₃ ⁻ ²) as CaCO ₃ *	BDL[D L=1]	BDL[D L=1]	BDL[D L=1]	BDL[D L=1]	BDL[D L=1]	mg/L
19	Bicarbonates as (HCO ₃ ⁻) as CaCO ₃ *	370	270	286	276	292	mg/L
20	Chlorides as Cl ⁻	135	67	71	58	65	mg/L
21	Sulphates as SO_4^{2-}	90	70	74	62	66	mg/L
22	Fluoride as F	0.5	0.4	0.5	0.3	0.4	mg/L
23	Boron as B	0.3	0.2	0.3	BDL[D L=0.1]	0.2	mg/L
24	Iron as Fe	BDL[D L=0.06]	BDL[D L=0.06]	BDL[D L=0.06]	BDL[D L=0.06]	BDL[D L=0.06]	mg/L
25	Zinc as Zn	BDL[D L=0.02]	BDL[D L=0.02]	BDL[D L=0.02]	BDL[D L=0.02]	BDL[D L=0.02]	mg/L
26	Mercury as Hg	BDL[D	BDL[D	BDL[D	BDL[D	BDL[D	mg/L





Sr. No.	Test Parameter	GW1	GW2	GW3	GW4	GW5	Unit
		L=0.006	L=0.006	L=0.006	L=0.006	L=0.006	
27	Total Coliform Bacteria*	5	4	6	2	4	MPN/10 0 ml
28	Fecal coliform*	BDL[D L=2]	BDL[D L=2]	BDL[D L=2]	BDL[D L=2]	BDL[D L=2]	MPN/10 0 ml
29	E. Coli*	Absent	Absent	Absent	Absent	Absent	-

Table 3-23: Ground Water Quality Results – March to May 2022

Sr. No.	Test Parameter	GW1	GW2	GW3	GW4	GW5	Unit
1	Color	BDL[D L=1]	BDL[D L=1]	BDL[D L=1]	BDL[D L=1]	BDL[D L=1]	Hazen
2	Odor*	Agreeab le	Agreeab le	Agreeab le	Agreeab le	Agreea ble	-
3	Temperature	27.1	26.9	27.1	26.8	26.8	^{0}C
4	Turbidity	0.9	0.7	0.8	0.6	0.7	NTU
5	pН	7.8	7.7	7.7	7.8	7.8	-
6	Electrical Conductivity	1090	790	782	740	735	µS/cm
7	Total Dissolved Solids	695	502	496	462	478	mg/L
8	Total Suspended Solids	5	2	4	3	4	mg/L
9	Total Hardness as CaCO ₃	436	344	334	326	312	mg/L
10	Ammonical Nitrogen as NH ₃ -N	BDL[D L=0.1]	BDL[D L=0.1]	BDL[D L=0.1]	BDL[D L=0.1]	BDL[D L=0.1]	mg/L
11	Nitrates as NO ₃ ⁻ -N	0.9	0.9	1	0.8	0.8	mg/L
12	Nitrite as NO_2^- - N	0.018	0.014	0.018	0.01	0.014	mg/L
13	Phosphates as PO ₄ ³⁻	BDL[D L=0.01]	BDL[D L=0.01]	BDL[D L=0.01]	BDL[D L=0.01]	BDL[D L=0.01]	mg/L
14	Potassium as K	3.1	1.9	1.5	1.6	1.7	mg/L





Sr. No.	Test Parameter	GW1	GW2	GW3	GW4	GW5	Unit
15	Sodium as Na	87	46	47	38	43	mg/L
16	Calcium as Ca	93	71	69	67	66	mg/L
17	Magnesium as Mg	50	40	39	38	36	mg/L
18	Carbonates (CO_3^{-2}) as CaCO ₃ *	BDL[D L=1]	BDL[D L=1]	BDL[D L=1]	BDL[D L=1]	BDL[D L=1]	mg/L
19	Bicarbonates as (HCO ₃ ⁻) as CaCO ₃ *	386	292	296	296	300	mg/L
20	Chlorides as Cl ⁻	145	77	78	63	72	mg/L
21	Sulphates as SO ₄ ²⁻	94	80	76	68	76	mg/L
22	Fluoride as F ⁻	0.6	0.5	0.6	0.4	0.5	mg/L
23	Boron as B	0.4	0.3	0.4	0.2	0.3	mg/L
24	Iron as Fe	BDL[D L=0.06]	BDL[D L=0.06]	BDL[D L=0.06]	BDL[D L=0.06]	BDL[D L=0.06]	mg/L
25	Zinc as Zn	BDL[D L=0.02]	BDL[D L=0.02]	BDL[D L=0.02]	BDL[D L=0.02]	BDL[D L=0.02]	mg/L
26	Mercury as Hg	BDL[D L=0.006]	BDL[D L=0.006]	BDL[D L=0.006]	BDL[D L=0.006]	BDL[D L=0.00 6]	mg/L
27	Total Coliform Bacteria*	4	2	5	4	5	MPN/10 0 ml
28	Fecal coliform*	BDL[D L=2]	BDL[D L=2]	BDL[D L=2]	BDL[D L=2]	BDL[D L=2]	MPN/10 0 ml
29	E. Coli*	Absent	Absent	Absent	Absent	Absent	-

 Table 3-24: Ground Water Quality Results – October to December 2022

Sr. No.	Test Parameter	GW1	GW2	GW3	GW4	GW5	Unit
1	Color	BDL[DL =1]	BDL[DL =1]	BDL[DL =1]	BDL[DL =1]	BDL[DL =1]	Hazen





Sr. No.	Test Parameter	GW1	GW2	GW3	GW4	GW5	Unit
2	Odor*	Agreeabl e	Agreeabl e	Agreeabl e	Agreeabl e	Agreeabl e	-
3	Temperature	26.5	27.1	26.9	27.2	27.3	⁰ C
4	Turbidity	0.8	0.5	0.6	0.4	0.5	NTU
5	pН	7.6	7.5	7.4	7.6	7.6	-
6	Electrical Conductivity	1048	750	728	715	711	μS/cm
7	Total Dissolved Solids	688	488	482	442	462	mg/L
8	Total Suspended Solids	4	3	2	2	2	mg/L
9	Total Hardness as CaCO ₃	424	332	320	316	304	mg/L
10	Ammonical Nitrogen as NH ₃ -N	BDL[DL =0.1]	BDL[DL =0.1]	BDL[DL =0.1]	BDL[DL =0.1]	BDL[DL =0.1]	mg/L
11	Nitrates as NO_3 -N	0.8	0.8	0.7	0.7	0.7	mg/L
12	Nitrite as NO ₂ -N	0.014	0.01	0.013	0.008	0.01	mg/L
13	Phosphates as PO_4^{3-}	BDL[DL =0.01]	BDL[DL =0.01]	BDL[DL =0.01]	BDL[DL =0.01]	BDL[DL =0.01]	mg/L
14	Potassium as K	2.8	1.7	1.3	1.4	1.5	mg/L
15	Sodium as Na	80	43	45	34	41	mg/L
16	Calcium as Ca	91	68	66	65	63	mg/L
17	Magnesium as Mg	48	39	38	37	36	mg/L
18	Carbonates (CO_3^{-2}) as Ca CO_3^*	BDL[DL =1]	BDL[DL =1]	BDL[DL =1]	BDL[DL =1]	BDL[DL =1]	mg/L
19	Bicarbonates as (HCO_3) as	374	284	286	288	290	mg/L





Sr. No.	Test Parameter	GW1	GW2	GW3	GW4	GW5	Unit
	CaCO ₃ *						
20	Chlorides as Cl ⁻	133	71	75	57	68	mg/L
21	Sulphates as SO_4^{2-}	90	72	70	63	70	mg/L
22	Fluoride as F	0.5	0.4	0.5	0.3	0.4	mg/L
23	Boron as B	0.3	0.2	0.3	0.1	0.2	mg/L
24	Iron as Fe	BDL[DL =0.06]	BDL[DL =0.06]	BDL[DL =0.06]	BDL[DL =0.06]	BDL[DL =0.06]	mg/L
25	Zinc as Zn	BDL[DL =0.02]	BDL[DL =0.02]	BDL[DL =0.02]	BDL[DL =0.02]	BDL[DL =0.02]	mg/L
26	Mercury as Hg	BDL[DL =0.006]	BDL[DL =0.006]	BDL[DL =0.006]	BDL[DL =0.006]	BDL[DL =0.006]	mg/L
27	Total Coliform Bacteria*						MPN/100 ml
28	Fecal coliform*	BDL[DL =2]	BDL[DL =2]	BDL[DL =2]	BDL[DL =2]	BDL[DL =2]	MPN/100 ml
29	E. Coli*	Absent	Absent	Absent	Absent	Absent	-

3.11.3 Marine Water Quality

Marine water monitoring was carried out at 7 different locations. Detailed results of marine water quality analysis have been given below. Laboratory monitoring results are attached as **Appendix V**.





Table 3-25: Marine water quality results - December 2021 to February 2022

Sr. no.	Test Paramete r	Unit	MW1	MW2	MW3	MW4	MW5	MW6	MW7
1	Color	Hazen	BDL[D L=1]						
2	Odor	-	Agreeab le						
3	Temperat ure	⁰ C	28.8	28.9	29.2	29.8	28.9	28.7	28.9
4	Turbidity	NTU	5.8	6.5	4.8	5.8	6.3	7.1	7.5
5	pН	-	7.6	7.8	7.9	7.7	7.8	7.7	7.9
6	Electrical Conductiv ity	µS/cm	52200	55420	52840	53880	54350	36270	38800
7	Salinity	Ppt h		33.4	30.0	30.8	31.5	23.3	24.0
8	Total Dissolved Solids	mg/L	33930	34840	31750	32920	33280	23580	25240
9	Total Suspende d Solids	mg/L	15	22	18	20	14	10	12
10	Ammonic al Nitrogen as NH ₃ -N	mg/L	BDL[D L=0.1]						
11	Nitrates as NO_3^- -N	mg/L	0.8	0.9	0.7	0.8	1	0.8	0.9





Sr. no.	Test Paramete r	Unit	MW1	MW2	MW3	MW4	MW5	MW6	MW7
12	Nitrite as NO_2^- -N	mg/L	0.016	0.018	0.012	0.016	0.0	0.03	0.038
13	Phosphate s as PO ₄ ³⁻	mg/L	0.2	0.12	0.1	0.14	0.11	0.17	0.2
14	Biochemi cal Oxygen Demand (27 ⁰ C, 3Days)	mg/L	BDL[D L=2]						
15	Chemical Oxygen Demand	mg/L	16	8	16	20	8	12	16
16	Dissolved Oxygen	mg/L	5.8	5.9	5.7	5.6	6.1	5.8	5.7
17	Chlorides as Cl ⁻	mg/L	17787	18482	16606	17023	17440	12924	13271
18	Sulphates as SO_4^{2-}	mg/L	2845	3128	2547	2841	2951	1547	1624
19	Oil & Grease	mg/L	BDL[D L=2]						
20	Iron as Fe	mg/L	BDL[D L=0.006]						
21	Zinc as Zn	mg/L	BDL[D L=0.02]						

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Sr. no.	Test Paramete r	Unit	MW1	MW2	MW3	MW4	MW5	MW6	MW7
22	Total Coliform Bacteria	MPN/10 0 ml	1600	900	1600	500	500	900	1600
23	Fecal coliform	MPN/10 0 ml	90	50	90	12	10	18	20
24	E. Coli	-	Present						

 Table 3-26: Marine water quality results – March- May 2022

S r. n o.	Test Paramet- er	Unit	MW1	MW2	MW3	MW4	MW5	MW6	MW7
1	Colour	Haz en	BDL[DL=1]	BDL[DL =1]	BDL[DL =1]	BDL[DL =1]	BDL[DL =1]	BDL[DL =1]	BDL[DL =1]
2	Odor	-	Agreea ble	Agreeabl e	Agreeabl e	Agreeabl e	Agreeabl e	Agreeabl e	Agreeabl e
3	Temperat ure	⁰ C	29.2	29.3	29.4	29.9	29.1	28.9	29.1
4	Turbidity	NT U	6.2	6.8	5.3	6.1	6.8	7.6	7.8
5	pН	-	7.7	7.9	8	7.9	7.9	7.9	8
6	Electrical Conducti vity	μS/c m	53100	55490	52910	53960	54420	37880	38870





S r. n o.	Test Paramet- er	Unit	MW1	MW2	MW3	MW4	MW5	MW6	MW7
7	Salinity	ppth	32.4	33.8	30.0	31.5	33.3	24.6	24.7
8	Total Dissolved Solids	mg/ L	33880	35290	31790	32980	34620	24620	25270
9	Total Suspende d Solids	mg/ L	5	8	4	5	6	6	3
1 0	Ammonic al Nitrogen as NH ₃ -N	mg/ L	BDL[DL=0. 1]	BDL[DL =0.1]	BDL[DL =0.1]	BDL[DL =0.1]	BDL[DL =0.1]	BDL[DL =0.1]	BDL[DL =0.1]
1 1	Nitrates as NO ₃ ⁻ - N	mg/ L	0.9	1	0.8	0.9	1.1	0.9	1
1 2	Nitrite as NO_2^- -N	mg/ L	0.021	0.021	0.16	0.018	0.021	0.032	0.04
1 3	Phosphat es as PO_4^{3-}	mg/ L	0.32	0.14	0.15	0.17	0.14	0.19	0.26
1 4	Biochemi cal Oxygen Demand (27 ⁰ C, 3Days)	mg/ L	BDL[DL=2]	BDL[DL =2]	BDL[DL =2]	BDL[DL =2]	BDL[DL =2]	BDL[DL =2]	BDL[DL =2]
1 5	Chemical Oxygen Demand	mg/ L	20	12	20	24	12	16	20





S r. n o.	Test Paramet- er	Unit	MW1	MW2	MW3	MW4	MW5	MW6	MW7
1 6	Dissolved Oxygen	mg/ L	5.7	5.8	5.5	5.5	5.9	5.7	5.6
1 7	Chlorides as Cl ⁻	mg/ L	17926	18691	16594	17440	18413	13618	13688
1 8	Sulphates as SO ₄ ²⁻	mg/ L	2912	3184	2612	2914	2988	1624	1684
1 9	Oil & Grease	mg/ L	BDL[DL=2]	BDL[DL =2]	BDL[DL =2]	BDL[DL =2]	BDL[DL =2]	BDL[DL =2]	BDL[DL =2]
2 0	Iron as Fe	mg/ L	BDL[DL=0. 006]	BDL[DL =0.006]	BDL[DL =0.006]	BDL[DL =0.006]	BDL[DL =0.006]	BDL[DL =0.006]	BDL[DL =0.006]
2 1	Zinc as Zn	mg/ L	BDL[DL=0. 02]	BDL[DL =0.02]	BDL[DL =0.02]	BDL[DL =0.02]	BDL[DL =0.02]	BDL[DL =0.02]	BDL[DL =0.02]
2 2	Total Coliform Bacteria	MP N/10 0 ml	1600	900	1600	500	900	500	900
2 3	Fecal coliform	MP N/10 0 ml	50	40	20	10	40	20	10
2 4	E. Coli	-	Present	Present	Present	Present	Present	Present	Present




Table 3-27: Marine water quality results – October to December 2022

Sr. No.	Test Parameter	MW1	MW2	MW3	MW4	MW5	MW6	MW7
1	Colour	BDL[DL=1]	BDL[D L=1]	BDL[D L=1]	BDL[D L=1]	BDL[DL=1]	BDL[D L=1]	BDL[D L=1]
2	Odor	Agree able	Agreea ble	Agreea ble	Agreea ble	Agree able	Agreea ble	Agreea ble
3	Temperature	28.7	28.8	29	28.9	28.6	28.7	28.6
4	Turbidity	5.8	6.5	5.1	6.4	6.5	7.3	7.2
5	pН	7.6	7.8	7.9	7.7	7.7	7.8	7.8
6	Electrical Conductivity	52700	55450	52580	53920	54380	37240	38240
7	Salinity	31.6	33.0	30.0	31.0	32.5	23.9	
8	Total Dissolved Solids	33470	35270	31270	32840	34220	24250	24890
9	Total Suspended Solids	10	8	7	9	11	10	8
10	Ammonical Nitrogen as NH3-N	BDL[DL=0. 1]	BDL[D L=0.1]	BDL[D L=0.1]	BDL[D L=0.1]	BDL[DL=0. 1]	BDL[D L=0.1]	BDL[D L=0.1]
11	Nitrates as NO ₃ ⁻ -N	0.8	0.9	0.7	0.8	0.9	0.8	0.8
12	Nitrite as NO_2^- - N	0.02	0.018	0.012	0.014	0.018	0.029	0.029
13	Phosphates as PO ₄ ³⁻	0.28	0.12	0.13	0.15	0.11	0.17	0.23
14	Biochemical Oxygen Demand (27 ^o C, 3Days)	BDL[DL=2]	BDL[D L=2]	BDL[D L=2]	BDL[D L=2]	BDL[DL=2]	BDL[D L=2]	BDL[D L=2]
15	Chemical Oxygen Demand	16	8	16	20	8	12	16
16	Dissolved Oxygen	5.8	5.9	5.6	5.7	6	5.8	5.7
17	Chlorides as Cl	17509	18274	16606	17162	17996	13202	12993
18	Sulphates as SO4 ²⁻	2854	2988	2544	2844	2788	1588	1580
19	Oil & Grease	BDL[DL=2]	BDL[D L=2]	BDL[D L=2]	BDL[D L=2]	BDL[DL=2]	BDL[D L=2]	BDL[D L=2]





Sr. No.	Test Parameter	MW1	MW2	MW3	MW4	MW5	MW6	MW7
20	Iron as Fe	BDL[DL=0.	BDL[D L=0.00	BDL[D L=0.00	BDL[D L=0.00	BDL[DL=0.	BDL[D L=0.00	BDL[D L=0.00
21	Zinc as Zn	BDL[DL=0. 02]	BDL[D L=0.02]	BDL[D L=0.02]	BDL[D L=0.02]	BDL[DL=0. 02]	BDL[D L=0.02]	BDL[D L=0.02]
22	Total Coliform Bacteria	1600	900	1600	500	900	500	900
23	Fecal coliform	50	40	20	10	40	20	10
24	E. Coli	Presen t	Present	Present	Present	Presen t	Present	Present

Marine Water observations and interpretation

Winter Season (December 2021- February 2022):

pH is an important parameter to determine the acidity or alkalinity and neutral scale. It greatly affects the microbial population as well as the solubility of metal ions and regulates nutrient availability.

pH is in the range of 7.6-7.9.

The Electrical Conductivity ranges of 36270 to 55420 μ S/cm

Dissolved oxygen is found between the ranges of 5.6 - 6.1 mg/L.

Total dissolved solids detected in range of 23580 to 34840 mg/L.

Chlorides are found in the range of 12924-18482 mg/L.

Nitrate is found in between 0.8-1 mg/L.

Summer Season (March-May 2022):

pH is an important parameter to determine the acidity or alkalinity and neutral scale. It greatly affects the microbial population as well as the solubility of metal ions and regulates nutrient availability.

pH is in the range of 7.6-7.8.





The electrical conductivity ranges of 36270 to 55420 mS/cm.

Dissolved oxygen is found between the ranges of 5.6 - 6.1 mg/L.

Total dissolved solids detected in range of 23580 to 34840 mg/L.

Chlorides are found in the range of 12924-18482 mg/L.

Post-Monsoon Season (October-November-December 2022):

pH is an important parameter to determine the acidity or alkalinity and neutral scale. It greatly affects the microbial population as well as the solubility of metal ions and regulates nutrient availability.

pH is in the range of 7.7-7.9

The electrical conductivity ranges of 37240 to 55450 mS/cm.

Dissolved oxygen is found between the ranges of 5.6- 6 mg/L.

Total dissolved solids detected in range of 24250 to 35270 mg/L.

Chlorides are found in the range of 12993-18274 mg/L.

3.12 Marine Sediments

A close relationship exists between the sediments and physicochemical and biological parameters of water. Similarly, the activities in the area also have a profound effect on the sediment composition. Hence, an understanding of the physicochemical and biological characteristics of the sediments is essential. With this view, the sediment samples from selected marine sampling stations were also collected. Monitoring locations for Marine sediments are given in Table 3.13 and shown in Figure 3.15. Results for the same are described in Table 3.24, 3.25 and 3.26. Laboratory monitoring results are attached as **Appendix VI**.

Winter Season (December 2021-February 2022):

It was observed that the sediments are slightly alkaline as their pH is in the range of 8-8.6. Organic matter present in sediment influences its physical and chemical properties. Coastal





sediment analysis shows that the concentration of organic matter is in the range of 1.4-2.3 % and organic carbon is in the range of 0.8-1.3 %.

Nickel was found to be between 15-31 mg/kg, Zinc is in the range of 35-60 mg/kg, Iron in the range of 15325-22421 mg/kg and Manganese in the range of 39-89 mg/kg.

Summer Season (March-May 2022)

It was observed that the sediments are slightly alkaline as their pH is in the range of 7.6-8.5. Organic matter present in sediment influences its physical and chemical properties. Coastal sediment analysis shows that the concentration of organic matter is in the range of 1.26 - 2.11 % and organic carbon is in the range of 0.73 - 1.22%.

Nickel was found to be between 18-35 mg/kg, Zinc is in the range of 30-59 mg/kg, Iron in the range of 15376 – 22469 mg/kg and Manganese in the range of 40 - 67 mg/kg.

Post-Monsoon Season (October-November-December 2022):

It was observed that the sediments are slightly alkaline as their pH is in the range of 7.6 - 8.5. Organic matter present in sediment influences its physical and chemical properties. Coastal sediment analysis shows that the concentration of organic matter is in the range of 1.5 - 2.2 % and organic carbon is in the range of 0.9 - 1.3 %.

Nickel was found to be between 23-30 mg/kg, Zinc is in the range of 33-42 mg/kg, Iron in the range of 32712 – 37171 mg/kg and Manganese in the range of 521 - 621 mg/kg.



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Table 3-28: Marine Sediments Quality in Study Area – December 2021 to February 2022

S. No.	Test Parameter	Unit	SD1	SD2	SD3	SD4	SD5	SD6	SD7
1	Color*	-	Gray	Gray	Gray	Gray	Gray	Gray	Gray
2	pH(1:2.5 Soil: Water)	-	8.2	8.5	8.1	8.3	8	8.6	8
3	Organic Matter	%	1.7	2.3	2	1.7	1.4	1.8	1.7
4	Total Organic Carbon	%	1	1.3	1.2	0.9	0.8	1.1	1
5	n-Hexane extractable material	%	0.3	0.1	0.3	0.4	0.2	0.3	0.1
6	Total Nitrogen as N	mg/kg	534	707	634	606	649	620	663
7	Organic Nitrogen	mg/kg	513	685	614	588	629	602	643
8	Total Phosphorus as P	mg/kg	380	404	361	405	361	367	435
9	Cadmium as Cd	mg/kg				BDL[DL=2]			
10	Chromium as Cr	mg/kg	89	75	68	60	79	81	57
11	Cobalt as Co	mg/kg	35	38	25	20	27	28	32
12	Copper as Cu	mg/kg	20	15	21	18	22	20	29
13	Iron as Fe	mg/kg	15325	20213	18924	22421	19254	16524	17025
14	Lead as Pb	mg/kg	BDL[DL=5]						
15	Manganese as Mn	mg/kg	47	40	39	40	53	62	89



S. No.	Test Parameter	Unit	SD1	SD2	SD3	SD4	SD5	SD6	SD7
16	Mercury as Hg	mg/kg				BDL[DL=2]			
17	Nickel as Ni	mg/kg	19	15	20	28	19	24	31
18	Zinc as Zn	mg/kg	38	46	52	60	50	35	41

 Table 3-29: Marine Sediments Quality in Study Area – March – May 2022

S. No.	Test Parameter	Unit	SD1	SD2	SD3	SD4	SD5	SD6	SD7
1	Color*	-	Gray	Gray	Gray	Gray	Gray	Gray	Gray
2	pH(1:2.5 Soil: Water)	-	8.1	8.4	7.6	8.4	7.9	8.5	8
3	Organic Matter	%	1.61	2.11	1.81	1.54	1.26	1.61	1.54
4	Total Organic Carbon	%	0.93	1.22	1.05	0.89	0.73	0.93	0.89
5	n-Hexane extractable material	%	0.4	0.1	0.3	0.3	0.3	0.2	0.1
6	Total Nitrogen as N	mg/kg	591	721	735	634	378	577	634
7	Total Phosphorus as P	mg/kg	433	439	341	381	368	427	393
8	Cadmium as Cd	mg/kg				BDL[DL=2]]		
9	Chromium as Cr	mg/kg	81	74	65	70	85	89	60
10	Cobalt as Co	mg/kg	38	40	29	34	22	37	30



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S. No.	Test Parameter	Unit	SD1	SD2	SD3	SD4	SD5	SD6	SD7
11	Copper as Cu	mg/kg	25	19	27	22	29	31	35
12	Iron as Fe	mg/kg	15376	20352	19324	22469	18534	19543	18024
13	Lead as Pb	mg/kg				BDL[DL=5]]		
14	Manganese as Mn	mg/kg	52	45	40	43	60	58	67
15	Mercury as Hg	mg/kg				BDL[DL=2]]		
16	Nickel as Ni	mg/kg	20	18	23	32	22	20	35
17	Zinc as Zn	mg/kg	40	50	59	35	38	30	43

 Table 3-30: Marine Sediments Quality in Study Area – October to December 2022

Sr. No	Test Paramet er	Test Method	MS1	MS2	MS3	MS4	MS5	MS6	MS7	MS8
1.	Color*	Visual Observation	Gray	-						
2.	pH(1:2.5 Soil: Water)	IS2720(Part 26): 1987	8.2	8.5	8.1	8.3	8	8.6	8	-
3.	Organic Matter	IS 2720(Part 22) :1972	1.7	2.3	2	1.7	1.4	1.8	1.7	%



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4.	Total Organic Carbon	IS 2720(Part 22) :1972	1	1.3	1.2	0.9	0.8	1.1	1	%
5.	n-Hexane extractabl e material	UT/LQMS/SOP/ S09	0.3	0.1	0.3	0.4	0.2	0.3	0.1	%
6.	Total Nitrogen as N	IS 14684-1999	534	707	634	606	649	620	663	mg/k g
7.	Organic Nitrogen	UT/LQMS/SOP/ S20	513	685	614	588	629	602	643	mg/k g
8.	Total Phosphor us as P	UT/LQMS/SOP/ S28	380	404	361	405	361	367	435	mg/k g
9.	Cadmium as Cd	UT/LQMS/SOP/ S35 & S37	BDL[DL= 2]	mg/k g						
9. 10.	Cadmium as Cd Chromiu m as Cr	UT/LQMS/SOP/ S35 & S37 UT/LQMS/SOP/ S35 & S37	BDL[DL= 2] 89	BDL[DL= 2] 75	BDL[DL= 2] 68	BDL[DL= 2] 60	BDL[DL= 2] 79	BDL[DL= 2] 81	BDL[DL= 2] 57	mg/k g mg/k g
9. 10. 11.	Cadmium as Cd Chromiu m as Cr Cobalt as Co	UT/LQMS/SOP/ S35 & S37 UT/LQMS/SOP/ S35 & S37 UT/LQMS/SOP/ S35 & S37	BDL[DL= 2] 89 35	BDL[DL= 2] 75 38	BDL[DL= 2] 68 25	BDL[DL= 2] 60 20	BDL[DL= 2] 79 27	BDL[DL= 2] 81 28	BDL[DL= 2] 57 32	mg/k g mg/k g k g
 9. 10. 11. 12. 	Cadmium as Cd Chromiu m as Cr Cobalt as Co Copper as Cu	UT/LQMS/SOP/ S35 & S37 UT/LQMS/SOP/ S35 & S37 UT/LQMS/SOP/ S35 & S37 UT/LQMS/SOP/ S35 & S37	BDL[DL= 2] 89 35 20	BDL[DL= 2] 75 38 15	BDL[DL= 2] 68 25 21	BDL[DL= 2] 60 20 18	BDL[DL= 2] 79 27 22	BDL[DL= 2] 81 28 20	BDL[DL= 2] 57 32 29	mg/k g mg/k g mg/k g
 9. 10. 11. 12. 13. 	Cadmium as Cd Chromiu m as Cr Cobalt as Co Copper as Cu Iron as Fe	UT/LQMS/SOP/ S35 & S37 UT/LQMS/SOP/ S35 & S37 UT/LQMS/SOP/ S35 & S37 UT/LQMS/SOP/ S35 & S37 UT/LQMS/SOP/ S35 & S37	BDL[DL= 2] 89 35 20 15325	BDL[DL= 2] 75 38 15 20213	BDL[DL= 2] 68 25 21 18924	BDL[DL= 2] 60 20 18 22421	BDL[DL= 2] 79 27 22 19254	BDL[DL= 2] 81 28 20 16524	BDL[DL= 2] 57 32 29 17025	mg/k g mg/k g mg/k g mg/k g

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Mangane se as Mn	UT/LQMS/SOP/ S35 & S37	47	40	39	40	53	62	89	mg/k g
Mercury as Hg	UT/LQMS/SOP/ S35 & S37	BDL[DL= 2]	mg/k g						
Nickel as Ni	UT/LQMS/SOP/ S35 & S37	19	15	20	28	19	24	31	mg/k g
Zinc as Zn	UT/LQMS/SOP/ S35 & S37	38	46	52	60	50	35	41	mg/k g

3.13 Soil Quality

15.

16.

17.

18.

Five (5) samples were collected from the 10 km study area during summer, post- monsoon and winter season. The physico - chemical characteristics of soil have been determined at **5** locations during the monitoring period. The sampling locations have been selected to represent the study area. Soil sampling locations are given in Table 3.32 and shown in Figure 3.1





Table 3-31: Soil sampling locations

Code	Location	Latitude & Longitude	Direction	Distance(km)
S 1	Near Project Site	12°55'30.75"N 74°49'5.40"E	-	-
S2	Near Panambur Beach Parking	12°56'17.83"N 74°48'19.18"E	NW	2
S 3	Kulai Near Bhrama Shree Narayana Guru Samaja seva sangha	12°57'47.65"N 74°48'29.14"E	Ν	4.30
S 4	New Mangalore, Industrial Area Near Ruchi Soya Industries	12°56'46.03"N 74°49'58.86"E	NE	2.96
S5	Kodikkal Temple	12°55'3.85"N 74°49'36.61"E	SE	1.25





Figure 3-17: Soil Quality Monitoring Locations





3.13.1 Survey Methodology

3.13.1.1 Pre-methodology of sampling

Pre methodology for soil sampling, take the plastic bags and sampling equipment called Augur, For the physico-chemical parameters, about 1 kg of soil sample was collected from each site. Representative soil sample from depth (0-15 cm) were collected for estimation of the physicochemical characteristics of soil sample to know the quality of the soil.

