FINAL ENVIRONMENT IMPACT ASSESSMENT REPORT FOR WIDENING OF EXISTING CONTAINER BERTH AT JAWAHARLAL NEHRU PORT, NAVI MUMBAI, MAHARASHTRA (CARGO HANDLING CAPACITY= 22.1 MTPA)

SCHEDULE: 7(E) PORTS, HARBOURS, BREAKWATERS, DREDGING (Category A; as Cargo Handling Capacity is ≥5 MTPA)

PROJECT PROPONENT

M/S JAWAHARLAL NEHRU PORT AUTHORITY

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MANTEC CONSULTANTS PVT. LTD.

(QCI Accredited EIA Consultant at Vide letter no. QCI/NABET/ENV/ACO/23/2942 as per List of Accredited Consultant Organizations/Certificate no. NABET/EIA 2026/RA 0305 on dated 11/OCTOBER, 2023)

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ABBREVIATIONS

AAQM	:	Ambient Air Quality Modelling
AAS	:	Atomic Absorption Spectroscopy
ALARP	:	As Low As Reasonably Practicable
BGL	:	Below Ground Level
BOD	:	Biochemical Oxygen Demand
CDU	:	Crude Distillation Unit
CO	:	Carbon Monoxide
COD	:	Chemical Oxygen Demand
COT	:	Crude Oil Tank
CPCB	:	Central Pollution Control Board
CSR	:	Corporate Social Responsibility
CTE	:	Consent to Establish
CTO	:	Consent to Operate
DFO	:	Divisional Forest Officer
EAC	:	Expert Appraisal Committee
EIA	:	Environmental Impact Assessment
EMP	:	Environmental Management Plan
FDU	:	Feed Preparation Unit
GIS	:	Geographic Information System
GLC	:	Ground Level Concentration
HDA	:	Haldia Development Authority
IMD	:	Indian Meteorological data
ICP	:	Inductively Coupled Plasma
IUCN	:	International Union for Conservation of Nature
Km	:	Kilometer
Km/hr	:	Kilometer/hour
KLD	:	Kilolitres per Day
LOS	:	Level of service
Leq dB (A)	:	Equivalent Sound Level in decibels for Human Hearing
LPG	:	Liquified Petroleum Gas
LULC	:	Land use and land cover
m/s	:	Metre per second
M bgl	:	Meter below ground level
MoEF&CC	:	Ministry of Environment Forests and Climate Change
MRL	:	Mean Reference Level
NOC	:	No Objection Certificate
NAAQS	:	National Ambient Air Quality Standards
NABL	:	National Accreditation Board for Testing and Calibration Laboratories

NH	:	National Highway
Ni	:	Nickel
NO_2	:	Nitrogen Dioxide
Pb	:	Lead
SDU	:	Solvent Dewaxing Unit
SH	:	State Highway
SPCB	:	State Pollution Control Board
TDS	:	Total Dissolved Solids
TOR	:	Terms of Reference
TPA	:	Tons Per Annum
V	:	Vanadium
VOC's	:	Volatile Organic Compounds
WBPCB	:	West Bengal Pollution Control Board
ZLD	:	Zero Liquid Discharge

जनेप प्राधिकरण
JNPA

ISO 9001 : 2015
ISO 14001 : 2015
ISO 27001 : 2013
ISO 45001 : 2018

जवाहरलाल नेहरु पत्तन प्राधिकरण
JAWAHARLAL NEHRU PORT AUTHORITY

पत्तन कार्यालय : प्रशासन भवन, शेवा, नवी मुंबई - 400707. Port Office : Administration Bldg., Sheva Navi Mumbai - 400 707.
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मुख्य प्रबंधक (यातायात) Chief Manager (Traffic) - (022) 2724 4191 : मुख्य प्रबंधक (यां.एव.वि.अ.) Chief Manager (M&EE) - (022) 2724 4181 :
मुख्य प्रबंधक (वित्त) Chief Manager (Fin) - (022) 2724 4081 : मुख्य प्रबंधक (प.यो.वि.) Chief Manager (PP&D) - (022) 2724 4156
उप-संरक्षक Dy. Conservator (022) 2724 4171 : हार्बर मास्टर (022) 2724 4173.
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UNDERTAKING BY PROJECT PROPONENT

The Final Environmental Impact Assessment Report for **Widening of Existing Container Berth at Jawaharlal Nehru Port, Navi Mumbai, Maharashtra (Cargo Handling Capacity = 22.1 MTPA)** prepared by Mantec Consultants Pvt. Ltd. has been reviewed thoroughly at our end before submission. I, on behalf by Jawaharlal Nehru Port Authority (JNPA), hereby undertake that the data and information provided in the report are correct to the best of our understanding, and we own responsibility for correctness of contents of the EIA report.

(Dr. G. Vaidyanathan)
Chief General Manager (PP&D)

UNDERTAKING BY ACCREDITED CONSULTANT ORGANIZATION

I, A. S. Brara, hereby confirm that this "**Final Environmental Impact Assessment Report for Widening of Existing Container Berth at Jawaharlal Nehru Port, Navi Mumbai, Maharashtra (Cargo Handling Capacity= 22.1 MTPA)**" has been prepared at Mantec Consultants Pvt. Ltd.

I also confirm that I shall be fully accountable for any mis-leading information mentioned in this Report.

Signature	:	
Name	:	Mr. A.S. Brara
Designation	:	CMD

Name of the EIA Consultant Organization: Mantec Consultants Pvt. Ltd., Noida-201301

QCI/NABET Accredited EIA Consultant at Vide letter no. QCI/NABET/ENV/ACO/23/ 2942 as per List of Accredited Consultant Organizations/Certificate no. NABET/EIA 2026/RA 0305 on dated 11/OCTOBER, 2023 and MoEF & CC and NABL approved Laboratory.

NABET Annexure – VII

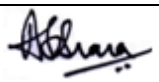
DISCLOSURE OF CONSULTANTS

Declaration by Experts contributing to the Rapid EIA/EMP Report for **"Final Environmental Impact Assessment Report for Widening of Existing Container Berth at Jawaharlal Nehru Port, Navi Mumbai, Maharashtra (Cargo Handling Capacity= 22.1 MTPA)"**,

Declaration by Experts contributing to the EIA:

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

EIA Coordinator:

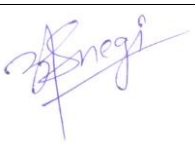
Name	Mr. A.S. Brara
Period of Involvement	October 2022 to till Date
Contact Information	0120-4215000
Signature & Date	

Functional Area Experts

S. No.	Functional Areas	Name of the Experts	Involvement (task & period)	Signature & Date
1	AP*	Mr. A.S. Brara(FAE)	**October 2022 - till now;** Identification of Air Quality Monitoring Network Supervision of ambient air quality monitoring Review of primary air quality monitoring report and analysis Addressing air quality issues in EIA Report and suggesting mitigation measures for impacts due to air pollution and review Review and analysis of primary meteorological data	

2	WP*	Mr. A.S. Brara (FAE)	**October 2022 - till now;** Identification of water sampling locations, their time and frequency pertaining to site conditions Counter checking of analysis of data by literature study and consultation with local people and concerned departments Identification of water quality by analysis report study and detection of potential hazards due to developmental activity Checking of water availability by literature study and by interacting concerned Govt. Officials like GWB and irrigation dept.	
		Mr. Ranjan Kumar Keshri (FAA)	**January 2023-till now;** Assisted FAE for Selection of the water Monitoring stations and development of EMP, Identification of water quality by analysis report study and detection of potential hazards due to developmental activity, Checking of water availability by literature study and by interacting concerned Govt. Officials like GWB and irrigation dept	
		Mr. Gajanand Mallick (FAE)	**October 2022 - till now;** Assisted FAE for Identification of water sampling locations, their time and frequency pertaining to site conditions, Counter checking of analysis of data by literature study and consultation with local people and concerned departments, Identification of water quality by analysis report study and detection of potential hazards due to developmental activity	

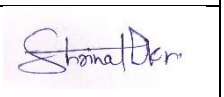
3	SHW*	Mrs. Rekha Singh (FAE)	**October 2022 - till now;** Assess the waste sources and status in the study area. After studying the sources have prepared the Impact report and suggested Mitigation measures and development of EMP	
4	SE	Mr. Braj Vallabh Pandey (FAE)	**October 2022 - till now;** Design and develop format/ questionnaire for baseline survey, social changes arising out of development projects and assessment of data so collected Evaluation of socio economic status of tribal/ non- tribal areas Assessment of social impact Collection of secondary information Survey tool design Reconnaissance study, transect walk Community participation, Mitigation plan Stakeholder consultation	
		Mr. Pankaj Kumar (FAA)	**October 2022 - till now;** Data mining from Census of India 2011 and other sources. Assisted in report making under the guidance of the FAE.	
5	EB	Mr. Kamal Kumar Saxena (FAE)	**October 2022 - till now;** Identification of potential impact due to the project interventions and developing mitigation measures by direct field study and consulting the stakeholders like forest and wildlife officials, local people etc.	

		Ajay Singh Negi (FAA)	**June, 2023-till now;** Ecology and Biodiversity conditions in the core and buffer zone. With the help of the literature and the data collected during the site visit the report was prepared and related impact and mitigation measures and EMP was prepared.	
		Mr. Gajanand Mallick (FAE)	**October 2022 - till now;** Identification of potential impact due to the project interventions and developing mitigation measures by direct field study and consulting the stakeholders like forest and wildlife officials, local people etc.	
6	HG*	Mr. R. K. Khanna (FAE)	**October 2022 - till now;** Identification of the water sources and drainage pattern Analyze them to identify the likely impacts Devise mitigation measures and assisted in preparation of the EIA report.	
		Ms. Richa Gupta (TM)	**October 2022 - till now;** Assisted FAE to Identification of the water sources and drainage pattern and visited the site to assess the hydrological condition in the study area. After studying the possible sources have prepared the Impact, risk report and suggested Mitigation measures and development of EMP.	

7	GEO*	Mr. S.I. Tanveer (FAE)	**February 2023- till now** Identification of Geological condition of the project site and After studying the possible sources have prepared the Impact, risk report and suggested Mitigation measures and development of EMP	
		Ms. Richa Gupta (TM)	**October 2022 - till now;** Assess the geological features in the study area. After studying the possible sources have prepared the Impact, risk report and suggested Mitigation measures and development of EMP	
8	SC*	Dr. B.J Prasad (FAE)	**October 2022 - till now;** Review of soil quality and soil type for establishing the baseline condition. Assessing the impact on soil due to various activities of the project. Suggest mitigation measures for control the adverse impact and soil conservation.	
		Mr. Kamal Kumar Saxena (TM)	**October 2022 - till now;** Assessed the soil quality of the study area as well as core zone. After analyzing possible impacts due to the proposed project have suggested mitigation measures	
		Mr. Susheel Kumar Yadav (FAA)	**September 2023 - till now;** Assessed the soil quality of the study area as well as core zone. After analyzing possible impacts due to the proposed project have suggested mitigation measures	
		Mr. Ajay Singh Negi (FAA)	**September 2023 - till now;** Assessed the soil quality of the study area as well as core zone. After analyzing possible impacts	

			due to the proposed project have suggested mitigation measures	
9	AQ*	Mr. A.S. Brara (FAE)	**October 2022 - till now;** • Analysis of air quality data, meteorological data, traffic data etc. as per the requirements of Pollution Dispersion model (ISCST3) • Assessment of secondary data requirements for modeling, collection of secondary data like mixing height, stability class etc. • Predict air quality using pollution dispersion model (ISCST3) • Interpretation, analysis and presentation of predicted results of pollution dispersion modeling • Review and finalization of report	
		Ms. Priyanshi Vashistha (FAA)	• Assisting in Analyzing of air quality data, meteorological data, traffic data etc. as per the requirements of Pollution Dispersion model (ISCST3) • Assisting in Assessment of secondary data requirements for modeling, collection of secondary data like mixing height, stability class etc.	

10	NV*	Mr. A. S. Brara (FAE)	**October 2022 - till now;** • Identification of Noise Quality Monitoring Network and noise sensitive location along the project stretch • Supervision of ambient noise quality monitoring • Review of noise quality monitoring report • Addressing noise related issues in EIA report and suggesting measures for impacts due to noise pollution. Analysis of noise quality data, traffic data etc. as per the requirement of mathematical model of FHWA-TNM Interpretation, analysis and presentation of predicted results.	
11	LU*	Mr. Jaideep (FAE)	**October 2022 - till now;** Identification and collection of satellite images and other associated maps for the project area Creation of GIS data base and processing of satellite imageries	
		Mr. Braj Vallabh Pandey (TM)	**October 2022 - till now**; Devised measure to save sensitive and productive land uses by suggesting option of realignment, bypass and eccentric widening Analysis of land use map and incorporation of land use details into EIA	
12	RH*	Mr. P.K. Srivastava (FAE)	**October 2022 - till now;** Identification of the potentially hazardous material and events that night occur during various Phases of the project Devising contingency plan for each type of hazard	

			Incorporation of the same in the EIA report.	
		Mr. Shrinath Kumar (FAA)	**January 2023- till now;** Devising contingency plan for each type of hazard Incorporation of the same in the EIA report.	

