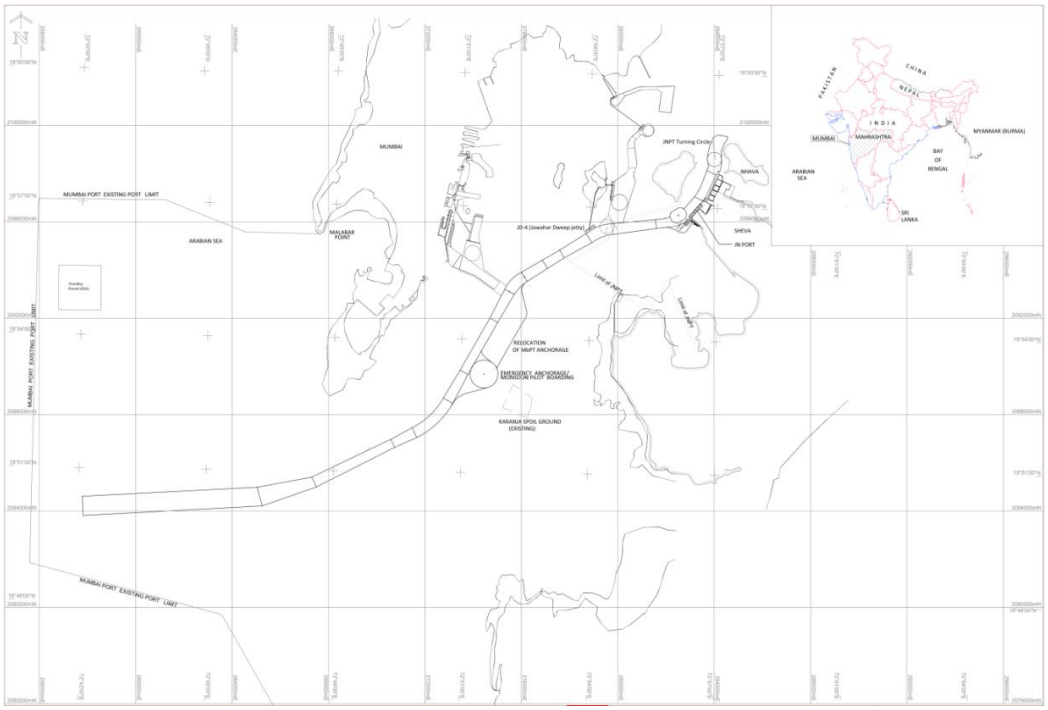
EXECUTIVE SUMMARY

ABOUT JAWAHARLAL NEHRU PORT TRUST

The Jawaharlal Nehru Port Trust (JNPT) at Navi Mumbai (formerly known as the Nhava Sheva Port) located within the Mumbai harbour on the west coast of India, commissioned on 26th May 1989. It occupies a place of prominence among the major Indian ports. It is the second youngest and one of the most modern major ports of the country. It was initially planned to be a "satellite port" to the Mumbai Port with the purpose of decongesting traffic at the latter, eventually it was developed as an independent port on its own right and it became the country's largest container port. Jawaharlal Nehru Port (JNP), is one of the twelve major ports of India. JNP has five terminals - three terminals for handling container cargo, one terminal for handling liquid cargo and one shallow water terminal for handling dry & break bulk cargo. The cargo handling capacity of the port in 2015 is about 64 million tons per annum (MTPA) which includes container handling capacity of 4.2 million TEUs per annum (MTEUsPA).