3.13.1.2 Soil Characteristics observed in study area

Sr. No	Test Parameter	S1	S2	S 3	S4	S 5	Unit
1.	Color*	Brown	Brown	Brown	Brown	Brown	-
2.	Texture	Sily Loam	Sily Loam	Sily Loam	Sily Loam	Sily Loam	-
3.	pH(1:2.5 Soil: Water)	6.8	6.5	6.8	6.3	6.9	-
4.	Electrical Conductivity (1:2 Soil: Water Extract)	0.148	0.152	0.185	0.152	0.221	mS/cm
5.	Bulk Density	1128	1117	1105	1121	1138	kg/m ³
6.	Organic Matter	0.8	1.1	1.1	0.7	0.9	%
7.	Total Organic Carbon	0.4	0.6	0.6	0.4	0.5	%
8.	Moisture Content	5.2	4.1	4.9	5.7	6.4	%
9.	Water Holding Capacity	53.1	57.1	55	54.1	52.3	%
10.	Cation Exchange Capacity	23.8	24.9	24.6	23.3	23.8	meq/100g
11.	Sodium as Na (Exchangeable)	1.5	1.6	1.1	1.2	1.9	meq/100g
12.	Sodium as Na	6.3	6.4	4.5	5.2	8.0	%

Table 3-32: Winter Season (December 2021- February 2022)





Sr. No	Test Parameter	S 1	S2	S3	S4	S 5	Unit
	(Exchangeable)						
13.	Potassium as K (Exchangeable)	0.6	0.7	0.5	0.4	0.7	meq/100g
14.	Potassium as K (Exchangeable)	2.5	2.8	2.0	1.7	2.9	%
15.	Calcium as Ca (Exchangeable)	12.2	11.2	13.3	12.2	14.3	meq/100g
16.	Calcium as Ca (Exchangeable)	51	45	54	52	60	%
17.	Magnesium as Mg (Exchangeable)	13.4	13.4	12.4	12.4	11.4	meq/100g
18.	Magnesium as Mg (Exchangeable)	56.3	53.8	50.4	53.2	47.9	%
19.	Sodium as Na (water Extractable)	45	64	58	47	54	mg/kg
20.	Potassium as K (water Extractable)	35	42	42	30	28	mg/kg
21.	Calcium as Ca (water Extractable)	98	106	106	131	139	mg/kg
22.	Magnesium as Mg (water Extractable)	64	59	59	40	45	mg/kg
23.	Chloride as Cl ⁻ (water Extractable)	49	39	59	68	78	mg/kg
24.	Sulfate as SO ₄ (water Extractable)	85	78	108	112	104	mg/kg
25.	Available Phosphorus as P ₂ O ₅	78	65	58	62	71	kg/ha





Sr. No	Test Parameter	S1	S2	S 3	S4	S5	Unit
26.	Available Potassium as K ₂ O	216	282	211	231	236	kg/ha
27.	Available Nitrogen as N	108	123	115	107	111	kg/ha
			TCLP	Metals			
1.	Cadmium as Cd	BDL[DL =0.018]	BDL[DL =0.018]	BDL[DL =0.018]	BDL[DL =0.018]	BDL[DL =0.018]	mg/L
2.	Total Chromium as Cr	BDL[DL =0.06]	BDL[DL =0.06]	BDL[DL =0.06]	BDL[DL =0.06]	BDL[DL =0.06]	mg/L
3.	Cobalt as Co	BDL[DL =0.06]	BDL[DL =0.06]	BDL[DL =0.06]	BDL[DL =0.06]	BDL[DL =0.06]	mg/L
4.	Copper as Cu	BDL[DL =0.06]	BDL[DL =0.06]	BDL[DL =0.06]	BDL[DL =0.06]	BDL[DL =0.06]	mg/L
5.	Iron as Fe	BDL[DL =0.09]	BDL[DL =0.09]	BDL[DL =0.09]	BDL[DL =0.09]	BDL[DL =0.09]	mg/L
6.	Lead as Pb	BDL[DL =0.06]	BDL[DL =0.06]	BDL[DL =0.06]	BDL[DL =0.06]	BDL[DL =0.06]	mg/L
7.	Manganese as Mn	BDL[DL =0.12]	BDL[DL =0.12]	BDL[DL =0.12]	BDL[DL =0.12]	BDL[DL =0.12]	mg/L
8.	Nickel as Ni	BDL[DL =0.06]	BDL[DL =0.06]	BDL[DL =0.06]	BDL[DL =0.06]	BDL[DL =0.06]	mg/L
9.	Zinc as Zn	BDL[DL =0.018]	BDL[DL =0.018]	BDL[DL =0.018]	BDL[DL =0.018]	BDL[DL =0.018]	mg/L

Table 3-33: Summer Season (2022)

Sr. No.	Test Parame ter	Test Method	S1	S2	S 3	S 4	S 5	Unit
1.	Color*	Visual Observa tion	Brown	Brown	Brown	Brown	Brown	-
2.	Texture	UT/LQ MS/SO	Silty Loam	Silty Loam	Silty Loam	Silty Loam	Silty Loam	-





Sr. No.	Test Parame ter	Test Method	S1	S2	S 3	S4	S 5	Unit
		P/S39						
3.	pH(1:2. 5 Soil: Water)	IS 2720 (Part 26) 1987	7.1	6.8	7.2	6.5	6.7	-
4.	Electric al Conduct ivity (1:2 Soil: Water Extract)	IS :14767- 2000	214	175	210	195	202	mS/cm
5.	Bulk Density	UT/LQ MS/SO P/S03	1101	1116	1120	1152	1141	kg/m ³
6.	Organic Matter	IS 2720 (Part 22) : 1972	0.9	1	1.2	1.3		%
7.	Total Organic Carbon	IS 2720 (Part 22) : 1972	0.5	0.6	0.7	0.7		%
8.	Moistur e Content	IS 2720(Pa rt 02) 1973	5.9	5.2	6.3	5.9	4.5	%
9.	Water Holding Capacit y	UT/LQ MS/SO P/S12	56.7	57.1	54.9	52.6	56.2	%
10.	Cation Exchang e Capacit y	UT/LQ MS/SO P/S18	26.4	27.1	27.6	26.4	25.6	meq/100 g
11.	Sodium as Na (Exchan	UT/LQ MS/SO P/S13	1.5	1.3	1.2	1.3	1.3	meq/100 g





Sr. No.	Test Parame ter	Test Method	S1	S2	S 3	S4	S 5	Unit
	geable)							
12.	Sodium as Na (Exchan geable)	UT/LQ MS/SO P/S13	5.68181 8182	4.79704 797	4.34782 6087	4.92424 2424	5.07812 5	%
13.	Potassiu m as K (Exchan geable)	UT/LQ MS/SO P/S14	0.6	0.6	0.6	0.5	0.5	meq/100 g
14.	Potassiu m as K (Exchan geable)	UT/LQ MS/SO P/S14	2.27272 7273	2.21402 214	2.17391 3043	1.89393 9394	1.95312 5	%
15.	Calcium as Ca (Exchan geable)	UT/LQ MS/SO P/S15	12.2	12.2	13.3	12.2	13.3	meq/100 g
16.	Calcium as Ca (Exchan geable)	UT/LQ MS/SO P/S15	46.2121 2121	45.0184 5018	48.1884 058	46.2121 2121	51.9531 25	%
17.	Magnesi um as Mg (Exchan geable)	UT/LQ MS/SO P/S16	14.5	12.4	12.4	13.4	12.4	meq/100 g
18.	Magnesi um as Mg (Exchan geable)	UT/LQ MS/SO P/S16	54.9242 4242	45.7564 5756	44.9275 3623	50.7575 7576	48.4375	%
19.	Sodium as Na (water Extracta ble)	UT/LQ MS/SO P/S19	59	61	53	50	52	mg/kg





Sr. No.	Test Parame ter	Test Method	S1	S2	S 3	S4	S 5	Unit
20.	Potassiu m as K (water Extracta ble)	UT/LQ MS/SO P/S20	37	47	46	33	38	mg/kg
21.	Calcium as Ca (water Extracta ble)	UT/LQ MS/SO P/S21	98	106	98	106	106	mg/kg
22.	Magnesi um as Mg (water Extracta ble)	UT/LQ MS/SO P/S22	59	55	64	64	59	mg/kg
23.	Chloride as Cl ⁻ (water Extracta ble)	UT/LQ MS/SO P/S23	59	59	68	49	59	mg/kg
24.	Sulfate as SO ₄ (water Extracta ble)	UT/LQ MS/SO P/S24	115	112	104	102	111	mg/kg
25.	Availabl e Phospho rus as P ₂ O ₅	UT/LQ MS/SO P/S28	69	78	71	69	73	kg/ha
26.	Availabl e Potassiu m as K ₂ O	UT/LQ MS/SO P/S29	226	256	244	211	219	kg/ha
27.	Availabl	UT/LQ	117	116	123	124	126	kg/ha





Sr. No.	Test Parame ter	Test Method	S1	S2	S 3	S4	S 5	Unit
	e Nitroge n as N	MS/SO P/S30						
			Т	CLP Meta	ls			
1.	Cadmiu m as Cd	UT/LQ MS/SO P/S36& S37	BDL[D L=0.018]	BDL[D L=0.018]	BDL[D L=0.018]	BDL[D L=0.018]	BDL[D L=0.018]	mg/L
2.	Total Chromi um as Cr	UT/LQ MS/SO P/S36 & S37	BDL[D L=0.06]	BDL[D L=0.06]	BDL[D L=0.06]	BDL[D L=0.06]	BDL[D L=0.06]	mg/L
3.	Cobalt as Co	UT/LQ MS/SO P/S36 & S37	BDL[D L=0.06]	BDL[D L=0.06]	BDL[D L=0.06]	BDL[D L=0.06]	BDL[D L=0.06]	mg/L
4.	Copper as Cu	UT/LQ MS/SO P/S36 & S37	BDL[D L=0.06]	BDL[D L=0.06]	BDL[D L=0.06]	BDL[D L=0.06]	BDL[D L=0.06]	mg/L
5.	Iron as Fe	UT/LQ MS/SO P/S36 & S37	BDL[D L=0.09]	BDL[D L=0.09]	BDL[D L=0.09]	BDL[D L=0.09]	BDL[D L=0.09]	mg/L
6.	Lead as Pb	UT/LQ MS/SO P/S36 & S37	BDL[D L=0.06]	BDL[D L=0.06]	BDL[D L=0.06]	BDL[D L=0.06]	BDL[D L=0.06]	mg/L
7.	Mangan ese as Mn	UT/LQ MS/SO P/S36 & S37	BDL[D L=0.12]	BDL[D L=0.12]	BDL[D L=0.12]	BDL[D L=0.12]	BDL[D L=0.12]	mg/L
8.	Nickel as Ni	UT/LQ MS/SO P/S36 & S37	BDL[D L=0.06]	BDL[D L=0.06]	BDL[D L=0.06]	BDL[D L=0.06]	BDL[D L=0.06]	mg/L
9.	Zinc as	UT/LQ	BDL[D	BDL[D	BDL[D	BDL[D	BDL[D	mg/L





Sr. No.	Test Parame ter	Test Method	S1	S2	S 3	S 4	S 5	Unit
	Zn	MS/SO	L=0.018	L=0.018	L=0.018	L=0.018	L=0.018	
		P/S36 &]]]]]	
		S37						

 Table 3-34: Post-Monsoon Season (2022)

Sr. No.	Test Parameter	S1	S2	S 3	S4	85	Unit
1.	Color*	Brown	Brown	Brown	Brown	Brown	-
2.	Texture	Silty Loam	Silty Loam	Silty Loam	Silty Loam	Silty Loam	-
3.	pH(1:2.5 Soil: Water)	7	7.2	7	7.5	6.9	-
4.	Electrical Conductivit y (1:2 Soil: Water Extract)	0.152	0.173	0.214	0.221	0.216	mS/cm
5.	Bulk Density	1115	1143	1088	1116	1133	kg/m ³
6.	Organic Matter	0.8	1.1	1	0.8	0.9	%
7.	Total Organic Carbon	0.5	0.7	0.6	0.5	0.5	%
8.	Moisture Content	5.7	5	6.4	5.1	4.5	%
9.	Water Holding Capacity	54.1	57.2	55.5	53.9	53.7	%
10.	Cation Exchange Capacity	27	28	27.7	25.3	26.9	meq/100g





Sr. No.	Test Parameter	S 1	S2	S 3	S4	S 5	Unit
11.	Sodium as Na (Exchangea ble)	1.5	1.7	1.2	1.1	1.6	meq/100g
12.	Sodium as Na (Exchangea ble)	5.555555 556	6.071428 571	4.332129 964	4.347826 087	5.947955 39	%
13.	Potassium as K (Exchangea ble)	0.7	0.8	0.5	0.4	0.6	meq/100g
14.	Potassium as K (Exchangea ble)	2.592592 593	2.857142 857	1.805054 152	1.581027 668	2.230483 271	%
15.	Calcium as Ca (Exchangea ble)	12.2	14.3	13.3	12.2	14.3	meq/100g
16.	Calcium as Ca (Exchangea ble)	45.18518 519	51.07142 857	48.01444 043	48.22134 387	53.15985 13	%
17.	Magnesium as Mg (Exchangea ble)	12.4	12.4	11.4	13.4	10.3	meq/100g
18.	Magnesium as Mg (Exchangea ble)	45.92592 593	44.28571 429	41.15523 466	52.96442 688	38.28996 283	%
19.	Sodium as Na (water Extractable)	51	62	62	46	57	mg/kg





Sr. No.	Test Parameter	S 1	S2	S 3	S 4	85	Unit
20.	Potassium as K (water Extractable)	45	44	43	32	48	mg/kg
21.	Calcium as Ca (water Extractable)	98	98	106	131	106	mg/kg
22.	Magnesium as Mg (water Extractable)	69	44	59	50	64	mg/kg
23.	Chloride as Cl ⁻ (water Extractable)	68	59	78	68	88	mg/kg
24.	Sulfate as SO ₄ (water Extractable)	124	120	109	119	116	mg/kg
25.	Available Phosphorus as P ₂ O ₅	78	63	73	66	77	kg/ha
26.	Available Potassium as K ₂ O	234	278	222	215	251	kg/ha
27.	Available Nitrogen as N	118	119	120	111	113	kg/ha
			TCLP	Metals			
1.	Cadmium as Cd	BDL[DL =0.018]	BDL[DL =0.018]	BDL[DL =0.018]	BDL[DL =0.018]	BDL[DL =0.018]	mg/L
2.	Total Chromium as Cr	BDL[DL =0.06]	BDL[DL =0.06]	BDL[DL =0.06]	BDL[DL =0.06]	BDL[DL =0.06]	mg/L
3.	Cobalt as	BDL[DL	BDL[DL	BDL[DL	BDL[DL	BDL[DL	mg/L





Sr. No.	Test Parameter	S 1	S2	S 3	S 4	85	Unit
	Со	=0.06]	=0.06]	=0.06]	=0.06]	=0.06]	
4	Copper as	BDL[DL	BDL[DL	BDL[DL	BDL[DL	BDL[DL	ma/I
4.	Cu	=0.06]	=0.06]	=0.06]	=0.06]	=0.06]	mg/L
5	Iron as Fa	BDL[DL	BDL[DL	BDL[DL	BDL[DL	BDL[DL	ma/I
5.	non as re	=0.09]	=0.09]	=0.09]	=0.09]	=0.09]	mg/L
6	Lood og Dh	BDL[DL	BDL[DL	BDL[DL	BDL[DL	BDL[DL	ma/I
0.	Leau as PD	=0.06]	=0.06]	=0.06]	=0.06]	=0.06]	mg/L
7	Manganese	BDL[DL	BDL[DL	BDL[DL	BDL[DL	BDL[DL	ma/I
7.	as Mn	=0.12]	=0.12]	=0.12]	=0.12]	=0.12]	mg/L
0	Nickel as	BDL[DL	BDL[DL	BDL[DL	BDL[DL	BDL[DL	m a /I
0.	Ni	=0.06]	=0.06]	=0.06]	=0.06]	=0.06]	mg/L
0	Zina as Zn	BDL[DL	BDL[DL	BDL[DL	BDL[DL	BDL[DL	ma/I
9.	Zinc as Zn	=0.018]	=0.018]	=0.018]	=0.018]	=0.018]	mg/L





Winter Season 2022

a) Physical Properties of Soil

The physical properties of soil determine the aeration of the soil and the ability of water to infiltrate and to be held in the soil, Color, Bulk density, Water Holding Capacity etc. Soil in the study area is Sandy loam to sandy clay loam.

The soil being of friable consistency, the bulk density & water holding capacity of the soil in the range of 1105 to 1138 kg/m3 & 52.3 -57.1 respectively.

b) Chemical Properties of Soil

The collected soil samples were analysed for various chemical parameters. The parameters selected were pH, electrical conductivity, soluble anions and cations, nutrients and organic carbon content.

PH is an important parameter indicating alkaline and acidic nature of soil. It severally affects the microbial population as well as the solubility of metal ions that regulates nutrient availability. The pH of the soil in the study area is slightly acidic to Neutral having pH is in the range of 6.3-6.9

The soluble salts were determined from soil extract (1:2). The soluble salts are expressed in terms of electrical conductivity (EC). The (Electrical Conductivity) of the soil extract in the study area is in the range of 0.152-0.848 mS/cm. which is less than 2 mS/cm indicating no salinity problem to be expected in the soil

CEC is in between 23.3 and 24.9 meq /100g, moreover it can be interpreted that soil has Moderate productivity & high absorption capacity.

Most of the important cations present in soluble salts in the soil are Calcium, Magnesium, Sodium, Potassium; it was observed that the concentration levels of Calcium and Magnesium were 98- to 139, 40 to 64 mg/kg, & Sodium, Potassium 45-54, 28-42 mg/kg respectively.





c) Nutrient Status of Soil

Organic matter present in the soil influences its physical and chemical properties. It commonly accounts as one third or more of the cation exchange capacity of surface soil and is also responsible for stability of soil aggregates. Analysis shows that the concentration of organic matter is in the range of 0.7 to 1.1% and total organic carbon is in the range of 0.5 to 0.7 %. Table 3.3 c) on comparison with the classification made as shown in Tables 3.3 (c) it was observed that Soil samples are Medium fertile in nature based on organic carbon contents.

Available phosphorous potassium and nitrogen, of the soil samples are found to be in the range of 58 -78, 211-282 & 107 -123 kg/ha respectively, It was observed that P2O5 content in the soil indicates fertile soil & K20 content in the soil indicates medium fertile soil, while Nitrogen content in the soil are adequate to classify the soil as poor fertile

d) Heavy Metal Content in the Soil

The heavy metals occur in the solution as cations and are adsorbed by the negatively charged soil particle. They are held strongly as complex on the surface of clay, alumino silicates, hydrated oxide and humus. In general adsorption increases with pH, heavy metals pollution is serious because it can persist for many decades. The heavy metals also create problems in the nutrient utilization in plant and also marked reduction in chlorophyll content.

Soil samples were also analyzed for heavy metals such as Chromium (Cr), Zinc (Zn), Lead (Pb), Nickel (Ni), Cadmium (Cd), Cobalt (Co), Manganese (Mn), Iron (Fe) and Copper (Cu) and their concentrations are presented in The presence of heavy metals at proper pH enhances the microbial activity. In soil the concentration of heavy metals found in the study area is normal.

(Summer Season 2022)

a) Physical Properties of Soil

The physical properties of soil determine the aeration of the soil and the ability of water to infiltrate and to be held in the soil, Color, Bulk density, Water Holding Capacity etc. Soil in the study area is Sandy loam to sandy clay loam





The soil being of friable consistency, the bulk density & water holding capacity of the soil in the range of 1101 to 1152 kg/m3 & 52.6 -57.1 respectively.

b) Chemical Properties of Soil

The collected soil samples were analysed for various chemical parameters. The parameters selected were pH, electrical conductivity, soluble anions and cations, nutrients and organic carbon content.

pH is an important parameter indicating alkaline and acidic nature of soil. It severally affects the microbial population as well as the solubility of metal ions that regulates nutrient availability. The pH of the soil in the study area is slightly acidic to Neutral in reaction having pH is in the range of 6.5 -7.2

The soluble salts were determined from soil extract (1:2). The soluble salts are expressed in terms of electrical conductivity (EC). The (Electrical Conductivity) of the soil extract in the study area is in the range of 0.175 - 0.928 mS/cm. which is less than 2 mS/cm indicating no salinity problem to be expected in the soil

CEC is in between 25.6 and 27.6 meq /100g, moreover it can be interpreted that soil has Moderate productivity & high absorption capacity.

Most of the important cations present in soluble salts in the soil are Calcium, Magnesium, Sodium, Potassium; it was observed that the concentration levels of Calcium and Magnesium were 98- to 106, 55 to 64 mg/kg, & Sodium, Potassium 50-61, 33-47 mg/kg respectively.

c) Nutrient Status of Soil

Organic matter present in the soil influences its physical and chemical properties. It commonly accounts as one third or more of the cation exchange capacity of surface soil and is also responsible for stability of soil aggregates. Analysis shows that the concentration of organic matter is in the range of 0.9 to 1.3% and total organic carbon is in the range of 0.5 to 0.7 %. Table 3.3 c) on comparison with the classification it was observed that Soil samples are Medium fertile in nature based on organic carbon contents.





Available phosphorous potassium and nitrogen, of the soil samples are found to be in the range of 69-78, 211-256 & 116 -126 kg/ha respectively, It was observed that P2O5 content in the soil indicates fertile soil & K20 content in the soil indicates medium fertile soil, while Nitrogen content in the soil are adequate to classify the soil as poor fertile.

d) Heavy Metal Content in the Soil

The heavy metals occur in the solution as cations and are adsorbed by the negatively charged soil particle. They are held strongly as complex on the surface of clay, alumino silicates, hydrated oxide and humus. In general adsorption increases with pH, heavy metals pollution is serious because it can persist for many decades. The heavy metals also create problems in the nutrient utilization in plant and also marked reduction in chlorophyll content.

Soil samples were also analyzed for heavy metals such as Chromium (Cr), Zinc (Zn), Lead (Pb), Nickel (Ni), Cadmium (Cd), Cobalt (Co), Manganese (Mn), Iron (Fe) and Copper (Cu) and their concentrations are presented in The presence of heavy metals at proper pH enhances the microbial activity. In soil the concentration of heavy metals found in the study area is normal.

Post-monsoon Season 2022

a) Physical Properties of Soil

The physical properties of soil determine the aeration of the soil and the ability of water to infiltrate and to be held in the soil, Color, Bulk density, Water Holding Capacity etc. Soil in the study area is Sandy loam to sandy clay loam

The soil being of friable consistency, the bulk density & water holding capacity of the soil in the range of 1088 to 1143 kg/m3 & 53.7 -57.2 respectively.

b) Chemical Properties of Soil

The collected soil samples were analysed for various chemical parameters. The parameters selected were pH, electrical conductivity, soluble anions and cations, nutrients and organic carbon content.





pH is an important parameter indicating alkaline and acidic nature of soil. It severally affects the microbial population as well as the solubility of metal ions that regulates nutrient availability. The pH of the soil in the study area is Neutral to slightly alkaline having pH is in the range of 6.9-7.5

The soluble salts were determined from soil extract (1:2). The soluble salts are expressed in terms of electrical conductivity (EC). The (Electrical Conductivity) of the soil extract in the study area is in the range of 0.173-0.1.05 mS/cm. which is less than 2 mS/cm indicating no salinity problem to be expected in the soil

CEC is in between 25.3 and 28 meq /100g, moreover it can be interpreted that soil has Moderate productivity & high absorption capacity.

Most of the important cations present in soluble salts in the soil are Calcium, Magnesium, Sodium, Potassium; it was observed that the concentration levels of Calcium and Magnesium were 98- to 106, 44 to 64 mg/kg, & Sodium, Potassium 46-62, 32-48 mg/kg respectively.

c) Nutrient Status of Soil

Organic matter present in the soil influences its physical and chemical properties. It commonly accounts as one third or more of the cation exchange capacity of surface soil and is also responsible for stability of soil aggregates. Analysis shows that the concentration of organic matter is in the range of 0.8 to 1.1% and total organic carbon is in the range of 0.5 to 0.7 %. Table 3.3 c) on comparison with the classification it was observed that Soil samples are Medium fertile in nature based on organic carbon contents.

Available phosphorous potassium and nitrogen, of the soil samples are found to be in the range of 66-78, 215-278 & 111 -120 kg/ha respectively, It was observed that P2O5 content in the soil indicates fertile soil & K20 content in the soil indicates medium fertile soil, while Nitrogen content in the soil are adequate to classify the soil as poor fertile.





d) Heavy Metal Content in the Soil

The heavy metals occur in the solution as cations and are adsorbed by the negatively charged soil particle. They are held strongly as complex on the surface of clay, alumino silicates, hydrated oxide and humus. In general adsorption increases with pH, heavy metals pollution is serious because it can persist for many decades. The heavy metals also create problems in the nutrient utilization in plant and also marked reduction in chlorophyll content.

Soil samples were also analyzed for heavy metals such as Chromium (Cr), Zinc (Zn), Lead (Pb), Nickel (Ni), Cadmium (Cd), Cobalt (Co), Manganese (Mn), Iron (Fe) and Copper (Cu) and their concentrations are presented in the presence of heavy metals at proper pH enhances the microbial activity. In soil the sconcentration of heavy metals found in the study area is normal.

CEC	Range in meq/100g	Absorptivity	Sampling Locations
Very low	<10	Low or Limited absorption	None
Low	10-20	Moderate absorption	
Moderate	21-30	High absorption	Sr. No1,2,3,4,5
High	>30	Very High absorption	None

 Table 3-35 a): Relationship of CEC with Absorptivity

Table 3-36 b) Relationship of CEC with Productivity

CEC	Range (cmol (p+) kg-1)	Productivity	Sampling Locations
Very low	< 10	Very low	None





CEC	Range (cmol (p+) kg-1)	Productivity	Sampling Locations
Low	10 - 20	Low	
Moderate	20 - 50	Moderate	Sr. No. 1,2,3,4,5
High	> 50	High	None

Table 3-37 c) Fertility Status Classification

Fertility Status	Organic Carbon (%)	Nitrogen (kg/ha)	P_2O_5 (kg/ha)	K ₂ O (kg/ha)
Poor Soil	<0.5	<280	<23	<133
Medium Fertile Soil	0.5-0.75	280-560	23-57	133-337
Fertile Soil	>0.75	>560	>57	>337

Source: Soil Survey Manual by IARI (Indian Agricultural Research Institute)

3.14 Biological Environment

Study of biological environment is one of the most important aspects for Environmental Impact Assessment. In view of the need for conservation of environmental quality and biodiversity study, biological environment is one of the most important aspects for Environmental Impact Assessment. Ecological systems show complex inter-relationships between biotic and abiotic components including dependence, competition and mutualism. Biotic components comprise of both plant and animal communities, which interact not only within and between them but also with the abiotic components viz. physical and chemical components of the environment. Generally, biological communities are the indicators of climatic and edaphic factors. The biological environment includes mainly terrestrial ecosystem and aquatic ecosystem.





3.14.1 Study Area:

As per guidelines of MoEF&CC for Environmental Impact Assessment, the study area was restricted up to 10 km radius from the project site. The data was generated with reference to topography, land use, vegetation pattern, animals etc.

Sampling Locations:

Qualitative assessment was carried out for vegetation & fauna around vicinity and nearby villages in 10 km radius of study area. Quadrat sampling (Stratified Random) was carried out around 10 km area of Manglore port total 16 locations were identified to study the ecology and biodiversity in 10 km radius of the proposed Project site. Sampling locations are shown in Figure 3.14 and details are provided in Table 3.39.



Figure 3-18: Study area for Biological Environment





Sr.	Location	GPS location	
No.	Location	Latitude	Longitude
1	Manglore Port	12°55'26.21"N	74°49'1.55"E
2	Behind Netravati building	N12°59'11.2"	E74°51' 11.9"
3	Jokkatte village	N12°57' 59.6"	E74°50' 39.1"
4	Opposite to Ruchi soya company	N12°57' 04.6"	E74°50' 00.1"
5	Kullur Village	N12°56' 29.3"	E74°50' 02.6"
6	Kotteture Area	N12°56' 29.3"	E74°50' 02.6"
7	Kalavar Village	N12°58' 25.9"	E74°51' 0.33"
8	ThokurVillage	N12°58' 00.5"	E74°49'55.7"
9	Bajpe Village	N12°58' 06.6"	E74°52'13.9"
10	Kolambe Village	N12°57' 50.1"	E74°53'22.9"
11	Padpu Village	N 12°57'6.56"	E74°51'0.69"
12	Padushede	N12°55'37.41"	E74°52'41.10"
13	Kavuru	N 12°55'0.81"	E74°51'27.43"
14	Mangaluru Town	N 12°52'43.96"	E 74°49'43.10"
15	Maroli	N12°52'38.36"	E 74°52'31.38"
16	Jappinamoguru	N 12°51'0.40"N	E 74°51'49.10"

Table 3-38: Sampling Locations in the Study Area

Methodology

- To achieve the above objectives a detailed study of the area was undertaken within 10 km radius from the Project site. The different methods adopted were as follows:
- Generation of primary data by undertaking systematic ecological studies in the study area;
- Primary data collection for flora through random sampling method for trees, shrubs and herbs from the selected locations to know the vegetation cover qualitatively;





- Different types of animals, including avifauna, available in this area, have been recorded.
- To spot the fauna in the study area and also to identify the fauna by secondary indicators such as pugmarks, scats, fecal pellets, calls and other signs;
- For ecological information, the secondary sources such as local officials & villagers were interviewed
- Identified vegetation patterns at different locations through GIS map and physically surveyed representative sites

Secondary data, up to 10 Km boundary from the project site have been collected from literature, forest department, and discussions with local people & NGO

Flora

Floral Assessment Methodology: Primary observations for flora and fauna from study area included different villages covering patches of forest, agricultural fields, marshy lands, waste lands, grazing lands, and also coastal vegetation. Quantitative study was carried out to understand the diversity of vegetation present near project site. Quadrat size of 10m x 10m was laid down to determine Frequency, Density, Abundance, Important Value Index (IVI) and species diversity of trees (John G. Rau and David C. Wooten, Environmental Impact Analysis handbook, 1980, pp 1-44).

That reflects the dominance and distribution of species. The identification of the flora in the radius of 10 km was done based on personal observations, authentic secondary literature, and indepth exploration of the entire area.

Density, Diversity and Species Composition of Flora

The structure and com position of vegetation was studied by taking observations on diverse plant species and their numerical composition at each sampling site (Figure 3.1) Number of external factors of the ecosystem to which they are subjected; the forest types of the division are diverse and complex. Variations in climatic, edaphic, topographic and biotic factors have led to variations in the nature and growth of the vegetation. There is no reserved & protected Forests &





notified forest regions present within the 10 km radius of the proposed project site, Favorable climatic and edaphic factor have favored in experimenting with different type of Plantations of Rubber, Cashew, Cocoa, Casuarina, *Ailanthus*, Exotic Acacia. Clove Oil palm, Teak, Bamboo Cane, Tad, Areca nut etc. have been raised successfully. Natural vegetation prominently consists of *Hopea parviflora*, *Hopea ponga*, *Vateria indica*, *Cassia fistula*, *Delonix regia*, *Diospyros ebenum*, *Olea dioica*, *Syzygium species*, *Terminalia paniculata*, *Lagerstroemia lanceolata*, *Cinnamomum spp*, *Mangifera indica*, *Artocarpus hirsuta*, *Holigarna arnotiana* in shrubs *Mimosa pudica Jatropha curcas*, *Lantana camara*, *Cassia toraetc*, *In herbs Glorea superba*, *Datura metal*, *Sida acuta* etc. The plant species commonly found in the study area are listed in Table 3.35.

The costal vegetation observed in Gurupur river basin had coconut (*Cocos nucifea*), Tari palm (*Borassus flabellifer*) as dominant floral elements. *Cyperus rotundus* and other Cyperaceae members were seen at the banks of water streams where mud was present. Aqatic weeds like Ipomoea cornea and Char sp. were observed in the ponds in the study area, other than this, *Ammania sp.* and *Hydrilla sp.*, occupied some of the areas of water submergence.

Free-floating plants like *Wolffia arrhiza, Pistia stratiotes* were seen frequently. Dominant trees along the coastal vegetation, Mangroves were also present in respective habitats. Many of these plants are of natural origin and presences of recently planted trees of exotic nature were also observed. The study area is rich in vegetation in forests, around villages/human habitations and road sides. Study area was represented by more shrubs, grasses, climbers than tree species. Trees were also having stunted and bushy growth.







Cheilocostus speciosus (Crepe Ginger)



Borassus flabellifer (Tad)



Anacardium occidentale (Cashew nut)



Cocos nucifera (Coconut)



Areca catechu (Supari)



Largerstromea sp.(Crepe-myrtle)





Table 3-39: Presence of vegetation within Study area

SN.	Botanical name	Common name	Family
Trees			
1.	Acacia nilotica	Babool	Mimosaceae
2.	Azadirachta indica	Neem	Meliaceae
3.	Artocarpus heterophyllus	Jackfruit	Moraceae
4.	Acacia auriculiformis	exotic Acacia	Mimosaceae
5.	Alstonia scholaris	Doddapala	Apocynaceae
6.	Albizzia lebbek	Baage	Mimosaceae
7.	Ailantus excelsa	Hemmara	Simaroubaceae
8.	Acacia nilotica	Jaali Mara	Fabaceae
9.	Albizzia chinensis	Medicinal, Kalbage	Mimosaceae
10.	Anacardium occidentalis	Godambi Mara	Anacardiaceae
11.	Baccaurea courtallensis	Koli kukke	Euphorbiaceae
12.	Brevnia vitis idaea	Bilisuli	Phyllanthaaceae
13.	Bambusa bambos	Hebbidiru	Poaceae
14.	Bombax ceiba	Kempu Booruga	Bombacaceae
15.	Careya arborea	kavalu mara	Lecythidaceae
16.	Cochlospermum religiosum	Aarasina buruga	Bixaceae
17.	Cassia fistula	Swarna Pushpa	Fabaceae
18.	Calophyllum inophyllum	Nameru mara	Calophyllaceae
19.	Calliandra haematocephala	Red powder puff	Fabaceae
20.	Casuarina equisetifolia	Junglisaru	Casuarinaceae
21.	Canarium strictum	Kai dhupa	Burseraceae
22.	Cinnanomum zeylanicum	Dalchini	Lauraceae
23.	Delonix regia	Kempu Torai	
24.	Dalbergia lotifolia	Gandha garige	Fabaceae





SN.	Botanical name	Common name	Family
25.	Dillenia pentagyna	Kaadu kanagilu	Dilleniaceae
26.	Diospyros ebenum	Karimara ebony	Ebenaceae
27.	Dipterocarpus indicus	Dhuma	Dipterocarpaceae
28.	Erythrina variegata	Bili Vaarjipe	Fabaceae
29.	Ficus racemosa	Athimara	Moraceae
30.	Ficus benghalensis	Alada Mara	Moraceae
31.	Ficus religiosa	Arali Mara	Moraceae
32.	Ficus amplissima	Bili basari	Moraceae
33.	Ficus arnottiana	Kallashwathha	Moraceae
34.	Garcinia indica	Punarpuli	clusiaceae
35.	Ficus hispida	Adavi atthi	Moraceae
36.	Haldina cordifolia	Arasina taega	Rubiaceae
37.	Hopea parviflora	Kiralbogi	Dipterocarpaceae
38.	Lagerstroemia lanceolata	Nandi	Lythraceae
39.	Madhuca longifolia	Ippe	Sapotaceae
40.	Mangifera indica	Maavu	Anacardiaceae
41.	Mesua nagassarium	Naagasampige	Clusiaceae
42.	Morinda citrifolia	Maddi	Rubiaceae
43.	Millingtonia hortensis	Birade Mara	Bignoniaceae
44.	Nyctanthesarbor-tristis	Harisringi	Oleaceae
45.	Polyalthia fragrans	Gowri mara	Annonaceae
46.	Phyllanthus niruri	Kandankathiri	Phyllanthaceae
47.	Pajanelia longifolia	Alangi	Bignoniaceae
48.	Phylanthus emblica	Nelli kaayi	Phyllanthaceae
49.	Pterocarpus marsupium	Honne	Fabaceae




SN.	Botanical name	Common name	Family		
50.	Semecarpus anacardium	Kadagaeru	Anacardiaceae		
51.	Spathodea campanulata	Neerukayi	Bignoniaceae		
52.	Syzygium cumini	Nerale hannu	Myrtaceae		
53.	Sapindus emarginatus	Soap nut	Sapinadaceae		
54.	Syzygium cumini	Nerale	Myrtaceae		
55.	Streblus asper	Mitli mara	Moraceae		
56.	Tectona grandis	Tega Teak	Verbenaceae		
57.	Terminalia bellerica	Thare	Combretaceae		
58.	Terminalia chebula	Gallnut Halale	Combretaceae		
59.	Terminalia paniculata	Hunal	Combretaceae		
60.	Terminalia tomentosa	Mathi Banpu	Combretaceae		
	S	Swamps			
1.	Holigarna arnottiana	Chaere	Anacardiaceae		
2.	Knema attenuata	Raktamara	Myristicaceae		
3.	Myristica fatua	Ramapatre	Myristicaceae		
4.	Myristica malabarica	Ramapatre	Myristicaceae		
5.	Nymphoides indicum	Naidile	Menyanthaceae		
6.	Pandanus foetida	Kaadu dodda kaetaki	Pandanaceae		
7.	Pandanus unipapillatus	Bili kaetaki	Pandanaceae		
Shrubs					
1.	Alternanthera sessilis	Honagone	Amaranthaceae		
2.	Allamanda cathartica	Arsina hoo	Apocynaceae		
3.	Alternanthera sessilis	sissoo spinach	Amaranthaceae		
4.	Agave americana	century plant	Asparagaceae		
5.	Agave tequilana	Blue agave	Asparagaceae		





SN.	Botanical name	Common name	Family
6.	Calotropis gigantea	yakki gida	Apocynaceae
7.	Catharanthus roseus	Periwinkle	Apocynaceae
8.	Cyclea peltara	Haade bali	Minispermaceae
9.	Centella asiatica	Indian pennywort	Apiaceae
10.	Cassia tora	Chagache	Fabaceae
11.	Clitoria ternatea	Girikarniballi	Fabaceae
12.	Cassia javanica	Apple blossom tree	Fabaceae
13.	Cleome rutidosperma	Fringed Spider Flower	Cleomaceae
14.	Dregea volubilis	Kaadu Haale balli	Apocynaceae
15.	Dioscorea bulbifera	ambali genasu	Dioskorea
16.	Drynaria quercifolia	oakleaf basket fern	Polypodiaceae
17.	Euphorbia hirta	Akkigida	Euphorbiaceae
18.	Getonia floribunda	Marasutta balli	Combretaceae
19.	Hibiscus rosa-sinensis	Dasavala	Malaceae
20.	Ichnocarpus frutescens	Gauriballi	Apocynaceae
21.	Ixora coccinea	jungle geranium	Rubiaceae
22.	Justicia adhatoda	Adhatoda	Acanthaceae
23.	Jatropha curcas	kaadu haralu	Euphorbiaceae
24.	Jasminum malabaricum	Malabar jasmine	Oleaceae
25.	Hibiscus cannabinus	Gonguru	Malvaceae
26.	Hyptis suaveolens	Natitulasi	Lamiaceae
27.	Hibiscus surattensis	Mullu gogu	Malvaceae
28.	Hybanthus enneaspermus	Purusharathna	Violaceae
29.	Lantana camara	Rozagida	Verbenaceae
30.	Maytenus emarginata	Halumanike	Celastraceae





SN.	Botanical name	Common name	Family
31.	Mimosa pudica	Halumanike	Celastraceae
32.	Mukia maderaspatana	Manithonde	Cucurbitaceae
33.	Nyctanthes arbor-tristis	Coral Jasmine	Oleaceae
34.	Naregamia alata	Nelabevu	Meliaceae
35.	Orthosiphon aristatus	Java tea	Lamiaceae
36.	Plectranthus amboinicus	Dodda patre	Lamiaceae
37.	Psydrax dicoccos	Edrani	Rubiaceae
38.	Psidium guajava	Common guava	Myrtaceae
39.	Ricinus communis	Haralu	Euphorbiaceae
40.	Sida rhombifolia	jelly leaf	Malavaceae
41.	Senna tora	coffee pod	Fabaceae
42.	Senna Occidentalis	styptic weed	Fabaceae
43.	Scoparia dulcis	goatweed	Plantaginaceae
44.	Tabernaemontana divaricata	Nandi Battalu	Apocynaceae
45.	Thunbergia grandiflora	skyvine	Acanthaceae
46.	Tecoma stans	Koranekelar	Bignoniaceae
47.	Tridax procumbens	Shaavanthi	Asteraceae
48.	Tinospora sinensis	Sudharshanaballi	Menispermaceae
49.	Zizyphus oenoplia	Surumullu	Rhamnaceae
50.	Ziziphus jujuba	Yolachi	Rhamnaceae
Herbs			
1.	Tephrosia purpurea	Kaggi	Fabaceae
2.	Argemone mexicana	Arasina-ummatta	Papaveraceae
3.	Aerva lanata	mountain knotgrass	Amaranthaceae
4.	Leucas aspera	Thumbe gida	Lamiaceae
5.	Nymphoides indica	water snowflake	Menyanthaceae





SN.	Botanical name	Common name	Family	
6.	Rungia pectinata	Comb Rungia	Acanthaceae	
7.	Datura metal	Dhattura	Solanaceae	
8.	Sida acuta	Bheemana Kaddi	Malvaceae	
9.	Grewia hirsute	Udipe	Tiliaceae	
10.	Tribulus terrestris	Senna Negalu	Zygophylaceae	
11.	Boehmeria cylindrica	bog hemp	Urticaceae	
12.	Gloriosa superba	Agnishike	Colchicaceae	
Grassess				
1.	Apluda mutica	Akku hullu	Poaceae	
2.	Aristida funiculate	Wiregrasses	Poaceae	
3.	Aristida hystrix	Rigid Niddle Grass	Poaceae	
4.	Aristida setacea	Dodda Hanchi Hullu	Poaceae	
_		Swollen Finger	Poaceae	
5.	Chloris barbata	Grass		
6.	Cynodon dactylon	Garike Hullu	Poaceae	
7.	Fibristylis aphylla	Fimbristyle	Cyperaceae	
8.	Fimbristylis miliacea	Hoorahgrass	Cyperaceae	

Note: Source: Primary data generation by ULTRA TECH team & Working Plan of Manglore Forest Division 2012-13 to 2023-24

3.14.2 Medicinal Plant:

The conservation of medicinal plants means every species of plants in its natural habitat should be protected and preserved. The observed common species having some medicinal properties are given in Table 3.36.