ToR COMPLIANCE

Point wise compliance of ToR issued by Ministry of Environment Forest, & Climate Change, New Delhi, Expert Appraisal Committee (EAC) vide ToR Identification no. TO23A3501MH5915492E and File no. 10/48/2023-IA.III. (Copy enclosed as **Annexure-I**).

SPECIFIC TOR			
S No.	**Description**	**Responses**	**Citation**
1.	PP shall submit the latest Certified EC compliance report by the concern IRO of the Ministry.	PP already submitted Letter to Regional Office, Nagpur dated 31.07.2023. Application for EC compliance audit submitted to MoEF&CC, Nagpur Office and Letter. Vide letter no. JNP/PPD/MOM/EAC/2023/847 on dated 31-Jul-2023 letter is attached as **Annexure-II.**	Attached as **Annexure- II.**
2.	Importance and benefits of the project.	Importance and benefits of the project is Already incorporated in EIA Report. Detailed in the EIA report of Chapter-8.	Chapter-8,
3.	Submit a copy of layout superimposed on the HTL/LTL map demarcated by an authorized agency on 1:4000 scale	The HTL/LTL map is enclosed as Attached as Figure-2.12 on chapter no. 2. HTL/LTL map demarcated by an Institute of Remote Sensing (IRS), Anna University, on 1:4000 scale attached as **Annexure – III.**	Attached as **Annexure - III**
4.	Recommendation of the Maharashtra CZMA shall be obtained and submitted.	Noted and Already submitted, Maharashtra Coastal Zone Management Authority (MCZMA) recommendation obtained vide letter no. CRZ 2022/CR 312/TC 4 on dated 14.02.2023.	Attached as **Annexure - IV**
5.	Submit superimposing of latest CZMP as per CRZ (2011) on the CRZ map.	Noted	Attached as **Annexure - III**

6.	Submit a complete set of documents required as per para 4.2 (i) of CRZ Notification, 2011.	Noted,	Submitted
7.	Hydrodynamics study on impact of dredging on flow characteristics shall be carried out.	CWPRS recommended that, after scrutiny of these drawings / proposal and as communicated by JNPA, it seems that dredging is not envisaged for the development under consideration. Considering the above, since the dredging is not proposed in the said development, there is no scope to carry out the hydrodynamic studies to assess the impact of dredging on flow characteristics.	CWPRS recommendation letter is attached as **Annexure - V.**
8.	Study the impact of dredging and dumping on marine ecology and draw up a management plan through the NIO or any other institute specializing in marine ecology.	Addressed in Chapter 3&4 and details are given in NIO Report is attached as **Annexure - VI.**	NIO report is attached as **Annexure - VI.**
9.	Requirement of water, power, with source of supply, status of approval, water balance diagram, man-power requirement (regular and contract).	Addressed in Chapter 2 & 11 under the Environmental Management Plan.	Chapter 2 & 11
10.	A certificate from the local body supplying water, specifying the total annual water availability with the local authority, the quantity of water already committed the quantity of water allotted to the project under consideration and the balance water available. This should be specified separately for ground	This is JNPA's Existing container berth with a quay length of 680 m was commissioned in 1989. JNPA had planned 12 MLD water supply scheme during inception of the port in 1989 and subsequent development happened in the port expansion including various capacity	MJP is the local body supplying water JNPA MJP Letter is attached as **Annexure- VII**

	water and surface water sources, ensuring that there is no impact on other users.	augmentation projects. The total demand envisaged is 40 MLD including earlier 12 MLD, the work is in progress at Site through Maharashtra Jeevan Pradhikaran at JNPA. Noted, Addressed in Chapter 2 & 3. and Certificate is attached as Annexure- VII.	
11.	A certificate of adequacy of available power from the agency supplying power to the project along with the load allowed for the project.	JNPA has total power capacity of 100 MVA through MSEDCL to feed all terminals of JNPA including NSFTPL. Agreement for Power Distribution Franchisee between JNPA and MSEDCL and Light Bill of NSFTPL is attached as Annexure- VIII.	Agreement for Power Distribution Franchisee between JNPA and MSEDCL and Light Bill of NSFTPL is attached as **Annexure- VIII**.
12.	A certificate from the competent authority handling municipal solid wastes, indicating the existing civic capacities of handling and their adequacy to cater to the M.S.W. generated from project.	JNPA have Solid Waste Management Authorization for Solid Waste Management of JNPA for port estate area. Noted, JNPA MPCB SWM Authorization Certificate is attached as **Annexure- IX**	JNPA MPCB SWM Authorization Certificate is attached as **Annexure-IX**.
13.	An assessment of the cumulative impact of all development and increased inhabitation being carried out or proposed to be carried out by the project or other agencies in the core area, shall be made for traffic densities and parking capabilities in a 05 kms radius from the site. A detailed traffic management and a traffic decongestion plan drawn up through an organization of repute and specializing in Transport Planning shall be submitted with the EIA.	This is JNPA's Existing container berth with a quay length of 680 m was commissioned in 1989. Noted, Traffic Management and Traffic Decongestion Plan is attached as **Annexure- X.**	Traffic Management and Traffic Decongestion Plan is attached as **Annexure- X.**

14	Disaster Management Plan for the project shall be prepared and submitted.	Noted, Addressed in Chapter 7 and The detailed Report of comprehensive Risk Assessment & Disaster Management Plan has been attached as **Annexure- XI.**	DMP is attached as **Annexure- XI.**
15	Details and status of court case pending against the project, if any.	Not Applicable	-
16	Public hearing to be conducted and issues raised and commitments made by the project proponent on the same should be included in E1A/EMP Report in the form of tabular chart with financial budget for complying with the commitments made.	Public hearing Action Plan has been given in the Chapter-7 of Final EIA report.	Public hearing Minutes & Action Plan has been attached as **Annexure-XII**
17	A tabular chart with index for point-wise compliance of above ToRs. The specific ToRs as recommended above are in addition to all the relevant information as per the 'Generic Structure of EIA' given in Appendix III and IIIA in the EIA Notification, 2006.	Noted,	Compiled
18	As per the Ministry's Office Memorandum F. No. 22-65/2017-IA.III dated 30th September, 2020, the project proponent, based on the commitments made during the public hearing, shall include all the activities required to be taken to fulfill these commitments in the Environment Management Plan along with cost estimates of these activities, in addition to the activities proposed as per recommendations of EIA Studies and the same	Public hearing Action Plan has been given in the Chapter-7 of Final EIA report.	Public hearing Minutes & Action Plan has been attached as **Annexure-XII**

	shall be submitted to the ministry as part of the EIA Report. The EMP shall be implemented at the project cost or any other funding source available with the project proponent.		
19	In pursuance of Ministry's OM No stated above the project proponent shall add one annexure in the EIA Report indicating all the commitments made by the PP to the public during public hearing and submit it to the Ministry and the EAC.	Public hearing Action Plan has been given in the Chapter-7 of Final EIA report.	Public hearing Minutes & Action Plan has been attached as **Annexure-XII**
Standard Conditions of TOR			
S No.	**Description**	**Responses**	**Citation**
1	Reasons for selecting the site with details of alternate sites examined/ rejected/selected on merit with comparative statement and reason/ basis for selection.	No alternative site has been investigated as the JNPA Existing container berth with a quay length of 680m was constructed in 1989 and Environmental Clearance for the then called Nhava Sheva Port was accorded by Ministry of Environment & Forest vide Office Memorandum no. J-11013/21/88-1A dated 16th Sept 1988 for entire development of Nhava Sheva Port.	EC copy of MOEF&CC is attached as **Annexure- XIII.**
2	The examination should justify site suitability in terms of environmental angle, resources sustainability associated with selected site as compared to rejected sites.	The formation of JNPA was conceptualized in late 1970's keeping in view the decongestion of Mumbai Port. The Detailed Project Report included Environmental Impact Assessment (EIA) and Environmental clearance was obtained from MoEF for construction of Port. In view of the commitment towards sustainable	EC copy of MOEF&CC is attached as **Annexure- XIII.**

		aspects of development, the port has taken adequate measures to maintain ecological balance, since its formation in May 1989.	
3	The analysis should include parameters considered along with weightage criteria for short-listing selected site.	analysis of the parameters has been considered along with weightage criteria for short-listing	The details are given in the Chapter-3
4	Submit the status of shore line change at the project site.	This is JNPA's Existing container berth with a quay length of 680 m was commissioned in 1989. No Shoreline changes due to the project site, this exiting terminal, proposed development towards land.	-
5	A detailed draft EIA/EMP report should be prepared in accordance with the above additional TOR and should be submitted to the Ministry in accordance with the Notification.	Complied	-
6	The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.	**Existing- Rs. 675.34 Crores** **Proposed- Rs. 196.82 Crores** **Total- Rs. 872.16 Crores** Cost towards implementation of EMP will be submitted after Public Hearing in consultation with JNPA. Details are given in **chapter no. 10**	Chapter: 10
7	Any further clarification on carrying out the above studies including anticipated impacts due to the project and mitigative measure, project proponent can refer to the model ToR available on Ministry.	Addressed in **chapter no. 4**	Chapter-4,

8	Details of the land use break-up for the proposed project. Details of land use around 10 km radius of the project Site.	Details of the land use break-up within 10km radius given in chapter no. 3	Chapter-3,
9	Submit details regarding R&R involved in the project	The widening of terminal berth will be done in existing port limit only and no human settlements found and hence, no R&R is envisaged.	NO, R & R is envisaged.
10	Examine and submit detail of land use around 10 km radius of the project site and map of the project area and 10 km area from boundary of the proposed/existing project area, delineating project areas notified under the wild life (Protection) Act, 1972/critically polluted areas as identified by the CPCB from time to time/ notified eco-sensitive areas/ interstate boundaries and international boundaries.	Covered in chapter no. 1 of EIA Report.	Chapter-1,
11	Erosion and accretion study at the mouth of the creek which is adjacent to the proposed site be carried out and Submitted.	This is existing berth constructed in 1989 and no erosion /accretion is envisaged.	-
12	Detailed modelling studies to understand whether the selected site can withstand severe cyclones and develop design in accordance to due safety measures.	This is existing berth constructed in 1989, development towards landward side. Designing of berth is done taking into the various parameters including cyclones etc.	-
13	Submit superimposing of latest CZMP as per CRZ Notification (2011) on the CRZ map. And also submit a copy of layout superimposed on	The HTL/LTL map is enclosed as Attached as Figure-2.12 on chapter no. 2. HTL/LTL map demarcated by an IRS on 1:4000 scale attached as **Annexure - III.**	Attached as **Annexure - III**

	the HTL/LTL map demarcated by an authorized agency on 1:4000 scales.		
14.	Submit a complete set of documents required as per Para 4.2 (i) of CRZ Notification, 2011.	Noted,	--
15.	Hydrodynamics study on impact of dredging on flow characteristics shall be carried out.	CWPRS recommended that, dredging is not envisaged for the development under consideration. Considering the above, since the dredging is not proposed in the said development, there is no scope to carry out the hydrodynamic studies to assess the impact of dredging on flow characteristics.	CWPRS recommendation letter is attached as **Annexure - V.**
16.	A detailed study on the impact of proposed activity on marine ecology and marine biodiversity with specific focus on the corals, mangroves and Mud flats in the proximity of the site should be conducted and required mitigation plan be submitted.	Addressed in Chapter 3 & 4 and details are given in NIO Report is attached as **Annexure - VI.**	NIO report is attached as **Annexure - VI.**
17.	A management plan for the area under which mangroves are or likely to be removed and compensatory mangrove plantation plan be submitted.	Details are given in chapter no. 3 and 4. NIO Report is attached as **Annexure - VI.**	Chapter-3 & 4 NIO Report is attached as **Annexure - VI.**
18.	Analysis should be made based on latest satellite imagery for land use with raw images.	Covered in Chapter no. 1 of EIA Report	Chapter no. 1
19.	Submit the present land use and permission required for any conversion such as forest, agriculture etc.	The Land use map of the study area is enclosed in chapter no. 3	Chapter no. 3

20.	Land acquisition status, rehabilitation of communities/ villages and present status of acquiring Forest and Agricultural activities.	N/A	-
21.	Examine the details of water requirement, impact on competitive user, treatment details, use of treated waste water. Prepare a water balance chart.	Total water requirement for widening purpose for existing would be 50 KLD and 30KLD for expansion phase which will be sourced from M/s Maharashtra Jeevan Pradhikaran/ City and Industrial Development Corporation of Maharashtra Limited (CIDCO) through JNPA.	Chapter-2,
22.	Examine and submit the water bodies including the seasonal ones within the corridor of impacts along with their status, volumetric capacity, and quality likely impacts on them due to the project.	N/A	-
23.	Submit the details of fishing activity and likely impacts on the fishing activity due to the project.	This is existing berth constructed in 1989, development towards landward side.	-
24.	Specific study on effects of construction activity and pile driving on marine life.	Details are given in chapter no. 4. NIO Report is attached as **Annexure - VI.**	NIO Report is attached as **Annexure - VI.**
25.	Submit a copy of the contour plan with slopes, drainage pattern of the site and surrounding area.	The contour plan with slopes, drainage pattern of the site and surrounding area is enclosed in chapter no. 3.	Chapter no. 3
26.	Examine details of Solid waste generation treatment and its disposal.	JNPA have Solid Waste Management Authorization for Solid Waste Management of JNPA for port estate area. Noted, JNPA MPCB SWM Authorization Certificate is attached as **Annexure- IX**	JNPA MPCB SWM Authorization Certificate is attached as **Annexure-IX**.