FIG. 1 LOCATION OF JN PORT AND CHANNEL



ABOUT THE PROJECT

JNPT conceptualized the capital dredging of channel in two phases to enable the movement of these new generation vessels. In Phase I,EC/CRZ clearance obtained from MOEF & CC in year 2009. It includes deepening additional depth from (-) 11 m CD to (-)13.1 in JNP area and (-) 14.20 m CD in outer channel to facilitate handling vessels of 14 m draft (about 6000 TEU) with utilization of tidal window. The channel length was increased from 29.5 km to 33.5 km. In phase

II i.e. proposed project involves dredging of channel 14.7m to 15.9 m depth which will handle 18 m draft. Location of JNPT and access channel is given in Fig. 2.1. To cater depth need of the modern vessels JNP has proposed deepening and widening of existing channel. The layout of alignments of the existing and proposed extension of the channels are presented as Fig. 2.2 and Fig. 2.3 respectively.

FIG. 2 LAYOUT OF EXISTING CHANNEL

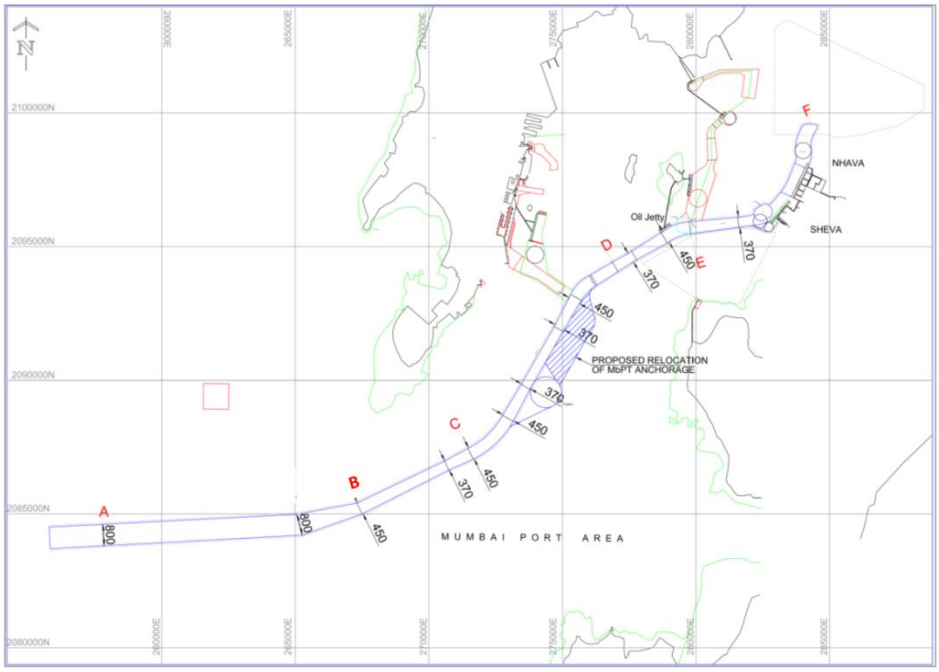


FIG. 3 LAYOUT OF PROPOSED CHANNEL

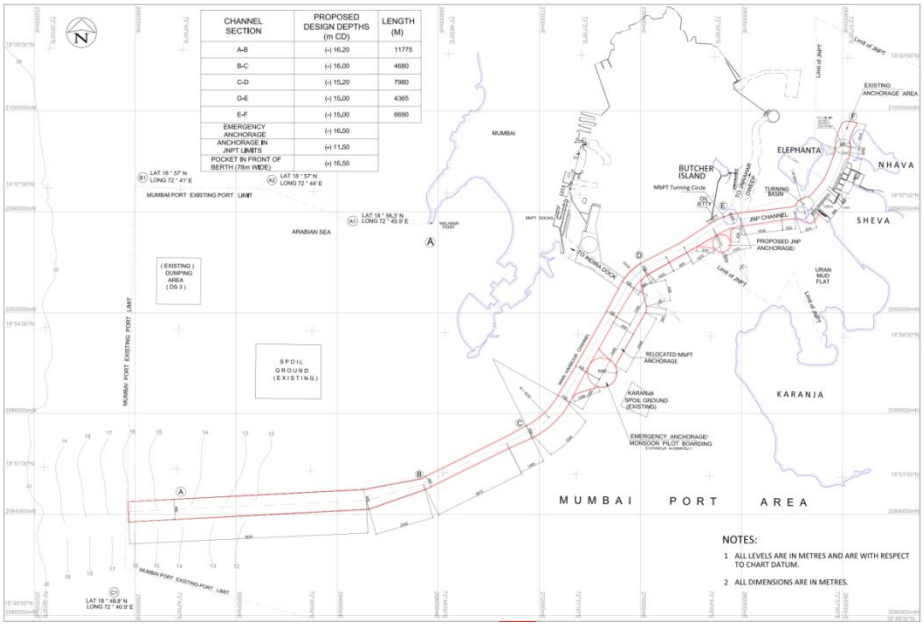


TABLE 1. DESCRIPTION OF THE VARIOUS SECTIONS OF THE CHANNEL

Section		Orientation	No. of legs	Width	Length	Depth
A-B			2		9,775 m	vary from (-)14.3 m CD and (-)15.5 m CD.
		87° wrt north	1-7,430 m	800 m		
		74° wrt north	2-2345 m long	450 m		
B-C		64° wrt north	1	Narrows down from 450 m to 370 m	4,680 m	vary from (-)14.6 m CD and (-)14.9 m CD
C-D (Karanja)		64° wrt north to 29° wrt north	1	At the bend is 450 m which gradually reduces to 370 m in the straight section	7,890 m	vary from (-)14.3 m CD and (-)15.0 m CD
D-E (Uran)		29° to 58° wrt north	1	At the bend is 450 m, which gradually reduces to 370 m in the straight section and again increases to 450 m near the oil jetty	4,365 m	vary from (-) 14.0 m CD and (-)15.0 m CD
E-F (Eliphanta)	South Elephanta sector	58° to 85° wrt north	-	370 m	2,825 m	vary from (-)13.1 m CD and (-)14.9 m CD
	Elephanta deep sector	85° to 43°	-	370 m	3,865 m	vary from (-) 13.1 m CD and (-)18.5 m CD.