Table 3-40- Medicinal Plant Species Present in the Study Area

Sr. No.	Botanical Name	Local Name	Family
1	Abrus precatorius	Gulaganji	Papilionaceae
2	Acacia occidentalis	Chendeballi	Mimosaceae
3	Acacia sinuate	Seege Balli	Mimosaceae
4	Acronychia pedunculata	Sonemavu	Rutaceae
5	Alangium salvifolium	Ankole	Alengiaceae
6	Aphanamixis polystachya	Banta Kepulu	Meliaceae
7	Archidendron monadelphum	Kadukonde mara	Mimosaceae
8	Arenga wightii	Siga mara	Palmae
9	Artocarpus gomezianus	Vatehuli	Moraceae
10	Atalantia monophylla	Kadulimbe	Rutaceae
11	Calamus thwaitessa	Handibetta	Palmae
12	Calamus vattavilla	Devarabetta	Palmae
13	Calicopteris floribunda	Engiru	Combretaceae
14	Callicarpa tomentosa	Pandavarabatti	Verbenaceae
15	Calophyllum polyanthum	Honne	Calophyllaceae
16	Centella asiatica	Thimare	Apiaceae
17	Cinnamomum malabatrum	Dalchini	Lauraceae
18	Cinnamomum verum	Dalchini	Lauraceae
19	Dalbergia horrid	Sisau	Papilionaceae
20	Dichaptalum gelanioides	Cherumaram	dichapetalaceae
21	Diospyros ebenum	Karimara	Ebenaceae
22	Diospyros prurians	Gaub	Ebenaceae
23	Dipterocarpus indicus	Dooma	Dipterocarpaceae
24	Dracaena terniflora	Madocompa	Liliaceae
25	Entada pursaetha	Pallekai	Papilionaceae





Sr. No.	Botanical Name	Local Name	Family
26	Flacourtia montana	Hennu Sampige (Appi hannu)	Flacourtiaceae
27	Garcinia indica	Punarpuli	Guttiferae
28	Garcinia morella	Ardala	Guttiferae
29	Gnetum ula	Nokote	Gnetaceae
30	Harpullia arborea	Bidasale	Sapindaceae
31	Helicteres isora	Edamuri Balamuri	Sterculiaceae
32	Holygarna arnottiana	Chere	Anacardiaceae
33	Hopea ponga	Karmara	Dipterocarpaceae
34	Humboldtia bruninis	Kadu ashoka	Caesalpiniaceae
35	Ixora brachiata	Korajji	Rubiaceae
36	Jasminum flexile	Kadumallige	Oleaceae
37	Justicia adhatoda	Adusoge	Acanthaceae
38	kingiodendrom pinnatum	Ennemara	Caesalpiniaceae
39	Knema attenuata	Rakthamara	Myristicaceae
40	Litsea laevigata	Mulakunari	Lauraceae
41	Lygodium flexuosum	Zerri gida	Lygodiaceae
42	Neolitsea foliosa	Nees	Lauraceae
43	Ochlandra travancorica	Ote	Gramineae
44	Olea dioica	Bili saroli	Oleaceae
45	Pandanus unipapillatus	Mundevu	Pandanaceae
46	Piper nigrum	Karimenasu	Piperaceae
47	Polyalthia fragrans	Gowrimara	Annonaceae
48	Sarcostigma kleinii	Ingudi	Icacinacaceae
49	Scleropyrum wallichianum	Naikuli	Santalaceae
50	Solanum torvum	Kalyate	Solanaceae
51	Sterculia guttata	Jenu tadala	Sterculiaceae
52	Syzygium gardener	Kadu Nerale	Myrtacaea





Sr. No.	Botanical Name	Local Name	Family
53	Tabernae montana heyneana	Kokke Kai	Apocynaceae
54	Thottea siliquosa	Chakranike	Aristolochiaceae
55	Trewia polycarpa	Chennimara	Euphorbiaceae
56	Ventilago madraspatana	Dinesh Balli (Aithala)	Rhamnaceae
57	Vepris bilocularis	Munguppe	Rutaceae
58	Veteria indica	Saaldupa	Dipterocarpaceae
60	Zalthoxylum rhetsa	Kavate	Rutaceae
61	Zingiber neenum	Inji	Zingiberaceae





Table 3-41: Phyto Sociological Studies in different Sampling Locations within 10 km Radius

Area

Common Name	Botanical Name	Relative Frequenc	Relativ e	Relative Abundanc	IVI value
Ear leaf acacia	Acacia auriculiformis	7.69	7.69	8.58	23.97
Jackfruit	Artocarpus heterophyllus	7.68	7.69	11.42	26.81
Andipunar	Carallia brachiata	5.14	5.13	12.59	22.82
Daddal	Careya arborea	5.13	5.13	4.54	14.76
Tad	Borassus flabellifer	2.54	2.56	3.13	8.26
Gaali-mara	Casuarina equisetifolia	5.15	5.13	3.32	13.56
May flower	Delonix regia	2.56	2.56	4.51	9.65
Kanapade	Falconeria insignis	5.12	5.13	2.50	12.76
Attimara	Ficus glomerata	5.14	5.12	2.04	12.30
Chere	Holigarna feruginea	7.68	7.69	11.66	27.04
Karmar	Hopea ponga	5.14	5.13	4.29	14.55
Uppalige	Macaranga peltata	5.13	5.13	4.19	14.44
Mango	Mangifera indica	5.13	5.13	1.52	11.77
Renje	Mimusops elengi	10.24	10.28	4.67	25.20
Kayaar	Strychnos nux-vomica	5.13	5.13	5.95	16.21
Mahogany	Swietenia macrophylla	2.56	2.56	2.53	7.68
Jamun	Syzygium cumini	2.56	2.56	0.55	5.66
Hunasemara	Tamarindus indica	2.56	2.56	7.04	12.16
Teak, Thega	Tectona grandis	2.56	2.56	1.05	6.19
Dhoopa	Vateria indica	5.13	5.13	3.91	14.17
	Total	100	100	100	300.00





As per our quadrate sampling *Holigarna feruginea* emerged as the dominant tree species with IVI of 27 followed by *Artocarpus heterophyllus* (26.79), *Minusops elengi* (25.18), *Acacia auriculiformis* (24) while least IVI value was observed for Tectona grandis (6.19) and *Swietenia macrophylla* (7.68) Phyto-sociological studies shows that the maximum IVI was found to be of *Holigarna ferruginea* (27.04) followed by *Artocarpus heterophyllus* (26.81), while the species like *Acacia auriculiformis, Minusops elengi* and *Carallia brachiata*, the IVI value was found to be 25.18, 25.20 and 22.84 respectively. The highest IVI value indicates that these species are dominant and important for this region

There were certain species of plants like *Borassus flabellifer*, *Syzgium cumini* and *Tectona grandis* whose IVI value was found to be 8.26, 5.66 and 6.19 respectively, that signifies the species are medium dominant and very frequently observed in the study area. The values of IVI are given in Table 3.42

3.14.3 Mangroves in Study Area

Mangalore Port area is devoid of Mangrove species. However, mangroves patches are present along the estuarine bank of Gurupura river having dominant species i.e *Avicennea officinalis* along with other species such as Kandelia candel, *Avicennea alba, Rhizophora mucronata,* Vegetation including mangroves in the study area along the Gurupur estuary List of Mangroves & Mangrove associate observed in study area given in Table 3.38. The Mangroves are present within 10 km of the project site. Mangroves near Kasba Bengre – Approx. 3.56 km and Mangroves near Baikampady – Approx. 3.35 km.

Sr. No.	Scientific Name	Common Name	Family Name
1	Acanthus ilicifolius	Harkata	Acanthaceae
2	Avicennia alba	Uppati	Avicenniaceae
3	Avicennia marina	Ipati	Avicenniaceae
4	Avicennia officinalis	Baen	Avicenniaceae

Table 3-42: List of Mangroves & Mangrove associate observed in Study Area





5	Excecaria agallocha	Gangiva, Haarogida	Euphorbiaceae			
6	Kandelia candel	Kandale Rhizopho				
7	Rhizophora mucronata	Kandla, Bhora	Rhizophoraceae			
8	Sonneratia caseolaris	Chakkarakandal	Sonneratiaceae			
	Mangrove associate					
1	Acrostichum sp.	Leather ferns	Pteridaceae			
2	Caesalpinia crista	Squirel's Claws	Caesalpinioideae			
3	Caesalpinea bondue	Nicker bean	Caesalpinioideae			

Source; Primary data generation by ULTRA TECH team Working Plan of Manglore Forest Division 2012-13 to 2023-24.



Avicennia officinalis

Kandelia candel

Figure 3-19: Prominent Mangroves observed in Study area

3.14.4 Fauna

Methodology

Field observations of fauna were carried out. The commonly available mammals, amphibians, reptiles, butterflies, with 10km surroundings were enumerated. The method followed for avifauna survey has been outlined in respective section. To prepare a detailed report on the status of faunal diversity within study area, field studies were conducted. Both direct (sighting) and





indirect (evidences) observations methods were used to survey the faunal species around the study area. Further, information towards faunal diversity from secondary sources was collected on interaction with the local people and Forest Dept. officials.

Observation

I) Vertebrates

Mammals: Indian five stripped squirrel, Porcupine, Fox, common Mongoose, and Indian Hare. Flying Fox were observed during primary survey. Dialogue with local villagers located within the study area fox found in study area, but no wild mammalian species was directly sighted during the field survey.

II) Reptiles & Amphibians:

On the basis observations during site visits & secondary data, 5 species of Reptiles & 3 species of Amphibians found in the study area (Table 3.44). As per dialogue with local villager's rock phython i.e. a schedule I species was recorded in the study area but not observed during site visit.

III) Avifauna:

Birds were studied by direct observation with the help of "Olympus 10 x 50 DPS I" binocular and were identified by adopting available literature (Grimmett *et al.* 1998).During the survey survey, a total of 29 species of avifauna were identified and recorded from the entire block area and surrounding area. It has been observed that the majority of birds were insectivorous in habit preferring insects, worms the bird population of study area is rich and diverse. The birds observed during primary data collection survey were *Milvus migrans* (Black Kite), *Halias turindus* (Brahminy kite) *Nycticorax nycticorax* (Night Heron) (Figure 3.19) *Vanellus indicus* (Redwattled lapwings), *Euploea core* (Common Crow), *Phalacrocor axauritus* (Cormorant) etc. Checklist of avifauna as per available secondary literature and primary observations during survey are given in Table 3.43 Based on discussions with local people and forest officials, it is recorded that besides commonly available birds, species like Indian Peafowl (*Pavo cristatus*)





under schedule I of Wildlife (protection) Act 1972 was observed within 10 km boundary of the project site

In order to mitigate the impact of the project on the Schedule-I and endangered species found in the buffer zone, a detailed biodiversity management & Conservation plan has been prepared by NIO specifically for the Mangroves, Peacock, Marine turtles, Sharks, and Marine mammals is attached as **Annexure V**



Halias turindus (Brahminy kite)



Nycticorax nycticorax(Night Heron)







Milvus migrans (Black kite)



Pavo cristatus(Indian Peafawl)

Figure 3-20: Common Birds Observed in Study Area

Butterflies

Study area comprises of 5 species of butterflies, dominated by Lime butterfly, Peacock pansy, Common sailor (Figure 3.20) Butterfly diversity and community composition are dependent on plants, as their caterpillars are highly specific to host plants on which they feed and metamorphose into the adults. Fairly good butterfly diversity in this area is conspicuous due to presence of wide varieties of flowering trees. Therefore, richness of host plant diversity contributes to butterfly diversity. None of these is endangered (Schedule I) as per Wildlife (Protection) Act 1972.

Dragonflies & Damselflies

Four species each of dragonflies and two species of damselflies were recorded. Species like *Neurothemis tullia*, *Crocothemis servilia* (Figure 3.18) commonly seen throughout the project area while damselflies *Enallagma cyathigerum & Prodasineura autumnalis* was common in the periphery of the project site.







Neptis hylas (Common sailor)



Papilio demoleus (Lime Butterfly)



Neurothemis tullia (Pied Percher)



Crocothemis servilia (Ruddy marsh skimmer)

Figure 3-21: Butterflies & Dragonflies observed in study area

Table 3-43: List of Fauna recorded in the study area

SN	Scientific Name	Common Name	IUCN Status		
1	Pteropus giganteus	Flying Fox	Least concern	Sch-IV	
2	Vulpes bengalensis	Fox	Least concern	Sch-II	
3	Sus scrofa	Wild boar	Least concern	Sch - III	
4	Lepus nigricolis	Indian Hare	Least concern	Sch - IV	
5	Hystrix indica	Porcupine	Least concern	Sch - IV	
6	Herpestes sp.	Common mongoose	Least concern	Sch - II	
	Reptiles				
1	Daboia siamensis	Eastern Russel's Viper	Least concern	Sch - II	
2	Python molurus	Indian Rock Python		Sch - I	
3	Naja naja	Cobra	-	Sch - II	





SN	Scientific Name	Common Name	IUCN Status	
4	Calotes versicolor	Common garden lizard	Not assessed	Not assessed
5	Ptyas mucosa	Yellow Rat Snake	Not assessed	Sch - II
1	Bufo viridis	Common toad	Least concern	-
2	Rana spp.	Indian Bull frog	Least concern	Not assessed
3 Bufo melanostictus Common Indian toad Least concern		Least concern	Not assessed	
		Avifauna		
1	Bubulcus ibis	Cattle Egret	Least concern	Sch-IV
2	Columba livia	Rock Dove	Least concern	Sch-IV
3	Coracias benghalensis	Indian Roller	Least concern	Sch-IV
4	Corvus splendens	House crow	Least concern	Sch-V
5	Centropus sinensis	Greater Coucal	Least concern	Sch-IV
6	Corvus marorhynchos	Common Crow	Least concern	Sch-IV
7	Acridotheres tristis	Common Myna	Least concern	Sch-IV
8	Acridotheres fuscus	Jungle Myna	Leastconcern	Sch-IV
9	Passer domesticus	House Sparrow	Least concern	Sch-IV
10	Turdoides spp.	Babbler	Least Concern	Sch-IV
11	Tringa hypoleucos	Common Sandpiper	Least Concern	Sch-IV
12	Pycnonotus cafer	Red Vented Bulbul	Least Concern	Sch-IV
13	Psittacula krameri	Rose-ringed Parakeet	Least concern	Sch-IV
14	P sitta cula cyano cephala	Plum- headed Parakeet	Least concern	Sch-IV
15	Milvus migrans	Black Kite	Least concern	Sch-IV
16	Haliastur Indus	Brahminy Kite	-	Sch-IV
17	Copsychus saularis	Oriental Magpie-robin	Least concern	Sch-IV
18	Ardea cinerea	Grey Heron	Least concern	Sch-IV
19	Nycticorax nycticorax	Night Heron	Least concern	Sch-IV
20	Ardea purpurea	Purple Heron	Least concern	Sch-IV
22	Merops orientalis	Green Bee-eater	Least concern	Sch-IV
23	Halcyon smyrnensis	White-breasted Kingfisher	Least concern	Sch-IV
24	Egretta garzetta	Little Egret	Least concern	Sch-IV
25	Egretta gularis	Reef heron	Least concern	Sch-IV
26	Falco tinnunculus	Common Kestrel	Least concern	Sch-IV
27	Upupa epops	Ноорое	Least concern	Sch-IV
28	Pavo cristatus	Indian Peafowl	Least concern	Sch-I
29	Ploceus philippinus	Baya Weaver	Least concern	Sch-IV





SN	Scientific Name	Common Name	IUCN Status								
30	Prinia inornata	Plain Prinia	Least concern	Sch-IV							
31	Porphyrio porphyrio	Purple Swamp hen	-	Sch-IV							
32	Motacilla maderaspatansis	Large pied Wagtail	Least concern	Sch-IV							
33	Nectarinia asiatica	Purple Sunbird	Least concern	Sch-IV							
34	Oriolus oriolus	Eurasian Golden Oriole	Least concern	Sch-IV							
35	Ardeola grayii	Indian Pond-heron	Least concern	Sch-IV							
36	Saxicoloides fulicata	Indian Robin	Least concern	Sch-IV							
37	Sturnia pagodarum	Brahminy Starling	Least concern	Sch - IV							
38	Vanellus indicus	Red-wattled Lapwing	Least concern	Sch-IV							
39	Vanellus malabaricus	Yellow-wattled Lapwing	Least concern	Sch-IV							
Butterflies											
1	Neptis hylas	Common sailor	Not assessed	Not assessed							
2	Papilio demoleus	Lime Butterfly	Not assessed	Not assessed							
3	Preais iphita	Chocolate Pansy	Not assessed	Not assessed							
4	Junonia hierta	Yellow Pansy	Not assessed	Not assessed							
5	Junonia almana	Peacock pansey	Least Concern	Not assessed							
Dragonflies											
1	Neurothemis tullia	Pied Perche	Not assessed	Not assessed							
2	Crocothemis servilia	Ruddy marsh skimmer	Not assessed	Not assessed							
3	Diplacodes trivialis	Ground skimmer	Not assessed	Not assessed							
4	Orthetrum Sabina	Green marsh hawk	Not assessed	Not assessed							
Damselflies											
1	Enallagma cyathigerum	Common blue damselfly	Not assessed	Not assessed							
2	Prodasineura autumnalis	Black Threadtail	Not assessed	Not assessed							





Note: Source: Primary data generation by Ultra-Tech team & Ref: Working Plan of Manglore Forest Division 2012-13 to 2023-24

3.14.5 Park and Sanctuaries

No National Park and Sanctuary is present within 10 km from the proposed site.

Pilikula Nisarga Dhama

Pilikula Nisarga Dhama is a multifaceted ecopark/center developed near Mudashedde village on the bank of Gurupur River which is present at a distance of 9 km from project site. In local language 'Pili' means tiger and 'Kula' means pond. As per information from local people, earlier it used to be told that tiger used to come for water to the tank in this area. Thus, people named this place as 'Pilikula'.Pilikula Nisarga Dhama spread over about 380 Acre land. It comprises an arboretum, greenhouse & nursery, a Bio-park and an Artisan village with boating facilities. About 120-acre area is covered by Bio-park, while Arboretum covers about 80 Acre land and the balance area is used for Artisan village and a water pond/reservoir. This park/center apart from its biological significance, it also attracts visitors as picnic spot. Arboretum comprises about 225 plant species, out of which few are listed below with their relative significance. Among these, some are endemic to Western Ghat, viz..viz. Calophylum apetatum, Ochlandra travancorica, Dillenia pentagyna, Vateria indica and Alstonia Scholaris. The fauna (animals) observed in the Bio-park are given below: Jackal, Sambar, Porcupine, Chital, Sambar etc.

3.14.6 Fishery

The coastal fish communities are the most important component of marine ecosystems During study period the survey of fish diversity was conducted from local fish market of Panambur & Suratkal village. The common fish diversity includes Cat fish, Flat fish, Eels, Crabs, Prawns Tuna, Ribbon fishes etc. were reported in study area.

3.14.7 Marine Ecology

As per summary of National Institute of Oceanography (NIO), Goa, Hydrographic observations revealed a coast-to-offshore temperature and salinity gradient due to the influence of Netravati and Gurupura rivers. A low saline patch of 10 psu was observed in the nearshore waters of the





study region due to the influence of the river runoff. The hydrographic parameters were within the normal range of values reported from unpolluted coastal areas. The bacteriological investigation in the study area shows that the water quality sustains good biodiversity. The bacterial counts were relatively higher at stations inside the port. Similarly, the abundance of coliforms was generally low in the study sites, except in the riverine region. The distribution of phytoplankton biomass and abundance showed any significant spatial variation. The sites inside the port showed exceptionally high phytoplankton biomass, which is typical for coastal and lagoon areas during the season. To conclude, the prevailing environmental and ecological features in the NMPA port premises did not exhibit any adverse conditions that may affect the survival and propagation of the biota in the region. However, precautions may be taken to maintain similar conditions in the future.



Figure 3-22: Local Fish Market in Study Area





3.15 Socioeconomic Environment

3.15.1 Introduction

Socio-economic has been recognized as, a component of environment. It focuses primarily on the social and economic effects that are likely to occur as a result of the construction and operation of the proposed development. It includes various factors, viz. demographic structure, availability of basic amenities such as housing, education, health and medical services, occupation, water supply, sanitation, communication and power supply, prevailing diseases in the region as well as features such as places of tourist attraction and monuments of archaeological importance. The study of these parameters helps in identifying predicting and evaluating the likely impacts due to project activity in the surrounding region. Any developmental activity exerts direct, indirect, positive and negative impacts on the socioeconomic environment of the region. The objective of the study based on the TOR (terms of reference) received from EAC.

Objective

Objectives of Socioeconomic study as follows: -

- To study demographic strusscture and facilities available in the study area.
- To identify and assess the impact on socioeconomic status of the study area.
- To identify all potential significant adverse and beneficial social impacts of the Project.
- To recommend the mitigation measures to reduce the adverse impact of the project.
- To verify compliance with the environmental regulations and industry's standards.
- To recommend cost effective measures to be implemented to mitigate the expected impact.

The study area for socio economic assessment defined as an area within 10 km radius from project site as per the statutory requirement of the Ministry of Environment & Forest.





Designation of impact zone is based on the EIA guidance manual. Primary data and secondary data are collected and use for socio economic study.

Data Collection

Data collection is a term used to describe a process of preparing and collecting data. Systematic gathering of data for a particular project from various sources, that has been systematically observed, recorded, organized. Data are the basic inputs to any decision making process in project.

Primary Data Collection

Primary data means original data that has been collected specially for the purpose. The data collected from the field under the control and supervision of an investigator. This type of data is generally afresh and collected for the first time. It is useful for current studies as well as for future studies. While collecting primary data collection in study area following methods are uses.

- 1. Observation Method
- 2. Focus group discussion (FGD)
- 3. Surveys and questionnaires

Secondary Data Collection

Secondary data is 'Data gathered and recorded by someone else prior to and for a purpose other than the current project.' Secondary data are collected from different offices like Census offices (India Census 2011), Statistical department, Health offices, Land and Revenue department, Municipal Councils, Zilla Parishad and Non-Governmental organizations.

Concept & Definitions

• **Study Area:** The study area, also known as impact area has been defined as the sum total of core area and buffer area with a distance of 10 Kilometers from the periphery of the core area. The study area includes all the land marks both natural and manmade, falling therein.





• **QoL:** The Quality of Life (QoL) refers to degree to which a person enjoys the important possibilities of his/her life. The 'Possibilities' result from the opportunities and limitations, each person has in his/her life and reflect the interaction of personal and environmental factors. Enjoyment has two components: the experience of satisfaction and the possession or achievement of some characteristic.

• **Household:** A group of persons who normally live together and take their meals from a common kitchen are called a household. Persons living in a household may be related or unrelated or a mix of both. However, if a group of related or unrelated persons live in a house but do not take their meals from the common kitchen, then they are not part of a common household. Each such person is treated as a separate household. There may be one-member households, two member households or multi-member households.

• Sex Ratio: Sex ratio is the ratio of females to males in a given population. It is expressed as 'number of females per 1000 males.

• **Literates:** All persons aged 7 years and above who can both read and write with understanding in any language are taken as literate. It is not necessary for a person to have received any formal education or passed any minimum educational standard for being treated as literate. People who are blind but can read in Braille are also treated as literates.

• **Literacy Rate:** Literacy rate of population is defined as the percentage of literates to the total population aged 7 years and above.

• **Labour Force:** The labour force is the number of people employed and unemployed in a geographical entity. The size of the labour force is the sum total of persons employed and unemployed. An unemployed person is defined as a person not employed but actively seeking work. Normally, the labour force of a country consists of everyone of working age (around 14 to 16 years) and below retirement (around 65 years) that are participating workers, that is people actively employed or seeking employment. People not counted under labour force are students, retired persons, and stay-at home people, people in prisons, permanently disabled persons and discouraged workers.





• **Work:** Work is defined as participation in any economically productive activity with or without compensation, wages or profit. Such participation may be physical and/or mental in nature. Work involves not only actual work but also includes effective supervision and direction of work. The work may be part time, full time, or unpaid work in a farm, family enterprise or in any other economic activity.

• **Worker:** All persons engaged in 'work' are defined as workers. Persons who are engaged in cultivation or milk production even solely for domestic consumption are also treated as workers.

• **Main Workers:** Those workers who had worked for the major part of the reference period (i.e. 6 months or more in the case of a year) are termed as Main Workers.

• **Marginal Workers:** Those workers who did not work for the major part of the reference period (i.e. less than 6 months) are termed as Marginal Workers

• Work participation rate: The work participation rate is the ratio between the labour force and the overall size of their cohort (national population of the same age range). In the present study the work participation rate is defined as the percentage of total workers (main and marginal) to total population.

3.15.2 Project Introduction

New Mangalore Port is an artificially created lagoon type harbour with an approach channel. The Port is an all-weather port situated at Panambur, Mangalore (State of Karnataka in south India), on the west coast of India, 170 nautical miles south of Mormugao and 191 nautical miles north of Cochin Port. The project is located at New Mangalore Port Authority, Village Panambur, Tehsil Surathkal, Dakshina Kannada District, and Karnataka. The proposed location of the berth No. 17 has been identified as the existing waterfront in between berths No. 8 and berth No. 13. This is shown in the Figure 3-20. As can be seen, there is sufficient back up area behind the berth for the storage of cargo.







Figure 3-23: Proposed Project Location



Figure 3-24: Site Visit - Ultra tech Team





While discusses the baseline scenario of the socio-economic environment in the 10 km radius area total 14 villages, Town, Municipal Council area are comes under study area. The detailed information on these villages is presented in the given various tables and graphs.





Figure 3-25: Villages within 10 Km. Radius Area from Project Site.



Draft Environmental Impact Assessment Report of Development of

Multipurpose Cargo Berth (Berth No.17) at New Mangalore Port

Authority



3.15.3 Demography

Table 3-44: Demography of study area

			Tota	al Pop.	0-6	SC Pop.		ST Pop.		Literate Pop.		Illiterate Pop.		Working Pop.		Non-Working Pop.	
SN	Name	House	Male	Female	age	Male	Female	Male	Female	Male	Female	Male	Female	Main	Marginal	Male	Female
			Pop.	Pop.	Рор	Pop.	Pop.	Pop.	Pop.	Pop.	Pop.	Pop.	Pop.	Pop.	Pop.	Pop.	Pop.
1	Mangalore	39786	96431	98692	20230	3344	3383	894	904	81396	76691	15035	22001	82170	6171	40007	66775
2	Hosabettu	498	1095	1165	182	86	71	49	58	942	934	153	231	909	128	432	791
3	Madya	387	802	822	141	101	118	58	62	672	648	130	174	619	193	310	502
4	Permude	492	1117	1125	200	0	0	8	20	946	866	171	259	921	31	465	825
5	Kalavar	233	560	555	87	8	9	1	0	480	435	80	120	479	3	227	406
6	Malavoor	778	1721	1747	346	340	339	81	83	1377	1262	344	485	1441	320	626	1081
7	Adyapady	448	1043	1046	202	107	111	25	31	872	742	171	304	1081	29	401	578
8	Bala (OG)	663	1324	1313	334	29	24	30	22	1100	1037	224	276	1022	8	556	1051
9	Bajpe (CT)	1976	5179	4522	988	166	137	58	49	4372	3568	807	954	3964	311	1959	3467
10	Thokur-62 (CT)	1396	4074	3359	877	101	113	16	18	3409	2608	665	751	3015	325	1489	2604
11	Kenjar (CT)	1135	2718	2620	492	217	239	12	5	2261	1889	457	731	2417	259	993	1669
12	Kolambe (CT)	1239	2761	2831	498	187	187	26	24	2322	2158	439	673	2319	334	1099	1840
13	Mudushedde (CT)	1832	3922	4233	717	205	197	87	92	3276	3192	646	1041	4090	360	1426	2279
14	Neermarga (CT)	1292	2677	2826	443	86	81	24	19	2340	2287	337	539	2864	71	999	1569

Source: Census of India 2011

*above information is as per 2011 official census





Male and female population

According to recent censes (2011) Population of study is (10 Km radius from project site) 252280 in 52155 households. Mail population is 125424 and female population is 126856. Highest population in study area is in Mangalore city Corporation (CT) (195123).

There are 52155 households in the study area and the average size of household is 5 members per household in the study area. The dependent population below 6 years is 25737 (10.2% of the total population) in the study area. The sex ratio of the study area is 1011 females per 1000 males. The sex ratio of the study area is lower site as compare to district sex ratio of Dakshina Kannada Dist. (1020). (Source: https://www.census2011.co.in/census/district/252-dakshina-kannada.html).

• Male - Female Ratio is: 1011 Male: 1148 Female

• Population Density in study area is: 803 person per Sq. Km. (Population Density = Number of People in study area (10 Km radius from project site))



Figure 3-26: Male-Female Population Distribution Chart





SC and ST Population:

According to the 2011 census, the ratio of Scheduled Caste population in the study area to the total population is 4% which is low as compared to the SC population in the district which is 7.1%.

whereas the Scheduled Tribe population in the study area to the total population is 1.1% which is Lower as compared to the ST population of the district which is 3.9%. Together they constitute 5.1% of total population of the study area within 10 km radius. This can be observed in figure 3-25.



SC and ST Population Distribution

Figure 3-27: SC and ST Population Distribution

Religion:

Majority of Population in study area is Hindu religion followers. Nearly 68% of total population is Hindus, 17% Muslims and Christians are 13%. Buddhist, Jains, Sikh and others forms the rest proportion of population in the study area. People of different religion worship their religious beliefs in Churches, Masjids, Gurudwaras, Jain temples and other religious places that is located in the study area.

There are many religious places area noted some are; Jagadambika Temple, Shree Malaraya Panjurli Temple, Kodikkal Temple, Shree Nandaneshwara Devasthana, Siddivinayaka Temple, Sri Sri Kuru Amba Rajarajeshwari Temple, Koragajja Temple, Shri Nagaraja Temple,





Koorikatta, Nagabana Temple, Guttige Manethanada Dharma Daivagala Temple, Nagabana temple, Sri Ayyappa Swamy Devasthana, Shree Mahaganapathi Temple, Urwa temple, Sri Rakteshwary Temple, Payyaragudde Shree Kaanteri Jumadi (Dhumavathi) Daivastana, Shree Vishnumurthy Devastana, Shri Babbuswami Kshethra, Shri Babbu Swamy Temple, Shree Panchalingeshwara Temple, Navadurgambika Temple, Shri Malaraya Dhoomavati Temple, Naga Brahma Sannidi, Shree Narayana Guru Mandira, Shree Vidya Saraswathi Kshetra, Badavide Sree Vishwanatha Temple, Kukkadi Shri Bhagavathi Temple & Shri Arasu Mundathaya Daivasthana, Om Sri Ayyappa Swamy Mandir, Shri Mariamma Temple, Shree Maha Ganesh Bhajana Mandira, Boloor shanivara temple etc.

Mangalore is a multi-lingual city where several prominent regional languages such as Tulu, Konkani, Kannada, and Beary are spoken. The city is known as Kudla in Tulu, Kodial in Konkani, Maikāla in Beary, Mangalapuram in Malayalam, and Mangaluru in Kannada. Among most of the residents of the city, Kudla is the most commonly used name to refer to it. There are also smaller communities of Tuluva Jains, Gujaratis, Tamils, and Marathis. Tulu is a predominant language in Mangalore and Kannada is the administrative language of Mangalore, but the city is multi-cultural. According to the 2011 Census, Tulu is spoken as a first language by 33.7% of the population, Konkani by 14.03%, Kannada by 12.45%, Malayalam by 5.64%, and other languages are spoken by 34.18%. Unlike other cities in Karnataka where Kannada is a primary language, Kannada is the third most spoken language, Tulu is predominant language in Mangalore, and Konkani is the second most spoken language in Mangalore.







Figure 3-28: Religious Places near project site

Educational status:

According to census 2011; in the study area the average literacy rate is 80.9%, whereas out of total literate population the male literacy is 51.8% and female literacy is 48.2% in the study area. The average literacy rate of the district (88.6%) is high as compared to the literacy rate of study area, The female literacy rate is low in the study area, which is a pan India phenomena. The education status has been mentioned in the following figure.



Figure 3-29: Literates and Illiterate Population distribution

The districts of Dakshina Kannada and Udupi are considered to be a major education corridor in India. Deralakatte is a University and Medical town in Mangalore where Universities like





Mangalore University, Nitte, Yenepoya, Father Mullers, and Kanachur are situated. In schools and colleges which are below university-level, the media of instruction are mostly English and Kannada, and English is used for teaching in universities. Schools and colleges in Mangalore are either government-run or are operated by private trusts and individuals. Schools are affiliated with either the Karnataka State Board, Indian Certificate of Secondary Education (ICSE), the Central Board of Secondary Education (CBSE), or the National Institute of Open Schooling (NIOS) boards.