27.	Details of oil spill contingency plan.	Covered in Chapter no. 2 &4 of EIA report and detailed oil spill contingency plan report is attached as **Annexure - XIV.**	Oil Spill Contingency plan report is attached as **Annexure - XIV**
28.	Details of the layout plan including details of channel, breakwaters, dredging, disposal and reclamation.	No additional changes to the existing Channel, breakwaters no dredging required.	-
29.	Submit the details of terrain, level with respect to MSL, filling required, source of filling materials and transportation details etc.	This is existing berth constructed in 1989, development towards landward side.	-
30.	Submit a copy of layout superimposed on the HTL/LTL map demarcated by an authorized agency on 1:4000 scale along with the recommendation of the SCZMA.	The HTL/LTL map is enclosed as Attached as Figure-2.12 on chapter no. 2. HTL/LTL map demarcated by an IRS on 1:4000 scale attached as **Annexure - III**	Attached as **Annexure - III**
31.	Details of bathymetry study.	A Bathymetry Study plan is covered in chapter no. 2 of Final EIA Report and The Bathymetry Study Plan map is attached as **Annexure- XV.**	The Bathymetry Study Plan map is attached as **Annexure- XV.**
32.	Details of ship tranquility study.	The formation of JNPA was conceptualized in late 1970's keeping in view the decongestion of Mumbai Port. The Detailed Project Report included Environmental Impact Assessment (EIA) and Environmental clearance was obtained from MoEF for construction of Port. This is JNPA's Existing container berth with a quay length of 680 m was commissioned in 1989.	NA
33.	The ecologically fragile area including CRZ 1A area etc. shall be demarcated and	The HTL/LTL map is enclosed as Attached as Figure-2.12 on chapter no. 2.	Attached as **Annexure - III**

	superimposed on the layout plan and submitted.	HTL/LTL map demarcated by an IRS on 1:4000 scale attached as **Annexure - III.**	
34.	Examine road/ rail connectivity to the project site and impact on the existing traffic network due to the proposed project / activities.	This is existing berth constructed in 1989, development towards landward side..	-
35.	A detailed traffic and transportation study should be made for existing and projected passenger and cargo traffic.	This is existing berth constructed in 1989, development towards landward side	-
36.	Details of handling of each cargo, storage, transport along with spillage control, dust preventive measures.	Address in Chapter no. 10 of Final EIA Report	Chapter no. 10
37.	In case of coal, mineral cargo, details of storage and closed conveyance, dust suppression and prevention filters.	No Coal, Mineral Cargo handled for the Project Site	N/A
38.	An assessment of the cumulative impact of all development and increased inhabitation being carried out or proposed to be carried out by the project or other agencies in the core area, shall be made for traffic densities and parking capabilities in a 05 kms radius from the site. A detailed traffic management and a traffic decongestion plan drawn up through an organization of repute and specializing in Transport Planning shall be submitted with the EIA.	This is existing berth constructed in 1989, development towards landward side.	-
39.	Details of rainwater harvesting and utilization of rain water.	This is existing berth constructed in 1989, development towards landward side.	

40.	Examine baseline environmental quality along with projected incremental load due to the proposed project/ activities.	Environmental Baseline has been collected for post monsoon season (i.e. 15.09.2022-04.12.2022) is incorporated in Chapter-3. The incremental load and impacts on air, water, noise, ecology, land use etc, are covered in Chapter-4 of Final EIA Report.	Chapter No. 3 & 4.
41.	The air quality monitoring should be carried out according to the notification issued on 16th November, 2009.	Ambient air Quality Monitoring has been done within study area as per 16th November, 2009 is given in Chapter-3. and Monitoring lab report is enclosed as **Annexure- XVI.**	Monitoring lab report is enclosed as **Annexure- XVI.**
42.	Examine separately the details for construction and operation phases both for Environmental Management Plan and Environmental Monitoring Plan with cost and parameters.	Address in Chapter no. 10 of Final EIA Report	Chapter no. 10
43.	Submit details of a comprehensive Risk Assessment and Disaster Management Plan including emergency evacuation during natural and man-made disasters.	Noted, Covered in Chapter 7 of Final EIA report and The detailed Report of comprehensive Risk Assessment & Disaster Management Plan has been attached as **Annexure- XVI & XI.**	DMP is attached as **Annexure- XVI & XI.**
44.	Details of desalination plant and the study for outfall and intake.	Not Applicable	-
45.	Submit details of the trees to be cut including their species and whether it also involves any protected or endangered species.	No trees will be cut.	-
46.	Measures taken to reduce the number of the trees to be removed should be explained in detail.	No trees removed from the area.	-

47.	Submit the details of compensatory plantation.	Not Applicable	-
48.	Explore the possibilities of relocating the existing trees.	No trees are located at the site of construction.	-
49.	Examine the details of afforestation measures indicating land and financial outlay.	No trees are cut.	-
50.	Landscape plan, green belts and open spaces may be described. A thick green belt should be planned all around the nearest settlement to mitigate noise and vibrations.	This is existing berth constructed in 1989, development towards landward side.	-
51.	The identification of species/ plants should be made based on the botanical studies.	Jawaharlal Nehru port is committed to sustainable development and adequate measures are being taken to maintain ecological balance. The port has received many awards towards its green efforts. The total land available with JNPA is around 3400 hectares out of this, 1200hectares' area (34%) of the port is under green cover including mangroves. The port's ecosystem consists of rich and diversified flora and fauna.	-
52.	Details of litigation pending against the project, if any, with direction /order passed by any Court of Law against the Project should be given.	N/A	-
53.	As per the Ministry's Office Memorandum F. No. 22-65/2017-TA.Ill dated 30th September, 2020, the project proponent, based on the	Public Hearing details has been given in Chapter-7 of final EIA report.	Public Hearing MOM attached as **Annexure-XII**

	commitments made during the public hearing, specific studies shall include all the activities required to be taken to fulfill these commitments in the Environment Management Plan along with cost estimates of these activities, in addition to the activities proposed as per recommendations of EIA Studies and the same shall be submitted to the ministry as part of the EIA Report. The EMP shall be implemented at the project cost or any other funding source available with the project proponent.		

CHAPTER-1 : INTRODUCTION

1.1 GENERAL

Jawaharlal Nehru Port Authority, hereinafter referred as JNPA or "Port" is one of the major Indian Ports located on the east side of Mumbai Harbour adjoining the main land of the West Coast of India and was commissioned on 26th May 1989. It is about 6 nautical miles by water route from Gateway of India. JNPA is ISO -14001-2015 and ISO -45001-2018 Certified, the Port has an Integrated Management System (IMS), which includes ISO-14001 Environment Management System. It is a fast growing and ISO 9001:2015 certified Port with single window operations, round the clock pilotage, good vessel traffic management system and dedicated facilities for handling containers, dry bulk and liquid bulk.

It is the only Indian Port built with international standards with a high level of automation and computerized functioning. Constructed in a record time of just three and half years, JN Port today is the major catalyst for country's trade and commerce and vanguard of multinational transport. It is the greenest Port in India and ranks among top 30 container Ports in the world.

Presently, JN Port handles 55-60% of total containerized cargo in India. The Jawaharlal Nehru Port Authority (JNPA) 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 - Currently JNPA operates five container terminals: The Nhava Sheva Free Port Terminals (NSFT formerly JNPCT), the Nhava Sheva International Container Terminal (NSICT), the Gateway Terminals India Pvt. Ltd. (GTIPL), Nhava Sheva International Gateway Terminal (NSIGT), and the newly commissioned Bharat Mumbai Container Terminals Private Limited (BMCT). The port also has a shallow Water Berth for general cargo and Coastal Berth which is being run by M/s. JM Baxi on PPP Mode. Liquid Cargo Terminal which is managed by BPCL-IOCL consortium. The Fourth Container Terminal is being developed in two phases of which Phase-I is operational and Phase-II is expected to be fully operational by April 2025 with a quay length of 2,000 metres adding an annual capacity of 4.8 million TEUs. JNPA has developed a multi-product SEZ in its owned free hold land of 277 hectares to attract international capital and global giants in manufacturing. In addition, the JNPA is also developing 4 Dry Ports – Jalna, Wardha, Sangli and Nashik to promote industrialization of the hinterland. JNPA has firmly anchored itself as the major catalyst for the trade and commerce in the country and is strongly committed to providing seamless services to the world that docks here. JNPA handled 35.25 million Tonnes of total cargo & 2,599,834 TEUs of containers from Apr-2023 to Aug-2023 which is higher by 4.58% & 4.88% respectively as compared to corresponding period in previous financial year.

JN Port handled 6.05 million TEUs of container traffic during the financial year 2022-23, increase of 6.44 % from the previous annual container handling of 5.68 million TEUs during the year 2021-22. Of the total traffic of 6.05 million TEUs, the share of the Port operated JNPCT was 0.21 million TEUs (03.40%), the share of NSFT was 0.05 million TEUs (0.82%), the share of NSICT was 1.10 million TEUs (18.13%), 1.14 million TEUs (18.79%) were contributed by M/s. Nhava Sheva (India) Gateway Terminal Pvt. Ltd. (NSIGT), 1.85 million TEUs (30.52%) were contributed by M/s. APM Terminals (APMT) and remaining 1.71 million TEUs (28.33%) were handled by PSA's Terminal Bharat Mumbai Container Terminal Pvt. Ltd. The container handled at JNPA constitute about 53.00% of total container traffic handled by all Major Ports (11.391 million TEUs).

Environmental Impact Assessment (EIA) is one of the tools available with the planners to achieve the above-mentioned goal.
It is desirable to ensure that the development options under consideration are sustainable. In doing so, environmental consequences must be characterized early in the project cycle and accounted in the project design.

There are many Acts/Rules & Notifications issued by MoEF&CC, New Delhi for keeping the environment in and around project sites congenial for healthy/better standard of living. Few of them are mentioned below:

1. Environment (Protection) Act, 1986
2. Environment (Protection) Rules, 1986
3. Water (Prevention & Control of Pollution) Act, 1974
4. Air (Prevention & Control of Pollution) Act, 1981
5. Environmental Impact Assessment (EIA) Notification, dated 27th January, 1994
6. Environmental Impact Assessment (EIA) Notification, dated 14th September, 2006
7. Environmental Impact Assessment (EIA) Notification as amended on 1st December, 2009
8. Environmental Impact Assessment (EIA) Notification as amended on 14thAugust, 2018

1.1.1 PROJECT LOCATION

The project site is located at Village– Nhava, Navi Mumbai, District– Raigad, and State-Maharashtra. National Highway- NH 348 is located at approx. 5.0 kms in East direction from the project site. The nearest village is Nhava. Chatrapati Shivaji International Airport located at approx. 50 kms in NNW from the project site. The site and study area falls in the survey of India, Topo Sheet No –E43G13. There are no Wildlife sanctuaries &National Park within 15 km radius. The location is in Seismic Zone-III. The geographical location of the project site is as follows**.**
Latitude from 18°57'9.50"N to 18°57'28.38"N
Longitude from 72°56'43.99"E to 72°56'53.46" E.

1.2 GENERAL DESCRIPTION OF THE EXISTING PROJECT

JN Port handles 55-60% of total containerized cargo in India. The Jawaharlal Nehru Port Authority (JNPA) 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.

The location of the project site is represented in Figure 1.1. The satellite Imagery of the site is shown Figure 1.2.