Channel dimensions

The existing channel to JNP is a 33.5 km long two way channel with a width of 370 m along straight stretches and 450 m at bends. Layout of the existing channel is shown in **Figure 2.2.**

For purposes of study and analysis, the entire channel has been divided into 5 sections viz. A-B, B-C, C-D, D-E and E-F. The channel is shared by Mumbai port and JNP from Section A-B to Section D-E. Section E-F falls in JNP port limits. Description of the various sections of the channel is presented in table 1. In the channel area under consideration for the present study it is observed that the maximum depth of the navigational channel to be dredged is about -15.9 m while the estimated channel width is maximum 450 m.

Anchorages

Northern Anchorage Area ('A' Area) – Refer NHO Chart 2016

This anchorage is quite far off from Mumbai Port entrance and is generally not preferred by ships/port as ships take almost 2½ to 3 hours to arrive at the pilot station from this location. Water depths vary between 20 m to 30 m.

Southern Anchorage Area ('B' Area) – Refer NHO Chart 2015

The southern anchorage area is bounded by the following co-ordinates:

TABLE 2 LOCATION OF PROJECT

Southern	Lat. 18º35.7' N	Long. 72º33.6' E
Eastern	Lat. 18º42.0' N	Long. 72º41.6' E
Northern	Lat. 18º53.0' N	Long. 72º31.5' E
Western	Lat. 18º46.0' N	Long. 72º23.0' E

This area is towards southwest of port entrance and is quite extensive. It is quite closer to the port entrance and is preferred by the port as well as ships. It takes about 1 to 1½ hours to travel from this location to the pilot station.

Sheltered Anchorages

Mumbai harbour being a natural harbour provides a large number of sheltered anchorages. For use in fair weather season, designated/marked anchorages starting soon after pilot station are lettered V to Z (Rows) upto Sunk Rock Light House and A to J from Sunk Rock to South of Tucker Beacon. Anchorages are numbered 1 to 4 (or 5) from West to East.