Here are some of the earliest schools and colleges established in Mangalore, and their years of establishment

Schools and Collages in Study area:

Basel Evangelical School, Milagres School, Rosario High School, University College, St. Ann's High School, St. Aloysius College, Canara High School, St. Agnes PU College, St. Agnes College, Sacred Hearts' School, Cascia High School, Carmel School, Kulur High School, Shri Amritha Nursery School, SDM School Mangaluru, St. Peters Primary School, Kodikal,Primary School, NMPA High School, EuroKids Preschool Kuloor, Daya School of Art, Sri Chaitanya school, Ashoknagar Higher Primary School, Podar International School, Mangalore, Bearys Public School, NMPA Mahila Samaj Nursery School, Vidyanagara Panjimogaru School, Ladyhill English Higher Primary School, Little Steps Nursery School, Kendriya Vidyalaya No.1 Panambur, Vidya Higher Primary School, Little Elly Preschool Ashok Nagar, St. Ann's High School, Early Learning Centre (ELC), St. Aloysius English Medium School, Ashoka Vidhyalaya, Pompei High School, Swastika National School, Kala Shaale, Government Pre-university Collage, Bockapatna, Karavali Group of Colleges, Mahesh Collage, TLC PU College, Prasanna Collage of Nusing, Karavali, Collage Of Physiotherapy Manglore, Government pre-university collage Chelairu etc.







Figure 3-30: NMPA School and Govinda Dasa Pre University Collage

Healthcare:

The city is served by various hospitals such as the KMC Hospitals, Father Muller Charitable Institutions (FMCI), AJ Hospital, and Wenlock Hospital. Wenlock Hospital, a teaching hospital of KMC Mangalore has around 1000 beds and caters to the healthcare needs of the neighboring districts. Mangalore is a hub for medical tourism and receives patients from foreign countries. From 2017–19, around 240 foreign nationals were treated in three hospitals across the city. Approximately 50 per cent of the patients (the foreign nationals) arrived in 2018 and 2019. KMC, AJ, and Yenepoya Hospitals have received the highest number of foreign patients, including those from the United States. At Yenepoya Hospital, 68 foreign nationals have availed treatment during 2017–19. The largest inflow of foreign patients into Mangalore is from the Gulf countries. Deralakatte is a main healthcare hub of Mangalore.

While site visit there are many healthcare units are noted some are follow; NMPA Hospital, A.J. Hospital & Research Centre, Highland Hospital Research & Diagnostic Centre, Unity Hospital, ULLAL General Hospital, S.C.S.Hospital, Athena Hospital, Hegade Hospital, Sherays Clinic, Dr T M A Pai Rotary Hospital, Yenepoya Specialty Hospital, Jayashree Hospital, A J Hospital rural primary health centre, KMC Hospital, Attavar, Padmavathi Hospital, Government Lady Goschen Hospital, Wenlock hospital, Colaco Hospital, Vaishnavi Hospitals, Mangalore Institute Of Oncology Hospital etc.







Figure 3-31: NMPA Hospital and A.J. Hospital & Research Centre

Economy:

Industrial and commercial activities dominate study area's economy. Mangalore is the only city in Karnataka to have all modes of transport — air, road, rail and sea.

Industrial, commercial, agricultural processing, and port-related activities comprise this city's economy. The New Mangalore Port is India's seventh-largest container port.

Dakshina Kannada district has the highest percentage of workers employed in industry and the second-highest industry-to-district GDP ratio in Karnataka. Imports through New Mangalore port include crude oil, edible oil, liquefied petroleum gas, and timber.

Mangalore is the 2nd largest business centre in Karnataka. Around 75% of India's coffee, timber and cashew nuts exports are handled by the New Mangalore Port. Mangalore is one among the 5 cities in the country to have both a Major Port and an International Airport.

within study area total working population is 45.9% and non-working population is 54.1% out of working population almost 92.6% peoples are in main working population category. And 7.4% population is in marginal population category.

The relative importance of the main spheres of economic activity is the gauged from the pattern of distribution of total workers according to broad fourfold classification namely, cultivators, agricultural labour, household industry workers and other economic activities. In the study area,





cultivators (2.4%) and agricultural labour (1.7%) together constitute 4.1% of the total workers as shown in following figure. It reflects that agricultural sector has absorbed most of the workers in the study area. The proportion of workers in other economic categories is 77.9% of the total workers shows that they are engaged in manufacturing, processing, servicing and repairs, Tourism, Fishing, trade and commerce etc.

Non-working population is study area is 136426 which are 54.1 % out of total population. This category includes below 15 years age population and not willing to any work is considered. Also after Retirement age population also include in this category.





Figure 3-32: Distribution of working population

Food:

The Mangalorean dishes which are known for their flavors are also very spicy and rich in coconut oil. Rice is the main staple food for the people residing here. The non-vegetarians prefer the fish more. Fruits like jackfruits bananas and sweet cucumber are another important part of the cuisine. The important feature of the sweet dishes is that instead of using sugar they use a jiggery made of palm.







Figure 3-33: Food Culture

Local Festivals, Art & Music:

The main festivals celebrated in Mangalore are the Aati festival, Dussehra, Sri Krishna Janmashtami and Ganesh Puja. These festivals are celebrated with a great deal of pomp and festivities. Mangalore is also very famous for the various art and music which have been evolving since the historic times.



Figure 3-34: Traditional dresses





Infrastructure, Transport and Communication

This section analyses the infrastructure facilities like water supply, roads, markets, banks, post offices, schools and electrification in the study area.

The project is located at New Mangalore Port Authority, Village Panambur, Tehsil Surathkal, Dakshina Kannada District, and Karnataka. The proposed location of the berth No. 17 has been identified as the existing waterfront in between berths No. 8 and berth No. 13.

Mangalore is the only city in Karnataka to have all modes of transport - air, road, rail and sea.

Local public transport

Karnataka State Road Transport Corporation is plying buses in multiple routes in city and surrounding area. There are two distinct sets of routes for the buses, with the city routes being covered by city buses, and the intercity routes being covered by service and express buses.

There are also KSRTC JnNurm green colour city buses from State Bank bus stand. These buses travel to different parts of the city and its suburbs. Service buses essentially touch some towns and villages on the intercity route. Service are run to various location like Udupi, Karkala and Kateel.

Another mode for local transportation is the autorickshaw. Taxi services in Mangalore are provided by Ola Cabs and Uber, whose services extend to the Mangalore International Airport. Motorcycle rental providers have also begun offering transport services in the city.

Roads and Highways:

Five national highways connect Mangalore with various parts of Karnataka and India.

• NH-17 (now NH-66) connects Mangalore with Udupi, Bhatkal, Karwar, Mumbai, Goa, Kochi, Trivandrum and Kozhikode.

- NH-13 (now NH-169) connects Mangalore Shimoga.
- NH-48 (now NH-75) connects Mangalore with Vellore, Bangalore, Kunigal, Hassan and Sakleshpura.




• NH-73 connects Mangalore to Tumkur via Charmadi, Mudigere and Belur.

• NH-275 also connects Mangalore with Bangalore via Mysore. It starts at Bantwal near Mangalore city and passes through Madikeri, Mysore and Mandya. It ends at Bangalore spanning a total length of 378 kilometres (235 mi).

National Highway 66, Mumbai to Kanyakumari highway passing adjacent to project site.



Figure 3-35: National Highway 66, Mumbai to Kanyakumari

Railways

Mangalore has 3 railway stations - Mangalore Central, Mangalore Junction & Surathkal railway station.

Mangalore has direct trains to Chennai, Trivandrum, Kochi, Kollam(Quilon), Coimbatore, Hyderabad, Puducherry, Nagercoil through the Southern Railway and to Mumbai, Bhatkal, Karwar and Goa via the Konkan Railway. Navyug Express train connects Mangalore with Katra in Jammu and Kashmir. Thiruvananthapuram Rajdhani Express connects Mangalore with the national capital New Delhi.





Air:

Mangalore International Airport is located near Bajpe-Kenjar and about 13 km (8 mi) north-east of Mangalore city center and 11.2 km away from project site. It operates regular scheduled flights to major cities in India and the Middle East. It is the second-largest and second-busiest airport in Karnataka.

Sea:

The Mangalore Harbour provides a connection by sea to the rest of the world. Currently dry, bulk and fluid cargos are handled by the New Mangalore Port, providing an important gateway to the state of Karnataka. It is also the station for the Coast Guard and has a unit of CISF.

Various cruise ships such as Regent Seven Seas, Norwegian Star, Oceania, Celebrity, Costa, AIDA, Nautica and Royal Caribbean International have visited the New Mangalore Port. Foreigners can enter Mangalore through the New Mangalore Port with the help of Electronic visa (e-visa). Cruise ships from Europe, North America and UAE arrive at New Mangalore Port to visit the tourist places around Mangalore.





Figure 3-36: Transportation Accessibility of project site





Infrastructure Amenities and Distances:

Sr.	Amenities	Name	Distance (in km)		Contact		
No.				Aerial	No.		
1	Airport	Mangaluru International Airport	11.20 km	7.00 km	0824 222 0400		
2	Railway	Mangalore Railway Station	11.50 km	7.40 km	139/182		
2	Station	Thokur Railwau Station	10.70 km	4.50 km	139/182		
3	Bus Depot	Karnataka State Road Transport Corporation Mangalore 2nd Depot - Department of Transportation near A J Hospital,Bejai,Mangalore	6.70 km	4.30 km	081051 13506		
	Kuloor - Bus stop		3.00 km	1.30 km			
		Urwa Police Station - Near Urwa Store Market,Ashok Nagar.MangalorePoliceKavoor Police Station - Kavoor, Mangalore		3.20 km	0824 222 0521		
4	Police Station			4.60 km	0824 222 0533		
		Panambur Police Station Mangaluru	4.40 km	2.80 km			
5	Fire Station	Panambur Fire Station, Mangalore	1.20 km	1.00 km	0824 2407 7488		
6	Post	Kulur Sub Post Office -Mangalore	3.10 km	1.20 km	0824 245 9478		
0	Office	Office Panambur Sub Post Office -Mangalore		2.15 km	0824 240 7230		
	Kulur High School Kuloor.SchoolsNMPA Higher Primary School		3.00 km	1.25 km	0824 245 8313		
7			5.30 km	2.00 km	0824- 2407934		
		Vibgyor Roots and Rise School, Kulur,	5.00	1.40	076193		





Sr. No.	Amenities	Name	Distance (in km)		Contact No.
		Mangalore		km	56089
		NMPA English Medium School	3.30 km	2.00 km	
		NMPA High School		2.10 km	0824 240 7844
		Kendriya Vidyalaya No.1 Panambur		2.50 km	0824 240 7337
		EuroKids Preschool Kuloor, Kuloor		1.70 km	098800 02009
		Vidyanagara Panjimogaru School Padukodi	4.60 km	3.00 km	
		Karavali Group Of Colleges, Mangalore	4.50 km	2.00 km	0824 245 5656
	8 College	Dr M.V Shetty Group Of Colleges, Mangalore,	4.70 km	3.00 km	0824 248 1048
		Dr. M.V.Shetty College of Speech & Hearing – College, Kavoor	5.40 km	3.20 km	0824 248 3193
8		Government First Grade College Kavoor.	6.00 km	4.00 km	0824 2482 036
		University College -Mangalore	11.00 km	7.00 km	0824 242 4760
		Shree Gokarnanatheshwara College Of Education – College ,Gandhinagar, Mangalore,	7.80 km	4.60 km	0824 245 1216
		Corporation PHC - Hospital Bejai - Kavoor Rd, Bejai, Mangalore	7.30 km	4.75 km	070370 85956
0	Hospital	Jyothi Clinic - Medical Center Kuloor, Junction, Mangalore	3.30 km	1.25 km	
	nospitai	A.J. Hospital & Research Centre - Kuntikana, Mangalore	6.50 km	4.20 km	0824 222 5533
		ECHS Polyclinic Kotekani, Mangalore	5.50 km	3.30 km	0824 245 7549





Sr. No.	Amenities	Name	Distance (in km)		Contact No.
		Wenlock District Hospital - Hampankatta, Mangalore	11.00 km	7.00 km	0824 241 3208
		Mangalore Institute of Medical Sciences & Government Hospital - Mangalore	9.50 km	6.50 km	0824 241 3455
	Historical	Tippu sultan fort Historical place - Historical landmark, Ashok Nagar, Mangalore	8.50 km	4.00 km	
10	/Religious Places	Shree Nandaneshwara Devasthana - Hindu temple, Mangalore,	3.00 km	1.70 km	
		Panambur Beach - Tourist attraction	5.00 km	2.00 km	
11	Highway / Road	Panvel - Kochi-Kanyakumari hwy NH- 66		1.00 km	
12	Port Terminal/ Indian	Indian Coast Guard - Coast guard station Panambur Beach Rd, New Mangalore, Post Box no.19,Panambur, Post Mangalore	4.70 km	2.00 km	
12	Coast \Guard	Old Port Mangalore - Transportation service Old Port Rd, Bamboo Bazar, Bunder, Mangalore	10.30 km	7.15 km	

Mangalore Electricity Supply Company Limited is an Indian electricity supplier to the study area and districts Dakshina Kannada.

Telecom services are handled and run by the BSNL telecom and other private companies. Broadband and wireless internet services are provided by all private mobile operators (BSNL, Idea, Airtel, Vodaphone and Reliance).





Emergency Contact No:

Sr. No.	Office Name	Telephone Nos.	
Emer	gency Control Room		
1	New Mangalore Port Authority 0824 2407341 /18 1222		
Healt	h care services / Government Hospital		
1	Wenlock District Hospital - Government hospital Hampankatta, Mangalore0824 241 3208		
2	2 Mangalore Institute of Medical Sciences & Government Hospital - Government hospital,32, Mydan Road, Hampankatta, Mangalore 08242		
Priva	te Hospitals		
1	A.J. Hospital & Research Centre - General hospital National Highway 66 Kuntikana, Mangalore0824 222 5533		
2	ECHS Polyclinic Mangalore - Medical clinic Kottara Sankesha Rd, Kotekani, Mangalore	0824 245 7549	
Ambu	ulance		
1	Air Ambulance Services - Ambulance service	088090 88765	
Police	2		
1	Urwa Police Station - Near Urwa Store Market, Ashok Nagar, Mangalore0824 222 0521		
2	Kavoor Police Station - Kavoor, Mangalore0824 222 0533		
Fire l	Brigade Service		
1	Fire Control Room	0824-2405092	
2	Wharf Fire Station0824-2407222		
3	Oil Terminal Fire Station0824-2407673		
4	Fire Service (Berth No.9) 0824-2407330		
Airpo	ort		
1	Mangaluru International Airport	0824 222 0400	
Railw	/ay		
1	Mangalore Railway Station	139/182	
2	Thokur Railway Station139/182		





Sr. No.	Office Name	Telephone Nos.
Local	Transport Service	
1	Karnataka State Road Transport Corporation Mangalore 2nd Depot - Department of Transportation near A J Hospital, Bejai, Mangalore	081051 13506
Near	by School / Collages	
1	NMPA High School	0824-2407844
2	Kulur High School - Panvel - Kochi - Kanyakumari Hwy, near St. Antony Church, Kuloor, Kavoor	0824 245 8313
3	NMPA Higher Primary School	0824-2407934
4	Karavali Group Of Colleges,NH- 66, Near Kottara Chowki Junction Mangalore.	0824 245 5656
Helpl	ine numbers	
1	New Mangalore Port Authority	0824- 2407341 /1800-599- 1222
Any o	other project specific emergency Contact number	
1	VIP Guest House New Mangalore Port Authority Guest House	0824-2887720
2	Medical Officer In charge	0824-2407948
3	Traffic Manager	0824-2407440
4	Safety Officer	0824-2887274
5	Export / Import Section	0824-2887276 / 280
6	Container Terminal	0824-2887788
7	Container Scanner	0824-2887278
8	Oil Jetty	0824-2887279
9	Asst. Director - Strategic Management	0824-2887390
10	Chief Engineer (Civil)	0824-2407493
11	Mechanical Division – II (Mobile Crane and Weighbridge Sub-Division)	9945597437
12	Auto Garage Sub-Division	9448910767
13	MARINE DEPARTMENT	0824-2407419
14	Launch Maintenance / Crew Rest Room	0824-2407269
15	Chief Medical Officer 0824-2407948	





Sr. No.	Office Name	Telephone Nos.
16	General Physician	9847364307
17	Port's Labour Union / Welfare Association Offices	0824-2400150



Socio Economic Survey:

Socio economic survey was undertaken in the project site and study area. The main objective of the survey was to visit the project site and collect the socio-economic data from the study area and observe the basic infrastructure available. A keen observation of the quality of life of the study area was also carried out.

The project site visit, observations, and questionnaire survey has been used 'data collection methods' for collecting data about people and processes as part of qualitative research. Special care was taken to observe prevailing socio-economic condition in the sample area and also assess awareness opinion and reaction of the inhabitants about the project.

Objective of the study:

The objective of conducting socio economic study is to obtain the





- Existing conditions of the project surrounding area.
- Prevailing socio-economic condition of the project surrounding area.
- Awareness, opinion and aspirations of the peoples, about proposed project.

Methodology

The present study was carried out with the help of both primary and secondary sources. The primary sources included socio economic data collected from a sample of population residing in the study area through a well-structured and pre-tested questionnaire. The secondary sources included the existing literature comprising of reports and studies on the existing area. In the socio-economic survey, besides age, sex and education, issues related to livelihood, basic amenities and post project scenario etc. were discussed with the peoples where focus of the discussion was on the existing facilities and their aspirations regarding the development of project.

The interviews conducted through structured questionnaires have derived quantitative data, but has also extended discussion with sample respondents in order to supplement the structured findings of the questionnaires with qualitative information as well. Hence, the data collection exercise has been quantitative as well as qualitative in nature. The structured questionnaire covered 5 key areas:

- a. Socio-demographic characteristics
- b. Basic amenities status
- c. Livelihood status
- d. Issues regarding basic living environment
- e. Perception & opinion on the peoples.

The target respondents were either head of the household or a member of the household residing in the study area. The recorded data is analysed using statistical methods to draw the out the findings and conclusion. Socio-Economic survey are attached as **Appendix VII.**





Socio Economic Survey:



ULTRA-TECH Team during Socio-Economic survey





Findings and Conclusion:

Questions were asked to respondents to seek their opinions, perceptions and aspirations regarding the proposed project. Opinions are important vehicle through which one could understand the existing mental attitude of people in general and groups, and community in particular.

• Concerning the sex structure of the respondents, 52 percent of the respondents were males while 48 percent were females. This finding is in line with the trend of the sex structure of household heads in India, whereby males dominate.

• The average household size was found to be 5 members.

• Education is one of the keys to success and development and as such, people pay much attention to their educational status. Most of the sample respondents interviewed had some kind of formal education. Nearly 75 % of the respondents had attained education till graduation also Post Graduation, whereas 20 % of the respondents have completed SSC/HSC. 5 percent of the respondents have education till primary (Class 1-5) as the formal education.

• Questions were asked about the number of earning members in the family their type of income and their respective jobs. Most of the respondent are engaged in nearby industrial area for job, some area having self-employed occupation like Fishing, Fish trade, Fishing stall, Motor garage, grocery shops, fruit and vegetables seller etc. very few respondents area working in government jobs like Primary and secondary Teachers, Government Engineer, Municipal Employee, Police Services, Defiance services etc.

• House constitutes the most vital aspect of the basic needs of man and basic amenities form an integral part of the housing facility. All respondent using Pakka type (Cement Conceit) of houses. Basic amenities are measured through the availability of drinking water facility, toilet, drainage, garbage disposal, electricity, cooking fuel etc. all respondent using LPG Gas for cooking fuel. Municipal Corporation provide drinking water and other essential facility.





• Availability of toilet is an important indicator of the sanitation. All of the respondent are used private toilet facility. Public Toilet facility are available in study area.

• When asked about the most pressing problem faced in surrounding area respondent highlighted the traffic problem in study area. But still the people were happy.

• Questions were asked to respondents to seek their opinions, perceptions and aspirations regarding the project. Opinions are important vehicle through which one could understand the existing mental attitude of people in general and groups, and community in particular.

Many local respondents were aware of the project, which reflects that the project proponent has carried out regular consultation with the local resident and fisherman. All respondents are in support of the project fully. Their only demand is to give the preference to local people for working labour, labour contractors, transporters and raw material suppliers etc. in construction phase and job opportunity in operation phase.





4 ANTICIPATED ENVIRONMENTAL IMPACT

This chapter deals with the expected impacts and the respective mitigation measures of the project on the environment during different stages. It indicates the levels up to which the proposed

Depending on the nature of interaction and the degree of impact made on the environment, aspects have been considered as significant/insignificant. The significant impacts are further classified as reversible and irreversible. Reversible impacts are those which have the ability to restore natural conditions if suitable mitigating measures are taken to avoid, reduce or offset negative environmental impacts. Irreversible impacts are those which cannot be restored to natural conditions/avoided. Table 4.1 indicates major activities carried out during proposed project and its interaction with various environmental components and degree of impact it makes on the environment.







Table 4-1: Environmental Impact Assessment Matrix for development of berth

Activities/ Parameters	Transpo rtation of material and manpow er	Construct ion of Jetty	Dredging	Generati on of solid waste	Operati on of DG Sets & Machine s	Operati on of Ferry	Utilitie s
Land Environment	2x1=2	1x1=1	1x1= 1	3x3= 9	2x1=2	2x1=2	2x2= 4
Water Environment	2x1=2	1x1= 1	1x1=1	2x3= 6	1x1=1	1x1=1	1x1=1
Marine Environment	2x1=2	3x3=9	4x4= 16	3x2= 6	1x1=1	5x2=10	2x2 =4
Biological (Terr. F&F)	2x2= 4	1x1= 1	1x1=1	2x1=2	2x1=2	2x2= 4	1x1=1
Air Environment	3x3= 9	3x3=9	2x2=4	2x1=2	3x3= 9	5x2=10	1x1=1
Noise Environment	3x3= 9	3x3=9	2x2=4	1x1= 1	3x2= 6	5x2=10	1x1=1
Socio Economic Environment	3x3= 9	1x1=1	1x1= 1	2x1=2	1x1= 1	4x1=4	2x2=4





Likeli	hood	Severi	ity		
1	Remote	1	Negligible Impact		
2	Probable	2	Slight Impact		
3	Particular phase	3	Considerable Impact		
4	Repetitive	4	Significant Impact		
5	Permanent	5	Highly Significant Impact		

Insignificant and Reversible Significant and Reversible Insignificant and Irreversible Significant and Irreversible

4.1 General

All mitigation and avoidance measures are designed or formulated to negate the predicted possible and probable impacts described for all relevant environmental parameters including ecological and physical environmental and social components. During the whole process the nature, type of the predicted potential impacts likely on the physical, biological and social environmental components are assessed to the extent possible. For the assessment of impacts, (primary surveys, secondary surveys, field visits and stakeholder consultations) relating to various environmental components have been utilized.

Baseline environment for which impacts have been determined include "avoidance" as the best mitigation measure to avoid all major impacts. All such events have been completely addressed at the design stage itself. Further, in addition to the regulatory mitigation measures, all possible environmental enhancement measures which normally could improve the public perception about the project has also been adopted and provided in the following sections.

Project impacts assessed are for:

- Land Environment
- Water Environment
- Marine Environment
- Air Environment

• Noise pollution

1 to 5

6 to 10

11 to 15

16 to 20

- Biological Environment
- Waste Management





An Environmental Management Plan (EMP) for anticipated environmental impacts is a key to ensure a sustainable environment during the Project construction, operation phases and finally the decommissioning phase. The EMP envisages the plans for the proper implementation of mitigation measures to reduce the potential adverse impacts arising out of the project activities. This proposed mitigation framework has been prepared for addressing issues like – pollution control/mitigation measures for abatement for the undesirable impacts caused during the Project construction and operation stages.

For each of the identified impacts specific mitigation measures have been defined. The general rule in designing such measures is:

- Avoidance of major impacts: major impacts are generally considered unacceptable, certainly ones that would endure into the long-term or extend over a large area
- Minimization of impacts and reduction of major and moderate risks to "As Low as Reasonably Practicable" (ALARP) by planning, designing and controlling mitigation measures. This implies that technically feasible and cost effective mitigation measures will be applied. The appropriate technologies and measures are established by good international industry practices.
- Where minimization is not possible to compensate or offset residual impacts Implementation of good Contractor practices will be ensured so that such impacts are not neglected, but managed adequately.

Generally, mitigation measures need to be considered in the design of the project through a hierarchy as described in Similar considerations, in the context of ALARP, will apply to the ongoing development of mitigation measures during the development of the port and the detailed design.





Table 4-2: Various Impacts Mitigation Strategies applied in this Project

Strategy	Approach and Methodology					
Avoid or	Avoiding or reducing at source is essentially "designing" the project so that a					
Reduce at feature causing an impact is designed out (e.g. road re-route) or alte						
Source	part of the project or activities					
Abate on Site	This involves adding something to the basic design to abate the impact - pollution controls fall within this category, often called "end-of-pipe.					
Abate at	If an impact cannot be abated on-site then measures can be implemented off site -					
Receptor	impact at a nearby residence					
Prevention	Preventing negative environmental impacts					
Preservation	Achieved by extending legal protection from any future actions					
Minimization	Limiting reducing the degree, extent, magnitude or duration of adverse impacts					
Rehabilitation	Repairing or enhancing affected resources such as natural habitats, water resources or human habitats					
Restoration	Restoring the affected resources to an earlier State, typically back ground or pristine condition					
Compensation	Creation, enhancement or protection of the same type of resource at another location to compensate for resources lost to development. Where other mitigation approaches are not possible or fully effective, then compensation, in some measure, for loss, damage and general intrusion might be appropriate. This could be 'in kind', such as planting new woodland elsewhere to replace what has been lost.					
Enhancement	Enhancement of Environmental resources as a value addition to the project with					





minimum cost and better appreciation

4.2 Land Environment

Impact to land resources is one of the most potential impacts due to the construction and operation of the port project, development of ancillary sites.

4.2.1 Potential Impact due to Port Location, Land Acquisition and Changes in Land Use

The proposed project includes construction additional multi-purpose berth within the existing port to cater to the displaced cargo due to planned changes at other berths. The existing Port has been accorded environmental clearance and the proposed project development activity is planned within the existing port. Since the proposed development is within an operational port, there will not be any major impacts on the environmental components due to the location of the proposed development. The proposed project activities are planned within existing port area; hence no land acquisition is required. Construction related activities such as clearing the site, excavation, the generation of construction waste etc. affect the land environment directly.

Clearing the site and excavation coupled with removal of vegetation triggers soil erosion and loss of top soil. Soil erosion can in turn trigger an increase in the turbidity levels in the coastal water. However, no major clearance of vegetation is required for development of backup area within the port limits. The site for the proposed development of facilities is plain land, with little to no undulations. No major cutting and filling will be required for prepping the land. Hence, no major impacts are anticipated.

4.2.2 Contamination of the Soil

a) Pre-construction phase

Soil contamination may take place due to movement of vehicles or solid wastes generated from the labour camp set up during pre-construction stage. This impact is significant at locations of construction camps, stockyards etc. and adequate means must be taken to ensure that all operations avoid potential land contamination.





b) Construction Phase

Contamination of soil during construction phase is primarily due to allied activities. The sites where construction vehicles are parked and serviced are likely to be contaminated because of leakage or spillage of fuel and lubricants. Refuse and solid waste from labour camps can also contaminate the soil. Contamination of soil during construction might be a major long-term residual negative impact. Unwarranted disposal of construction spoil and debris will add to soil contamination. It is also important to assess the quality of dredge material for heavy material, pesticide and oil contamination as this material will be used for filling port area on land. This contamination is likely to be carried over to water bodies in case of dumping being done near water body.

c) Operational Phase

Periodic dredging for maintaining the depth of the channel will be important operation phase activity. Once tested, one can find out a way of proper handling and disposal of the dredged material. The solid and hazardous wastes generated from ships and from port operations may contaminate land and water bodies if not disposed properly.

Soil contamination may be envisaged if proper measures are not taken for the following activity at port

• Port operation includes ship-related factors such as vessel traffic, cargo-related factors such as cargo handling and storage, handling equipment which may cause soil contamination.

- Municipal wastes in the form of canteen wastes, domestic wastes, papers, etc
- Other hazardous and non-hazardous wastes generated from operations

Mitigation Measures - Land and Soil

The land use of the backup areas may not be changed and the facilities and other building will be constructed as per the existing landscape without any major cutting and filling and hence will not be impacted. The planning will be in accordance with landscape planning concepts to minimise





major landscape changes. The change in land use pattern will be limited to the proposed backup area and will be carried out in such a way that to ensure the proper drainage by providing surface drainage systems including storm water network, etc. The construction waste generated shall be partly used for land filling and restoration of the project site. Balance material will be disposed as per the guidance of Mangaluru City Corporation (MCC) at designated sites.

During the operation phase adequate measures shall be taken to ensure that all waste generated at the site is collected and disposed as per the requirements Mangaluru City Corporation (MCC). Hazardous waste likely to be generated from proposed facilities is the wastes such as oil and grease from machinery and equipment must be disposed as per Hazardous waste (management) Rules 2016.

4.2.3 Potential Impacts on Local Infrastructure

During construction phase, significant amount of construction material will be required, particularly quarry stone for the construction of bunds, buildings, etc. This will be obtained generally by excavating from the quarry sites. It is imperative that these sites be treated/closed/isolated, once the excavation of construction material is completed. The ideal measure for treatment is the refilling of these sites to its original level and their re-vegetation. This will be an indirect impact and the stone for construction will be sourced from licensed contractors.

Borrow Areas - impacts & mitigation measures: NMPA and EPC (Engineering Procurement Construction) Contractor has to ensure that the sourcing of borrow material shall not lead to any potential impact to the local communities

- Borrow pits would be located along the natural drainage course and not across the natural drainage.
- Borrow pits will be in a series, so that they can be inter-connected leading the collected water to the lowest level of the pit, which will be of sufficient size to hold the discharge from the upstream pits. The bottom of each pit will be gently sloped towards the next pit





below in the series and the inter-connections will be done by pipes or open drains filled with broken stone, to prevent scouring of drains.

• Top fertile soil shall not be used for construction material.

Construction Workers - impacts & mitigation measures:

There will be a requirement of about 100 to 150 work force (excluding service providers) during the construction phase (about 24 months).

As far as possible the workforce would be local hence no labour camps would be required to be set up, therefore not adding any additional stress on the local infrastructure. This would also ensure that there is no conflict with the local population. To mitigate impacts from health hazards, sanitation self-sufficient infrastructure facilities must be provided.

Mitigation Measures during Construction Phase

- To mitigate impacts from transportation of construction material, existing roads will be strengthened and widened if required,
- Trucks with construction material susceptible for fugitive suspension will be covered with tarpaulin covers
- Transportation management will be adopted for movement of dumpers transporting quarry stones and construction materials and traffic will be regulated
- Vehicles deployed will conform to emission norms (air/noise) of CPCB and have valid Pollution Under Control (PUC) certificates
- Dumpers and trucks will comply with standards for exhaust emissions and noise levels
- All vehicles used will be in good condition with all valid number plates and documents. Older than
- 15 year vehicles will not be allowed to use in any of the construction sites
- No bore-wells will be driven to meet the water requirements to avoid impacts on groundwater resources
- All these will be part of the Contractors Quarry Management Plan to be prepared and approved with the help of the supervision of consultants





• If there are any accidental spillages of hazardous substances on soil that may pose the risk of contaminating run off, such areas will be immediately remediated.

4.2.4 Discharges from Ships on Land - Potential Impacts and mitigation measures during Operation

No discharge of wastewater/waste from the ships calling at New Mangalore port will be permitted into the port area. Facilities for discharge of waste oil will be provided at the port. The ships will have their own sewage reception/treatment facilities on board and hence no discharge of sewage will be done at the port. In addition, the ships are expected to discharge sewage in deep seas as per defined procedures for international ship movements (Ref: MARPOL Convention). This will ensure the ships have their own storage capacities in their on board sewage receptions to handle wastes generated during the period/days the ship is at the port. Ships shall conduct ballast water exchange at least 200 nautical miles from nearest land and in water at least 200 m in depth prior to calling at a port. Where ballast water exchange at 200 nautical miles from nearest land and in water record book which may be an electronic recording system. Port officers may inspect the ballast water record book.

4.3 Water Environment

4.3.1 Potential Impacts on Surface Water

The preliminary assessment indicates that daily demand of water during the construction phase will be around 100 KLD. The water demand will be met by the rainwater harvesting system of capacity about 1,43,930 KL within the port area. In rare cases of shortage, the demand will be met by water tankers and water suppliers. The water will be stored in sump before use. Major impacts caused by such activities on surface water bodies is due to litter, construction waste and other pollutants carried by wind, dewatering runoff or periodic rainfall, effluent and fuel through accidental spills, inadequate storage and management, vehicle wash down and overuse of water for wetting. Wastewater generation at construction site includes surface runoff also which may





contain pollutants and traces of solvents, paints, metal compounds, etc. which may impact the groundwater and nearby surface water resources, if not managed properly.

There are several activities associated with construction of the proposed project, which could have impacts on surface water:

- Poor control of run-off from site activities leading to siltation and eventual blocking of drains caused by excessive sand and silt in the storm water run-off
- Pollution of surface water caused by improper handling and disposal of other types of construction site wastewater
- Contamination of surface water sources if wastes and wastewater from workers not managed properly
- Blockage of the outlets (small natural streams) by debris from construction of solid structures may lead to ponding in the area behind the actual port. The design should therefore cater for a free flow of the discharge water, even in the wet season
- Surface water regimens may be altered because of potential changes to the drainage pattern. Water pollution may result from wastewater produced by the quarry activities and by the accidental spillage of fuel, lubricants and other chemicals used in the quarry process.

The major surface water bodies in the area surrounding the project site are – Gurupur River (0.65 km away), Netravathi River (9.5 km away), Baggundi Lake (4.00 km away) and Kavoor Lake (9.30 km away). Gurupur River is a tidal influenced water body and according to the CZMP prepared by NCSCM the salinity reduces below 5 parts per thousand at about 6 km from the project site.

Potential impacts during operation phase

Storm water and excess dust suppression water runoff from the cargo storage areas and other areas of the project facilities may contaminate marine water quality if not regulated properly and will impact the marine water quality by increase in turbidity and reduce DO levels which in turn will impact the marine life. Wastewater generation during operation includes surface





runoff also which may contain pollutants and traces of solvents, paints, metal compounds, sewage etc. which may impact the groundwater and nearby surface water resources if not managed properly.

The freshwater requirement during the operation phase will be around 10 kld for domestic purposes such as flushing. The facilities within the port are capable of meeting this need without having to source any additional water from MMC or any groundwater sources.

Mitigation measures – Surface Water

- Project Water Management Plan should be developed in order to secure the project sustainable water balance and in the project region in the construction phase.
- A surface water monitoring program shall be implemented during the construction phase. Effective water conservation measures should be followed.
- The existing rainwater system should be regularly monitored and maintained to ensure reliable continued supply of water.
- The port already has a functional STP of 1.2 MLD capacity. All the wastewater and surface run-off must be treated before it is used for sprinkling, dust suppression and greenbelt development. This facility must be monitored and maintained regularly.
- Effluents must not be discharged in any streams, lakes and sea.

4.3.2 Potential Impacts on Groundwater

There are several activities associated with construction of the proposed project, which could have an impact on groundwater. However, for the proposed development at New Mangalore Port, which is given below-

- Spillage or infiltration of oils, fuels and hydraulic fluids from plant maintenance and refuelling areas into the soil.
- Blockage of three present natural drains in the port area will lead to higher groundwater tables and a permanently changed drainage pattern.
- New drainage structures due to the quarry activities might affect groundwater levels and quality. Where blasting is used in quarry, there is a potential for infiltration of nitrate and





ammonia residues, in groundwater. This should be managed through appropriate blasting design and procedures, including ensuring the correct burning of explosives.