1.3 BRIEF DESCRIPTION OF NATURE, SIZE, LOCATION OF THE PROJECT AND ITS IMPORTANCE TO THE COMPANY REGION

Table-1: Brief Description of the Project

S. No.	Particulars	Details
	Type of Project	**7(e) Ports, Harbours, breakwaters, dredging**
A.	**Nature and Size of the Project**	Widening of Existing Container Berth at Jawaharlal Nehru Port Authority, Navi Mumbai, and Maharashtra.
B.	**Location**	
	Village	Nhava
	City	Navi Mumbai
	District	Raigad
	State	Maharashtra
	Geographical Coordinates	Latitude from 18°57'9.50"N to18°57'28.38"N Longitude from 72°56'43.99"E to72°56'53.46"E
	Manpower Requirement	**Constructional Phase-** Permanent Employment- 10 nos. Contractual Employment- 360 nos. **Operational phase-** Existing Permanent Employment- 125 nos. Proposed Permanent Employment- 15 nos. Contractual Employment- 360 nos.
	Water Requirement	Total water requirement for widening purpose for existing would be 50 KLD and 30 KLD for expansion phase which will be sourced from M/s Maharashtra Jeevan Pradhikaran /City and Industrial

		Development Corporation of Maharashtra Limited (CIDCO) through JNPA.
C.	**Cost of the project**	Existing- Rs. 675.34 Crores Proposed- Rs. 196.82 Crores Total- Rs. 872.16 Crores
	Cost for EMP	Rs. 17.9 Lakhs (During Construction phase) Rs. 6.3 Lakhs (During Operation phase)
D.	**Environmental Settings of the area**	
	Location of National Park/Wild life sanctuary/ Reserve Forest within 10Km radius of the project.	No national park/ Wildlife Sanctuary/ Reserve Forest within 10 Km radius of the project site is envisaged
	Inter-state boundary within 5 Km radius.	No Interstate Boundary is present within 10 km radius of the study area.
	Nearest Town/Major City with 200000 population	Navi Mumbai is at approx. 20 kms in ENE.
	Nearest State Highway/ National Highway	National Highway- NH 348 is at approx 5.0 kms in East direction.
	Nearest Airport	Chatrapati Shivaji International Airport ~ Approx. 50 kms in NNW direction.
	Seismic Zone	Zone III

(Source: Baseline Data, DPR/ Pre-feasibility Report)