NEED OF THE PROJECT

JNP and Mumbai Port share a common navigation channel for a substantial part of its length. Till 2012, the depth of the channel was (-) 11 m CD and the depth alongside berth at JNP was (-) 13.50 m CD. With increasing cargo handling requirements, consequent expansion in its capabilities and competition from neighboring ports, JNP has been called upon to handle new generation container vessels with wider beam and deeper drafts. JNPT conceptualized the capital dredging of channel in two phases to enable the movement of these new generation vessels. In Phase I, the channel depth was increased from (-) 11 m CD to (-)13.1 in JNP area and (-) 14.20 m CD in outer channel to facilitate handling vessels of 14 m draft (about 6000 TEU) with utilization of tidal window. The channel length was increased from 29.5 km to 33.5 km. JNPT is contemplating to undertake the Phase II dredging of the approach channel to facilitate handling vessels with larger drafts.

Ports are transfer hubs for trade and are usually built near natural harbors and channels are major components of growth of the port. The capital & maintenance dredging would help to maintain this channels that are beneficial for movement of larger vessels.

Estimation of Dredging Quantities

TABLE 3. TOTAL AREA- DREDGING:

Sr. No.	Attribute	Existing Channel	Proposed Channel
1	length	33490 m	35490 m
2	width	370 m to 800 m	450 m to 800 m
3	depth	13.1 m to 14.2 m below CD	14.7 m to 15.9 m below CD
4	Total Soil to be dredged	---	33.3 million cum
5	Total Rock to be dredged (Rock	---	1.73 million cum

	dredging will be done with the help of cutter suction dredger and controlled blasting)		
6	Total Quantity to be dredged	---	35.03 million cum

Maintenance Dredging

TABLE 4. ESTIMATED QUANTITY OF ANNUAL MAINTENANCE DREDGING

Channel Portion	**Expected Quantity of Siltation due to Widening and Deepening of Channel (Million cum)**
A-B	2.32
B-C	0.55
C-D	1.06
D-E	0.41
E-F	1.18
Anchorage	0.47
Total	**6.00**

METHODOLOGY ADOPTED FOR THE CAPITAL DREDGING:

For widening and deepening of the JNP channel and Mumbai Harbour channel following methods found to be suitable,