Mitigation measures – Groundwater

Baseline review of the existing groundwater resources and current consumption in the project region. A study should be initiated to investigate the change in hydro-geological conditions, the available aquifers and safe yield levels. A groundwater monitoring program should be implemented during the construction phase.

4.4 Marine Environment

4.4.1 Impacts on Marine Environment during the Construction Phase

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

Disturbance from construction activities may cause displacement of fishery resources and another mobile bottom biota. Dredging removes bottom biota and dumping of dredged material covers bottom habitat, both of which may reduce fishery resources. Settlement of suspended sediments on fragile marine fauna and flora damages the ecosystem.

Impacts on current and sediment transport due to new offshore constructions are discussed separately in Chapter 7 – Additional Studies. Hydrodynamic modeling for these aspects has been carried out by CWPRS, Pune.

Mitigation measures

Construction activity shall be completed within designated period. Dredging must be confined to project area and must be completed within stipulated time period. Dredging shall not be carried out during fish breeding season.





4.4.2 Impacts during the Operation Phase

Contamination of sediment is not envisaged once construction is complete.

In case of accidental spills, the existing oil spill contingency plan of the NMPA will be put into action. The spill will be contained by deploying oil booms and the trapped oil will be skimmed for pumping and collection. Also, dispersant chemicals will be used to treat the spill. The collected oil will be stored temporarily and disposed through authorized contractors. Periodical clean-up of floating wastes will also be undertaken, when necessary, for maintaining the desired Port water quality.

The CWPRS, Pune has been designated to carry out an Oil spill modelling study in the project area.

Mitigation measures

The turbidity levels during maintenance dredging should be measured and checked with the baseline as a reference. If turbidity spreads beyond the area earmarked for dredging, the operation should be suspended until baseline is attained. Discharge of waste wastes into sea should be prohibited. Post dredging monitoring program should be carried out to assess the effect of dredging and disposal on marine ecology.

4.5 Biological Environment (Terrestrial Ecology)

Terrestrial Ecology

Impacts on Terrestrial Ecology during Construction Phase

No threatened species were observed under the impact area. Project site is surrounded by port activities and there is an very less vegetation exists in the vicinity. Hence, no major impact on terrestrial ecology is envisaged at project site. Fugitive emission formed during the construction activity may accumulate on the leaves of the plant which may diminish photosynthesis of young plants. The noise generated during the construction activity may have some negative impact on birds in the area. However, these impacts are localized, short termed and reversible.





Impacts on Terrestrial Ecology during Operation

The proposed project would not dispose effluent or solid waste in the existing environment. In addition to the wastes, noise generation from project operation would also be minor. Hence there will not be any major adverse impact on ecology during operation phase. Further, the proposed site is covered with open scrub vegetation but after proposed project, greenbelt area will be developed which will result in beneficial impacts on ecological layout of the project area. As per the survey close to the proposed site and in the vicinity, no endangered species or wildlife is reported.

Mitigation measures:

Care must be taken to minimize the dust formation due to construction activity viz. sprinkling of water. Noise generated by construction equipment's will be controlled through provision of mufflers in machines and implementation of other noise control measures.

Impacts on Marine Ecology

The proposed activities at NMPA will have at the most temporary and localized impact on the marine environment. A localized increase in turbidity may temporarily affect the dissolved oxygen, biological oxygen demand and photosynthetic activity in the coastal region.

The proposed activities at NMPA will have at the most temporary and localized impact on the marine environment. A localized increase in turbidity may temporarily affect the dissolved oxygen, biological oxygen demand and photosynthetic activity in the coastal region.

Some damage to subtotal and inter tidal benthic fauna may occur in the area of proposed dredging/construction activity (348.2 m x 26.05 m). These impacts are, however, temporary and limited to the construction phase, and are reversible with a relatively short recovery period.

Another potential impact on the marine biological environment during the construction may be the removal of intertidal soil during dredging and berth construction. A temporary disturbance of the benthic habitat may locally disturb the demersal fishery resources of the area for a short period.





Mitigation Measures

The impacts arising during construction phase will be of temporary in nature, proper care should be taken to reduce possible risks.

Although the impacts arising during construction phase will be of temporary in nature, proper care should be taken to reduce possible risks.

During dredging, spotting of marine mammals and turtles would form part of the Project work while at sea. If these species are observed in the vicinity of the work area, the vessels would execute measures to avoid destruction or disturbance.

To minimize the above potential impacts, major construction activities would be scheduled during normal daylight working hours and would be implemented consistent with the applicable standards.

The resettlement and repopulation of organisms is expected within a short time. The inter-tidal and sub-tidal areas should be restored to their original contours on completion of the construction.

4.6 Socio-economic Impact

The setting up of any kind project would undoubtedly include significant impact on socioeconomic and cultural life of the people in the project area. Here, an attempt is made to visualize and discuss such tentative impacts likely to be induced by the project. The likely impacts due to project activity are described below:

Positive Impacts

The project does not involve any displacement of inhabitants and so issues like resettlement and rehabilitation does not figure. Proposed project is within port limit.

Proposed developmental activities will provide direct and indirect benefits to the people residing in the nearby areas.

The project construction and operation will generate revenue for the State and Central Government by way of payment of royalty, tax and sharing of port revenue.





Port development will attract investments into the region and thereby contribute to economic growth of Dakshina Kannada District, the State of Karnataka.

The Port is well equipped to handle bulk, liquid chemicals, hazardous cargoes, Crude and POL products, heavy lifts, machinery, containers, project cargo etc.

By the provision of an additional berth and developing other facilities the benefits may be realized either as upcoming of industries such as thermal power plants, mineral-based plants, small scale industries and their allied ancillary units.

Other benefits would be the generation of either direct or indirect employment to the local people.

The connectivity will also improve the ecotourism facility which will provide employment to the local people.

An opportunity to develop the area and the quality of life of people

A great opportunity to increase the financial status of government

Better infrastructural development

Improvement of cultural and social affairs

Development of small scale industries

Increase in export and import business.

Negative Impacts

Due to the project activity, influx of population may increase during the construction phase. This may lead to strain on infrastructure facilities in the area as well as increase in population at local level. However, this impact is only for the short duration and temporary in nature.

The construction activity could lead to increased nuisance level from air emissions and noise due to transportation of material and equipment as well as laborers.





Socio Economic Environment: Mitigating Measures

In order to mitigate the adverse impacts likely to arise in the surrounding area due to proposed project activity, it is necessary to formulate an effective mitigation plan. The suggestions are as follows:

Before Commencing and During Initial Phase:

Information regarding the proposed development plan, community programmes etc. should be communicated to the local community in the form of display Poster, booklets and audio-visuals at project site.

Construction Phase:

Project proponent should take appropriate steps to keep environment clean and healthy during construction phase.

Provision of adequate drinking water, toilet and bathing facilities should be made available on project site.

Water shall be sprinkle/spread to suppress dust during construction phase to control air pollution. Control the ship and trawler traffic, Noise Pollution and thereby avoid adverse health impact.

Proper living condition with appropriate facilities for residential labours should be provided.

Proper Training and awareness programme should be carried out so that the workers understand the importance of wearing the personal protective safety equipment's.

Project proponent should take appropriate steps related to COVID – 19 outbreaks.

Operation Phase:

The project collectively will need a pool of Boat or trawler mechanic, Driver, Fisherman, Helper, watchmen, sweepers, plumbers, fitters, solid waste collectors or any kind of job opportunity. Preference should be given to local people for all this.

Provision of proper parking arrangement, traffic management plan for smooth flow of a vehicle also cargo ship helps to abate noise pollution due to traffic.





The project authority should help in promoting local people for livelihood commensurate with their will, skill and abilities by utilizing the minimum amount.

COVID-19 Pandemic:

Regular cleaning i.e. microbial disinfection of labour assembly point, office, canteen, labour colony etc.

Sanitization/ Hand wash stations.

Temperature checkup and maintenance of log of the same at labour camp and project site.

Regular medical check-up of all the workers and staff, First aid and essential medical services should be provided at site.

4.7 Air Environment

4.7.1 Potential Impact during Construction

Impact due to Transportation of Construction and Cargo Material

Some of the project activities (site clearance, dredging and reclamation, construction of breakwaters, construction of port infrastructure, traffic during construction and use of heavy machinery construction of road and rail) will generate air pollutants like NO₂, SO₂, HC, CO, PM, VOCs, etc. This has the potential to cause temporary impacts on the air quality.

The baseline concentrations of Particulate Matter (PM_{10} and $PM_{2.5}$), SO_2 , NO_2 and CO are within the limits of NAAQS stipulated by MoEF/CPCB. With the present background concentrations of air quality parameters, it is expected that there will only be a mild build-up of air pollutants. Further, because of the prevailing strong winds along the coastal region and the resulting dispersion the impact on air quality from pollutants would be reduced. The greenbelt developed towards landward side and on the periphery of the port area, will also nullify any air pollution impacts. In addition, adoption of suitable mitigation measures will ensure that these impacts are rendered insignificant.





Mitigation Measures

The following measures could mitigate the anticipated negative impacts on the ambient air quality:

- Transportation vehicles to be properly and timely maintained and serviced regularly to control the emission of air pollutants in order to maintain the emissions of NOX and SOX within the limits established by international regulations;
- All static and mobile diesel-powered plant / generator sets should be used only during power cuts;
- Use of good quality fuel and lubricants will be promoted. Moreover, low sulphur content diesel shall be used as fuel for generator sets to control emission of SO2;
- Generators, machineries and vehicles are to be serviced and maintained regularly to avoid generation of dust and other air pollutants;
- Regular verification of PUC certificates of all the vehicles entering into the port area;
- Vehicles older than 15 years will not allowed to operate during construction phase
- Storage facilities shall be equipped with leak detection systems.
- Include vegetation screens alongside the port access roads and apply of speed restrictions in order to the dispersion of pollutants from roads
- Minimize idling time for vehicles
- Dust Generation: If adequate measures such as sprinkling of water on haul roads around sites where clearance activities are on, covering material trucks especially those carrying sand and borrow materials etc. then the impacts can be reduced to a great extent. The main source of dust generation is due to site clearance activities, removal of trees and loading/unloading of construction material.
- Environmental awareness program/training will be organized to the personnel involved in developmental works
- Adequately sized construction yard will be provided at the site for storage of construction materials, equipment tools, earthmoving equipment, etc. In addition, temporary field





offices and worker amenities will be provided at site. Appropriate spill control measures and labelling / handling procedures will be maintained

Exhaust Gases Generation

Generation of exhaust gases is likely during the preconstruction stage during movement of heavy machinery, oil tankers, etc. This impact is envisaged to be insignificant during the preconstruction stage. High levels of SO2, HCs are likely from hot mix plant operations. Volatile toxic gases are released through the heating process during bitumen production. Although the impact is much localized, it can spread downwind depending on the wind speeds. The Environment Management Action Plan (EMAP) needs to ensure adequate measures especially for health and safety of workers such as providing them with pollution masks during working hours. Also, the contractor will be ensured that hot mix plants, stockyards, etc. are away from residential areas. Contractors also should be asked to provide regularly PUC Certificate for their vehicle mounted equipment and machinery as per prevalent norms. If adequate measures are taken, then impacts from generated gases can be negligible.

4.7.2 Potential Impact due to Operation

The following activities related to the operational phase will have varying impacts on the environment and are considered for impact assessment:

Impact on Air Environment

USEPA approved - ISCST3 dispersion model is used for prediction of impact around project site and in surrounding environment of the proposed modified Mangalore Port Project. This port project is in the respect of the 'Development of Multipurpose Cargo Berth (Berth No.17) at New Mangalore Port Authority located in Mangalore, Karnataka.

Anticipated Impacts

Prediction of impacts on air environment is carried out taking into consideration the proposed loading-unloading activities and net increase in air pollutant's emission. This air quality





prediction has been carried out at all AAQMS (Ambient Air Quality Monitoring Stations) located within 10 km radius of the study area.

Air pollution sources in the project are identified from following loading-unloading activities of

✓ loading- unloading of iron ore pellet

Spraying arrangement of water sprinkler or water fogg sprays system with high efficiency (>50%) will be used to ensure effective dust suppression.

USEPA approved model ISCST3 is used to predict impact over a radial distance of 10000m. at grid interval of 250 m. GLC is predicted around the proposed site and at various ambient air quality monitoring stations. GLC's are calculated at every grid point over the study area in all directions to predict combined impact of loading-unloading. Cartesian coordinates (X, Y) has been used for prediction of model results at various receptor locations representing project site, human settlements, commercial area and sensitive areas.

Emissions Details

Loading - unloading of iron ore pellets will be the main emission source in the proposed port activities releasing $PM_{10} \& PM_{2.5}$ affecting ambient air quality of the surrounding area. Emission during loading and unloading is considered as the area sources. Three mobile hopper cranes on berth no. 17 and the rate of cargo transfer from each crane will be 600 tons per hour.

Loading and Unloading - US EPA, 2008, revision of emission factor for AP-42 is used to calculate emission of particulate matter released into the atmosphere during loading and unloading, separately. Emission during loading is considered to be more as compared during unloading. Average wind speed is 7.30 Km/h (2.03 m/s) as observed with site data of winter season.

Meteorological data:

The meteorological data recorded at hourly interval during the month of December 2021 to February 2022 on wind speed, wind direction, dry & wet bulb temperature, humidity, cloud cover and rainfall are processed to extract hourly mean meteorological data as per the guidelines





of CPCB/MoEF&CC for prediction of impacts from the area source. As per CPCB, New Delhi guidelines worst case meteorological conditions have been considered for air pollution dispersion modeling. Stability class has been computed by Turner's method and mixing height is obtained from publication of IMD "Atlas of Hourly Mixing Height in India.

Data recorded from authorized source/Govt. agency are used as meteorological input for Dispersion Model, which is stored in the computer for further analysis and interpretation to study the local meteorology of the study area. Ambient air quality locations are selected based on the long- term wind meteorological data of the area.



Figure 4-1: Wind Rose December 2021 to February 2022




Frame work of Computation & Model details:

Local meteorology of the area influences pollutants released in the atmosphere. Air quality modeling is an important tool for prediction, planning and evaluation of Air Pollution Control (APC) equipment and emission control to meet the regulatory standards and to apply mitigation measures to reduce impact caused by loading-unloading activities. Twenty four hourly maximum impacts of PM₁₀, PM_{2.5}, SO₂, NO₂ and CO are envisaged due to low to moderate wind speed. Area source of iron ore mineral is contributing only particulates, therefore modeling have been carried out for particulates only.

 PM_{10} & $PM_{2.5}$ is the major pollutant occurred during Loading-unloading activities. Impact of area source is considered and prediction of impact is predicted in the worst - case scenario made on various monitoring locations in the study area due to loading-unloading activities. Hourly meteorological data used as input of the dispersion model– ISCST3 developed by U.S. EPA. Impact is predicted over the distance of 10,000 m at 250 m grid intervals in Cartesian coordinates (X,Y) to assess the impact at each receptor location. The concentration of PM 2.5 and PM10 has been calculated at 6561receptor point. Maximum incremental GLC's of PM_{10} & $PM_{2.5}$ are observed close to the source. Incremental concentration of particulated is superimposed on the maximum monitored base line base monitored data at the proposed site to predict total GLC's of PM_{10} & $PM_{2.5}$.

Model Results:

The Air Quality Impact Prediction has been done by using "Industrial Source Complex Short Term version 3 (ISCST3), of USEPA". The main sources of air pollution with regard to the proposed port project for the purpose of estimation of increase in air pollutants are identified due to

(i) Loading-unloading of iron ore pellets on various sampling locations as given in Table 4.3.





Table 4-3: Max. Background, Incremental and Projected GLCs of PM10 & PM2.5 Conc.due to Loading-Unloading

Sr. No.	Locations	Maximum Monitored		Incremental GLC in (µg/m ³)		Total Projected	
		Background Conc. (µg/m ³)				GLC in $(\mu a/m^3)$	
		PM	PM	DM. DM.			
		1 10110	1 112.5	1 14110	1 112.5	1 10110	1 112.5
AAQM-1	Near Project Site	89.00	43.00	9.61	6.4	98.61	49.4
AAQM- 2	Near Panambur Beach Parking	80.00	38.00	3.19	2.13	83.19	40.13
AAQM- 3	Kulai Near Bhrama Shree Narayana Guru Samajasevasangha	80.00	36.00	1.48	0.98	81.48	36.98
AAQM- 4	New Mangalore Industrial Area Near Ruchi Soya Industries	86.00	40.00	6.22	4.14	92.22	44.14
AAQM- 5	Karambar Near Rakshita Canteen	69.00	28.00	2.19	1.46	71.19	29.46
AAQM- 6	Bondel Near Business school Manel Srinivas Nayak Institute of Management – Business School	60.00	28.00	0.52	0.34	60.52	28.34
AAQM- 7	Derebail Near Sri Durgha Parameshwari Prasanna Temple	65.00	26.00	1.65	1.09	66.65	27.09
AAQM- 8	Urwa Near Church of Our Lady of Immaculate Conception	60.00	25.00	1.52	1.01	61.52	26.01
Max. impact during worst case		89.00	43.00	11.00	7.33	100.00	50.33





scenario without control system						
Incremental GLC's of particulate PM_{10} and $PM_{2.5}$ adopting control system	89.00	43.00	5.50	3.66	94.50	46.66
NAAQS of PM_{10} and $PM_{2.5}$ as per CPCB in $\mu g/m^3$						60

Note: The total projected concentrations considering maximum monitored 24 hourly baseline monitoring of all pollutants are found to be within the prescribed standards set by CPCB/ MoEF&CC as shown in above table.

The isopleths for incremental GLC's of PM10 & PM2.5 are superimposed on 10 km radius of the study area are shown in following Figure 4.2, 4.3.





Figure 4-2: Isopleths of incremental GLC's of PM10 in μ g/m3





Figure 4-3: Isopleths of incremental GLC's of PM2.5 in µg/m3

Discussion of Results and Conclusion

ISCST3 - Model was used for prediction of impact of air pollutants during worst case scenario: Loading-unloading activities are considered as area source model to predict GLC's of PM_{10} &PM_{2.5} during these conditions. Total projected 24 hourly during worst case scenario, maximum GLC's of PM_{10} &PM_{2.5} are found to be **100.00 µg/m³** & **50.33 µg/m³**. However, these incremental GLC's of PM_{10} & $PM_{2.5}$ will reduce down 50% during the use of water sprinklers or water fogg system at transfer points and resultant GLC's of PM_{10} & $PM_{2.5}$ would be **94.50 µg/m³** & **46.66 µg/m³**, which is within the stipulated standard of PM_{10} and $PM_{2.5}$.





These projected background concentrations due to proposed loading-unloading of iron ore pellets at Mangalore Port are found to be within the stipulated CPCB/MOEF&CC standards for ambient air quality. Therefore, ambient air quality of the surrounding area of the proposed Development of Multipurpose Cargo Berth project will not be degraded.

4.8 Noise Environment

4.8.1 Impact due to Port Construction Activities

Construction noise will result from operation of equipment including the dredger and associated tugs, piling equipment, tracked excavators, Lorries, dump trucks, and other earth-moving equipment, cranes, and generators / lighting equipment. The exact construction methods and plant utilised will depend on the EPC contractor. Noise nuisance during construction depends on the exact place of the receptor and of the source and the duration of the activity.

The noise and vibration generated by piling in water if not controlled and monitored properly, can be transmitted considerable distances through the water and therefore have the potential to impact on marine mammals. There are no marine mammals present in the port foot print area and nearby premises.

Such noise pollution may cause nuisances to the population. Atmospheric conditions that may affect noise levels include humidity, wind direction, and wind speed. The noise levels generated by construction equipment are given in Table 4.4.





Table 4-4: Noise levels expected to be generated from construction equipment

Equipment	Sound level (dBA)
Floating pontoon with mixer machine and crane	70
Winch machine	80
Transit mixer	75
Dumpers	75
Generators	85
Batching plant	90
Air compressors	90
Pile drivers	115

Mitigation Measures

The following measures could mitigate the negative impacts caused by noise emissions:

- Noise mitigation measures shall be in place prior to the commencement of any construction work.
- All contractors and subcontractors involved in the port construction phase should comply with the relevant international noise standards;
- Activities that take place near residential or sensitive receptors to be careful planned (restricted to daytime, taking into account weather conditions, etc.);
- Residents in the vicinity to be notified about construction schedules and activities;
- All plant and equipment to be fitted with silencers, mufflers, acoustic linings, or shields, as necessary.
- If necessary, measures to be taken to reduce noise emissions from the site shall include provision of screens or bunds to absorb noise and deflect it away from receptors;
- Employees working in noisy environment should be made to wear ear muffs/ear plugs to avoid any adverse impact of noise on them;
- Employees exposed to hand vibration while handling/operating of heavy machineries should compulsorily wear anti vibration gloves made up of visco elastic material;





- Shock absorbing techniques should be used to minimise the impact of vibration from heavy machineries;
- Heavy machineries and generators to be operated during day time only.
- A noise monitoring programme during construction should be implemented
- Vehicles older than 15 years will not be allowed to operate during construction and operational phase.
- Preferably battery operated very low noise generating vehicles will be used in the port premises during operational stage
- Before commencing any piling operations, the contractors shall be required to submit calculations to demonstrate that the appropriate standards will not be exceeded
- Timing and programming outside sensitive seasons (e.g. avoiding the migration seasons of marine mammals, etc.), especially concerning underwater noise;
- Apply a change management process to modify operations, if necessary to address noise issues;
- Vehicles and generator sets to be serviced regularly and maintained properly to avoid any unwanted generation of noise or vibration from them;

4.8.2 Impact due to Dredging

It is proposed to deepen the area in front of the proposed Berth no. 17. The dredging is proposed up to a depth of (-) 15.10 m. Capital dredging will be carried out and the quantity is assessed to be approximately 1, 50,000 cubic meters. while dredging activities will generate noise from a variety of sources, the primary sources of equipment noise would include the cutter suction dredger itself, with its associated pumps and generators and the tugboats used to position the dredger. Other equipment such as the crew boats and survey boats would not contribute substantially to the noise associated with the dredging activities. Additionally, noise will be generated by onshore plant used to spread the dredged materials and to assemble and periodically relocate pipelines. Generally speaking, a weighted noise intensity from working engines at the noise source shall not exceed a continuous level above approximately 120 dB (A). The noise





impact will be relatively more on marine mammals during the operational phase and construction workers during their duty hours.

Seawater is an efficient medium for sound propagation, particularly low frequency sound and therefore marine life over a wide area could be potentially affected. Underwater noise during the port construction will result from the equipment that are used for underwater activities, such as dredging, piling and ship movements. The noise and vibrations generated by the underwater activities can potentially be transmitted to considerable distances through the water and hence cause negative impacts on the marine mammals. Conditions that determine the transmission of noise emissions and vibrations are current pattern and strength and the hydrological/geomorphologic circumstances. The day to day terminal activities such as vessel loading / unloading, container handling, etc. will cause additional underwater noise emissions. Although significant, these impacts would be temporary and limited to the duration of dredging.

Mitigation Measures

- The noise level during piling, transport and erection of structures, operations of machinery/equipment etc. will be kept to a minimum by proper lubrication, modernization, maintenance, muffling and provision of silencers wherever possible.
- The machinery used for construction shall be of the high standard of reputed make and shall adhere to International Standards. These Standards itself take care of noise pollution control, vibration control, and air emission control.
- Optimizing dredging activity and duration to reduce the time factor

4.8.3 Impact due to Port Operation

Impacts during operations mainly will result from the port terminal activities such as vessel loading/unloading, container handling and access road/rail traffic that will result from container traffic arriving and departing through the port business day. Another major source of noise could be the operation of various equipment. Fitting of exhaust mufflers and intake mufflers could reduce the noise from equipment. It is very useful for reducing the low frequency noise levels.





Mitigation Measures

- Transmission of noise and vibration are limited by the distance from their sources. Noise could be considerably reduced by adoption of low noise equipment or installation of sound insulation barriers. Green belt can be a good barrier to noise as well as dust emissions.
- Proper lubrication, muffling and modernization of equipment shall be done to reduce the noise, D.G. Set with acoustic enclosure shall be provided. It is recommended that workers operating various equipment during project construction and operation phases are provided with ear plugs.
- Detailed consultations with the residents along the access road should reveal those potentially affected by terminal operations, specifically traffic. Acoustic fencing might be installed along the edge of the access road should the traffic-generated noise levels be significant to warrant mitigation measures
- Apply a change management process to modify operations, if necessary to address noise issues when they occur.
- Vehicles and generator sets to be serviced regularly and maintained properly to avoid any unwanted generation of noise or vibration from them.
- Employees working in noisy environment should be made to wear ear muffs/ear plugs to avoid any adverse impact of noise on them;
- A regular noise monitoring programme should be defined and implemented for the port O&M phase.

4.9 Solid Waste Management

4.9.1 Potential Impact during Construction

Construction and Other Wastes

Construction will potentially generate the following wastes: green wastes from vegetation clearance, excess construction materials, including offcuts and packaging; hazardous wastes; oils, fuels and other chemicals generated by onsite maintenance and repair of construction





equipment and machinery; Excavation materials; food wastes from construction personnel; site office wastes; and human waste; poor construction procedures that generate excessive wastes increase construction costs and results in disposal of otherwise valuable resources. In the study area no sanitary landfill is foreseen. Therefore, there is a moderate risk to the soil quality, surface and groundwater and marine environment.

The municipal waste generated during the project construction phase shall be of the order of only 50 to 100 kg/day. The dredged spoils shall be used in the extent possible for reclamation and unsuitable material will be disposed at the designated location. Municipal solid waste generated will be disposed through the concerned Municipal Authorities. The solid waste generation during the construction phase will consist of biodegradable waste such as food waste and non-biodegradable waste such as packaging materials, plastic, metal item, etc. All recyclable items shall be collected and sold to authorized recyclers.

Currently, the port premises including the residential colony generate about 1.25 tons of waste every day. In the port area the biodegradable and the non-biodegradable waste is separated. 11 nos. of vermi-bias of dimensions 4 m x 1 m x 1 m (volume 4 m^3) are deployed for composting the waste. An estimated amount of Rs. 72, 03,000 will be spent on the project. Annually 25 tons of manure is generated and used in greenbelt and soil remediation in other areas. This project is 98% complete and operational.

Hazardous Materials

Hazardous wastes (oil, chemicals, lubricants, paints, compressed gases, and varnishes, etc.) generated during the construction phase should be dealt with separately from non-hazardous waste.

Mitigation Measures/Solid Waste Management

A Waste Management Plan for construction and operation phase should be developed defining adequate measures for SW collection, segregation, reuse and disposal. The sewage/solid waste/hazardous wastes to be treated and disposed or sold to authorised recyclers as per the MoEF guidelines.





- Proper sanitation bins to be installed in the port area for collection of sewage/solid waste/construction wastes on site.
- Solid waste generated during the construction process to be separated and recycled where possible / appropriate.
- Burning of waste on site should not be permitted. All waste, which cannot be recycled on site, should be collected and taken off site for recycling/reuse or disposal to an official/municipal waste disposal site after consultation with local authorities.
- A "scavenging boat" should be available at all times for collection of windblown rubbish within the harbour basin itself.
- All rubbish, waste materials and debris shall be systematically cleared from working areas as they accumulate; all such materials should be cleared at the end of each working day.
- If removal of waste materials at the end of the working day is not possible, the materials should be covered with tarpaulin or similar.
- Waste materials not removed directly from the site shall be temporarily stored at designated points and covered, pending removal from the site.
- All working areas and site roads to be kept clear of mud, water, silt and other materials at all times. If earth, mud, or other debris is deposited on roads, it shall be immediately removed.
- Hazardous waste should only be handled by legitimate enterprises and following good international practices and applicable local and international regulations (Bazel and Rotterdam Convention)
- The non-degradable waste will be first segregated so as to remove the material that can be recycled. Metal items shall be collected and sold to scrap dealers. Tyres can be turned into fenders. The plastic materials (~30 kg/day) are to be collected and periodically handed over to authorized scrap dealers. Hazardous waste such as oily rags, empty drums, waste oil, etc. shall be disposed to recyclers authorized by Karnataka Pollution Control Board.

4.9.2 Potential Impact during Operation

The amount of solid waste produced by the operational activities in the proposed port may be quite substantial. Wastes originating at the port may include inert solid waste from cargo





packaging and from administrative offices, as well as hazardous or potentially hazardous waste associated with vehicle and equipment maintenance operations (e.g. used lubricating oils and engine degreasing solvents). Wastes originating from ships may include oily sludge, inert materials such as food packaging, and food waste. Among others, substantial amounts of solid waste will result from the terminal's daily and periodic activities, including the cleaning of storage tanks. Municipal solid waste will be generated from canteens and administrative area.

Mitigation Measures

The port Waste Management Plan should be developed defining adequate measures for SW collection, segregation, reuse and disposal.

- Port operation activities solid waste shall be adequately collected and managed by Contractor (as one option) in accordance with the relevant Indian laws, IFC PSs and IFC EHS guidelines for Waste Management Facilities.
- In accordance with the requirements of MARPOL 73 /78 and its annexes IV and V, appropriate facilities shall be provided for the reception of all wastes arising from ships. These should include facilities for the following basic categories of ship-generated wastes:
 - Oily waste (usually oil mixed with larger quantities of seawater, also fuel residues and sludge).
 - Garbage (originating from crew and passengers, maintenance of the ship, cargo).
- Dustbins must be provided along roadside and other areas at appropriate distances so people can use them for disposal of waste materials if any. Signboards can be installed at desired locations along the roadside propagating people about the environment to keep neat and clean.

4.10 Traffic Management Plan

The present study is aimed at understanding the impact of capacity addition at New Mangalore Port on road traffic. As a part of present study, a detailed data collection was undertaken. Initially a road inventory data was collected for all major roads and roads surrounding the NMPT area. It involved collecting details on road dimensions, conditions, and markings. Speed data was also collected with





the help of radar gun at intersections and mid-block sections to study the speed profiles of various vehicles. A classified volume count was collected at three intersections namely, Nanthoor Junction, KIOCL Junction and Surathkal junction. The data was collected by trained enumerators stationed at these locations. Along with the traffic volume survey, an origin destination survey was also carried out to understand the truck routings within and near the port area. Also, a driver perception survey was conducted to understand the driver behaviour using a questionnaire surveys.

The traffic volume data was used to understand the existing conditions of the road calculating the volume to the capacity ratios. The present-day v/c ratio suggests that the traffic flows are occurring near to capacity at various junctions. However, the present traffic at Nanthoor junction can be managed better by a systematic traffic signal control. The traffic volumes are taken and projected for every five-year interval, i.e., 2026-27, 2030-31, 2035-36 and 2040-41. Assuming a business-as-usual scenario, traffic simulations are run using PTV VISSIM. It helps in developing an insight into the traffic conditions. Based on the assessment of the traffic conditions of road networks, a series of improvements are suggested. These improvements are suggested phase wise for traffic movements on roads as well as within the port. The suggestions for improvements in road network at various times are as follows:

1. Immediate improvement (2023-24): To design and operate Nanthoor junction as a signalized intersection.

2. Improvements by 2026-27: To carry out lane widening of NH 66 and NH 73. Along with widening of existing highways, a four-lane flyover at Nanthoor junction in Bangalore-Mangalore direction is proposed.

3. Improvements by 2030-31: Along with the proposed improvements by 2026-27 at Nanthoor junction it is proposed to develop another two-lane interchange for each direction along Udupi-Kasaragod and Kasaragod-Udupi approaches at Nanthoor junction. It will result in a double-decker flyover arrangement at Nanthoor. Along with the flyovers, for the traffic moving at grade, dedicated left turning movements are provided. A signal is to be installed to manage the traffic at the ground level.





4. Improvements by 2035-36: In addition to the improvements suggested till the previous time duration, it is proposed to construct at flyover between Baikampady and KIOCL junction. The flyover will provide the movement on a three-lane road in each direction. It will help in avoiding the conflicts of port bound traffic and thus provide an uninterrupted traffic movement between the junctions. Also, a two-lane flyover is proposed at Surathkal junction for traffic movement from Udupi towards Bangalore.

5. Improvements by 2040-41: The projected traffic volumes of 2040-41 being very high, the proposed infrastructure may no longer be able to handle the same. To keep the road functional, it is best suggested to plan an alternative alignment bypassing the Mangalore town. The bypass road may start at some suitable location near Surathkal junction and connect NH 73 and further extend till some suitable location south of Nanthoor junction towards Kasaragod.

Apart from the improvements related to the road networks, few suggestions are also provided for the improving the port operations. These improvements are suggested based on the port bound truck projections for various years and simulations using PTV VISSIM. The phase wise improvement suggestions are as follows:

1. Immediate Improvements (2023-24): The entry exit gates in the present scenario with dual lane operation at US Mallya gate and single lane operations seems to be functioning suitably with reasonable queue with average queue length ranging between 5 to 7 trucks at any gate. However, it is proposed to improve the road conditions of road connecting KK gate and Baikampady industrial area to allow for a better manoeuvrability.

2. Improvements by 2026-27: The increased truck volumes by 2026-27 would require adoption of dual lane operations for all the gates for both entry and exit.

3. Improvements by 2030-31: The two-lane entry and two-lane exit can cater to the internal truck movements. To enhance efficiency to proposed increased mechanization of port options.

4. Improvements by 2035-36: The previously suggested changes with increased traffic volumes suggests a smooth operation of various gates. However, due to limited space availability near the Silver Jubilee gate, the truck turning manoeuvres may result in queuing of trucks. To improve





the situation, broadening of entry exit roads at the SJ gate is proposed. It will allow smooth movements of trucks entering and exiting through this gate.

5. Improvements by 2040-41: The improvements proposed till 2035-36 are found to be sufficient in handling the projected truck traffic. The detail study of Traffic Management and Traffic Decongestion Plan at New Mangalore Port by IIT, Bombay is enclosed as **Annexure VI**





5 ANALYSIS OF ALTERNATIVES

Analysis of alternatives is one of the most important steps that must be followed to enhance the overall

- 1) Positive impacts of the project and
- 2) Minimize the negative impacts of the project

This is particularly true in the case of social impacts. Avoidance of all major impacts along the dropped alternative alignments could be rated as the best impact mitigation achieved by way of avoidance strategy. The main activities of the proposed project will be construction multipurpose cargo Berth (Berth No.17) at New Mangalore Port Authority with > 5 million TPA of cargo handling.

5.1 Details of Site Selection and alternatives

As per the Traffic analysis carried out by AECOM, the projected traffic for NMPA for the year 2020 is estimated as 43.4 MTPA. Additionally the total growth is found raising high up to 61.2 MTPA by 2025 and 85.2 MTPA by 2035. The report predicts an increase in traffic is majorly due to dry bulk cargo demand and an additional capacity of 41.8 MT would be needed by 2035.

The cargo traffic can be accommodated by the port by developing a new deep draft berth. It is recommended to develop a new deep draft berth is proposed beside the iron ore berth (Berth 18). Since, the required open area and sheds for storage are proposed in the vacant area behind the berth.

5.2 Alternatives considered

Eastern arm has 6 berths (Berth 1 to 7) with the draft varying from -9.5 m CD to -10.5 m CD. The average occupancy of these berths is about 28%. The low berth occupancy is attributed to the following.