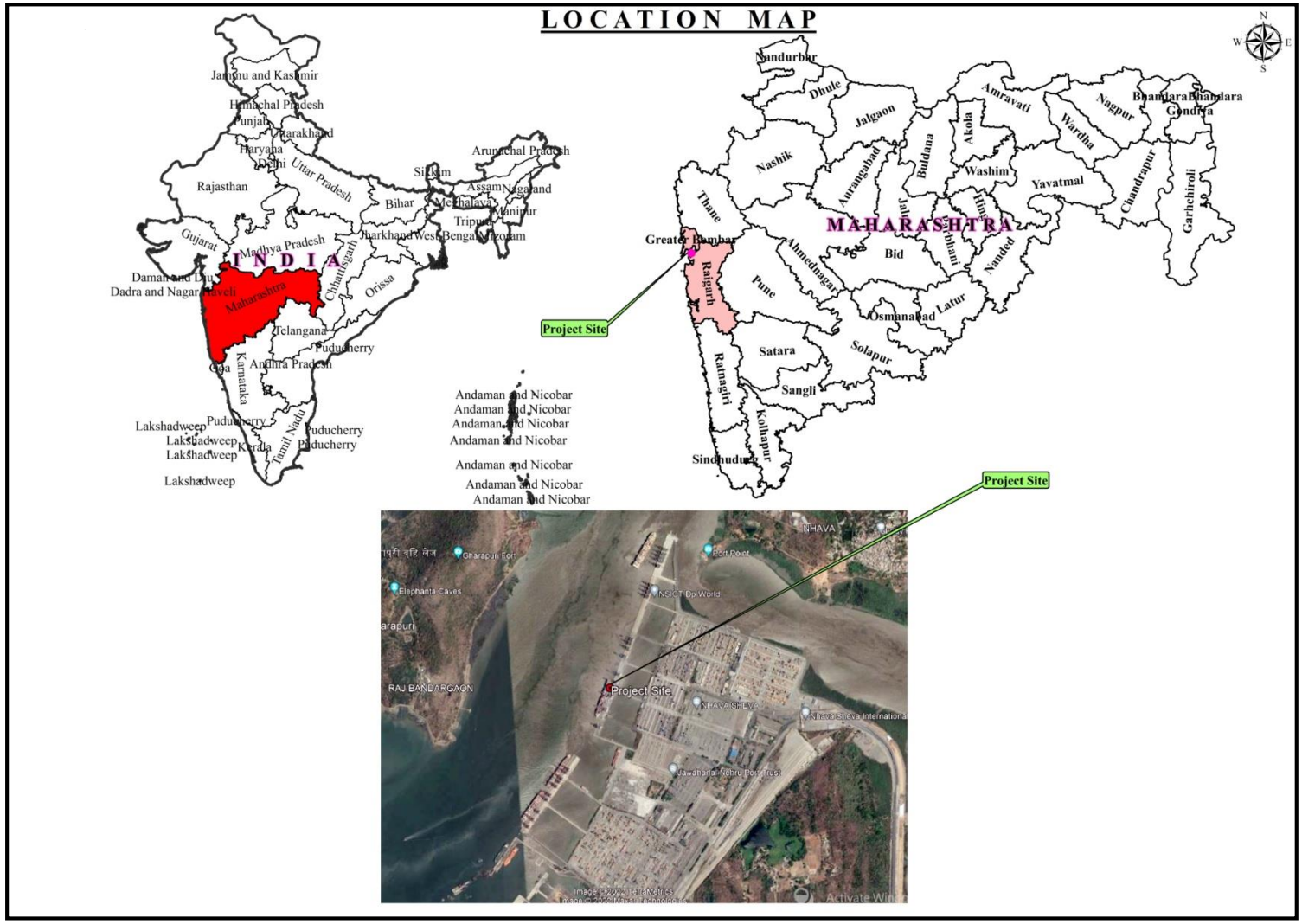


Figure-1 : Location Map of the project site

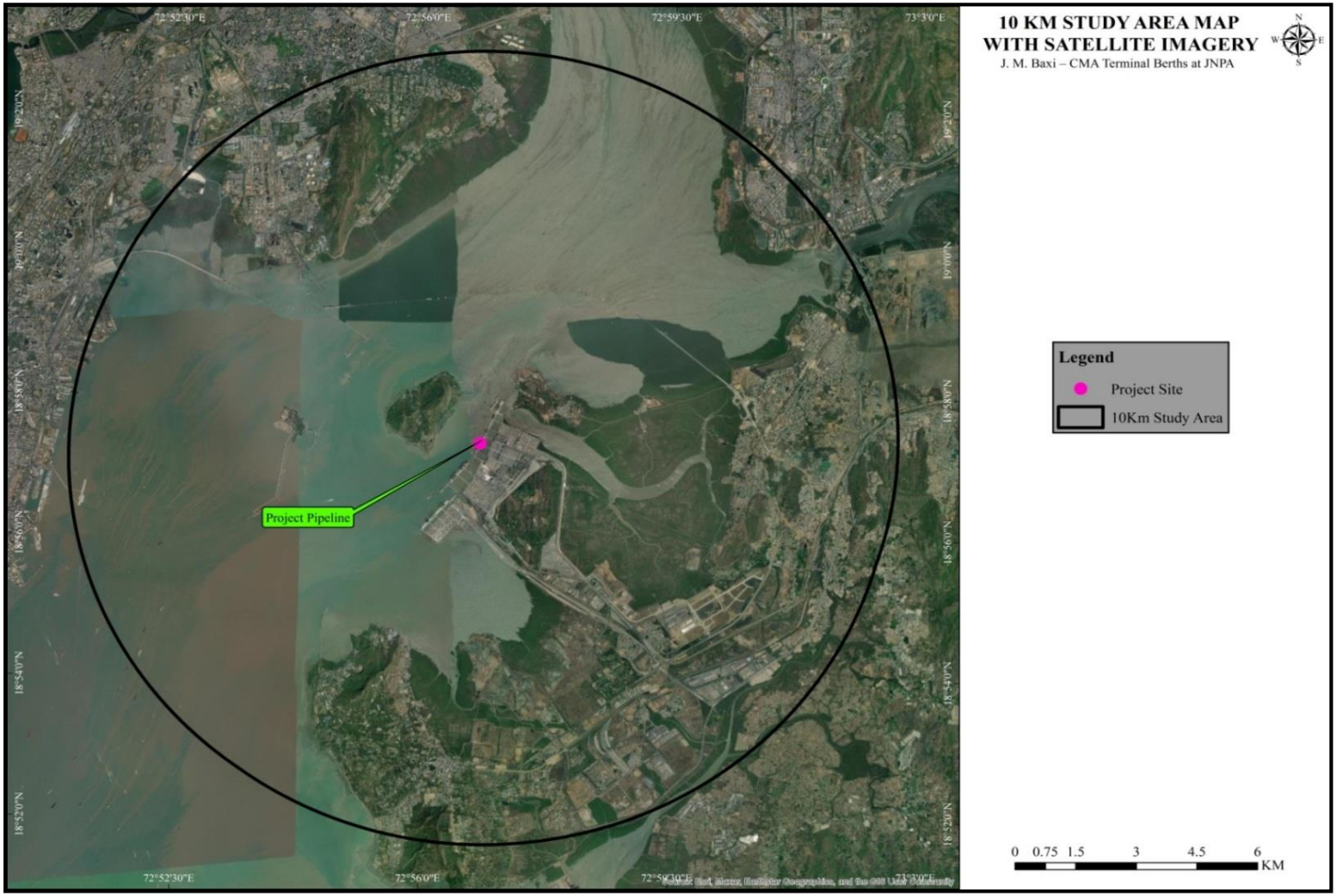


Figure -2 : Satellite Image of the Project site

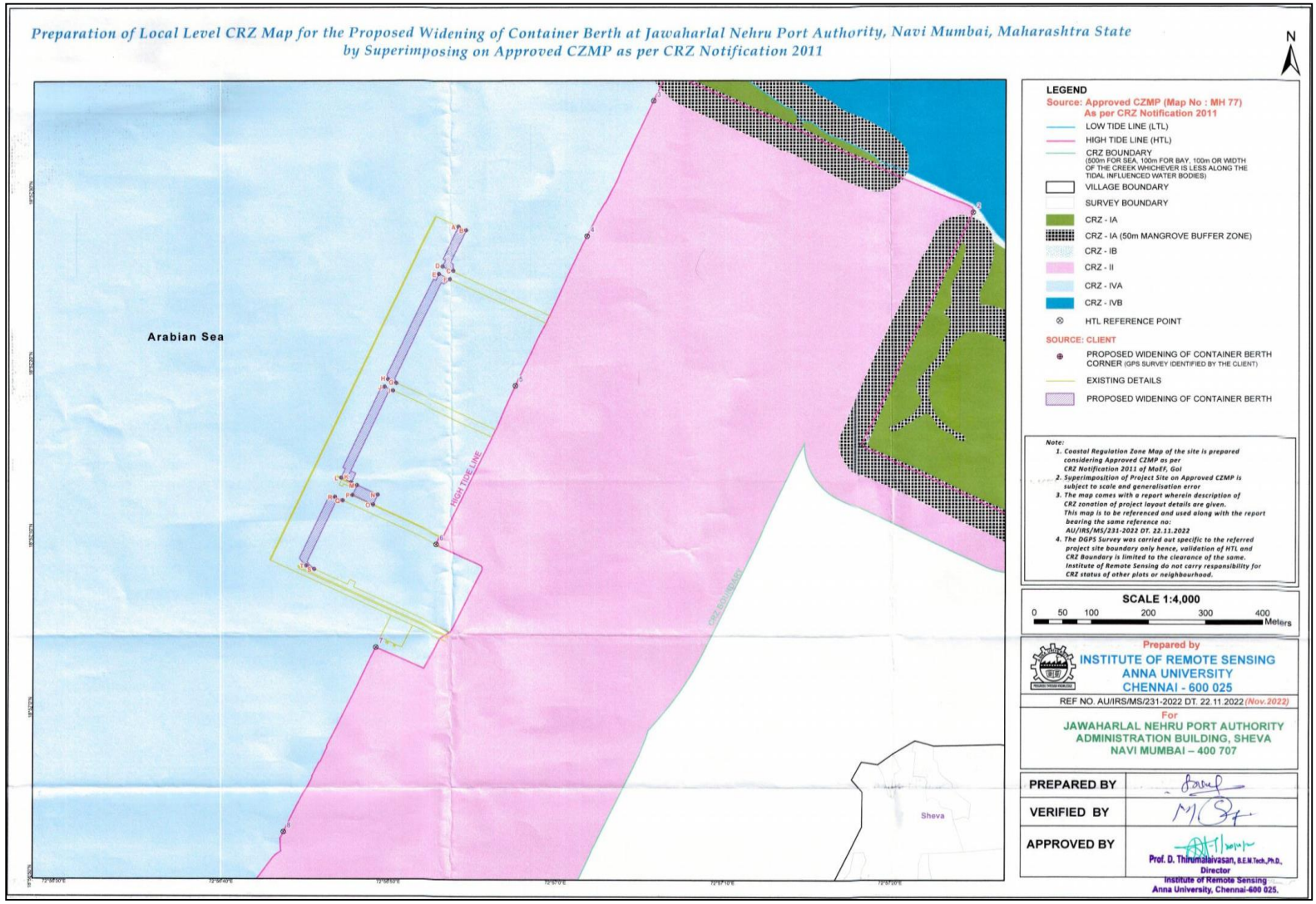


Figure -3: Coastal Regulation Zone Map on 1: 4000 scale for the Project Site

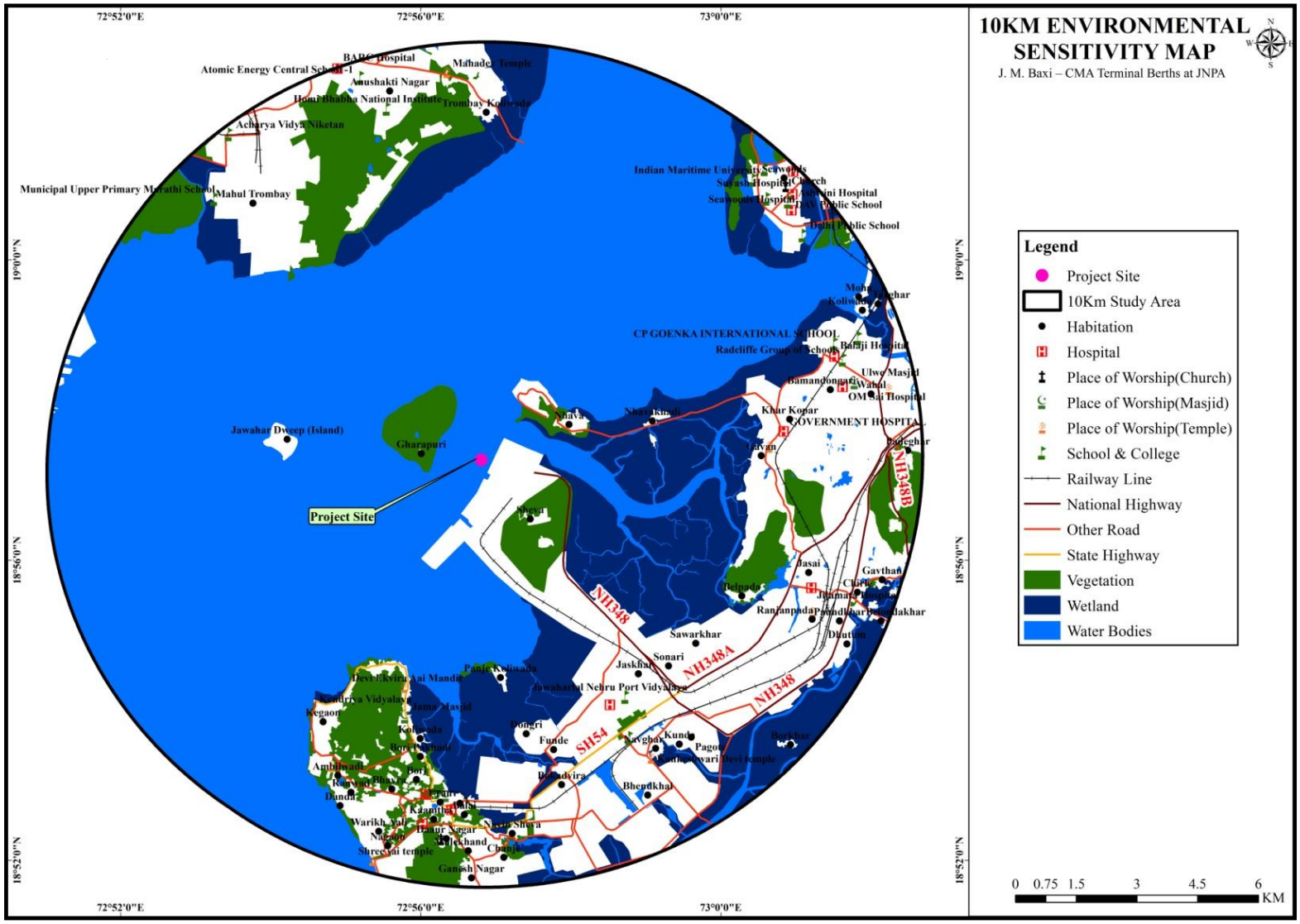


Figure -4: 10km Environmental Sensitivity Map

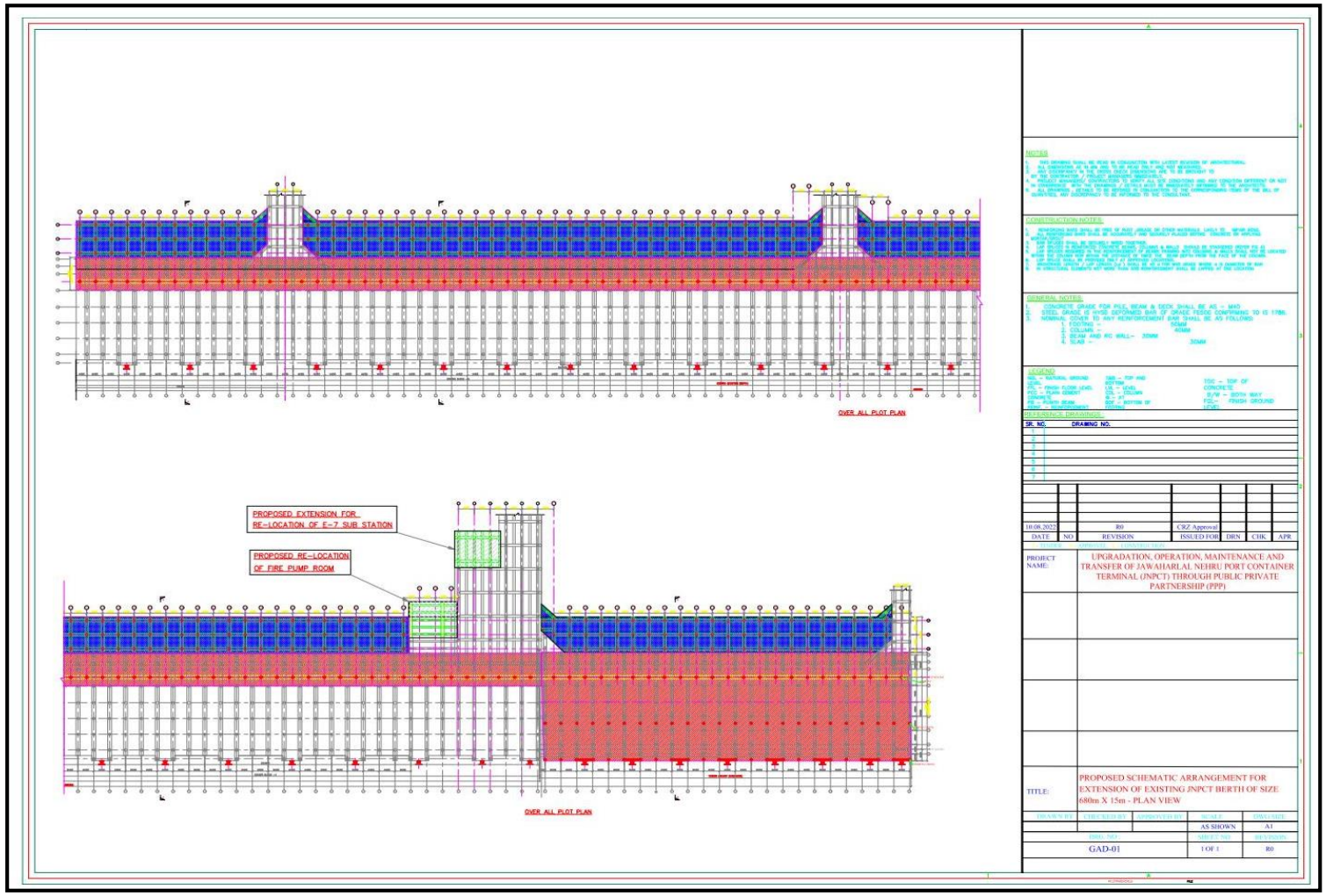


Figure -5: 10km GAD of Jetty- JNPA

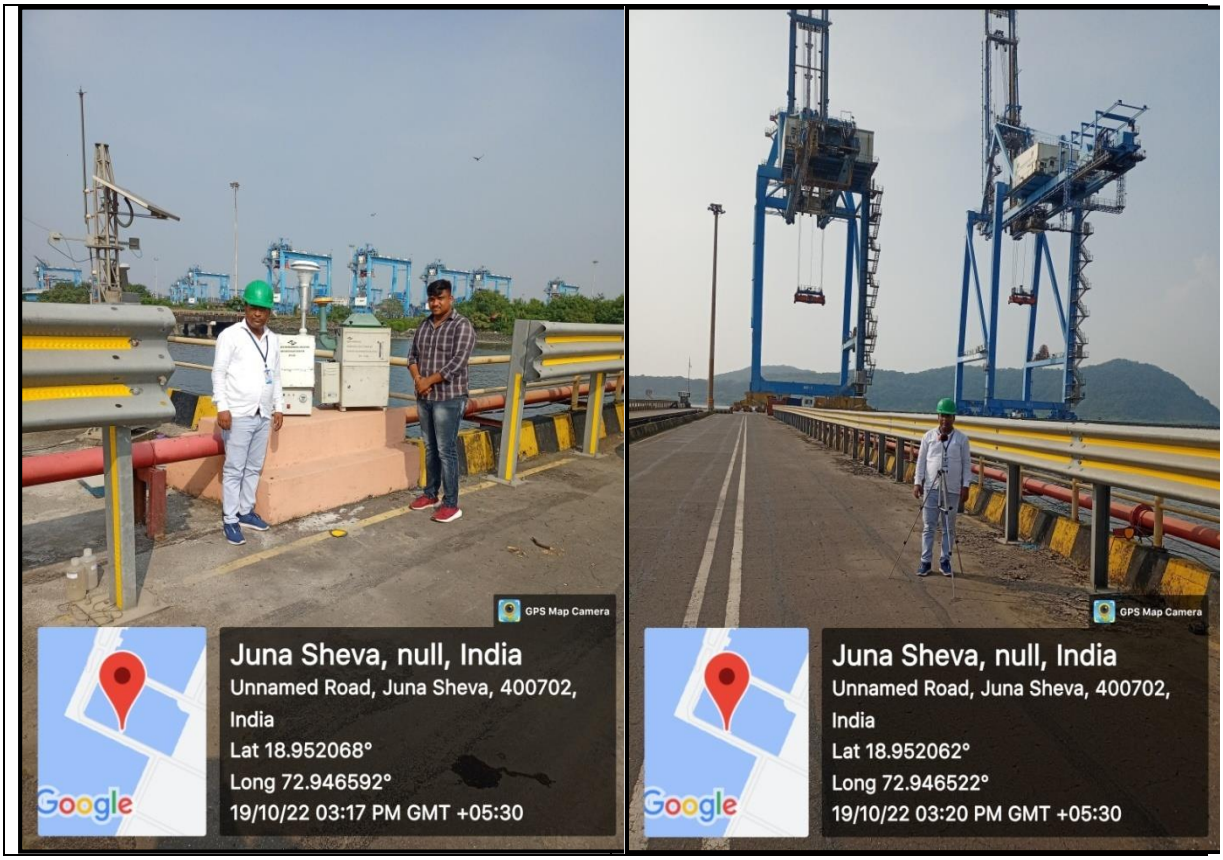


Figure -6: Project Site Photographs of the JNPA

1.4 NEED FOR THE PROJECT

The project requires EC+CRZ Clearance under EIA Notification 2006 & its subsequent amendments and Coastal Regulation Zone (CRZ) Notification (January 2011) respectively. Environmental Impact Assessment (EIA) study has been conducted as per guidelines stipulated in the EIA notification of September 2006 and CRZ Notification of January 2011. It is proposed to conduct an EIA study to assess the impacts likely to accrue as a result of various activities of the proposed projects.

The project for widening of existing container berth at Jawaharlal Nehru Port Authority at Sheva, Navi Mumbai superimposed in 1:4000 Scale CRZ map. This proposed widening part falls within the CRZ category such as CRZ IV- A (The water area and the sea bed area between the Low Tide Line up to twelve nautical miles on the seaward side shall constitute CRZ-IV A). The CRZ map of 1:4000 scale is prepared in accordance with the approved CZMP maps as per CRZ Notification, 2011 for Navi Mumbai, Maharashtra.