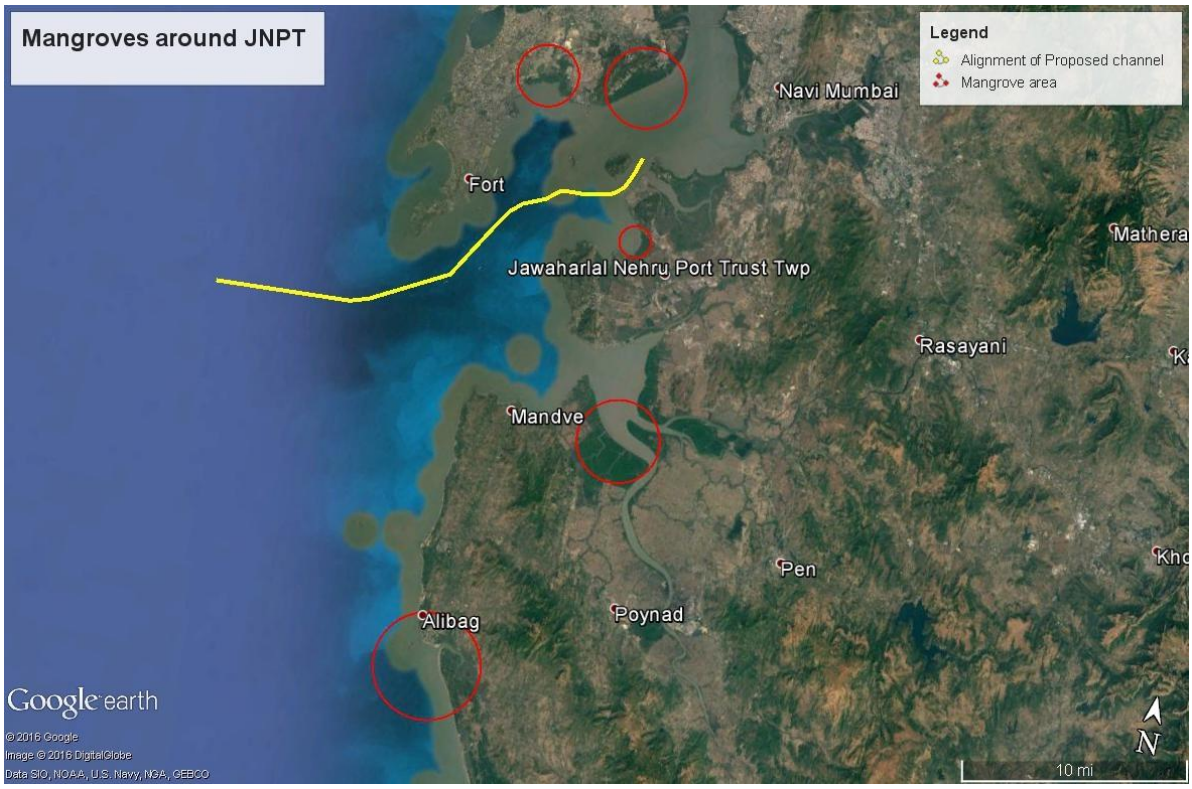
- Trailer Suction Hopper Dredger,
  TSHDs can be deployed for a great number of operations, because they are amongst the most flexible dredging plant available. This flexibility is evident in the types of material they can dredge, where this material can be placed and where they can work. For instance, they can dredge sands, clays, silt or gravel, and nowadays even some kinds of rock. They can work in calm, protected waters or more turbulent waters such as at entrance channels or far out to sea where weather and waves may be more active. Unlike stationary vessels, TSHDs can work in busy harbours because they are have no anchors or cables and are self-propelled so they can move about freely.
- Cutter Suction Dredger,
  CSDs are largely used in the dredging of harbours and fairways as well as for land reclamation projects when harder material needs to be dredged. They are also used when the distance between the dredging and disposal areas is shorter than the distances covered by trailing suction hopper dredgers.
- Under Water controlled Drilling and Blasting for hard rock
  Underwater drilling is the first part of the process during which drilling is done to make bore holes in the rock to place charges or explosives for blasting. Underwater controlled drilling and blasting rock will be carried out between the area C-D, D-E & E-F of the proposed alignment for widening and deepening.

DISPOSAL AND DISPERSION DREDGED MATERIAL

In this project dredged material cannot be used for any other purpose as the material is not suitable for reclamation or any other construction. IIT Mumbai has done a study and also

suggested that the dredged material cannot be used in reclamation. Hence it is proposed to disposed off the dredged material at the pre designated site DS-3. Dispersion studies were carried out by CWPRS (Central Water and Power Research Station) for site DS3 to ascertain the suitability of the site as a dumping site. During the dredging operations, the bed material gets disturbed and this process brings the bed material into suspension. Due to this resuspension, the sediment concentrations in the vicinity of the dredger temporarily increase and the tidal currents transport this suspended sediment Therefore, in order to ascertain the likely transport of the material in resuspension, dispersion studies were conducted for dredging operations in the channel. From these results, it is clear that the resuspended sediment due to dredging operations is not likely to be dispersed in to tidal flats near Sewri or Dhararntar where mangroves exist. However, there would be marginal increase in the suspended sediment concentrations in the Mumbai harbour area, near Butcher Island and this increase would be for a limited period during dredging operations.