Cargo complexion is fragmented and is handled in small parcel sizes. Cargoes are handled through ship gears and no equipment is deployed on berth. It may be noted that approximately 91% of container traffic is handled at berth in the eastern arm. With the proposed new container





terminal, all the container cargo would shift to berth 14. Berth 5 & 6 which predominantly handles non-hazardous liquid (palm/ edible oil) cargo, cement and fertilizer for which necessary infrastructure like pipelines, conveyors are in place. The eastern arm is approximately 600 m long with the tapered width varying from 195m to 160m. In order to cater deep draft vessels of panama x ships, it is required to provide the dock width of approximately 220 m to 250 m. The berth in the eastern arm was constructed when the port was commissioned i.e. 1975. Most of these berths have attained their design life and need retrofits. Given the established infrastructure along berth 5-7, it is proposed to increase the width of the dock along berth 2-4.

5.3 Layout Analysis

The plan was finalized and considered to be the best, inline to positive impact on the coastal environment with no marine side infrastructure construction activities, thus reducing the impacts associated with during construction phase due to dredging, reclamation and marine side construction works. The proposed development is planned to be confined to the existing port area and landside storage yards will be enhanced.

- No additional Land proposed as sufficient land is available within approved port premises
- No rehabilitation and resettlement are involved
- Road and Railway connectivity from the Port to its identified hinterland (market) is a key 'competitive advantage' factor vis-à-vis competing ports in the eastern India region, particularly with respect of multi - purpose cargoes.





6 ENVIRONMENT MONITORING PROGRAM

6.1 Introduction

In this chapter, Environmental Monitoring Program for the proposed facility is presented. Environmental Monitoring Program is an important component during environmental management of the project. Environmental monitoring will help to establish the existing scenario and help take informed decisions during project planning/operations. In the case of the proposed development, Environmental Monitoring Program/systems can help improve safety and enhance operational efficiency by monitoring meteorological and marine conditions. The main objectives of the environmental monitoring are said to be:

- To ensure the effective implementation of EMP
- To comply with all relevant environmental legislatives of Government of India
- To modify the mitigation measures and implementation arrangements, if any

The institutional mechanism to implement the planned mitigation and monitoring measures during all stages of the project are discussed in Chapter 10. The project management should always go for a rational approach with regards to environmental monitoring. This includes judicious decision making in consultation with responsible agencies such as Karnataka State Pollution Control Board (KSPCB) or reputed environmental consultants for appropriate changes in the monitoring strategy, changes in the sampling/monitoring frequency, sampling location, monitoring parameters and any new/additional requirements. The efficacy of the mitigation measures being followed during construction and operational phases can be assessed and the measures can be revised, made more stringent and reinforced based on the monitoring results. The environmental monitoring program for construction as well as operation phases shall be implemented by New Mangalore Port Authority. Besides the monitoring, compliances to all Environmental Clearance conditions and permits from KSPCB/ MoEF & CC shall be monitored and reported periodically. The likely significant impacts and mitigation measures will also be monitored.





The environmental attributes to be monitored during construction and operational phases of the project, sampling locations and frequency of monitoring, applicable standards, etc. are presented in Table 6-1.

Environment al Attributes	Parameters to be monitored	Frequency of Monitoring	No. of Sampling Location	Standards Methods for Sampling & Analysis	Compliance	
Construction Phase						
Ambient Air Quality	PM ₁₀ , PM _{2.5} , SO ₂ , NO ₂ , CO and HC	Twice in a week	Project site	Fine Particulate Samplers for PM ₁₀ , PM _{2.5} , Respirable Dust Sampler for SO ₂ and NOX, CO analyser/porta ble CO meter for CO and portable HC meter for HC	NAAQ Standards, 2009	
Noise Levels	Day and night noise levels	Once in a month during entire construction period	Project site	Portable hand-held sound pressure level meter.	CPCB Standards	
Marine Water Quality	Physical, Chemical and Biological	Once in a month both for low tide and high tide periods during construction	Two (02) • Project site • Monitoring within 5 km area of proposed trenching/	Bottom sampler (Nishkin Sampler) and analysis by using standard	Primary water quality standards for coastal water (SW –IV)	

Table 6-1: Environmental Monitoring Plan





Environment al Attributes	Parameters to be monitored	Frequency of Monitoring	No. of Sampling Location	Standards Methods for Sampling & Analysis	Compliance
		period	construction	methods.	
			activities		
Sediment Quality	Physical and Chemical	Once in a month both for low tide and high tide periods during construction period	 Two (02) Project site Monitoring within 5 km area of proposed trenching/ con struction activities 	Peterson's Grab Sampler and analysis by using standard methods	Baseline data
Plankton and Benthic Communities	Phytoplankto n, Zooplankton and Benthic Communities	Once in a month both for low tide and high tide periods during construction period	Two (02) • Project site • Monitoring within 5 km area of proposed trenching/ con struction activities	Plankton net of diameter of 0.35 m, No.25 mesh size 63 µ and analysis by using standard methods.	Baseline data
		Operatio	on Phase		
Ambient Air Quality	PM ₁₀ , PM _{2.5} , SO ₂ , NO ₂ , CO and HC	Twice in a week	 Two (02) At Project site With 2 km radius of the proposed constructio n activities 	Fine Particulate Samplers for PM ₁₀ , PM _{2.5} , Respirable Dust Sampler for SO ₂ and NOX, CO analyser/porta ble CO meter	National Ambient Air Quality Standards released during November, 2009





Environment al Attributes	Parameters to be monitored	Frequency of Monitoring	No. of Sampling Location	Standards Methods for Sampling & Analysis	Compliance
				for CO and portable HC meter for HC Standard	Emission
Stack Emission	PM ₁₀ , PM _{2.5} , SO ₂ , NO ₂ , HC, CO	Once in a month	One (01) • DG set at Project site	Stack emission methods	Limits for New Diesel Engines (upto 800 KW) For Generator Sets (Gensets) Applications, Rule 2(C) of The Environment (Protection) Second Amendment Rules, 2002 Notified Vide Notification G.S.R.371(E), Dated 17.5.2002, G.S.R.448(E), dated 12.7.2004, G.S.R.520(E), dated 12.8.2004
Fugitive emissions	Methane and non-methane hydrocarbons	Gas detection System	Onshore receiving facility		
Noise Levels	Day and night	Once in a	•DG set at	Portable	СРСВ





Environment al Attributes	Parameters to be monitored	Frequency of Monitoring	No. of Sampling Location	Standards Methods for Sampling & Analysis	Compliance
	noise levels	month	Project site	hand-held	Standards
				sound pressure level	
				meter	
Marine Water Quality	Physical, Chemical and Biological	Once in a month both for low tide and high tide periods during construction period	Two (02) Near Project site Monitorin g within 5 km area of proposed trenching/ constructio 	Bottom sampler (Nishkin Sampler) and analysis by using standard methods.	Primary water quality standards for coastal water (SW –IV)
Sediment Quality	Physical and Chemical	Once in a month both for low tide and high tide periods during construction period	 Two (02) Near Project site Monitorin g within 5 km area of proposed trenching/ constructio n activities 	Peterson's Grab Sampler and analysis by using standard methods	Baseline data
Plankton and Benthic Communities	Phytoplankto n, Zooplankton and Benthic Communities	Once in a month both for low tide and high tide periods during construction period	Two (02) • Near Project site • Monitoring within 5 km area of proposed trenching/	Plankton net of diameter of 0.35 m, No.25 mesh size 63 µ and analysis by using standard	Baseline data





Environment al Attributes	Parameters to be monitored	Frequency of Monitoring	No. of Sampling Location	Standards Methods for Sampling & Analysis	Compliance
			constructio n activities	methods.	

6.2 Monitoring and Compliance Reporting

As a part of environmental monitoring programme, following compliance reports shall be submitted to KSPCB and Regional Office of MoEF.

- Half yearly compliance reports in respect of the stipulated prior environmental clearance terms and conditions on June 01, and December 01, of every calendar year.
- Environmental statement for the financial year ending March 31, to KSPCB on or before September 30, every year.
- Format for maintaining records of hazardous waste if any in Form 3 as per Hazardous Waste (Management, Handling and Trans-boundary movement) Rules, 2008.
- Format for maintaining hazardous waste imported and exported in Form 10 as per Hazardous Waste (Management, Handling and Trans-boundary movement) Rules, 2008.
- Safety data sheet for hazardous chemicals shall be maintained as per schedule 9 of MSIHC rules, 1989 (amended 2000).
- Format for maintaining notification of major accident in schedule 6 as per MISHC rules, 1989 (amended 2000).

6.3 Plantation Monitoring Programme

Environmental Management team will monitor the following activities of greenbelt development:

- Development of nursery
- Treatment and sowing of seeds





- Watering
- Transport of seedlings
- Planting of seedlings
- Fencing of plantation area
- Weeding and soil working
- Pruning (trimming of plant)
- Replacement/ Inter planting
- Watch and ward of plantation

During operation phase periodic monitoring of plantation growth, manuring, watering, pruning, and replacement will be performed in order to properly maintain vegetation, greenbelt and green cover.

6.4 On-site Mock Drills Requirements

On-site mock drills are very important as it helps employees to be aware of the safety procedures and how to react during the time of crisis. Conducting mock drills at regular intervals enhances preparedness and checks the viability of environmental/ disaster management plan. Mock drills are essential for the following reasons helps

- In revising/ improving the environmental/ disaster management plan
- To evaluate whether the responsible officials are trained efficiently for the unforeseen event
- In evaluating whether the emergency equipment are being maintained at port premises

To ensure efficient environmental/ disaster management, VISL shall conduct periodic on-site mock drills in case of occurrence of the following activities:

- Fire
- Natural calamities (cyclones, floods, tsunami, earthquakes)
- Collision of vessels calling at port
- Oil spill
- Bomb threats





- War alerts/ terrorist attacks
- Power break down

Mock drills will involve fire department, police, municipal authorities, hospitals, Port users and other department/ agencies that are mandated to provide emergency support. Documenting the outcome of mock drills is an important aspect as this helps in revising the existing plan more efficiently.





7 ADDITIONAL STUDIES

This section describes about additional studies covering CRZ mapping, Hydrodynamic Modelling, Mathematical Model Studies for Ship Mooring Analysis, Preliminary Risk Analysis, Disaster Management Plan, Shoreline Changes and Public Hearing.

7.1 HTL/LTL Demarcation and CRZ Mapping

In order to comply with CRZ Notification, 2011 detailed HTL/LTL demarcation studies were conducted with respect to the project site. The study has been conducted through Institute of National Centre for Sustainable Coastal Management (NCSCM). The proposed Berth no.17 is falling in CRZ IV B and back up area falls under CRZ II. HTL/LTL map in 1:4000 scales superimposing the project layouts have been prepared and is attached as **Annexure VII**

7.2 Hydraulic Physical Model Studies for Wave Tranquility and Directional Spread

The physical model studies for the development of proposed deep draft multipurpose berth, Berth No.17, was referred to Central Water & Power Research Station (CWPRS), Pune, by New Mangalore Port Authority (NMPA). Hydraulic physical model studies were carried out on the existing 3-D random wave rigid bed model (scale 1:120 G.S.) by simulating the proposed berth development features in the model.

The CWPRS Technical Report (No: 5653, November 2018) is attached as Annexure VIII

7.2.1 Model description

The model facility comprise 3D hydraulic physical model to a scale of 1:120 (G.S.), housed in a hangar of size 72 m x 45 m. It is a rigid bed model simulated with latest bathymetry and other existing features. This model is equipped with regular and random wave generation facilities from the three critical directions for the harbour entrance namely West, South-West and North-West. The model is equipped with multi-channel wave data acquisition system and electronic water level indicator to monitor the water level during the experiments. Truncated approach channel is reproduced in the model for a distance of about 4000m from port basin entrance up to contour of -11.0 MCD along the sea bed bathymetry. The proposal of development of Deep Draft Multipurpose Berth, Berth-17 was tested in the model by conducting experiments from all





the three critical directions. Wave tranquility studies were carried out by conducting experiments from West, South-West and North-West directions by generating regular and random waves.

7.2.2 Results

The wave tranquility studies results for the proposed deep draft multipurpose berth indicated that the wave disturbances are within the limit of 0.8m considered for the study for all the three directions tested in the model. The model testing condition of wave height (for random waves) Hs = 2.5m / Tp=10 sec near the wave generator is the critical testing condition for port wave tranquility studies. This corresponds to about Hs = 4.0m/Tp = 10 Sec in deep water.

The measurement of wave disturbance at other locations in the port basin also indicated that there is no adverse effect on wave tranquility due to the development of deep draft multipurpose berth. This can be attributed to the sloping face with rock revetment proposed which will facilitate wave run up and absorption of most of the wave energy along this region.

The location for the proposed development is directly exposed to the harbour opening and the wave approaching at this location dissipates energy along the sloping land and rock pitching provided along this region. Earlier some erosion trend along these regions was indicated by port officials. For addressing these issues it is recommended to develop berthing structure on piled support similar to existing KIOCL berth adjacent to this location. On the land side rock pitching is recommended with suitable slope of about 1:5 for wave run-up and energy dissipation. This will be very useful in preventing the reflection of the waves from this region which in turn will be effective in keeping the harbour basin calm.

7.2.3 Conclusion

- I. For the proposed deep draft multipurpose berth will have adequate wave tranquility for the incident waves from the predominant directions viz., West, South-West and North -West for the tested condition and assumed tranquility limits.
- II. The proposed deep draft multipurpose berth will have a comfortable wave tranquility conditions for most part of the year as observed form the testing conditions on the model.





III. For making berthing alignment parallel to the incident waves, to avoid broad side wave effects on ships, the western tip of the berth need to be moved by around 10-15 m towards the waterfront in the harbour basin. However the alignment is suggested to be in line with existing KIOCL berth. This will facilitate ease in the movement of dredger during maintenance dredging. Further considering wave tranquility values at the proposed berth under tested conditions the alignment suggested will not have any adverse effects for the vessel operation at berth.

7.3 Desk and Mathematical Model Studies for Ship Mooring Analysis

7.3.1 Scope of the Study

The mathematical model studies for ship mooring analysis for the development of the Berth no.17 considering the critical condition of berths occupied with design vessel and fender design were carried out at CWPRS by using the software MIKE- 21 MA. The scope of Desk and Mathematical model studies for ship mooring analysis at the proposed Berth no.17 includes:

- Selection of fenders and fender arrangement for general cargo Berth no.17
- Determination of the moored ship motions, maximum mooring rope tensions and fender deflections for the prevailing environmental conditions at the general cargo Berth no.17.

The report prepared by CWPRS (Technical Report No.5758, December 2019) is attached as **Annexure IX**

7.3.2 Studies for Selection of Fenders

The studies for selection of fenders were carried out based on the guidelines and formulations given in the 'Guidelines for the design of fender systems: 2002, Report of Working Group 33 of the Marine Navigation Commission' for the design vessel.

7.3.3 Mathematical Model Studies for Moored Ship Motion

The berthing structures at Bulk cargo Berth no.17 are of pier type and the harbor is well protected from breakwaters. Mathematical model Studies were carried out to simulate the moored ship motions, the consequent mooring rope tensions and fender deflections for the





environmental conditions prevailing in the harbor and for the ships proposed to be berthed in the harbor. The motions of the ships moored at the berth were simulated taking into account the geometry of the ships, their inertial characteristics, added mass and other hydrodynamic characteristics. The arrangement of mooring ropes and fenders, their elastic properties and all other relevant aspects governing the behavior of moored ships were also considered in the studies. The necessary inputs for the wave and current conditions were obtained from the model studies conducted at CWPRS in the past.

7.3.4 Model operation and Results

The MIKE21 MA software was used to simulate the moored ship motions, the consequent mooring rope tensions and to determine the defections on the fender.

The model operation were carried out for all combination of wind, wave and current prevailing at the site and mooring configuration of the 1,20,000 DWT vessel. Nylon (polyamide) double braid ropes with diameter 72mm with ultimate braking strength of 94 tonnes were used. Initial pretensions of 8 tons about 8.5% of the ultimate breaking strength of the ropes were imparted to the mooring ropes of 120000 DWT vessels at the starting. The model was run first for Convergence mode in order to attempt to find the initial vessel displacement under governing constant or low-frequency conditions, leading to a uniform (pre-set) tension distribution among all mooring lines. Subsequently, the final simulations were carried out for different environmental conditions. The motions of the ship are less than the maximum allowable motions set for bulk carrier as per PIANC guidelines. The rope tensions and fender deflections are seen to be well within the safe limits of their ultimate breaking strength, keeping a reasonably good factor of safety. It may be noted that the environmental conditions considered for model operation are their peak values that can prevail at the site and also for the critical conditions that can happen round the year barring cyclones, hurricanes and seismic disturbances.

It can be also seen from typical plots of all the six motions in time domain that under adverse environmental conditions, wave heights of 1 m, wind speed of 15 m/s from west direction and value of current as 0.1 m/s have been considered. The maximum surge motion movement of the vessel is 0.36 m and this movement is within the permissible limit. Therefore, the ship motions,





mooring rope tensions and fender deflections for the normal environmental conditions would be much less than the values obtained with peak magnitudes.

The maximum loads in mooring lines and fender compressions are also within their respective limits. The fender selection was done as per the design ship of maximum size and the spacing of the fender and bollard was suggested as per the smallest size of vessel proposed to be handled at Berth No. 17. The maximum six degree of motions for design vessel (260 m LOA) are within safe limit. The motions for smallest size vessel too will be in safe limits with the suggested fenders design.

7.3.5 Conclusion

- I. Desk Studies showed that SCN1600 fender or equivalent ones (in dimension and elastic characteristics) are suitable for bulk cargo Berth no.17 for the design vessel (as per Table 1) and Fender spacing of 20 m is recommended considering the smallest size vessel of 50 m LOA.
- II. Nylon (polyamide) double braid rope with diameter 72 mm with ultimate braking strength of 94 tonnes were recommended for mooring of 1,20,000 DWT bulk carrier vessel with mooring arrangement. Initial pretensions of 8 tons about 8.5% of the ultimate breaking strength of the ropes should be imparted to the mooring ropes.
- III. Mooring analysis shows that there are no operationally unacceptable ship responses. On the basis of these results, downtime of the berth caused by normal environmental condition is expected to be infrequent.
- IV. Mooring line tension, fender deflections are well within safe limits ensuring high factor of safety.
- V. The recommended fenders are designed for berthing velocities less than 20 cm/sec. Therefore proper tug assistance may be provided to keep parallel berthing and the berthing velocities below the limits.
- VI. It was also recommended to impart proper pretensions to all the groups of mooring ropes.





7.4 Preliminary Risk Analysis

7.4.1 Background

This section addresses proposed project actions related risks associated with explosion, fire, or release of hazardous materials in the event of accident (grounding, collision, anchorage) or a natural disaster. Risk Analysis (RA) is an extensive hazard analysis, which involves the identification and quantification of hazards. RA involves assessment of the damage, injuries and financial costs likely to be sustained in a geographic area over a given period of time.

The main objectives of the risk analysis studies are:

- To define and assess emergencies
- To control and contain incidents
- To safeguard employees and people in vicinity
- To minimize damage to property and environment
- To inform the employees, the general public and the authority about the hazards / risk assessed, safeguards provided, residual risk if any and the role to be played in them in the event of emergency
- To inform authorities and mutual aid centers about the potential hazard
- To secure the safe rehabilitation of affected areas and to restore normalcy
- To provide authoritative information to the media.
- To preserve records, equipment, etc., and to organize investigation into the cause of emergency and preventive measures to stop its recurrences.

7.4.2 Methodology

Following steps are followed to carry out the risk assessment:

- Collection of the relevant information
- Hazard Analysis identification of the impact due to potential grounding & collision accidents using Brainstorming sessions and Bow-tie analysis;





- **Frequency Analysis** assess the frequency of collision and grounding accidents by using data as available from published literature and NMPA supplied data;
- **Consequence Analysis** assessment of the consequence of Property loss, life loss and damage to Environment and Port Business, Oil spill quantity assessment;
- **Risk Analysis and Review** risk estimation has been done based on the consequence and frequency as assessed. The estimated risks have been categorized as low, medium or high to enable identification of control measures accordingly in order to bring down the risk to the ALARP level;
- **Reporting** On completion of the study, a draft report has been developed for review by the NMPA. Comments on the draft report will be incorporated to finalise the report.

7.4.3 Hazards Identification

A preliminary list of significant hazardous scenarios with regards to oil spill accidents has been identified as follows:

- Scenario 1: Tanker /Bulk Carrier tug assisted berthing Contact with jetty
- Scenario 2: Contact during operations in turning circle (large vessels)
- Scenario 3: Grounding- during pilotage of deep draft vessel
- Scenario 4: Collision with dredger within the navigational channel
- Scenario 5: Grounding- Tanker/Bulk carrier transiting outer harbor
- Scenario 6: Collision with small craft Tanker / bulk carrier in harbour approach
- Scenario 7: Collision between two vessels in outer harbor (Regulated traffic)
- Scenario 8: Collision passing vessel in port waters outer harbor (Unregulated traffic)
- Scenario 9: Collision Dragging anchor

In summary there are two categories of accidents having potential for causing majoroil spills have been identified:

- Collisions
- Grounding





The collision accidents are dependent on maritime traffic situation (channel layout, traffic intensity, level of VTS management), weather conditions (wind, currents, and visibility), vessel characteristics (vessel type, vessel age, maneuverability, available bridge equipment, etc.), human factors (experience and capability of the captain and his crew, working conditions).

Groundings occur where there is inadequate water depth as compared to vessel draft, and do not often result in releases. This is due to the fact that the riverbeds of the most frequently traveled waterways are mostly soft mud or silts. However, there is always the potential for significant damage from rocks or debris, as well as physical distortion.

7.4.4 Consequence Estimation

Marine oil spills have the potential to cause serious impacts to natural resources and the livelihoods that depend on them. The extent of impact however is influenced by a number of factors such as the type and amount of oil spilled, the physical characteristics of the affected area, and the weather conditions at the time of the spill and the type and effectiveness of the response methods employed.

7.4.4.1 Impacts of Oil Spills

When the oil spills in large quantity, it temporarily affects the air-sea interaction, thus preventing the entry of oxygen from the atmosphere. The first set of organisms affected is the primary producers like phytoplankton, which are the basis of the marine food chain. The other free-swimming organisms such as fish larvae and fish also get affected. Further, when the oil sinks during the course of time, it affects the benthic organisms. The other amenities that are affected include mangrove forests, coral reefs and several marine resources. Oil spills can also have a serious economic impact on coastal activities and resources of the sea.

Spills close to the shoreline tend to have the greatest immediate impact because more diverse forms of life may come into contact with the oil. In addition to ecological concerns, shoreline spills can affect the air quality, due to the hydrocarbon gases and sulphur compounds present in the oil, and are also a potential fire hazard. They will also depress recreational areas, harbours,





industries, commercial fishing grounds and tourist attractions. The Oil Spill Contigency Plan is enclosed as **Annexure X**

7.4.4.2 Vulnerability Assessment

All coastal habitats are vulnerable to oil spill impact. The vulnerability analysis provides information about resources and communities that could be harmed in the event of an oil spill.

Vulnerable areas in and around NMPA are as follows:

- An oil spill will cause significant and long lasting impacts over entire CRZ-1 areas extending from the beaches at Suratkal in the north up to Tanner bhavi beaches in the south and falling within the Port boundaries. Cleaning up these areas would be protracted and may only be partially successful. It is equally possible that the spill may extend to areas lying in CRZ-1, outside of the Port Zone as well.
- Environmentally the region contains large areas of sand beaches, large areas of inter-tidal sand banks and estuarine mangroves, significant populations of rare and endangered fish and turtles.
- Economically the region has dominant tourism and fishing industries.
- Culturally the region will be supporting tourism and fishing communities, which will be a significant part of the local economy.

7.4.5 Natural Hazards/Calamities

7.4.5.1 Flood

Flood impact is one of the most considerable disasters in the world. Floods are caused due to natural factors such as heavy rainfall, high floods and high tides, etc., and human factors such as deforestation, improper land use, blocking of drainage channels etc. Floods result in damage properties and losses of life. Increase population results in more urbanization, more impervious area and less infiltration and greater flood peak and runoff. Flood loss prevention and mitigation includes structural flood control measures such as proper maintenance of the existing drainage system, construction of levees and non-structural measures such as flood hazard and risk management, flood forecasting and warning etc.





The study area receives about 95 per cent of its total annual rainfall within a period of about six months from May to October, while remaining extremely dry from December to March. The average annual precipitation is 3,796.9 mm (149 in). Humidity is approximately 75 per cent on average, and peaks during May, June and July. The maximum average humidity is 93 per cent in July and average minimum humidity is 56 per cent in January. The project can be affected by flash floods, which occurs on the coast when high intensity rainfalls in a localised area happens over a short period of time, in combination with high and spring tide. Most of the flooding problem in the area is due to poor or choked drainage conditions.

The port authority shall consider the following precautionary measures to meet any such events:

- Drainage routing to check blockages along the drainage
- Conduct flood route analysis
- Installation of water pumping stations
- Installation of warning systems (alarm, audio-visual public address system, etc.)
- Coordination with State and district level disaster management authorities

7.4.5.2 Coastal Hazards

Coastal Hazards such as erosion, storm surge, tidal waves, swell waves, etc.; have the potential to harm the people, property and the environment. The following initiatives shall be taken:

- Strict shoreline monitoring program shall be undertaken.
- Erosion control fabrics in critical areas if any.
- Establishment of shoreline protection wall if required.
- Coordination with State and district level disaster management authorities.

7.4.5.3 Tsunami

Tsunami is a series of waves in a water body caused by the displacement of a large volume of water, generally in an ocean or a large lake. Earthquakes, volcanic eruptions and other underwater explosions (including detonations, landslides, glacier calvings, meteorite impacts and other disturbances) above or below water all have the potential to generate a tsunami.




On the night of December 26, 2004, a massive quake of magnitude 9.1-9.3 — with its epicentre in Bay of Bengal — triggered one of the biggest Tsunamis the world had ever witnessed. The massive waves, measuring up to 30 meters, created havoc in 15 different countries killing more than 2,00,000 people. More than half of those who perished in the calamity belonged to Indonesia. In India, over 10,000 people were killed in the disaster, which is considered to be one of the deadliest in recorded history. The extent of damage it caused was attributed to a number of reasons, mainly poor infrastructure and warning systems and large population living in coastal areas.

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

Although these are rarest events the following measure shall be taken:

- Safety measures in accordance with mathematical study of Tsunami wave's height with respect to mean sea level (MSL)
- Tsunami Warning Systems
- Coordination with State and district level disaster management authorities
- Port has taken up the study of New Resilient Break water of safety of Port and Harbour against Tsunami.

7.4.5.4 Earthquake

As per Seismic Zoning Map of India, the project area falls under Zone-III (moderate to low risk zone) as per the IS: 1893, Part-I, 2002. With regards to Earth quake all design of the facilities should incorporate factor which would give the required structural integrity.





7.4.6 Man-Made Events

The risks of the man-made events on the project site and its surroundings like fire/explosion, ships collision; release of hazardous materials, etc. have been considered appropriate for analysis.

7.4.6.1 Ships Mishaps/Vessel accident

During towing and berthing of the ships, owing to natural calamity or piloting errors, there can be remote possibility of mishap of one to one ship collusion or ship hitting against the wharf or ship getting grounded. During such events, the ship may sink/break and could lead to accidental oil spill inside the port basin or in the vicinity. The ships mishaps/collusion shall be avoided by adopting following measures:

- Direct, control and manage the movement, position, timing and manner in which a vessel may enter and leave the port waters.
- Maintenance of safe and navigable channels and coordination of vessel movements.
- Removal of damaged vessels in order to avoid interruptions in marine traffic.

7.4.6.2 Fire/Explosion

There is risk of fire or explosion due to the electrical fault, handling, transportation and use of flammable materials. The Port authority should implement cost effective mitigation measures as per National and international rules and regulations.

- There are some recommendations that may be implemented as follows:
- Installation of Audio-Visual public address system to alert the personnel working in the terminal.
- Smoke or fire detectors will be placed at critical locations in the terminal.
- Fire alarm system.
- Strict ignition control such as prohibition of ignition source (smoking etc.).
- Periodic inspection and maintenance and adequate measures in the safety system design.





- Personal Protective Equipment (PPE) such as masks, respirators etc. may be provided to the workers.
- Fire extinguishers will be provided to withstand the fire or explosion condition.
- Training and Drill exercise.
- First aid box shall be provided.

7.4.6.3 Terrorist Activity

A terrorist action could be the cause of explosion, hazardous materials release or any such events which may damage the life and property within the Port area. Terrorism risk is a combination of threat, vulnerability and consequence. The expected threat of terrorist activity can be reduced by implementing security measure and emergency response preparations as per ISPS rules and regulations. The following security initiatives shall be taken:

- Establishment of port's waterside camera system.
- Establishment of restricted areas for non-commercial vehicles and vessels.
- Installation of additional shore side cameras at critical locations.
- Preparing and updating security plans for Port and ships.
- Developing a security awareness training program.
- Coordination between State and District Level authorities especially with the security agencies.

7.4.6.4 Hazardous Material Handling

Hazardous materials have adverse effect on public health and safety as well as environment due to the release or leakage of hazardous materials. Hazardous materials that may be stored, transported and handled within the Port area are classified by the following: (Hazardous Waste Management handling rules 1998 (amended)).

Corrosive materials – solids, liquids, or gases that can damage lining material or cause fire.





Flammable Liquids – a liquid having a flash point of not more than $60.5^{\circ}C$ (141°F), or any material in a liquid phase with a flash point at or above $37.8^{\circ}C$ (100°F) that is intentionally heated and offered for transportation or transported at or above its flash point in bulk packaging.

Flammable Gas – any material that is a gas at 20°C ($68^{\circ}F$) or less and 101.3 kilopascals (kPa) (14.7 pounds per square inch absolute [psia]) of pressure (material that has a boiling point of 20°C [$68^{\circ}F$] or less at 101.3 kPa [14.7 psia]), which is ignitable at 101.3 kPa (14.7 psia) when in a mixture of 13 percent or less by volume with air; or has a flammable range at 101.3 kPa (14.7 psia) with air of at least 12 percent regardless of the lower limit.

Explosive Materials – any substance or article (including device) that is designed to function by explosion (an extremely rapid release of gas and heat), or that by chemical reaction within itself, is able to function in a similar manner even if not designed to function by explosion.

Toxic materials – gases, liquids, or solids that may create a hazard to life or health by ingestion, inhalation, or absorption through the skin.

The Port authority shall develop a Hazardous Material Management Plan as part of its Environment and Social Management Plan (ESMP) prior to entering Operational phase. This plan describes mitigation and management measures to avoid or reduce the impact of hazardous material due to release or leakage. The objective of the Hazardous Material Management Plan is:

Prevention of uncontrolled or accidental release, leakage or spillage of any hazardous materials during transportation, storage, use and handling.

• Prevent injury to personnel, damage to property or the environment as well as minimizing or eliminating the impact to surrounding communities.

Storage:

- Storage installations and equipment shall conform to the provision of statutory and other regulations of Government of India (GoI).
- Storage facilities equipped with isolating and relief valves and fire protection systems.





- Leak detection systems are provided to warn if leak occur, and protected by insulation at support and deluge systems.
- Incorporate overfill protection measures in permanent tank design and install level gauges on tanks to measure volumes.

7.4.6.5 Loading/Unloading

- Loading/unloading area should be equipped with fire-fighting facility including the fire hydrants.
- Any spills or leakage in the area should be contained and cleaned immediately.
- Adequate training in operation of heavy equipment.
- Routine inspection of cranes and preventive maintenance to ensure safety operations.
- Operations at lay down areas and stockyards are performed under strict supervision from suitable trained personnel

7.4.7 Other Provisions

- Use of Personal Protective Equipment (PPE) such as gloves, masks, boots, etc.
- Use of engineering controls such as containment, automatic alarms and shut-off systems etc.; in accordance with the nature of the hazard.
- Warning and Restriction Signage.
- Regular inspection and maintenance.
- Good House Keeping and better solid waste management system
- Appropriate Labeling on vessels and vehicles with name or description of hazardous material.
- Implementation of Evacuation Program if incident occurs.

7.5 Disaster Management Plan

New Mangalore Port Authority (NMPA) has an existing Disaster Management Plan (DMP), prepared by TATA AIG Consulting Service in 2001 and subsequently updated in 2008 by Telos Consultancy Services when the port added two additional new berths. Telos has already carried





out risk analysis for oil handling berth no.13 and coal berth no.14. NMPA had approached IRS for carrying out Risk Assessment for collision and grounding accidents and update the DMP taking account of additional hazards and potential mitigating actions accordingly. The DMP was updated to include these points in March 2017.

New Mangalore Port Authority retained Environmental Technical Services Pvt. Ltd. For updating of the DMP in December 2016. An updated DMP was presented in March of 2017. Provisions in the DMP are briefly discussed in this section. Further revised draft DMP was prepared in October 2022 which is under consideration – Confirmation from Marine department. The DMP has been prepared taking into account the features, location and climatic conditions of the area. Various disasters addressed in the plan are enumerated below:

- Numerical Modeling of Tide Imposed Coastal Processes off Mangalore (Storm surge and Tide)
- Tsunami Disaster Management Plan by Tsunami Early Warning System along Western Coast
 - Early Warnings to the Coastal Community by Worst Scenario Detection
 - Tsunami Mitigation Measures
- 3. Handling Emergencies
 - Leakage of Ammonia from Unloading arm/ pipeline during unloading operation
 - LPG Fire at Berth 9 during unloading
 - Crude POL Products Fire
 - Maintaining Emergency Response Capabilities
- 4. Action Plan
 - 4.1 First Action Plan
 - 4.2 Organization Chart
 - 4.3 Emergency Organization Chart
 - 4.4 Action Plan Scenarios at NMPA
 - 4.4.1. Action plan fire on board tanker at tanker jetties
 - 4.4.2. Action Plan Tanker on Fire at Tanker Jetty





- 4.4.3. Fire on Board LPG Vessels (Berth 9)
- 4.4.4. Fire on Tank Farms
- 4.4.5. Fire in transit sheds
- 4.4.6. Fire In A Building Or Other Installations, Grass Fires
- 4.4.7. Duties and Responsibilities of Action Groups
- 4.4.8. Fire hazards from neighboring industries (MCF, KIOCL, ULTRATECH Cement)
- 4.4.9. Leakage of Ammonia from tanker
- 4.4.10. Leakage of Phosphoric Acid at Berth 4
- 4.5 Collision, Grounding Accidents
- 4.6 Emergency Action Plan
- 5. Security Threat Plan Bomb threat, Bomb threat messaging system, drill procedure, rescue and relief operation Plan
- 6. Off-site emergency plan The plan of coordination, off-site disaster control management structure plan
- 7. Integration of the DMP with National Disaster Management Authority

The Disaster Management Plan will be deployed in case of any disasters. The detailed DMP has been attached to this report as **Annexure XI**

7.6 Shoreline Changes Studies

Coastal changes are attracting more focus since they are important environmental indicators that directly impact coastal economic development and land management. Both natural and anthropogenic processes along the coast control the erosion, and accretion activities of the coastal zones.