1.5 OBJECTIVES OF THE EIA STUDY

The major thrust of the EIA study shall be to assess the impacts of various activities of proposed project on various aspects of environment. The study shall cover the impacts on water quality, noise, air quality, terrestrial ecology, wildlife, aquatic ecology including fisheries, etc. The study will include collection of baseline data, prediction of impacts and

formulation of Environmental Management Plan (EMP) for amelioration of adverse impacts. The Study Area for the EIA Study shall be the area within 10 km radius of the proposed navigation channel at the Centre. The objectives of the Environment Impact Assessment study are to:

- Determine the baseline status of the marine ecology, terrestrial environmental conditions, Ambient Air Quality, Land use, Noise levels and Socio-economic aspects of the study area.
- Identify and assess the probable impacts of the project on marine and terrestrial environment in the study area during project construction and operation phases.
- Suggest adequate mitigation measures to minimize the negative impacts during dredging operation and operational phases of the project.
- Recommend measures to mitigate adverse impacts and enhance positive impacts as a part of Environment Management Plan.
- Prepare Risk assessment and Disaster Management Plan considering the project activity.
- Formulation of an Environmental Monitoring Programme to monitor key parameters during project construction and implementation phases.
- Budget to be earmarked for implementation of various measures as a part of Environmental Management Plan and Environmental Monitoring Programme.

1.6 SCOPE OF STUDY

- Based on the scope of work, guidelines generally followed for EIA studies, a study area of 10 km around the project site has been taken as spatial frame for the impact assessment. Temporal frame of assessment has been chosen to reflect the impacts in the operational phase of the project. Time frame and the type of impacts will be different for the two phases of the project. The work has been carried out as mentioned in the entire tender document and in accordance with the guidelines set-forth by the Ministry of Environment, Forest and Climate Change (MoEF&CC), Govt. of India indicating that the Environmental Impact Assessment should include:
- Delineation of mitigation and compensation measures for all the identified significant impacts.
- Delineation of unmitigated impacts.
- Physical planning including work Programme, time schedule and locations for putting mitigation and compensation systems in place.
- Delineation of financial plan for implementing the mitigation measures in the form of budgetary estimates and demonstration of its inclusion in the project budget estimates.
- Technological measures have been specified to mitigate the impacts in each phase of the project and to comply with MoEF&CC' s EIA notification dated 14th September 2006 & its subsequent amendments made thereafter.

1.7 PREPARATION OF EIA

The EIA includes the following details:

1. Study of the reports like CRZ report, Pre-Feasibility Report (PFR)/Detailed Project Report and previous EIA Report made available by the client.
2. Present Environmental Setting around 10kms of Study Area has been considered.
3. Identification, prediction and evaluation of Anticipated Environmental Impact due to the proposed project and related facilities.

The environmental impacts will be anticipated in core and buffer zone on:

- Topography and drainage
- Climate
- Water quality (Surface/Ground)
- Hydro-geological Regime
- Air quality
- Noise Levels
- Soil Quality
- Flora and Fauna
- Traffic density survey
- Land-Use
- Socio-Economic Conditions
- Health, culture, human environment including public health, occupational health and safety
- Sensitive Places/Historical Monuments

This EIA Report has been prepared in accordance with EIA Notification, 2006 and its subsequent amendments and that has been divided into twelve chapters (in addition to Executive Summary) as briefed hereunder:

Chapter 1 – Introduction

The chapter provides description of project background, site and surroundings, objectives, scope and organization of the study and format of this report.

Chapter 2 – Project Description

This chapter provides information on project and capacity; need for the project; location; size or magnitude of operation; technology and process description; maps showing project layout, component of projects etc.

Chapter 3– Description of the Environment

This chapter deals with the methodology and findings of field studies undertaken with respect to ambient air, meteorology, water, soils, noise levels, ecology to define the various existing environmental status in the area of the project. This also deals with the infrastructural development as a part of project and sources of pollution from the proposed/expansion project.

Chapter 4 – Anticipated Environmental Impacts and Mitigation Measures

In this chapter, the potential impacts of the proposed project, which could cause significant environmental concerns, are identified and discussed. This discussion will form the basis for environmental management activities.

Chapter 5 – Analysis of Alternatives (Technology and Site)

This chapter includes a comparison of alternatives in this chapter to determine the best method of achieving the project objectives with minimum environmental impacts or indicates the most environmentally friendly and cost-effective options, if any.

Chapter 6 – Environmental Monitoring Program

This chapter will include ascertaining the environmental impacts; state of pollution within the project site and in its vicinity; planning for predictive or corrective actions in respect of pollution to keep it within permissible limits.

Chapter 7 – Additional Studies

This chapter will include outcomes of public consultation, risk assessment, social impact assessment, R&R action plan, Biodiversity conservation plan, watershed management etc.

Chapter 8 – Project Benefits

This chapter deals with improvements in the physical infrastructure, social infrastructure, employment potential and other tangible benefits due to proposed project activity.

Chapter 9 – Environmental Cost Benefit Analysis

This chapter includes environmental value enhancement (biodiversity, crop productivity, eco-tourism etc.)

Chapter 10 – Environmental Management Plan

This chapter will include the description of administrative aspects of ensuring that the mitigation measures suggested are implemented and their effectiveness is monitored, after approval of the EIA.

Chapter 11 – Summary

This will constitute the summary of EIA Report.

Chapter 12 – Disclosure of Consultant

This will include the names of the consultants engaged in preparation of EIA and nature of consultancy rendered.

1.8 LAWS APPLICABLE TO THIS PROJECT

- EIA Notification, dated 14th September 2006, as amended on 1st December, 2009.
- Environmental Impact Assessment (EIA) Notification, dated 27th January, 1994
- Environmental Impact Assessment (EIA) Notification, dated 14th September, 2006

- Environmental Impact Assessment (EIA) Notification as amended on 14thAugust, 2018.
- Environment (Protection) Act, 1986 Environment (Protection) Rules, 1986
- Air (Prevention and Control of Pollution) Act, 1987 (as amended) with Rules.
- Water (Prevention and Control of Pollution) Act, 1974 with Rules.
- Noise Pollution (Regulation and Control) Rules, 2006 (as amended)
- Municipal Solid Waste (Management and Handling) Rules, 2000
- Solid Wastes (Management and Handling) Rules, 2016
- Chemical Accident (Emergency Planning, Preparedness and Response) Rules, 1996
- Hazardous and Other Wastes (Management and Trans boundary Movement) Rules, 2016
- Public Liability Insurance Rules,1992
- The Boiler Acts 1923 & Rules 1950
- The Factory Act 1881
- Manufacture, Storage and Import of Hazardous Chemical Rules, 1989(as amended)
- CRZ Notification 2011, and its amendment
- The National Waterways Act, 2016.
- The Indian Maritime University Act, 2008

CHAPTER-2 : PROJECT DESCRIPTION

2.1 PROJECT BACKGROUND

The proposed project is for widening of existing container berth at Jawaharlal Nehru Port Authority which further involves i) Increase of crane Rail span from 20 m to 30.50 m for 680 m berth length; b) Increase of deck width of the berth by 15 m on land side for smooth vehicle maneuvering & for keeping vessels hatch covers; c) Up-gradation and strengthening of existing 530 m berth and 150 m wharf to accommodate design vessels of size 12200 TEU for which the facility was originally designed & commissioned; d)Up-gradation of Fenders and Bollards as may be necessary; e) Repairs and strengthening of existing damaged portion of the berth structures as may be necessary and f) Underdeck repairs of the existing structure wherever necessary.

As per EIA Notification, published in Gazette of India, Extraordinary Part-II, Section-3, subsection (ii) of Ministry of Environment, Forest & Climate Change dated 14.09.2006 and subsequent amendment in December, 2009, the project falls in Activity 7(e) Ports, Harbours, breakwaters, dredging. The cargo handling capacity of the port is 22.1 MTPA, therefore it is Category "A" project as per the EIA Notification 2006 and its subsequent amendments.

Jawaharlal Nehru Port Authority, hereinafter referred as JNPA or "Port" is one of the major Indian Ports located on the east side of Mumbai Harbour adjoining the main land of the West Coast of India and was commissioned on 26th May 1989. It is about 6 nautical miles by water route from Gateway of India. It is a fast growing and ISO 9001:2000 certified Port with single window operations, round the clock pilotage, good vessel traffic management system and dedicated facilities for handling containers, dry bulk and liquid bulk.

It is the only Indian Port built with international standards with a high level of automation and computerized functioning. Constructed in a record time of just three and half years, JN Port today is the major catalyst for country's trade and commerce and vanguard of multinational transport. It is the greenest Port in India and ranks among top 30 container Ports in the world.

Presently, JN Port handles 55-60% of total containerized cargo in India. The Jawaharlal Nehru Port Authority (JNPA) 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 Authority involves various aspects to be considered for expansion project.

- Increase of crane Rail span from 20 m to 30.50 m for 680 m berth length.

- Increase of deck width of the berth by 15 m on land side for smooth vehicle maneuvering & for keeping vessels hatch covers.
- Up-gradation and strengthening of existing 530 m berth and 150 m wharf to accommodate design vessels of size 12200 TEU for which the facility was originally designed & commissioned.
- Up-gradation of Fenders and Bollards as may be necessary.
- Repairs and strengthening of existing damaged portion of the berth structures as may be necessary.
- Under deck repairs of the existing structure wherever necessary.

The applicant is seeking prior EC+CRZ Clearance as per EIA notification 2006 & its subsequent amendment and as per CRZ notification 2011 and its amendments respectively.

In order to assess the likely impacts arising out of the project, the Environmental Impact Assessment (EIA) study along with the detailed Environmental Management Plan (EMP) will be undertaken, to minimize those adverse impacts.

2.2 TRAFFIC ANALYSIS AND PROJECTION

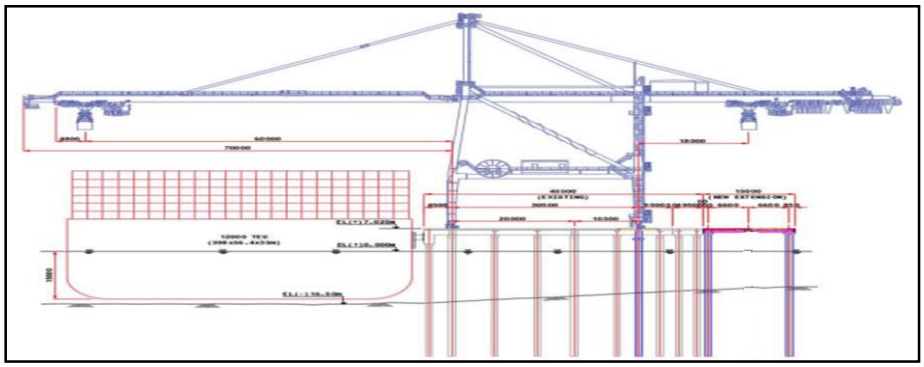
The container terminal handles about 0.5 million TEUs annually currently. With the expansion of the container terminal, the terminal is expected to handle 1.0 million TEUs annually.

Initiative for ease of Traffic Congestion: Total distance per TEU has reduced to 2.5 KM from earlier 5.0 KM. ITRHO Traffic has reduced to approx. 60% with green channel, reducing average from 45 TT to 15 TT performing the ITRHO operation on daily basis. The carbon footprint has drastically reduced to 50% with green channels.

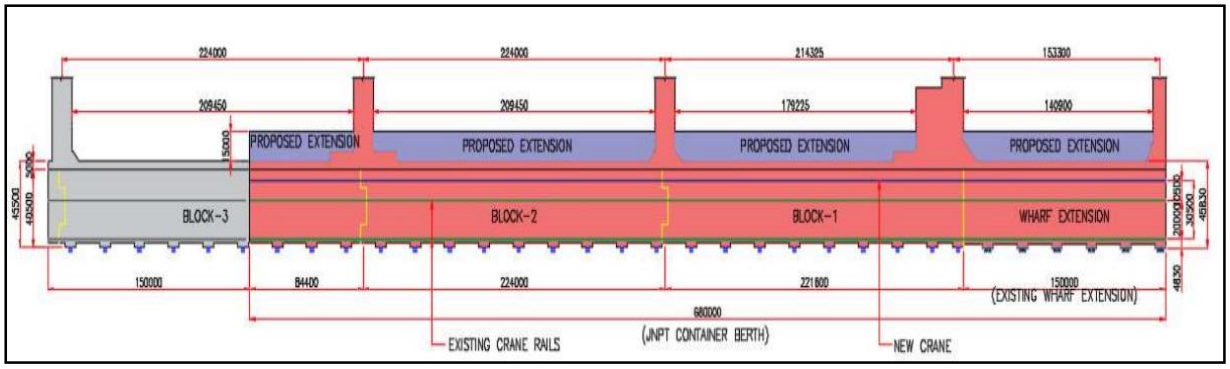
Centralized Parking Plaza: JN Port's Centralized Parking Plaza is equipped with a huge parking capacity to help park 1,538 tractor trailers in one go, hereby integrating document processing by Customs and streamlining traffic movement using Real Time Parking Management system. Reduce congestion on road.