FIG. 4 MANGROVE AREAS NEAR CHANNEL



ENVIRONMENTAL STUDIES

In order to assess the existing environmental status in the project area, primary and secondary data on various environmental attributes viz. air quality, noise levels, water quality, soil, ecology, land use etc. have been collected.

The studies for air, water, noise and biological studies were carried out using standard methods and also following the guidelines given by MoEF& CC and Pollution Control Board. Air Monitoring data collected from 6 locations viz. Port Operational Centre, IMC compound in

Liquid Chemical Terminal Area, JNP residential township, Elephanta Caves, Near North Gate Complex, Near South Gate Complex. Noise and water samples were collected from CTICT Container birth, NSICT container birth, Container yard near shift office, Container yard opposite to Ct. canteen, J. M. Bakshi, ICD 1-5, Port craft jetty, North Gate complex, Navratna Canteen, CFS Gate.

There is no effect on any mangrove e.g. mangrove cutting, disturbance, displacement etc. there is temporary phenomenon of turbidity increase which is restricted to the area of activity e.g. at site and disposal site.

There is an archeological monument viz. Elephanta caves categorized under (i) & (iii) criteria of World Heritage Sites of UNESCO. This is at crow fly distance from the project activity are minimum 1.60 km at JNPT end and 29 km at open sea end. The dredging is carried out by conventional techniques used worldwide. Whereas in the portion control blasting will be carried out which will not have any structural effect on the monument. NOC from ASI (Archeological Survey of India) has already been obtained in this regards.

METEOROLOGICAL DATA

The historical data collected from India Meteorological Department (IMD) and other secondary sources to represent the metrological conditions of the project area has been reviewed and presented below for various attributes such as Temperature, Wind, Cloud cover, Humidity, Rainfall, Cyclone, and Visibility The nearest IMD observatory to JNP is Mumbai, which is located at 18º54' N latitude and 72º 49' E longitude.

Table 5: METEOROLOGICAL DATA

Parameters	Remarks
Temperature	January is invariably the coldest month and May the warmest. With the onset of monsoon in early June there is a reversal of the temperature curve and the temperature during the period of monsoon remains very nearly uniform at about 27^0C The slight rise in temperature in October falls gradually till it reaches the coldest month in January
Wind	
Offshore wind	the wind blows from the SW to N sector for 83% of the time and the predominant wind direction is north (45.7%) The wind speed is less than 15 m/s (54 km/hr) for 75% of the time and 20 m/s (72 km/hr) for 90% of the time
Onshore wind	Prevailing wind speeds are higher in the afternoons than in the mornings. During short periods in a day, the wind speed exceeds prevailing wind speed
Humidity	The skies are clear and lightly clouded from December to March with a gradual increase in cloudiness thereafter till May. With the arrival of the southwest monsoon in June, there is a sharp increase in cloudiness and skies are overcast for 12 days in a month on an average. This condition continues till September
Rainfall	The rainfall during southwest monsoon season accounts for about 94% of the annual rainfall. Maximum rainfall occurs in the month of July (613.4 mm) and the number rainy days are about 22.
Visibility	On an average, the visibility is less than 4 km for about 18 days in a year.
Wave	

offshore wave climate	The wave height is less than 2 m for 83% of the time and the predominant wave period is 10 seconds
Nearshore wave climate	The predominant directions of normal waves in the nearshore zone are from the WSW, W, WNW, NW
Currents	The currents in the navigational channel are predominantly tidal currents with their directions aligned with the channel, except when the flow pattern is altered by runoffs from rivers and Creeks during the southwest monsoon period
Tides	Tidal levels are recorded extensively at three locations in the region, viz. Apollo Bandar, Mora and Trombay, for many years The tidal levels recorded at Apollo Bandar (Lat. 18° 55'N; Long 72°50'E) have been used in the design of approach channel since Apollo Bandar is geographically the most relevant location for the project area