As per shoreline change Atlas of Karnataka, Map No. 48L13NW prepared by Space Application Centre, ISRO, Ahmedabad. The Karnataka coast extends from 12° 43' N to 14° 51' N and 74° E to 75° E. The northern coast is rocky while the southern coast has long linear beaches. Coastal geomorphic features in Karnataka include beaches, rocky headlands, spits, estuaries, shallow lagoons, mudflats and mangroves at few places. Shallow lagoons are observed near Coondapur and the Kalinadi. Rocky coast is observed near Ankola to Karwar at numerous locations. The





shoreline change estimation is carried out along the 319 km stretch of the Karnataka coast (which does not include the mouth of the river/estuary, creeks and their inner parts). The southern sector of the Karnataka coast is more dynamic compared to the north. Around 40 km of the state is under erosion and 48 km of the coast is under accretion, while 231 km of the coast is stable in nature. The Shoreline Change Map is attached as **Annexure XI**

7.7 Public Hearing

The project proponent is required to conduct public consultation as per EIA Notification, 2006. Public consultation refers to the process by which the concerns of locally affected people and others who have probable stake in the environmental impacts of the mining activity. The Karnataka State Pollution Control Board shall conduct the public hearing. The minutes of public hearing will be sent to the regulatory authority for their consideration before a final decision is taken regarding grant of Environment Clearance.





8. **PROJECT BENEFITS**

8.1 Introduction

Ports and harbors conduct four important functions: administrative (ensuring that the legal, socio-political and economic interests of the state and international maritime authorities are protected), development (ports are major promoters and instigators of a country's or wider regional economy), industrial (major industries process the goods imported or exported in a port), and commercial (ports are international trade junction points where various modes of transport interchange; loading, discharging, transit of goods). The proposed developmental activities will provide direct and indirect benefits to the people residing in the nearby areas. One of the main aims of the proposed project is to bring significant benefits to the local people and also to the region as a whole. The various project benefits are discussed in this chapter. The exposure of economies to trade and its related activities gave prominence to the development of ports. Ports and shipping can be considered as the engines of growth for any country. The importance of ports and its related infrastructure plays a vital role in the growth of a Nation and its economy. The project construction and operation will generate revenue for the State and Central Government by way of payment of royalty, tax and sharing of port revenue. In addition, port development will attract investments into the region and thereby contribute to economic growth of Dakshina Kannada District, the State of Karnataka. The importance of ports and its related infrastructure plays a vital role in the growth of a Nation and its economy.

8.2 Infrastructure Facilities

The Port facilities provided are to face the growing challenges and emerging needs of the 21st century. The Port is well equipped to handle bulk, liquid chemicals, hazardous cargoes, Crude and POL products, heavy lifts, machinery, containers, project cargo etc. Some of the advantages of the port are as follows:

- Deepest Inner harbor on the west coast with 14 m draft.
- Proximity to Major International sea routes
- Road connectivity to 3 National Highways 66, 75 & 169





- Rail connectivity to 3 zonal railways Southern/South Western/Konkan
- Air connectivity through Mangalore International Airport Largest LPG handling Port in India
- Highest coffee exporting port in India
- An ISO 9001:2015, 14001:2015 & ISPS Compliant Port
- Operations and Administration powered by POS & ERP
- Hassle-free single-window clearance and simplified documentation system
- Availability of sufficient covered and open storage area in and outside the wharf area
- Concretized road network inside the port area
- Special care for customers
- Ideal port to handle project cargo for mega industries
- Concessional Vessel related Charges

By the provision of an additional berth and developing other facilities the benefits may be realized either as upcoming of industries such as thermal power plants, mineral-based plants, small scale industries and their allied ancillary units. Other benefits would be the generation of either direct or indirect employment to the local people. The connectivity will also improve the ecotourism facility which will provide employment to the local people.

8.3 Other Benefits

Other probable benefits from the perspective of various stakeholders can be summarized as below:

- An opportunity to develop the area and the quality of life of people
- A great opportunity to increase the financial status of government
- Development of institutions like schools, colleges and offices
- Agricultural development through better irrigation facilities
- Development of health care facilities
- Better infrastructural development
- Better road and transportation facility





- Better property values
- Better employment opportunities
- Improvement of cultural and social affairs
- Development of small scale industries
- Development in accessibility like improvement of the local road and rail networks
- Overall development of the economy and communication system
- Increase in export and import business.
- Overall technological development in the area





9. ENVIRONMENTAL MANAGEMENT PLAN

EMP (Environmental Management Plan) is a site specific plan which is designed to ensure that the project is implementing in an environmentally sustainable manner. All the key stakeholders like nearby dwellers, workers, contractors, consultants, design engineers etc. shall realize the risks that can arise during the construction as well as operational phase of the proposed project, on the site and how can they contribute in reducing those risks. EMP also ensures that the project implementation is carried out in accordance with the design and by performing appropriate mitigation actions to reduce adverse environmental impacts for a long term period.

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

- Air pollution due to the emission of particulate matter and gaseous pollutants;
- Noise pollution due to various noises generating equipment's like DG Sets, Vibrations from machineries, noise from vessels, noise due to congestion (road transport as well as commuters).
- Waste water generation from sanitary/domestic activities.
- Solid waste Management (Collection- Process & Disposal).
- Labor camp with water, power, sanitation and medical facilities.
- Impact of dredging on marine biological environment

9.1 Green Initiatives by NMPA

Nestled between the blue waters of the Arabian sea and the green towering Western Ghats – New Mangalore Port – during last five decades of its service has witnessed exponential growth in terms of trade & commerce without compromising key and critical elements of environment Land-Water-Air-Flora & Fauna- Animals and Human habitat. The Port has created a green belt





around the port and has earmarked 33% of its land area exclusively for greenery. For the last 5 years 1 lakh saplings were planted and the process is still going on.

Being ISO:14001certified, NMP had its Plan & vision in place and strives relentlessly to achieve the best results. The collective vision of Management had addressed the issue of "drinking water" and "sewage system" in the Port The Port has developed Sewage Treatment Plant with a capacity of 1.20 MLD inside the Port area. This STP is enabled to receive domestic sewage of township and inside the Port as well. The treated water is used for watering the green belt and also for water sprinkling in operational areas.

To meet the water requirement, the Port has envisaged comprehensive plan to harvest the rain water. In this direction, 3 large water bodies have been created inside the Port area, in the catchment areas covering 64,217 Sq.Mtrs. with a capacity of 1,10,340 CUM of water. Due to creation of water bodies, the water levels in the nearby village wells also got recharged. Port is now self sufficient in its water requirement.

Solar energy being a renewable energy resource can help in mitigating depletion of natural resources. In this direction the Port has installed 4 MW solar plant in addition to roof top solar panels at the top of buildings and storage sheds. Now the Port has achieved the coveted credit of meeting 100% of its power requirement from the solar panels.

The Port has also switched over to LED lighting which are more environment –friendly coupled with power saving

Over the years the port has mechanised almost 90% of its operations so as to mitigate dust and pollution in the operational areas. Handling of coal, IOP, cement, etc are now fully mechanised

The port is also not lagging behind in usage of e-vehicles. All the port vehicles will be changed to electrical vehicles in phases. Already 2 electric buses are put into operation inside the port area and electrical cars are expected soon.

Awards:

These efforts by the Port Management has yielded positive results;





For the consecutive 2 years the Port bagged Swachha Survekshan Award from Ministry of Shipping.

Greentech Environment Award in gold category in Port sector for the consecutive 5 years.

Samudra Paryavaran Award from Indian Coast Guard.

Aranyamithra award from Karnataka Forest Department.

Recognition from State Pollution Control Board and District Administration for the efforts of the Port in keeping the port and its vicinity clean and green.

These awards have motivated the port to sustain the efforts and to chalk out more projects in the future

Mission & Vision

NMPA continually improves its environmental performance by prevention of adverse environmental impacts in all its operations. NMPA prevents and controls pollution to maintain eco-friendly environment and imparts environmental awareness amongst all interested parties, so as to reduce and manage wastes in an environmentally responsible manner. NMPA teams up with all interested parties to work towards pollution free environment.

Sustainability Measures at NMPA

Zero Discharge of Waste Water: After construction of the Port and the colony, the first challenge for the Port was to conserve the soil and re-use the water generated out of the sewage both inside and outside the Port. In this direction, the management has conceived constructing a Sewage Treatment Plant with a capacity of 1.2 MLD inside the Port area. This STP is enabled to receive domestic sewage of township and inside the Port as well. It consumes 329 KW power/day for treating 0.75 MLD water/day. Periodic inspection and maintenance is carried out by Engineers and monitored by the Environment Cell of the Port.

Process Concept :- The domestic sewage emanated from the NMPA township containing floating matter and solids will be treted in the 1.2 MLD Sewage Treatment Plant works on SBR Technology. The sequencing batch reactor (SBR) is a fill-and draw activated sludge system for





wastewater treatment. In this system, wastewater is added to a single "batch" reactor, treated to remove undesirable components, and then discharged. Equalization, aeration, and clarification can all be achieved using a single batch reactor. To optimize the performance of the system, two or more batch reactors are used in a predetermined sequence of operations. The Port has been fully complying with the statutory requirements and proudly states that Port has adopted Zero Discharge.

Monitoring System: There is a scientific monitoring system in place in the Port. The monitoring process is carried out through NABL agregated established laboratories having resources and spare capacity. NMPA monitors air and water qualities through third party authorised by KSPCB, MOEF&CC, regularly and taken both preventive and corrective actions. This Environmental Management System improves the environmental conditions in general and public health of its employees in particular. The treated water out of Sewage Treatment Plant is used for the green belts created inside the Port in order to reduce the burden on water resources. Besides, it is also used for sprinkling inside the wharf to suppress the dust emanating out of cargo handling contributing to acheive Zero Discharge.

Drinking Water:- New Mangalore Port is proudly declares that it is self sufficient in Water. Port had built, so far 7 UGR (Under Ground Reservoir) with a capacity of 3917 K.L. and 8 ESR (Elevated Storage Reservoir) with a capacity of 2930 K.L. and 16 Energy Efficient Pumpsets with various capacities. These measures have been taken to reduce the dependency and stress on natural resources on City Municipal Corporation. Self sufficiency will further reduce the cost on Port. The Port had created its **own sources** to an extent of 10,51,169 KL. Total self sufficiency on drinking water is acheived. We are proud that the Port attained its self sufficiency by making use of available catchment areas to Rain water harvesting ponds.

Rain Water Harvesting:- The prudence exhibited in utilizing this scarce resource depends upon determination, vision and mission of the management. New Mangalore Port is perhaps the only Port that is blessed with this resource due to its topography. After Kerala on the West Coast, Mangalore is the second location on Indian map to catch the early rain. Mangalore receives roughly, around 4000 mm rain in Mansoon period which is perhaps the highest rain





fall next to Chirapunji. However, most of the water runs into Arabian Sea, since the land mass in the Port is significantly less and hilly terrain with laterite soil. Despite these adverse conditions, New Mangalore Port has envisaged comprehensive plan to harvest the rain water. In this direction, 3 large Rainwater Harvesting Ponds and Ground water Recharge ponds have been created inside the Port area, in the catchment areas covering 64,217 Sq.Mtrs. with a capacity of 1,10,340 CUM of water. This water is constantly used for "development of green belt", sprinkling to control dust emission and also drinking source for the animals, flora and fauna. Due to this rain water harvesting ponds, the water levels in the nearby village wells has constantly recharging. Port is not depend on MCC for water supply since Port is self sustain with its own Raintwater harvested ponds for water consumption.

Cargo-related Pollution & Preventing Measures:- For the financial year 2020-21, New Mangalore Port Authority had handled 36.5 Million MT of cargo. The cargo comprises Coal, Cement, Fertilizer, Oil products, Coffee, Cashew, Candles, Chemicals and Food grains etc. The environmental impact on humans, animals & plant population in the operational area can be hazardous, if it is not handled scientifically or established safe practices. New Mangalore Port has envisaged systmatic approach to addres this problem. Firstly, it has decided to construct settlement tanks in the areas where the storm water meets the Arabian Sea. Secondly, to concretize the internal roads that are used for casting the cargo for storage and evacuation. Demarcation of stackyards viz., timber, coal, containers, granite, machineries, etc.

Settling Tanks:- Construction of Settling Tanks in the Port is one of the age old practices where the turbid water containing the particles of cargo are filtered and the settled water is let out to the sea. NMPA is poineer in constructing several settling tanks inside the wharf and also outside the wharf area where remnants of cargo are prevented to flow into the sea. Regular cleaning of the tanks and its maintenance is done in two phases namely pre-monsoon preparation and post-monsoon maintenance. This process prevents direct discharge of contaminated storm water into sea, water logging inside the Port area and pollution of Marine water and ecology.

Coal Settling Pond:All the coal yards are provided with garland drains for collecting the overflow water coming out of yards due to coal dampening and/or dust suppression system





sprinklers, rain water etc. These drains are further connected to the coal settling pond for settling the coal particles and reuse of over flow clear water. The overflow water from coal settling pond will be collected in the overflow tank for reuse.

Dry Fog Dust Suppression System: To have control over the dust pollution, dust suppression system is provided at all fall points of cargo in the Bulk Handling System; Dry fog type dust suppression (DFDS) systems are provided on all the equipment viz. Ship Unloaders, Stacker Recalimers & Wagon Loading System and also in all Junction Towers of Conveyor system; This settles the dust generated from the coal during its movement through the bulk handling system

Concretization:- Port has envisaged concretization of existing roads in operational area both inside and outside the Port. These roads prevent recurring expenditure for wear and tear of the roads due to heavy trucks plying on the roads coupled with heavy monsoon. These concrete roads are built on high standards under the guidance of Central Roads Research Centre(CRRC), New Delhi & NITK. All the roads inside have been concretized to suppress and reduce the dust pollution. Budget allocation for concretization is part of plan expenditure in Port. These roads not only help the Port in quick evacuation of Cargo but also reduced the Air and Dust pollution to a great extent. So far the Port has spent more than Rs. 150 Crores for this infrastructure.

Paver Block Platforms: New Mangalore Port Authority has systematically planned creation of cargo storage yard on the rear side of Berths for transit storage of cargo and Containers. This facility enables the importers/shipping agents to discharge the cargo and faster turn around time of ships and also enables the exporters to store their cargo without contamination. New Mangalore Port Authority has used 'M40' grade quality paver block in creating the storage yards.

Monitoring of Air, Water, Noise: The Port is monitoring the environmental assessment studies on air, water, noise by KSPCB, MOEF&CC acredated laboratories every month. The results indicate the quality of air, water & noise are well within the standard tolerance limits prescribed by the statutory authorities. The Port is under process of installation of CAAQMS (Continous Ambient Air Quality Monitroing System) to monitory the Ambient Air Quality. All DG sets are with the Acoustic enclosure to prevent Noise Pollution.





Mechanized Sprinkling System: Sprinkling system inside the Port was the brain child of Inhouse Engineers. All most all the concrete roads inside the Port Have been installed with mechanised sprinklers on either side of the road. It operates every 30 minutes. This system ensures minimizing dust pollution in cargo opertional areas. The water used for this system is partly out of treated sewage water and partly from rain harvesting. This system is Complementary to the "Tank sprinkling" system. The sprinkling system is also provided in Railway Marshalling Yard to prevent / arrest the dust suppressed during the loading and unloading time.

Yard Sprinkler System:-Sprinklers are installed in the coal yards which can rotate 180 degrees and cover the entire coal stacks. This completely settles the dust generated from the coal stacks during operations. The automation mechanism gives aid to effective usage of water. The Sprinklers will Switch Off and Switch On for the predetermined time cycle automatically throughout the process thus minimizing water usage. The water will be recycled & reused for the same purpose after sediment separation.

Wind Barriers:-Wind Barrier has been installed on the boundary of the Terminal on North side along the Beach Road. This will prevent fine dust particles flying towards the beach road. Wind barrier made of Structural steel provided with net for a height of 12.5 m from the ground level is provided.

Oil Spill Controlling System:- Oil cargo accounts more than 50% share in total volume of cargo. Besides other measures, Port is also adopted Oil Spill Controlling System. As mentioned earlier, Ports & Harbours essentially located at the interface of land and water. The vessels visiting the Port not only carry cargo, and oil pollution they caused are also potential threat for the water, land & air. NMPA has envisaged advance response mechanism for controlling oil spills and minimizing their impacts on human health & environment. NMPA has already acquired Oil Spill boom– 650 mtr. long (AFTI "CS-24NC" (750gms./sq.mtr.), Oil Skimmer, Oil Absorbent Pads, OSD Sprayers, Recovery Bags, Oil Skimmers, Pollution Response Boats. In the eventuality of any pollution, Port Control will receive information and the Disaster Management Group headed by Chairman, Deputy Chairman, HODs., Dy. Conservator, Dock





Master, Pilots, Environmental Officer, Fire Safety Officer, & M/s. Yojaka India Pvt. Ltd. (cleanup contractor) will swing into action. In addition, the Port is having a Multipurpose Vessels to combat the pollution.

Risk Analysis, Fire Fighting System & Assessment:- NMPA handle liquid cargo such as LPG, Ammonia, Nafta, Furnace Oil etc., which are higly inflammable. Scientific risk assessment in handling these Cargos has been made in the Port. Mitigation measures such as fire fighting equipment, state of Art pumping facility at Oil Jetty is in place. Regular & Periodic inspections by Top Management is one of the features of the Port. Statutory compliances from Director General of Fire & Safety have been in place to handle these sensitive Cargos.

Dredging & Ecological Concerns:- Dredging is an inseperable activity in the Port Sector. To be a better competetor in the trade & Commerce, Port needs assured draft and depth at all times. Indian Ports are generally face siltage problems due to many factors, i.e. Mansoon, rivers and tropical climate. Dredging generally involves issues like disposal of dredged material, threat to Marine Flora & Founa. These issues have been scientifically addressed by NMPA with the help of CWPRS, Pune, (Central Water and Power Resource Station). CWPRS has identified safe zone for dumping the material. In addition the dredging material is also used to fill the land mass to make best use of land for "green cover" and other storage purposes.

Slop Reception Tanks:- NMPA is the only Port in the country which has constructed Slop Reception Facility for Oil Berths with a capacity of 5000 KL. 500 KL & 10 KL. These tanks receives wash water, oily water and it will be treated in Oily Water Seperator and processed oil will be disposed to KSPCB authorised recyclers. This facility ensures prevention of Marine Pollution from the ships, it will be monitored through online Swatch Sagar Portal by the Port to avoid any oil pollution.

Solid Waste Management: New Mangalore Port Authority installed Solid waste management system with shredder and vermicomposting units. This vermicomposting units produce the round 150-kg organic manure per day which will be used for horticulture and Port gardens at NMPA. Segregation of waste at the source is carried out. The organic waste is used for vermiculture and inorganic waste is disposed at designated location of MCC. To ensure better environment, the





management has declared NMPA as "No Plastic Zone" in the year 2013 to till now. Port is under the process of implementation of self management of waste whereas, organic waste will be used for the preparation of manure and inorganic waste will be disposed through authorised recyclers.

Mechanization of Cargo Handling:-The best way to deal with pollution is mechanization. Though it is costly affair, it is an order of the day and must in the modern day management. New Mangalore Port has introduced stateofart mechanise coal handling through conveyor system. Stacking of cargo, reloading of coal through conveyors into the railway wagons with investment of Rs.380 crore. Zero spillage of coal cargo is ensured. Part of the coal cargo is transported through truck. To ensure no pollution on roads, the tyres of the coal cargo truck are washed inside the coal yard.However, 100% mechanization of coal was achieved by PPP operator UPCL (Udupi Power Corporation) in the Port. Complete Mechanization is also achieved while handling the oil and cement cargo.

Vehicle Tyre Wash facility: The coal vehicle tyre wash facility is provided inside the terminal before crossing the gate all the vehicles shall go through this route and clean the tyres on its own and exit from the terminal with dust free.

Mechanised Loading of Iron Ore Pellets:-Port handles about 2 Million Tonnes of Iron Ore pellet through closed conveyor system. The pellets are moved from the terminal and loaded into ship through mechanisation without pollution. Port handles about 6 lakh tonnes of cement through conveyor system. No particle of cement is visible to the common man. Entire cement is handled in mechanised and is dust free environment.

Electric Bus at NMPA:- As a green Port Initiative and in order to decrease the Carbon Foot Print inside the port wharf area, Port introduced 02 Nos. 35 seater Electric Buses at the agreement cost 4.62 Crores for 6 years period. These buses are utilized by the Port users and other stakeholders of the Port to commute between the main gate (Mallya Gate) and various berths inside the port, thereby reducing carbon foot print inside the port area and improving the air quality. Introduction of these buses has reduced the vehicle movement inside the Port (Other than goods transporting vehicles), which would reduce accidents inside the Port area, thereby improving the safety of all the Port stakeholders. The vehicles shall also promote Cruise tourism





and shall be used to ferry passengers from cruise terminal to Main Gate and back. The deployed buses are fully electrically operated. The buses consume around 40 units of electricity to be fully charged and are capable of operating 200 KMs on a single charge. The buses are also equipped with fast charging facility that can be charged fully within 90 minutes. The buses also features superior comfort and safety add-ons like Air Conditioner, CC Camera, Fire extinguishers, emergency safety stop button, Driver Announcement facilities, Digital Displays, GPS etc.

Environmental Awareness Programmes: Every individual feels that he/she is champian of environment and he / she is aware of consequences. In reality no One actually bothers. To put it simple: Everyone wishes to be under the shade of a tree in the not seen, but no one is willing to plant a tree. That is the dilemma we all live in every day. We always want someone else to do that job. No One to be blamed. It is the human nature. It needs herculean efforts to make people aware of the environmental hazards. It needs positive relation with people to carry out "green initiatives" else nothing can be done. It is a continuous programme wherein the employees, students & housewives have been actively made as partners of change. These programmes includes celebration of events marking environment awareness, and regular plantation campaign in monsoon. etc.

Natural Vegetation:- Charity begins at home . It is the policy of NMPA that every VIP who visits the Port will Plant a sappling in the presence of employees of Port. It motivated the employees and further contributed for development of green belt. At present NMPA has achieved 33% of "green cover" as against 30%. Perhaps New Mangalore Port is the only Port in the country to achieve such landmark distinction among other major Ports. The journey in this direction is not an easy one. Management has spearhead the initiative in developing the vegetation programme. This initiative includes selection of "species" suitable to the land and environment. i.e. endemic and non-endemic sapplings, use of treated sewage water, use of natural gober, environmental friendly material such as laterite bricks for protection and survival, inputs from forest dept. and experts opinions etc. After due consideration of these inputs, a comprehensive programme was prepared and implemented . Firstly, an independent nursery was set up and nurtured. A systematic production and supply of sapplings made available under





supply chain management. So far more than 1,00,000 saplings have been planted in the Port area and survived too. New Mangalore Port is very near to the sensitive eco zone namely Western Ghats. The green cover developed by the Port in four years have definite bearing on climatic change in the Port due to the 'Carbon sink' and pure oxygen. One visible change noticed in the Port is the increased number of bird population and the presence of butterflies inside the Port. These two natural species are the direct outcome of environmental measures adopted by the Port. The variety of Plants developed and planted are enclosed to the report.

Solar Energy: NMPA has installed solar power plant at an expenditure of 33.75 Crores during the year 2016-17. NMPA is generating 5.2 MW with its own ground mounted & roof top solar grid contributing towards Carbon reduction NMPA has become 100% solar powered Port. Using solar power, NMPA has reduced the carbon foot print reduction of about 30,437 Tonnes every year.

Waste to Wealth:-Solid waste is heterogeneous in nature, and any single method is not sufficient for its management. But Non-toxic fraction of the solid wastes can be used as feedstock for various biological processes to recover or produce value-added products from solid wastes. Port has adopted vermicomposting for the kitchen waste of the Colony residents. In this process, earthworms convert compostable fraction of the solid wastes into stabilized, finely divided peat-like material called vermicompost that can be used as manure, this in turn contributing towards the Waste to wealth concept. The Port has adopted Zero Discharge of Sewage and Solid waste.

Environment Management System :- New Mangalore Port in its right earnest has evolved comprehensive Environmental Plan. New Mangalore Port is the Sixth Largest Port in the country in terms of volume of cargo handled per annum. In the absence of any comprehensive environmental plan, the issues of pollution may become chronic and cause problems to the Port operations. Pollution in the two natural sector, namely water and land need to be addressed and maintained through out the year. New Mangalore Port has successfully implemented the Environment Management System and monitoring plan to combat air, water & noise pollution by adopting various methods which are environmentally friendly.







1.2 MLD Sewage treatment plant



Rain Water Harvesting



Coal Settling Pond



Dry Fog Dust Suppression System





View of Concrete road

Sprinkling system at Railway marshalling yard







Sprinkler System at Wharf area



Wind Barriers



Mock Drill of Fire Fighting at Oil berths



Vermicomposting Units



Ballast Tanks & Slop reception facility



Cargo transportation through Wagons









Vehicle tyre washing

Mechanical coal handling through Quay Gantries

To ensure better environment in & around the project site as well as the neighboring population, an effective EMP is developed separately for construction phase.

Table 9-1: Activities during Construction Phase	e
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Phase Land-side Activity		Water-side Activity
Construction	 Site Clearing Transportation of Raw material Construction/ Precasting/ Fabrication/ Welding/ Crane tracks 	 Construction of the berth Dredging Men & Material Transportation Construction Waste Generation

Table 9-2:	Activities	during	Operation	Phase
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Phase	Land-side Activity	Water-side Activity
Operation	 Operation of Berth Parking & probable traffic congestion Basic Utilities Waste Management Operation of generators & machines 	 Loading Unloading of vessels Berthing





9.2 Environmental Management Cell (EMC)

It is a cell for Environmental Management at the project site. EMC's overall responsibility is coordination of the actions required for environmental management and mitigation, and for monitoring the progress of the proposed management plans and subsequent actions to be taken for the project. The Cell is to be headed by a qualified Environmental Engineer and the other members of the cell that will include an environmental field scientist, Health & Safety Engineer and operators for machines present on site.

Table 9-3: Institutional Composition of Environment Management Cell

Sr. No.	Designation	Qualification	Responsibilities
1	Manager- Environmental	B.Tech	Implementation of EMP, compliance
	Engineer (Reporting to	Enviroment	with regulatory conditions,
	Project Head – EHS)		Coordination with vendors
2	Health & Safety In charge	M.Sc.	Daily site inspection, compliance of
	(Reporting to Project Head –	Environment	EHS policies, reporting incidents,
	EHS)		

The EMC will prepare a formal report on environmental management on regular interval. Apart from responsibilities listed above, the EMC will have the responsibility of the following:

- > To implement the environmental management plan effectively,
- Risk identification and control of environmental problems
- > To assure regulatory compliance with all relevant rules and regulations,
- > To minimize environmental impacts as by strict adherence to the EMP,
- > To initiate environmental monitoring as per approved schedule.
- Maintain documentation of good environmental practices and applicable environmental laws as ready reference.
- > Maintain environmental related records.
- > Coordination with regulatory agencies, external consultants, monitoring laboratories.





- All the Environment related aspects will be handled by a dedicated group and will be responsible for the compliance to all the issues - To manage post project-monitoring plan as per approved EIA & EMP.
- > To develop & maintain green belt

9.3 Environmental Safety & Management System (EMS)

The objective is to establish a system to assess, monitor and manage environmental performances, which can be used to promote continual environmental improvement and prevention of pollution. Suggestion is to adopt Environment, Health & Safety Management System (EHS & MS) based on recognized international standards for environmental and safety management systems (ISO 14001 - 2015; OHSAS 18001- 2007, 2008).

The procedure that can be adopted in formulating the EMS is presented below:

- > Identify and list out environmental aspects due to the operation of the proposed project
- > Determine the key operations that have significant environmental impacts
- Identify and track environmental legislations, policies, codes and other relevant requirements



Authority



Table 9-4 Environmental Management Plan: Aspect Impact Matrix

S No.	Activity	Relevant Environmental components likely to be impacted	Likely Impacts and their significance in the absence of Mitigation Measures	Proposed Mitigation Measures	Responsible Agency for Implementation
			Constru	uction Phase	
1	Material transport, Storage yard development and equipment installation	Air Quality	Exhaust emissions from vehicles Fugitive dust during material unloading Dust suspension during site preparation and construction	Providing adequately sized construction yard for storage of construction materials, equipment tools, earthmoving Equipment, etc. Adopt spill control measures and labelling / handling procedures Provide enclosures on all sides of construction site Movement of material will be mostly during non-peak hours. On-site vehicle speeds will be controlled to reduce excessive dust suspension in air and dispersion by traffic	Construction Contractor/NMPA



Multipurpose Cargo Berth (Berth No.17) at New Mangalore Port



		vehicles will be periodically washed to accumulated dirt Water sprinkling will be carried out to suppress fugitive dust Environmental awareness training will be imparted to personnel involved in developmental works	
Noise	Noisefromfollowing activitiesVehiclestransportingconstructionmaterialDiesel run enginesofconstructionmachinery	Noise levels will be maintained below threshold levels stipulated by Central Pollution Control Board (CPCB)/ KSPCB Procurement of machinery / construction equipment will be done in accordance with specifications conforming to source noise levels less than 85 dB (A) Well-maintained construction equipment, which meets the regulatory standards for source noise levels, will be used Any equipment emitting high noise, wherever possible, will be oriented so that the noise is directed away from sensitive receptors Noise attenuation will be practiced for noisy equipment by employing suitable techniques	Construction Contractor and NMPA



Multipurpose Cargo Berth (Berth No.17) at New Mangalore Port

ÚLTRA TECH

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			such as acoustic controls, insulation and vibration dampers. High noise generating activities such as piling and drilling will be scheduled to minimize noise impacts Personnel exposed to noise levels beyond threshold limits will be provided with protective gear like earplugs, muffs, etc. Ambient noise levels will be monitored at regular intervals	
	Disturbance to Natural Drainage pattern	Impact to natural flow of runoff due to blockage and change of drainage course	Adequate storm water drainage system will be provided. If natural drainage disturbed, it will be reinstated No major impact on the natural drainage pattern is envisaged	
	Vegetation and Strain on Existing infrastructure	Loss of vegetation and strain on existing infrastructure.	There will be minimal loss of vegetation Construction workers will be procured from nearby villages, so that there will not be additional strain on villagers	NMPA
	Existing Traffic	Traffic addition	External connectivity is available. Internal road and approach road to the proposed site of the berth exists already.	



Multipurpose Cargo Berth (Berth No.17) at New Mangalore Port



				The roads must be regularly maintained and special care has to been taken to protect road from heavy load vehicular movement damage, various sub layers	
2	Solid Waste Management	Soil quality	Land contamination due to disposal of solid waste on ground	Composted bio-degradable waste will be used as manure in greenbelt. Other recyclable wastes will be sold. Excavated soil will be stockpiled in a corner of the site in bunded area to avoid run off with storm water. General refuse generated on-site will be collected in waste skips and separated from construction waste. Burning of refuse at construction sites will be prohibited.	Construction Contractor and NMPA
3	Handling of hazardous wastes	Human safety and property loss	Accidents during construction	Adequate safety measures as per OSHA standards will be adopted Construction site will be secured by	Construction Contractor and NMPA



Multipurpose Cargo Berth (Berth No.17) at New Mangalore Port



				fencing with controlled/limited entry points. Hazardous materials such as lubricants, paints, compressed gases, and varnishes etc., will be stored as per the prescribed/approved safety norms. Medical facilities including first aid will be available for attending to injured workers. Handling and storage as per statutory guidelines. Positive isolation procedures will be	
				adhered	
4	Dredging	Water Quality	Increase in turbidity	Dredging should be limited to specified project area and completed within stipulated time frame	
		Noise Quality	Increase in marine noise	Dredging should be limited to specified project area and completed within stipulated	



Multipurpose Cargo Berth (Berth No.17) at New Mangalore Port



				time frame	
		Soil Quality	Disturbance of	Dredging should be limited to specified	
			marine sediments	project area and completed within stipulated	
				time frame	
		Waste	Generation of	Dredged spoil should be dumped only at	
		Generation	dredged spoil	designated area.	
				Dredged spoil should not be used for land	
				filling in non CRZ area	
		Ecology	Reduction in	Dredging should be limited to specified	
			primary	project area and completed within stipulated	
			productivity,	time frame	
			smothering of fish		
			larvae		
			Opera	ation Phase	
5	Cargo	Air Quality	Emissions from	Storing coal, etc. in silos	NMPA
	handling and		loading / unloading		
	Inland Cargo		equipment, DG sets,	Using telescoping chutes to eliminate the	
			vehicular dust	need for slingers	



Multipurpose Cargo Berth (Berth No.17) at New Mangalore Port



			emissions, fugitive	Using vacuum collectors at dust-	
			emissions from	generating activities	
			storage areas,	Using slurry transport, pneumatic or	
			spillage of cargo	continuous screw conveyors, and covering	
				other types of conveyors	
				Scientific and regulated stacking of cargo piles	
				Regularization of truck movement	
				Periodic cleaning of cargo spills,	
				Greenbelt Development	
		Noise	Due to equipment	Acoustic Barriers and Enclosures	
			handling and vehicular	Personal Protection Equipment (PPE)	
			movement Ship	Greenbelt Development	
			unloading/loading	Counselling and traffic regulation	
			operations		
2	Accidental	Marine water	Change in marine	NMPA has their own oil spill contingency	NMPA
2.		quality and	water quality	i the intervention of the spin contingency	
	Cargo and Oil	ecology	1	plan fully equipped to cope with any rare	



Multipurpose Cargo Berth (Berth No.17) at New Mangalore Port



	spills			cases of oil spill.	
				In case of any cargo spillage during transfer	
				from/to ships, it will be attempted to	
				recover the spills.	
				Oil spill control equipment such as booms /	
				barriers will be provided for containment	
				and skimmers will be provided for	
				recovery.	
				Response time for shutting down the	
				fuelling, containment and recovery will be	
				quicker.	
3.	Water Supply	Water	Possible strain on	All the water demand of NMPA and the	NMPA
		resources	water resources	additional water required by the project can	
				be satisfied by the current rain water	
				harvesting and storage system.	
				There will not be any need to source water	
				from the municipal corporation	
4.	Wastewater	Water Quality	Impact due to runoff and disposal	NMPA currently has an extensive network	NMPA



Multipurpose Cargo Berth (Berth No.17) at New Mangalore Port



	Discharge		of untreated sewage	of sewage system and an STP of 1.2 MLD. All the treated water is reused for sprinkling and gardening.	
5.	Solid Waste Management	Groundwater and Soil quality	Impact due to disposal of solid waste on ground without treatment	All the solid waste must be either treated in the existing composting system if biodegradable or recycled as much as possible. Manure generated must be used in greenbelt.	NMPA and Contractoctor
6.	Handling of hazardous materials	Accidents due to products handling	Human life and loss of property	Hazardous materials will be stored as per the prescribed/approved safety norms. Operation areas will be secured by fencing with controlled/limited entry points. Hazardous wastes (used oil & used battery) will be sent to KSPCB approved recyclers. Medical facilities including first aid will be	NMPA


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Authority



7.	Operation of port	Socio- economic conditions of the region	available for attending to injured workers Regular check of pipelines and tank farms Emergency alarms, provision of fire hydrant system and fire station. Effective Disaster Management Plan (DMP) which covers onsite and offsite emergency plans. Recovery of spills to the maximum extent possible. During construction and operational phase, the port expansion is likely to generate direct and indirect employment for 100 and 500 persons respectively. Local people will be given preference based on their qualification and skill set. Together with this employment potential, project will help to enhance the socio-economic conditions of the area with better employment opportunities.
		Natural Hazards	Disaster Management Plan (DMP) has already been prepared and same shall be extended to the proposed development of Berth 17. Port Authorities will act as the overall in-charge of the control of educative, protective and rehabilitation activities to ensure least damage to life and property.