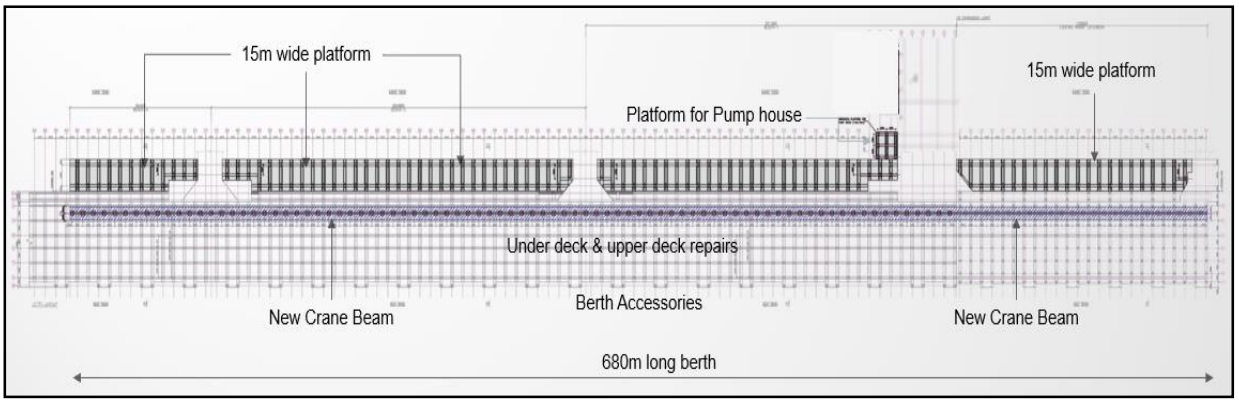
Ministry of Ports, Shipping and Waterways, GoI has formulated "Harit Sagar" Green Port Guidelines, to reduce carbon intensity and to develop an environment friendly ecosystem at Major Ports, same will be followed at JNPA. JNPA is putting maximum efforts to become JNPA as green Port by implementing Green Port initiatives in planned manner.

Proposed Extension of JETTY



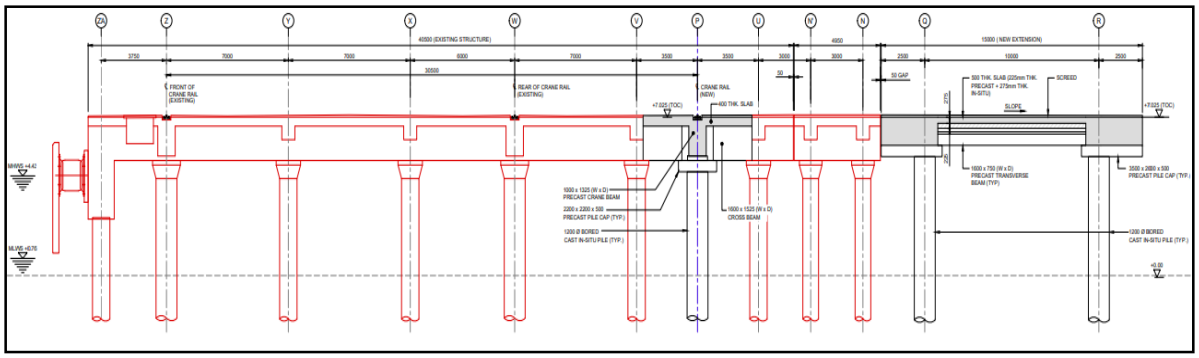
GAD OF JETTY



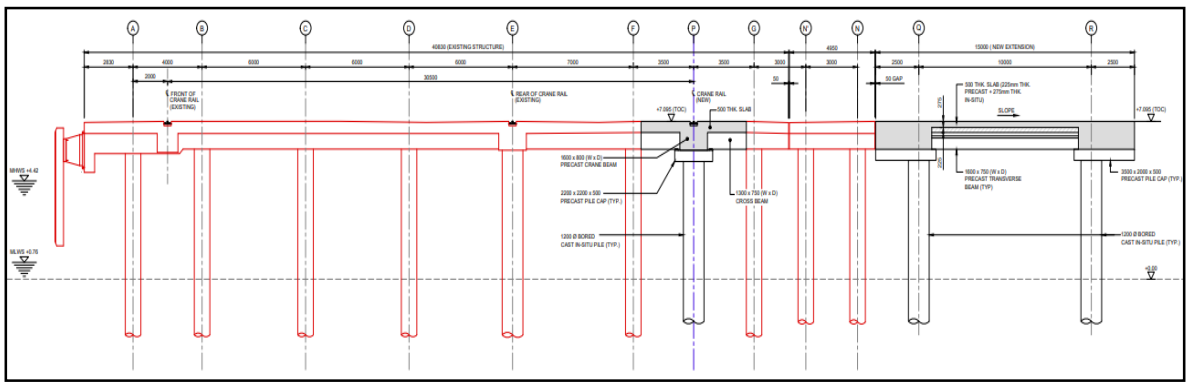


Plan View - Proposed Modification of Jetty towards Landside

SECTION OF JETTY



Sectional View - Proposed Modification of 530m Jetty towards Landside



Sectional View - Proposed Modification of 150m wharf towards Landside

2.3 MODIFICATIONS, EXTENSION AND UPGRADATION OF EXISTING CONTAINER BERTH AT JNPA

The JNP Container Berth with a quay length of 680 m was constructed in 1989 and Environmental clearance for the then called Nhava Sheva Port was accorded by Ministry of Environment & Forest vide Office Memorandum no. J-11013/21/88-1A dated 16th Sept 1988 for entire development of Nhava Sheva Port. Subsequently on 26th May 1989, the port was renamed as Jawaharlal Nehru Port Trust (JNPT) and the Container Terminal as JNP Container Terminal (JNPCT). The Environmental Clearance for Port was issued as per the extant rules prevailing then i.e. 1988. The Port projects were appraised based on capital investment upto EIA notification in 2006. The Environmental clearances with capacity as a criteria was stated after EIA Notification in 2006:

The JNPCT with quay length of 680 m has EC clearance and complies with conditions under environmental laws. The JNPCT has a valid Consent for Operations (CFO) issued by Maharashtra State Pollution Control Board (MSPCB) vide consent No. Format 1.0/CAC/ UAN/No.0000097172/CR-2103001085 dated 19th March 2021.The consent for operation of JNPA Container Terminal berth having length of 680 m is valid up to 30.09.2025.

The declared capacity for JNPCT berth of 680 m is 22.1 MTPA based on norms by Ministry of Shipping (MoS) and accordingly a Office memorandum was issued by MoS vide OM No F No PD-25021/30/2014-PD-I-Part (1) dated 5th October 2017. As per the standard norms for the Container Terminals, capacity in terms of TEU's (Twenty-foot equivalent unit) is 12 MT per TEU, and accordingly capacity of JNPCT is 1.84 MTPA. However, for the CFO purpose the capacity of JNPCT for new Concessionaire of JNPCT is 22.1 MTPA.

The existing container berth (680m length) of JNPA was initially designed in the year 1983 by the consultant M/S Howe (India) Pvt. Ltd. for 6000 TEU capacity vessels and later was verified for 9000 capacity TEU vessels by the same consultant in the year 2003. The container berth was extended for 150m in the year 1997.Later in the year 2018, JNPA requested I.I.T. Madras to verify the existing container berth with wharf structure for larger capacity vessels and the existing structure is verified based on 12200 TEU capacity vessels by IIT Madras.

Need for up gradation of the Berth Infrastructure

The existing berth needs repairs & refurbishment of damaged portions including the underdeck structures for improving the berth's physical condition & make it safer for operations.

The RMQCs (Rail Mounted Quay Cranes) of 20.00 M crane rail gauge are inadequate to service the handling requirements of larger container vessels and thus there is need to install cranes of 30.50 M gauge.

The RMQCs with 30.50 m rail gauge will require larger deck area for the container trailer movements as also for stacking of the Container Vessels' hatch covers. An extension of the deck structures is therefore necessary for safe placement of hatch covers and smooth and efficient movement of tractor trailers.

It is also necessary to relocate the E-7 substation & Fire Pump house in order to facilitate extension of the berth on the landside.

Nhava Sheva Freeport Terminal Private Limited (NSFTPL) – a SPV (Special Purpose Vehicle-a separate legal entity) formed by M/s J M Baxi Ports & Logistics Ltd and CMA Terminals has been awarded the project of "Up gradation, Operation, Maintenance and Transfer of Jawaharlal Nehru Port Container Terminal (JNPCT) on PPP Basis.

As a part of the project development the following

- Increase of Rail span from 20 m to 30.50 m for 680 m berth length.
- Increase of deck width of the berth by 15 m on land side for smooth vehicle maneuvering& for keeping vessels hatch covers
- Up gradation and strengthening of existing 530 m berth and 150 m wharf to accommodate design vessels of size 12200 TEU.
- Up gradation of Fenders and Bollards as may be necessary.
- Repairs and strengthening of existing damaged portion of the berth structures.
- Under deck repairs of the existing structure wherever necessary.

Proposed Modifications to 530-meter Container Berth:

For increasing the rail span from 20 m to 30.50 m a new row of piles and crane beam is proposed to be constructed on the existing deck between grid U & V as shown in the enclosed section drawing by dismantling of the existing deck slab and construction of new piles.

For smooth & safe vehicle maneuvering during the container handling by 30.50 m span quay crane, and to provide adequate space for storing hatch covers the existing deck slab is proposed to be extended by 15 m towards land side behind grid 'N' by construction of new deck with three rows of piles and deck slab as shown in the enclosed drawing. We understand from JNPA that increase in width falls in the CRZ-IV and is permitted activity. The additional width would require CRZ clearance under the CRZ-2011 notification.

Repairs to the Fenders are proposed to be carried out and 27 Nos. of 200 T capacity new bollards are also proposed to be installed.
Underdeck repairs to the corroded / damaged Structural portions will be carried out to arrest further corrosion**.**

Proposed Modifications to 150-meter Wharf Berth:
For increasing the rail span from 20 m to 30.50 m a new row of pile and crane beam is proposed to be constructed on the existing deck between grid F & G as shown in the enclosed section drawing by dismantling of the existing deck slab and construction of new piles.
For proper smooth & safe vehicle maneuvering during the container handling by 30.50 m span quay crane, and to provide adequate space for storing hatch covers the existing deck slab is proposed to be extended by 15 m towards land side behind grid 'N' by construction of new deck with three rows of piles and deck slab as shown in the enclosed drawing. We understand from JNPA that increase in width falls in the CRZ-IV and is permitted activity. The additional width would require CRZ clearance under the CRZ-2011notification.
Further for strengthening of the Fender beams and the deck for handling vessels of higher capacity, two rows of piles are proposed to be installed, one on the seaside before Grid 'A' and the other in between Grid 'C' and 'D'.
6 Nos. of new Fenders along with 6 Nos. of 200 T capacity new bollards are proposed to be installed.
Underdeck repairs to the corroded / damaged Structural portions will be carried out to arrest further corrosion**.**

2.4 EXISTING BERTH DETAILS

Location of container berth
The location of existing Container berth including wharf extension 150m, Shallow water berth, Approach and Tug berth is shown in figure below:

Location Plan

Existing berth details

The existing Container berth is of length 830m. The layout for existing container berth including 150m wharf extension is given in figure below. However, only 680m indicated in red color is being used by JNPA and the north 150m indicated in grey color issued by other operators.

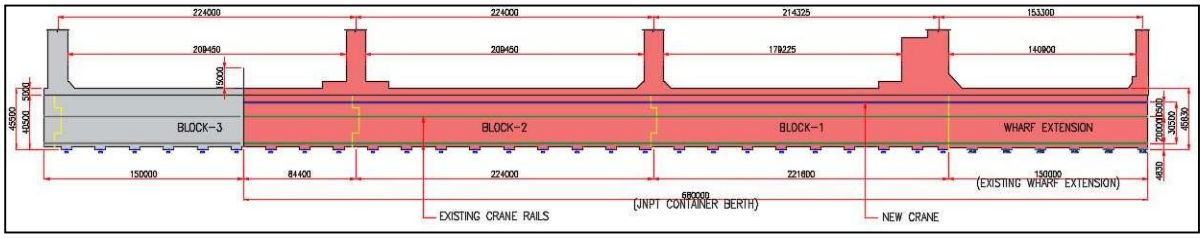


Figure -1: Layout of old container berth

Vessel characteristics

The Container berth has been originally designed for the vessel size of 6000TEU and subsequently JNPA has verified the existing berth for 9000 TEU vessel as also to accommodate the larger vessels of capacity 12200TEU. The dimensions for all the three types of vessels are given in table below.