Bathymetry

Bathymetry survey was carried out in May 2015 and the results are as follows:

- The water depth ranged from a minimum of (-) 14.2 m CD to a maximum of (-) 18 m CD at DS3.
- The water depths in emergency anchorage area ranged from (-) 8.2 m CD to (-) 17.8 m CD
- The water depths in main channel ranged from (-) 12.5 m CD to (-) 21.5 m CD

TABLE 6. STATUS OF AIR ENVIRONMENT, NOISE LEVEL AND PHYSICO-CHEMICAL PARAMETERS

Content	**Monitoring value (24 hrs) (µg/m^3)**		**Permissible limit as per CPCB (24 hrs)µg/m^3**	**Remark (specified for industrial area by CPCB as per gazatte notification of April 1984)**
	Minimum	**Maximum**		
Air environment				
SO_2 (µg/m^3)	22	48	120	Below the Permissible limits
NO_x (µg/m^3)	14	29	120	Below the Permissible limits
PM_{10} (µg/m^3)	119	199	500	Below the Permissible limits
$PM_{2.5}$ (µg/m^3)	32	58	150	Below the Permissible limits
Noise level				
Day dB (A)	60.08	85.1	75	In the month of September the levels were found to exceed the prescribed limits at some locations. All the noise monitoring results were found to be within the acceptable limits for the month of October and November for all the locations
Night dB (A)	59.2	77.1	70	In the month of September the levels were found to exceed the prescribed limits at some locations. All the noise monitoring results were found to be within the acceptable limits for the month of October and November for all the locations
Physico-chemical Parameters				
pH	6.98	8.70	--	Values did not show any spatial variation. This could be due to the continuous mixing of the water columns.

Salinity (ppt)	28.6	34.23	--	Average sea water salinity 35 ppt .
BOD Mg/lit	<2	<2	--	The index of organic pollution as reflected by the BOD values was found to be slightly high in the stations adjacent to the harbor.
Heavy metals (in water and in sediments)				
Copper (mg/lit)	15.2	69.5	--	The investigation of the heavy metals, both in the water column and sediments, exhibit station wise variation, giving fairly high concentration. However, the levels of zinc, Copper and Lead in both compartments were found to be higher compared to the other metals. The concentration of tress metals in these regions has revealed fluctuations and also varies with the place and time of sampling, nature of pollutants and the chemical characteristic of water body.
Zink	25.4	72.3	--	
Cadmium	20.5	48.2	--	
Nikel	--	<1.0	--	
lead	--	<0.05	--	
Mercury	0.06	0.60	--	

Table 7: MARINE BIODIVERSITY STUDY

Parameter	Observation
Phytoplankton	A total of 17 species were recorded during study. The population density of phytoplankton ranged from 53 to 70 cells/lit. The phytoplankton maximum population density (70cells/l) was observed at station-7 and minimum at station 2 and station 6 (53cells/l), In the present investigation, the diatoms were found to be the dominant group. Amongst the diatoms, the *Thalassiosira sp, Planktonella sp.* and *Coscinodiscus sp* were observed at all the stations. Density and total biomass of phytoplankton was found to be fairly high and sustained with healthy phytoplankton biomass in the sea and is responsible for the photosynthesis. Among the 11 stations sampled at JNPT
Zooplankton	A total of 22 species of zooplankton were recorded from the study area out of them 12 species of Copepods, 3 species of tintinids, 2 decapods species , a single species of arrow worm and 4 species of larvae were found in the area. The zooplankton density ranges from 65 to 118 No./l. Minimum was observe at station-5 and the maximum was observed at station-2, followed by station-9. . The present study also reveals that the Copapoda were the dominant groups compared to other zooplankton groups. Amongs the copepods *Acrocalanus sp. Centropages sp Acartia sp* were observed at all the station covered in the marine ecological survey The present investigation showed that larval forms were recorded at various stations monitored during the field survey
Benthos	Sediments samples were collected from various stations using Peterson;s dredgerand each group of organisms were individually identified and a quantitative qualitative analysis has been done. A total of 10 benthic species were recorded. e.g. *Nereis sp, Phyllodocidae sp, Amphinomie sp., Placenta sp., Tibia curta* etc
Primary productivity	The Gross Primary Productivity (GPP) ranged from 50 to 115 The maximum GPP was observed at station8 and station- 10. The Net Primary productivity (NPP) from 112.5 to 187.5at various sampling stations covered in the marine ecological survey The maximum was observed in station-2 and tha minimum was at station-3 and station-8. Primary productivity values shows that the low to moderate productive The area to be dredged has significant ship movement and is also dredged regular as a part of the maintenance dredging activities, all of which attribute to low to moderate productivity.
Chlorophyll 'a'	Chlorophyll 'a' value varied from 0.887 to 1.941 mg/m^3. The maximum density 1.941