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	Induced	The proposed developmental activities will provide direct and indirect benefits to the people
	Development	residing in the nearby areas. One of the main aims of the proposed project is to bring
		significant benefits to the local people and also to the region as a whole.
		The project construction and operation will generate revenue for the State and Central
		Government by way of payment of royalty, tax and sharing of port revenue. In addition, port
		development will attract investments into the region and thereby contribute to economic
		growth of Dakshina Kannada District, and the State of Karnataka.





9.4 Environment Management Fund

Table 0 5. Environment	Managamant	Cost for	Construction	and On	aration	Dhacac
Table 3-5. Environmen	i Management	C051 101	Constituction	anu Op	eration	I mases

Sr. No.	Environmental Aspect	Capital Expenditure in Lakhs (for Berth No. 17)	Annual Recurring Expenditure in Lakhs (for entire NMPA)
1	Air and Noise Pollution control	50	20
2	Wastewater Management	-	50
3	Solid Waste Management	-	24
4	Greenbelt Maintainance	25	275
5	Environmental Monitoring	25	15
6	Oill Spill Management	-	280
7	Marine Ecology Monitoring	60	40
	Total	160	Approx. 7.00 Cr

9.5 Details of CSR Budget

Sl. No.	Name of the work	Beneficiary	Expenditure (Rs.)	CSR Category
1	Financial for running school at Panambur for local children	Local children	2,55,00,000	Education & Imparting Vocational training
2	Expenditure for 3 no's of school buses for the transportation of school children from local villages to school, Panambur	Students from nearby villages	47,16,000	Education & Imparting Vocational training
3	Shifting of 12 cattles to Sri Ramachandrapura Mutt, Bhankuli, Siddapura, Uttar Kannada and annual maintenance cost of the cattles	Kamadugha Trust (R), Sri Ramachandrapura Mutt, Siddapura, Uttar Kannada	5,98,508	Pollution control measures, environment friendly technologies, preservation / restoration of environment / ecology and for sustainable development goals.

Table 9-6:	: Details	of CSR	Budget	of FY	2022-23
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Sl. No.	Name of the work	Beneficiary	Expenditure (Rs.)	CSR Category
4	Contribution of CSR fund to National Maritime Heritage Complex, Lothal, Gujarat (NMHC)	National Maritime Heritage Complex, Lothal, Gujarat	53,20,000,	As per Ministry guidelines
5	Contribution of CSR funds to Sainik Kalyan Board at District level.	Sainik Kalyan Board	10,00,000	As per Ministry guidelines
6	Contribution of CSR fundsNationalyouthDevelopment fund (NYDF)	National youth Development fund (NYDF)	10,00,000	As per Ministry guidelines
7	Financing for running school at Panambur for local children	New Mangalore Port Authority Education Society	1,40,00,000	Education & Imparting Vocational training
8	Expenditure for 3 nos. of school buses for the transportation of school children from local villages to school, Panambur	General public	47,16,000	Education & Imparting Vocational training
9	Shifting of 12 cattles to Sri Ramachandrapura Mutt, Bhankuli, Siddapura, Uttar Kannada and annual maintenance cost of the cattles	Kamadugha Trust (R), SrI Ramachandrapura Mutt, Siddapura, Uttar Kannada	5,98,508	Pollution control measures, environment friendly tech, preservation / restoration of environment / ecology and for sustainable development goals.
10	Construction of toilet block at Govt. PU College(high school section), maninalkur, Bantwal	Govt. Pre University College(high school section), maninalkur, Bantwal	5,25,000	Sanitation & Public Health
11	Construction of toilet block at D.K.Z.P. Higher Primary School, Chandalike, Bantwal	D.K.Z.P. Higher Primary School, Chandalike, Bantwal	10,00,000	Sanitation & Public Health
12	Construction of classrooms at D.K.Z.P. Higher Primary School, Kaniyoor, Puttur	D.K.Z.P. Higher Primary School, Kaniyoor, Puttur	13,50,000	Education & Imparting Vocational training
13	Construction of toilet block	Govt. Hr. Primary	10,00,000	Sanitation & Public Health



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Sl. No.	Name of the work	Beneficiary	Expenditure (Rs.)	CSR Category
	at Govt. Hr. Primary School Mannagudde, Mangalore	School Mannagudde, Mangalore		
14	Construction of classrooms at D.K.Z.P. Higher Primary School, Bhaktakodi, Sarve Post, Puttur	D.K.Z.P. Higher Primary School, Bhaktakodi, Sarve Post, Puttur	18,00,000	Education & Imparting Vocational training
15	Construction of toilet block at D.K.Z.P. Lower Primary School, Emaje, Netlamudnoor village	D.K.Z.P. Lower Primary School, Emaje, Netlamudnoor village	5,00,000	Sanitation & Public Health
16	Request for providing water cooler to Govt. Higher Primary School, Halady	Govt. Higher Primary School, Halady	53,400	Sanitation & Public Health
17	Financial assistance for the construction of community hall near Shree Bhadrakali Kshetra, Mudradi, Hebri, Udupi Dist	Shree Bhadrakali Kshetra, Mudradi, Hebri, Udupi Dist	12,50,000	Community Centers / Night Shelters / Old Age Homes
18	Construction of toilet block at the premises of Sri Mahalingeshwara temple, bannanje, Udupi	Bannanje Sri Mahalingeshwara temple, bannanje, Udupi - 576101	6,00,000	Sanitation & Public Health
19	RequestforMonetorysupportforprovidingcomputers,investors,officefurniture's	Kulai meenugarara sahakari sangha niyamitha	1,54,799	Community Centers / Night Shelters / Old Age Homes
20	Request for financial support for construction of mahila vikas Kendra, anganwadi, library and computer training centre at kulur mogaveera sangha (R), Kulai	kulur mogaveera sangha (R), Kulai	10,00,000	Setting up of skill development centres, impacting skill training, entrepreneurship development programme and placement assistance programme for youth.
TOTAL			3,58,67,707	
Monitoring of CSR activities (2% of Rs.3.66 Cr)			7,32,000	
GRAND TOTAL			3,65,99,707	





10. SUMMARY AND CONCLUSION

Introduction

New Mangalore Port is located on the West Coast of India and managed by New Mangalore Port Authority (NMPA) previously called as New Mangalore Port Trust (NMPT). The Port is a modern all-weather port situated at Panambur, Mangalore. The Mangalore Harbour Project started in 1962 and completed in May 1974. On 1st April 1980, the Port Trust Board was set up under the Major Port Trust Act, 1963 and the same was superseded on 18th February 2021, when Government of India by notification designated all the Major Port Trust as Major Port Authority. Since then, NMPA has been functioning as the 9th Major Port Trust and has fallen in line with other Major Port Trusts functioning in the country under the administrative control of Ministry of Ports, Shipping and Waterways (MoPSW). New Mangalore Port is a deep-water port and the only major port of Karnataka. The port is approached through a 7.5 km long channel with water depths -15.4 m CD in the outer channel and -15.1 m CD in the inner channel. The Port has a total land area of approximately 822 ha. and water spread area of about 120 ha.

Applicable of Environmental Clearances

The proposed project attracts Environmental Clearance under EIA Notification 2006 and its subsequent amendments. The port handling cargo more than 5 million tons per annum is scheduled as category A and requires Clearance from MoEF&CC, New Delhi.

Also, the project falls in CRZ zone II as per coastal zone management plan of Karnataka state. Hence requires CRZ recommendations from Karnataka Coastal Zone Management Authority followed by CRZ Clearance from MoEF&CC.

Project Description

Background and Need of the Project

NMPA has handed over the existing multipurpose deep draft Berth No. 14 for handling container through Mechanization to PPP operator and the Port will no longer have other deep draft berth general cargo to handle the large ships of 60,000 DWT and above. Therefore, Port has proposed to develop an additional deep draft general cargo berth in between berth No.8 and No.13, named





as Berth No. 17. It is proposed to handle RO-RO/ Cruise ships bunkering cargo ships Iron ore fines/concentrate, fertilizers, river sand, bentonite, gypsum, machinery, steel coil etc. at the proposed new berth No. 17. The proposed handling capacity of the multipurpose Berth No. 17 would be 6.13 MTPA.

Location of the Project Area

The proposed location of the berth No. 17 has been identified as the existing waterfront in between berths No. 8 and berth No. 13. Site Coordinates are - Latitude -12°55'26.39"N; Longitude- 74°48'58.66"E.

Project Siting

The proposed location of the berth No. 17 has been identified as the existing waterfront in between berths No. 8 and berth No. 13. There is a straight stretch of waterfront set back by about 40 m from the western end of berth No.8 and contained within the limit of the pump house near Berth No.13. It is possible to construct a berth of at least 300 m along this waterfront. The new berth could be in alignment with the existing berth No. 8 and with the same open-piled configuration.

The existing shoreline with pitched revetment will ensure that the waves would get absorbed instead of getting reflected. This will ensure tranquility being maintained in the harbour basin. The port also agreed with this suggestion as it will have an added benefit of providing flexibility in berthing of longer vessels either at berth No.8 or at berth No. 17.

Presently the waterfront at the proposed berth No. 17 is provided with extended stone pitching to protect the shore slope. Giving due consideration to this aspect, the new berth No. 17 is located in line with the berthing face of berth No. 8. Since this berth is located offshore, it is proposed to have three approaches.



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Proposed alignment and approach to Berth no. 17

It can be seen that on the western side of the new berth No. 17, there is the existing berth No. 13 which handles crude oil and LPG. It is generally accepted that for LPG the distance may be at least 150 m to the other installations on safety considerations. In this particular case, the edge of berth No. 17 is more than 250 m from the transfer point of the berth No. 13. Hence there is no issue on safety.

Structural model for Berthing Structures

General Arrangements

The proposed General Cargo berth is for 348.2m long with two Approaches connected to the land. The dimensions of berthing structure is 348.2m long and 26.05m wide for handling deep draft general Cargos and Approach jetty dimensions of 34m x 10m with 2 side berthing is used to connect the land. 2,00,000 DWT vessel is considered for the design of proposed Berth No.17 with dimensions of 303m (LOA) x 47m (Beam) x 18.2m (Draft) and Dredging depth is considered for (-)20.0m CD in front of proposed berth for future handling.

Berthing jetty

The structural system of proposed General cargo berth (Berth No.17) consists of 5 rows of RCC Bored cast in-situ pile with diameter of 1400mm (A-1 to 51 and E-1 to 51) and 1200mm (B1, C1, D1 to B51, C51, and D51). The deck level of proposed berth is (+) 4.66m. The dimensions





of the jetty structure (Unit -1/2/3) are 26.05m width and 116m in length. Service trench is provided on lee side of berthing structures, which will be the provision of water and electrical components throughout the jetty structures. The centre-to-centre distance for Bollard and Fender arrangements is 14m. The wearing coat is considered as 100mm. The provision is given for crane anchoring in storm condition. The centre-to-centre distance for crane rail is 22m. The dredging depth is (-) 20.0m CD in front of berthing structures. Geotextile mattress and Geo bags is considered for stability of dredging depth in front of berthing structures. Behind the berth natural slope will be adopted active to land side. The founding depth of pile berthing jetty for 1.4m and 1.2m diameter are (-) 34m CD and (-)32m CD respectively. While driving the 1.4m dia. pile and 1.2m dia. pile for hard rock stratum, a minimum of 3D (3 times the diameter of the pile) should be embedded into them, respectively.



Figure: General arrangements of Berthing Structure and Approach Structures

Storage Area

During the initial stages of operation of this new berth No.17, it will be handling only the displaced cargo from the berth No. 14. Of the dry bulk cargo handled there, it is understood that iron ore fines/concentrates, limestone, gypsum, fertilizers etc. all move directly to their respective destination and are not stored within the port. Only sand is being stored.



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Baseline Environment

Baseline environmental status has been established for various environmental attributes within a study area of 10 km radius from the project site. The study of area includes ambient air quality, water quality, marine water quality, sediment quality, noise, soil, ecology (terrestrial and aquatic/marine), land use, geology, hydrology and demographic & socio-economic conditions. The baseline data has been collected as per MOEF&CC/CPCB guidelines for three seasons – December 2021 to February 2022; March 2022 to May 2022 and October 2022 to December 2022.

Ambient Air Quality

The ambient air sampling was carried out at 8 different locations so as to determine the ambient air quality. The selected Sampling stations includes the near project site, downwind, upwind and cross wind spread across catchment, command and submergence. Assessment of the ambient air conditions has been done by studying the air quality at 8 different locations for three Seasons (December 2021-February 2022, March - May 2022 and October- December 2022). The values of PM2.5, PM10, SO2 & NOx observed in the project area and in the surrounding study are within the prescribed limits of NAAQ.

Noise Quality Level

The noise monitoring has been conducted for determination of noise levels at 8 locations in the study area. The main objective of the noise monitoring was to establish the baseline noise levels with respect to standards. The noise samples were collected in day time for 8 hours with sound level meter. The sampling locations were spread in within 10 km radius of the proposed activities. The overall noise levels in the project area are well within the limits as per ambient noise standards.

Surface Water Quality

The surface water sampling was carried out at 2 different locations so as to determine the surface water quality. The analysis results indicate that the pH values in the range of 7.3-7.6, DO was





observed to be in the range of 4.7-5 mg/l. The chlorides and Sulphates were found to be in the range of 56-71 mg/l and 53-56 mg/l which is under prescribed limit.

Ground Water Quality

The ground water sampling was carried out at 5 different locations so as to determine the ground water quality. The analysis results indicate that the pH ranges in between 7.4 to 7.8, which is well within the specified standard of 6.5 to 8.5. Chlorides were found to be in the range of 57-133 mg/l, Sulphates were found to be in the range of 62 to 90 mg/l, The Total Dissolved Solids (TDS) concentrations were found to be ranging in between 428-692 mg/l

Soil Quality

A total of 5 samples within the study area were collected and analyzed. The soil samples were examined for various parameters (viz pH, electrical conductivity, chloride, available calcium & magnesium, phosphorus, exchangeable sodium & potassium, available nitrogen etc.). Soil in the study area is Sandy loam to sandy clay loam, The soil being of friable consistency, the bulk density & water holding capacity of the soil in the range of 1088 to 1143 kg/m3 & 52.6 -57.1 respectively. The pH of the soil in the study area is slightly acidic to slightly alkaline in reaction having pH is in the range of 6.3-7.5.

Ecology and Biodiversity

Flora: Cashew, Cocoa, Casuarina, Rubber, Ailanthus, Acacia auriculiformis, Vateria indica Nutmeg, Clove, Oil palm, Teak, Bamboo Cane, Areca nut etc. have been raised successfully Natural vegetation in the study area prominently consists of *Hopea parviflora*, *Vateria indica*, *Diospyros microphylla*, *Eugenia gardnei*, *Aporasa lindleyana*, *Olea dioica*, *Syzygium species*, *Terminalia paniculata*, *Lagerstroemia lanceolata*, *Lophopetalum wightianum*, *Machilus macarantha*, *Cinnamomum spp*, *Mangifera indica*, *Artocarpus hirsuta*, *Holigarna arnotiana*, *Glorea superba*, *Ixora* and *Jatropha curcas* bushes etc.

Fauna

Mammals: Indian five stripped squirrel, Porcupine, Fox, common Mongoose, Indian Hare. Flying Fox were bserved during primary survey. Dialogue with local villagers located within the





study area fox found in study area, but no wild mammalian species was directly sighted during the field survey.

Avifauna The bird population of study area is rich and diverse. The birds observed during primary data collection survey were *Milvus migrans* (Black Kite), *Halias turindus* (Brahminy kite) *Nycticorax nycticorax* (Night Heron), *Vanellus indicus* (Red-wattled lapwings), *Euploea core* (Common Crow), *Phalacrocor axauritus* (Cormorant) etc.

In order to mitigate the impact of the project on the Schedule-I and endangered species found in the buffer zone, a detailed biodiversity management & Conservation plan has been prepared by NIO specifically for the Mangroves, Peacock, Indian fox, Marine turtles, Sharks and Marine mammals

Mangroves in Study Area

Mangroves are present along the estuarine bank of Gurupura River having dominant species i.e *Avicennea officinalis* along with other species such as Kandelia candel, *Avicennea alba*, *Rhizophora mucronata*, Vegetation including mangroves in the study area along the Gurupur estuary.

Socio Economic

Concerning the sex structure of the respondents, 52 percent of the respondents were males while 48 percent were females. This finding is in line with the trend of the sex structure of household heads in India, whereby males dominate.

-The average household size was found to be 5 members.

-Education is one of the keys to success and development and as such, people pay much attention to their educational status. Most of the sample respondents interviewed had some kind of formal education. Nearly 75 % of the respondents had attained education till graduation also Post Graduation, whereas 20 % of the respondents have completed SSC/HSC. 5 percent of the respondents have education till primary (Class 1-5) as the formal education.

-Availability of toilet is an important indicator of the sanitation. Public Toilet facility are available in study area. Many local respondents were aware of the project, which reflects that the





project proponent has carried out regular consultation with the local resident and fisherman. All respondents are in support of the project fully. Their only demand is to give the preference to local people for working labour, labour contractors, transporters and raw material suppliers etc. in construction phase and job opportunity in operation phase.

Anticipated Impact and Mitigation

Impacts on Land Environment

Impact to Land resources is one of the most potential impacts due to the construction and operation of the port project, development of ancillary sites.

Potential Impact due to Port Location, Land Acquisition and Changes in Land Use

The proposed project includes construction an addition multi-purpose berth within the existing port to cater to the displaced cargo due to planned changes at other berths. The proposed project activities are planned within existing port area; hence no land acquisition is required. Construction related activities such as clearing the site, excavation, the generation of construction waste etc. affect the land environment directly.

Clearing the site and excavation coupled with removal of vegetation triggers soil erosion and loss of top soil. Soil erosion can in turn trigger an increase in the turbidity levels in the coastal water. Hence, no major impacts are anticipated.

Contamination of the Soil

(a) Pre-construction phase

Soil contamination may take place due to movement of vehicles or solid wastes generated from the labour camp set up during pre-construction stage

(b) Construction Phase

It is also important to assess the quality of dredge material for heavy material, pesticide and oil contamination as this material will be used for filling port area on land. This contamination is likely to be carried over to water bodies in case of dumping being done near water body.

(c) Operational Phase





Periodic dredging for maintaining the depth of the channel will be important operation phase activity. The sea bed, from where dredging is to be done, can hold heavy metals The solid and hazardous wastes generated from ships and from port operations may contaminate land and water bodies if not disposed properly.

Mitigation Measures - Land and Soil

The land use of the backup areas may not be changed and the facilities and other building will be constructed as per the existing landscape without any major cutting and filling and hence will not be impacted. During the operation phase adequate measures shall be taken to ensure that all waste generated at the site is collected and disposed as per the requirements Mangaluru City Corporation (MCC). Hazardous waste likely to be generated from proposed facilities is the wastes such as oil and grease from machinery and equipment must be disposed as per Hazardous waste (management) Rules 2016.

Potential Impacts on Local Infrastructure

During construction phase, significant amount of construction material will be required, particularly quarry stone for the construction of bunds, buildings, etc. once the excavation of construction material is completed.

Borrow Areas - impacts & mitigation measures: NMPA and EPC (Engineering Procurement Construction) Contractor has to ensure that the sourcing of borrow material shall not lead to any potential impact to the local communities

- Borrow pits would be located along the natural drainage course and not across the natural drainage.
- Top fertile soil shall not be used for construction material.

Construction Workers - impacts & mitigation measures:

There will be a requirement of about 100 to 150 work force (excluding service providers) during the construction phase (about 24 months).





As far as possible the workforce would be local hence no labour camps would be required to be set up, therefore not adding any additional stress on the local infrastructure. This would also ensure that there is no conflict with the local population. To mitigate impacts from health hazards, sanitation self-sufficient infrastructure facilities must be provided.

Mitigation Measures during Construction Phase

- To mitigate impacts from transportation of construction material, existing roads will be strengthened and widened if required,
- Trucks with construction material susceptible for fugitive suspension will be covered with tarpaulin covers
- Transportation management will be adopted for movement of dumpers transporting quarry stones and construction materials and traffic will be regulated

Discharges from Ships on Land - Potential Impacts and mitigation measures during Operation

No discharge of wastewater/waste from the ships calling at New Mangalore port will be permitted into the port area. Facilities for discharge of waste oil will be provided at the port. The ships will have their own sewage reception/treatment facilities on board and hence no discharge of sewage will be done at the port.

Water Environment

Potential Impacts on Surface Water

The preliminary assessment indicates that daily demand of water during the construction phase will be around 100 KLD. The water demand will be met by the rainwater harvesting system within the port area. Major impacts caused by such activities on surface water bodies is due to litter, Wastewater generation at construction site includes surface runoff also which may contain pollutants and traces of solvents, paints, metal compounds, etc. which may impact the groundwater and nearby surface water resources, if not managed properly.





There are a number of activities associated with construction of the proposed project, which could have impacts on surface water:

- Poor control of run-off from site activities leading to siltation and eventual blocking of drains caused by excessive sand and silt in the storm water run-off
- Pollution of surface water caused by improper handling and disposal of other types of construction site wastewater
- Water pollution may result from wastewater produced by the quarry activities and by the accidental spillage of fuel, lubricants and other chemicals used in the quarry process.

Potential impacts during operation phase

Storm water and excess dust suppression water runoff from the cargo storage areas and other areas of the project facilities may contaminate marine water quality if not regulated properly and will impact the marine water quality by increase in turbidity and reduce DO levels which in turn will impact the marine life.

Mitigation measures – Surface Water

- Project Water Management Plan should be developed in order to secure the project sustainable water balance and in the project region in the construction phase.
- A surface water monitoring program shall be implemented during the construction phase.
- The port already has a functional STP of 1.2 MLD capacity. All the wastewater and surface run-off must be treated before it is used for sprinkling, dust suppression and greenbelt development. This facility must be monitored and maintained regularly.

Potential Impacts on Groundwater

There are a number of activities associated with construction of the proposed project, which could have an impact on groundwater; no significant impacts on groundwater environment are envisaged.





Spillage or infiltration of oils, fuels and hydraulic fluids from plant maintenance and re-fuelling areas into the soil.

Blockage of three present natural drains in the port area will lead to higher groundwater tables and a permanently changed drainage pattern.

Mitigation measures – Groundwater

Baseline review of the existing groundwater resources and current consumption in the project region. A study should be initiated to investigate the change in hydro-geological conditions, the available aquifers and safe yield levels. A groundwater monitoring program should be implemented during the construction phase.

Biological Environment (Terrestrial Ecology)

Terrestrial Ecology

Impacts on Terrestrial Ecology during Construction Phase

No threatened species were observed under the impact area. Project site is surrounded by port activities and there is a very less vegetation exists in the vicinity. Hence, no major impact on terrestrial ecology is envisaged at project site. Fugitive emission formed during the construction activity may accumulate on the leaves of the plant which may diminish photosynthesis of young plants. The noise generated during the construction activity may have some negative impact on birds in the area. However, these impacts are localized, short termed and reversible.

Impacts on Terrestrial Ecology during Operation

The proposed project would not dispose effluent or solid waste in the existing environment. In addition to the wastes, noise generation from project operation would also be minor. Hence there will not be any major adverse impact on ecology during operation phase. Further, the proposed site is covered with open scrub vegetation but after proposed project, greenbelt area will be developed which will result in beneficial impacts on ecological layout of the project area. As per the survey close to the proposed site and in the vicinity, no endangered species or wildlife is reported.





Mitigation measures:

Care must be taken to minimize the dust formation due to construction activity viz. sprinkling of water. Noise generated by construction equipment's will be controlled through provision of mufflers in machines and implementation of other noise control measures.

Socio-economic Impact

The setting up of any kind project would undoubtedly include significant impact on socioeconomic and cultural life of the people in the project area. Here, an attempt is made to visualize and discuss such tentative impacts likely to be induced by the project. The likely impacts due to project activity are described below:

Positive Impacts

The project does not involve any displacement of inhabitants and so issues like resettlement and rehabilitation does not figure. Proposed project is within port limit.

Proposed developmental activities will provide direct and indirect benefits to the people residing in the nearby areas.

The project construction and operation will generate revenue for the State and Central Government by way of payment of royalty, tax and sharing of port revenue.

Port development will attract investments into the region and thereby contribute to economic growth of Dakshina Kannada District, the State of Karnataka.

Negative Impacts

Due to the project activity, influx of population may increase during the construction phase. This may lead to strain on infrastructure facilities in the area as well as increase in population at local level. However, this impact is only for the short duration and temporary in nature.

The construction activity could lead to increased nuisance level from air emissions and noise due to transportation of material and equipment as well as laborers.





Socio Economic Environment: Mitigating Measures

In order to mitigate the adverse impacts likely to arise in the surrounding area due to proposed project activity, it is necessary to formulate an effective mitigation plan. The suggestions are as follows:

Before Commencing and During Initial Phase:

Information regarding the proposed development plan, community programmes etc. should be communicated to the local community in the form of display Poster, booklets and audio-visuals at project site.

Construction Phase:

Project proponent should take appropriate steps to keep environment clean and healthy during construction phase.

Provision of adequate drinking water, toilet and bathing facilities should be made available on project site.

Water shall be sprinkle/spread to suppress dust during construction phase to control air pollution. Control the ship and trawler traffic, Noise Pollution and thereby avoid adverse health impact.

Operation Phase:

The project collectively will need a pool of Boat or trawler mechanic, Driver, Fisherman, Helper, watchmen, sweepers, plumbers, fitters, solid waste collectors or any kind of job opportunity. Preference should be given to local people for all this.

Provision of proper parking arrangement, traffic management plan for smooth flow of a vehicle also cargo ship helps to abate noise pollution due to traffic.

COVID-19 Pandemic:

Regular cleaning i.e. microbial disinfection of labour assembly point, office, canteen, labour colony etc.

Sanitization/ Hand wash stations.





Temperature checkup and maintenance of log of the same at labour camp and project site.

Regular medical check-up of all the workers and staff, First aid and essential medical services should be provided at site.

Air Environment

Potential Impact during Construction

Impact due to Transportation of Construction and Cargo Material

Some of the project activities (site clearance, dredging and reclamation, construction of breakwaters, construction of port infrastructure, traffic during construction and use of heavy machinery construction of road and rail) will generate air pollutants like NO₂, SO₂, HC, CO, PM, VOCs, etc. This has the potential to cause temporary impacts on the air quality.

The baseline concentrations of Particulate Matter (PM_{10} and $PM_{2.5}$), SO_2 , NO_2 and CO are within the limits of NAAQS stipulated by MoEF/CPCB.

Mitigation Measures

The following measures could mitigate the anticipated negative impacts on the ambient air quality:

- Transportation vehicles to be properly and timely maintained and serviced regularly to control the emission of air pollutants in order to maintain the emissions of NOX and SOX within the limits established by international regulations;
- All static and mobile diesel-powered plant / generator sets should be used only during power cuts;
- Use of good quality fuel and lubricants will be promoted. Moreover, low sulphur content diesel shall be used as fuel for generator sets to control emission of SO2;





Potential Impact due to Operation

Operation of the port (container terminal, multi-purpose cargo, and cruise) does not include bulk or uncovered materials exported from or imported to the terminal or stored on site. The sources of air pollutants from port operations include combustion emissions from ships" propulsion and auxiliary engines and boilers, mainly consisting of sulphur dioxide (SO₂), nitrogen oxides (NOX), greenhouse gases (e.g. carbon dioxide [CO₂] and carbon monoxide [CO]), fine particulate matter [PM], and volatile organic compounds [VOC].

Mitigation Measures

The following measures could mitigate the anticipated negative impacts on the ambient air quality during operation phase:

- Generators, machineries and vehicles are to be serviced and maintained regularly to avoid generation of dust and other air pollutants.
- Regular verification of PUC certificates of all the vehicles entering into the port area.
- Developing air quality management procedures for ship operators, such as navigation of port access areas at partial power, achieving full power only after leaving the port area, limiting the practice of blowing soot from tubes or flues on steam boilers.

Impact due to Cargo Handling and Storage

During the initial stages of operation of this new berth No.17, it will be handling only the displaced cargo from the berth No. 14. Of the dry bulk cargo handled there, it is understood that iron ore fines/concentrates, limestone, gypsum, fertilisers etc. all move directly to their respective destination and are not stored within the port. Only sand is being stored.

Mitigation Measures

- Provision of adequate dust suppression measures, such as sprinklers, etc. must be made.
- Storage must be covered as far as possible.
- Workers must be provided with safety equipment and gas masks.





Noise Environment

Impact due to Port Construction Activities

Construction noise will result from operation of equipment including the dredger and associated tugs, piling equipment, tracked excavators, Lorries, dump trucks, and other earth-moving equipment, cranes, and generators / lighting equipment.

The noise and vibration generated by piling in water if not controlled and monitored properly, can be transmitted considerable distances through the water and therefore have the potential to impact on marine mammals. There are no marine mammals present in the port foot print area and nearby premises.

Mitigation Measures

The following measures could mitigate the negative impacts caused by noise emissions:

- Noise mitigation measures shall be in place prior to the commencement of any construction work.
- All contractors and subcontractors involved in the port construction phase should comply with the relevant international noise standards;
- Activities that take place near residential or sensitive receptors to be careful planned (restricted to daytime, taking into account weather conditions, etc.)

Impact due to Dredging

It is proposed activity, the dredging is proposed up to a depth of (-) 15.10 m. Capital dredging will be carried out and the quantity is assessed to be approximately 1, 50,000 cubic meters. while dredging activities it might increase the turbidity of the marine water, generate noise from a variety of sources, the primary sources of equipment noise would include the cutter suction dredger itself, with its associated pumps and generators and the tugboats used to position the dredger.





Mitigation Measures

- Where necessary, noise emissions should be minimized and controlled through the application of techniques which may include installation of sound barriers
- Optimizing dredging activity and duration to reduce the time factor

Impact due to Port Operation

Impacts during operations mainly will result from the port terminal activities such as vessel loading/unloading, container handling and access road/rail traffic that will result from container traffic arriving and departing through the port business day. Another major source of noise could be the operation of various equipment.

Mitigation Measures

- Transmission of noise and vibration are limited by the distance from their sources. Noise could be considerably reduced by adoption of low noise equipment or installation of sound insulation barriers. Green belt can be a good barrier to noise as well as dust emissions.
- Proper lubrication, muffling and modernization of equipment shall be done to reduce the noise, D.G. Set with acoustic enclosure shall be provided. It is recommended that workers operating various equipment during project construction and operation phases are provided with ear plugs.

Solid Waste Management

Potential Impact during Construction

Construction and Other Wastes

Construction will potentially generate the following wastes: green wastes from vegetation clearance, excess construction materials, Excavation materials; food wastes from construction personnel; site office wastes; and human waste; poor construction procedures that generate excessive wastes increase construction costs and results in disposal of otherwise valuable





resources. In the study area no sanitary landfill is foreseen. Therefore, there is a moderate risk to the soil quality, surface and groundwater and marine environment.

The municipal waste generated during the project construction phase shall be of the order of only 50 to 100 kg/day.

Hazardous Materials

Hazardous wastes (oil, chemicals, lubricants, paints, compressed gases, and varnishes, etc.) generated during the construction phase should be dealt with separately from non-hazardous waste.

Mitigation Measures/Solid Waste Management

The sewage/solid waste/hazardous wastes to be treated and disposed or sold to authorised recyclers as per the MoEF guidelines.

• Proper sanitation bins to be installed in the port area for collection of sewage/solid waste/construction wastes on site.

Solid waste generated during the construction process to be separated and recycled where possible / appropriate.

Potential Impact during Operation

The amount of solid waste produced by the operational activities in the proposed port may be quite substantial. Wastes originating at the port may include inert solid waste from cargo packaging and from administrative offices, as well as hazardous or potentially hazardous waste associated with vehicle and equipment maintenance operations (e.g. used lubricating oils and engine degreasing solvents).

Mitigation Measures

The port Waste Management Plan should be developed defining adequate measures for SW collection, segregation, reuse and disposal.





• Port operation activities solid waste shall be adequately collected and managed by Contractor (as one option) in accordance with the relevant Indian laws, IFC PSs and IFC EHS guidelines for Waste Management Facilities.

Additional Studies

No Rehabilitation and Resettlement is involved in the proposed project. Hence no R & R study has been carried out.

Project Benefit

- Proximity to Major International Sea routes
- Road connectivity to 3 National Highways 66, 75 & 169
- Rail connectivity to 3 zonal railways Southern/South Western/Konkan
- Air connectivity through Mangalore International Airport Largest LPG handling Port in India
- Highest coffee exporting port in India
- An ISO 9001:2015, 14001:2015 & ISPS Compliant Port

Other Benefits

- An opportunity to develop the area and the quality of life of people
- A great opportunity to increase the financial status of government

Environment Management Plan

The Environmental Management Plan [EMP] has been framed on the basis of baseline data, components of the project activities and relevant mitigation measures. While it emphasizes effectiveness of managing the recommended mitigative measures it was necessary to identify credible organizations/agencies which could be made responsible to implement them properly. Budgetary support has been made intrinsic with the management items.





11. DISCLOSURE OF CONSULTANT

This EIA report is prepared by Environmental Consultants M/s ULTRA TECH Environmental Consultancy & Laboratory, who have been accredited by QCI-NABET vide certificate no: NABET/EIA/2023/RA 0194 on behalf of NMPA.

ULTRA TECH offers environmental consultancy services to assist its clients to obtain environmental clearance from respective authorities. ULTRA TECH also provide STP/ETP/WTP project consultancy on turn-key basis apart from Operation and Maintenance of these projects on annual contract basis. Also, having MoEF&CC approved environmental laboratory, ULTRA TECH provide laboratory services for monitoring and analysis of various environmental media like air, water, wastewater, stack, noise and meteorological data to its clients all over India and abroad.

Credentials:

- State of Art Environmental Laboratory & Trained Manpower, Gazetted by MoEF&CC
- Environmental Advisor for Municipal Corporation, Federation of All India Textile Manufacturing Association and All India Lead Manufacturing Association
- Affiliated to Indian Green Building Council (IGBC), Hyderabad and United States Green Building Council (USGBC), US.
- ISO 9001:2008, 9001:2015, Quality Management System implemented.
- Environmental Consultants for All India Lead Manufacturing Association.
- Environmental Consultants for Federation of All India Textile Manufacturing Association

ULTRA TECH Environmental Consultancy and Laboratory [recognized by Ministry of Environment, Forests & Climate Change, Govt. of India] is an established Environmental Service provider since 1986. ULTRA TECH is serving in six environmental domains:

- EIA studies and Environmental Clearance
- Environmental Due Diligence and Audits
- Water and Wastewater Project consultancy and turnkey execution





- Post EC Compliances
- Environmental laboratory services and
- O&M for ETP/STP

ULTRA TECH has well developed infrastructure at Thane, Pune, Kochi, Delhi, Kolkata and Singapore to cater to needs of the clients for all environmental services.

Environmental Laboratory Services

Our Environmental Laboratory, recognized by Ministry of Environment Forests and Climate Change [MoEFCC], Government of India, is committed to provide Laboratory Services to valuable clients. Our laboratory is based in Thane plays a vital role in monitoring and analysis of environmental attributes like air, water, wastewater, microbiological (Coliform) and biological (Phyto and Zooplanktons, Benthic Micro and Macro invertebrates, Fish), soil, sludge, sediment, noise stack, etc.

Monitoring & Analysis Services

We have been providing following monitoring and analysis services for:

- Drinking water, packaged water, wastewater
- Industrial effluent analysis
- Microbial analysis for portability
- Ambient air quality monitoring
- Stack/process emission monitoring
- Efficiency assessment for air pollution control equipment
- Work place monitoring
- Monitoring as per the requirement of OSHA, ISO, factory act requirement
- Soil & sludge analysis
- MSW/hazardous waste analysis