(mg/m^3)	mg/m^3 was observed at station-11 and the minimum at station.-10 The variations of chlorophyll 'a' was associated with the numerical abundance of diatoms individuals
Phaeophytin (mg/m^3)	The phaeophytin level is below detectable level in all the stations

Mangroves

There is no disturbance/cutting/transplantation of any marine vegetation including mangroves. A total of 10 species were recorded in and around JNP area. *Avicennia marina* was found to be the most dominant species followed by *Acanthus illicifolius* , other species be insignificant in this region The dominance of *Avicennia marina* is due to its wide range of tolerance to the extreme environment The production of seeds, their survival rate, germination establishment and growth is altogether found to be more than the other species

PROJECT BENEFITS

- Increased depth and width of the channel will cater the need of larger new generation vessels to board JNP.
- Time will be saved due to better movement by vessels.
- Fright cost will be reduced due to larger vessels
- The development is envisaged to play a significant role in strengthening connectivity along the Maharashtra coastline.
- Enhancement in economy of Maharashtra.
- Substantial positive impact on socio-economic profile of the area, in Particular, and Raigad, in general, both in terms of overall employment and skill development of local workforce.
- Direct as well as indirect employment potential is envisaged.

TABLE 8 ENVIRONMENT MANAGEMENT PLAN FOR THE VARIOUS PARAMETERS LIKELY TO BE AFFECTED BY THE PROJECT

Sr. No.	Project Related Issues	Actions to be Taken	Responsible Organisation
1	Water Transport Safety and Traffic Management	Adequate number of proper & legible signs will be installed along the route, Prepare and administer a monitoring system on route/ accidents.	JNP
2	Air Quality	Monitor periodically ambient air quality at selected sites, Enforcing different control measures to check pollution (e.g. catalytic converters, unleaded petrol, proper serving etc.)	JNP
3	Noise level	Monitor periodically ambient noise level at selected sites, Minimisation of use of horns near sensitive locations/ silence zones with the help of sign boards at proper places.	JNP
4	Water Quality	Monitor periodically water quality for establishing the change of water quality, if any.	JNP
5	Sediment Characteristics	Periodic monitoring of soil quality (mainly Pb) at specified distance for assessing contamination by vehicular emissions. Checking the overflow of spillage from the carriageway.	JNP

6	Human Health and Safety	Proper training to staff regarding safety. Adopt proper & adequate safety measures for all Workers.	JNP

TABLE 9: BUDGET FOR ENVIRONMENTAL MANAGEMENT PLAN

Sr. No.	Items	Cost (INR in Lakh) During Dredging	Cost (INR in lakh) Operation
1	Air Environment	25	18
2	Water Environment	30	22
3	Noise Environment	18	10
4	Mangrove Management	75	30
5	Marine Ecology Management	35	20
6	Training and Education	15	05
7	Social Awareness	20	10
	Total EMP Cost	**218**	**115**