Table no.: Vessel characteristics

Ship type	Displacement tonnage	LOA (m)	Beam(m)	Loaded draft(m)	Berthing Velocity (m/sec)
6000 TEU	110,000	300	41.0	13.5	0.1
9000 TEU	150,000	340	51.0	14.5	0.1
12200 TEU	215,000	398	56.4	15.0	0.1

The spring lines and Bow/Stern lines can be arranged depending on the bollard locations. The proposed shore based Mooring points shall allow such variations and typical configurations are shown in Figures below.

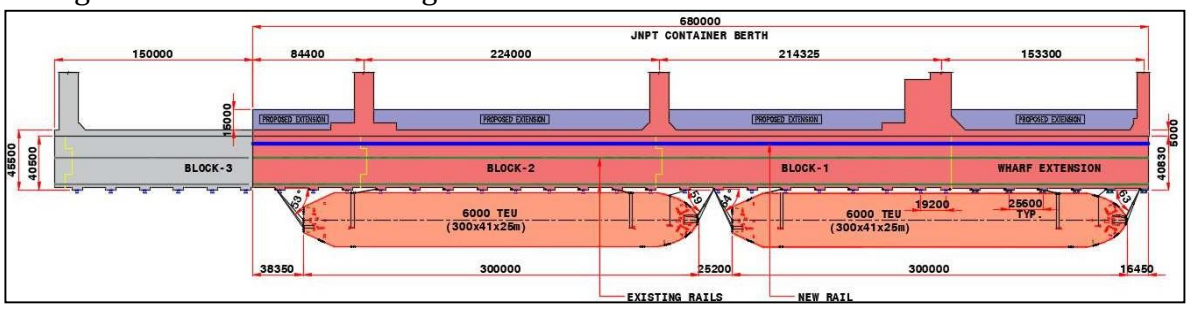


Figure no. 2: Mooring layout for 6000 TEU Vessel

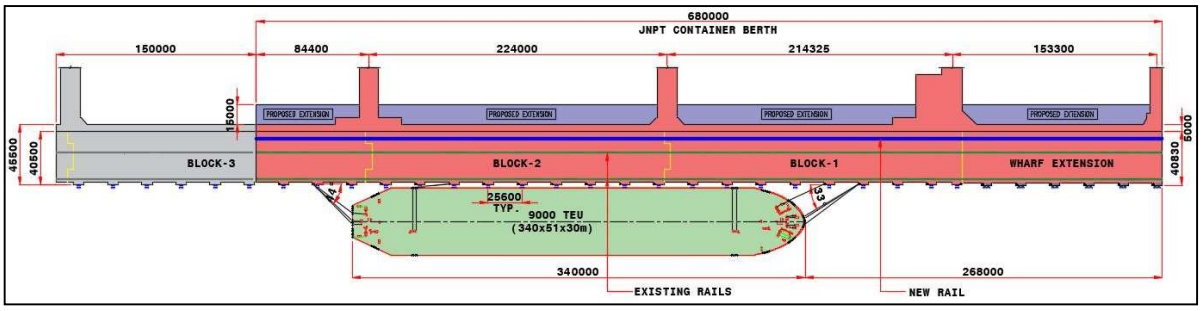


Figure 3: Mooring layout for 9000 TEU Vessel

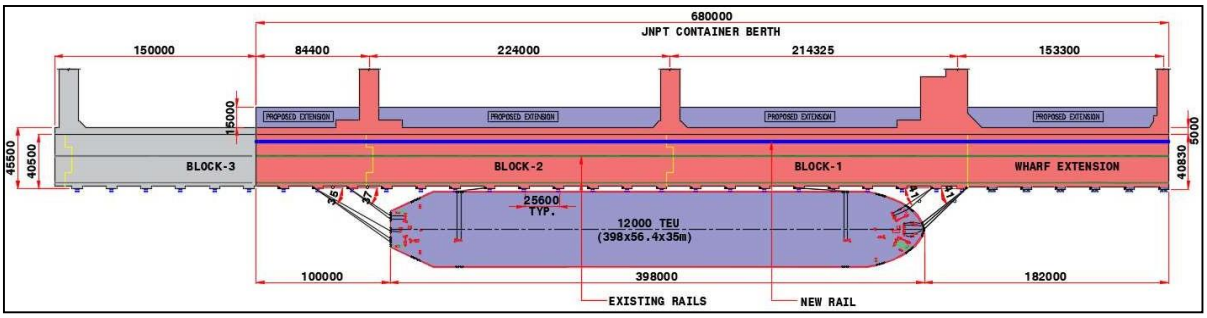


Figure 4: Mooring layout for 12200TEU Vessel

Based on the above data, M/s NSFTPL have independently cross – verified the feasibility studies carried out by M/s I.I.T. Madras on behalf of JNPA and confirm the findings thereof.

For the sake of clarity, the Technical Feasibility Study report carried out by I.I.T. Madras is appended to this explanatory note.

The proposed change would not result in any adverse impact on environment as most modern Green Port initiatives will be adopted by the Concessionaire which will have less impact on air, water and noise pollution in the operation area.

We understand from JNPA that the increase in the berth width falls in the CRZ-IV and is a permitted activity. The additional width would require CRZ clearance under the CRZ-2011 Notifications.

Benefits of up gradation & Extension of Berth

The repairs and refurbishment of the Berth will improve the health of the berth structures and would make for safer operations. Balance life of the Berth structure will also be improved.

The up gradation work will facilitate installation of new cranes with 30.50 m crane rail span will facilitate handling of containers on larger vessels of 12200 TEUs in a more efficient manner improving the vessel's turnaround times.

The extension of width of Berth by 15 m on the landside will enable safe and smooth maneuvering of Container laden trailer and will enable the stacking of the Container Hatch Covers.

2.5 NEED FOR ADDITIONAL FACILITY

Keeping in view the long-term usage and conditions of corrosive damages to the structure, the health of the berth structures need to be improved to ensure safer operations and to ensure safe working during the balance life of the Berth structure.

There is a requirement of facilitation to handling of containers on larger vessels of 12200 TEUs in a more efficient manner improving the vessel's turnaround times, which can be achieved only by installation of 30.5m gauge crane rails and bringing in higher capacity cranes towards which the facility was originally designed for.

In order to enable safe and smooth manoeuvring of vehicles on the wharf and to enable the stacking of the Container Hatch Covers, it is required to extend the width of Berth by 15 m on the landside.

2.6 ANALYSIS OF ALTERNATIVES

The existing route is required for widening of existing container berths as optimized one based on the following considerations.

- Alignment in horizontal plane parallel and along the Roads/Railway, as far as possible.
- Ground profile for pipeline hydraulics and avoidance of steep rising and falling ground, hills and valleys having sloping right of way.
- Availability of infrastructure and access to the pipeline route during construction and maintenance.
- Minimum crossing of existing pipelines, transmission lines, parallel alignment etc.
- Minimum Road, rail, river and nalas crossings.
- Avoidance of rugged and intricate grounds with hard strata, exposed rocks, boulders and queries.
- Avoidance of populated areas to a large extent

2.7 PROPOSED FACILITIES

- Increase of Rail span from 20 m to 30.50 m for 680 m berth length.
- Increase of deck width of the berth by 15 m on land side for smooth vehicle maneuvering& for keeping vessels hatch covers.
- Up gradation and strengthening of existing 530 m berth and 150 m wharf (steel structures) to accommodate design vessels of size 12200 TEU.
- Upgradation of Fenders and Bollards may be necessary.
- Repairs and strengthening of existing damaged portion of the berth structures.
- Under deck repairs of the existing structure wherever necessary

2.8 REQUIREMENTS FOR THE PROJECT

2.8.1 WATER REQUIREMENT

Total water requirement for widening purpose would be 50 KLD which will be sourced from M/s Maharashtra Jeevan Pradhikaran /City and Industrial Development Corporation of Maharashtra Limited (CIDCO) through JNPA.

2.8.2 POWER REQUIREMENT

200 KVA/KW will be required for widening purpose. This power shall be provided from MSEDCL through JNPA.

2.8.3 MANPOWER REQUIREMENT

As this is an expansion project, there is a great opportunity for employment during Construction Phase and Operation Phase. The JNP area is very well developed with all kind of infrastructure, power, water, storm water disposal management, sewage management facilities, educational & healthcare facilities, recreational facilities, housing & logistics required for existing JNP area.

During construction phase, no. of permanent employment will be approx. 10 nos and no. of contractual employment will be approx. 360 nos.

During Operational phase, no. of existing permanent employment will be approx. 125 and no. of proposed permanent employment will be approx. 15 no. of contractual employment will be approx. 360 nos. Total 500 no. of people will be benefitted during operation phase of the project.

2.9 LAND REQUIREMENT

The project is located between NSICT existing container berth and existing Shallow Water Berth of JNPA**.**

2.10 CONNECTIVITY

JNPA has very good road and rail linkages with hinterland as well as important business centres like Thane, Pune, Nasik, Aurangabad and Ahmedabad, which facilitate excellent port -industry interface.

Quantity of wastes to be generated (liquid and solid) and scheme for their management/disposal.

- 6.0 TPA domestic waste will be generated and further treated by handing over to MPCB authorized vendors.
- 6.0 TPA Wastes & Residues containing oil will be generated and further treated by handing over to MPCB authorized vendors.
- Used or spent oil will be generated and further send to MPCB authorized vendors

2.11 RAW MATERIALS

Raw material required for the widening of existing container berth is given below:

1. Concrete
2. Bricks
3. Sands
4. Cement
5. Aggregate
6. Pipes
7. Filler rod for welding pipe

2.12 DESCRIPTION OF CARGO HANDLING

The port handles both dry and liquid cargo at different jetties and locations part from undertaking lighter age through barges:

JAWAHALAL NEHRU PORT (JNPA)

The port lies along the eastern shore of Mumbai harbour off Elephanta Island on the Konkan mainland in location 18 56'43" North and 72 56'24" East .

The port shares a common 22.0 Km long main harbour channel with Mumbai Port up to No. 4 berth of Jawahar Dweep (J D) Terminal which is presently maintained to a depth of 10.7 to 11 mtrs. below Chart Datum.

The approach channel from J D to JNPA is 7.2 kms in length with maintained depths of 11 mtrs below Chart Datum with a width 350 meters at entry point i.e 460 meters off the berths. The available depth off the berths is 13.5 meters.

Making use of tidal window, large size vessels having a draught up to 12.5 mtrs. are able to navigate through Mumbai harbour main channel and JNP channel. The Port is deepening and widening the existing channel to accommodate up to 14 mtrs.

Cargo handling

The cargo handling berths comprise of anchorage berth of 600 meters diameter and 2000 meter of quay length for Container Berth apart from 445 meters of quay length for Feeder Container / Cement / Project Cargo Ships.

Most of the container cargo is handled from this port only. **Liquid Cargo Berths:-** The port handles POL cargo for BPCL, IOC and ONGC through dedicated berths. Cargo for BPCL and IOC is handled at Sheva, while, ONGC handles its Mumbai High supplies and vessels from Nhava.

1. Sheva: Liquid cargo is handled through the twin berth cargo jetty developed by M/s Bharat Petroleum Corporation Limited and Indian Oil Company Limited for handling liquid cargo including POL products. The jetty is 300 mtrs long with a width of 40.5 mtrs having capacity to accommodate two vessels of 85,000 DWT on seaside berth and 30,000 DWT on shore side berth.

Three dock lines are provided for white and black oil with a capacity of 5.5 million tones per annum. Jetty is provided wth six 12' marine loading and unloading arma (3each on sea and shore side) for working cargo. The dredged draught on seaside is 13.5 mtrs and 12 mtrs on shore side.

2. Nhava and Uran: Nhava is the main center for ONGC Mumbai High operations. The vessels operating in the High receive stores, fuel and lubricants from Nhava. The vessels calling Nhava are largely restricted to OSVs.

ONGC off shore facility – refinery and tank farm, is located at Uran and was established in 1974. The site is about 12 km east of Mumbai and is approachable by all-weather motor able roads.

3. The facility receives entire oil and part of natural gas produced in Mumbai offshore oil fields. Both the oil and gas received from offshore is processed at various units for producing value added products like LPG, C2-C3, LAN, apart from processing storage and transportation of oil.

4. The unstabilized crude oil is received from offshore platforms through 3 oil trunk lines. 30" MUT oil pipeline from Mumbai High and 24" HUT oil pipeline from satellite off-shore platform are the principal feed stock to plant. Processed product is shipped out through Jawahar Dweep.

2.13 BATHYMETRIC PLAN

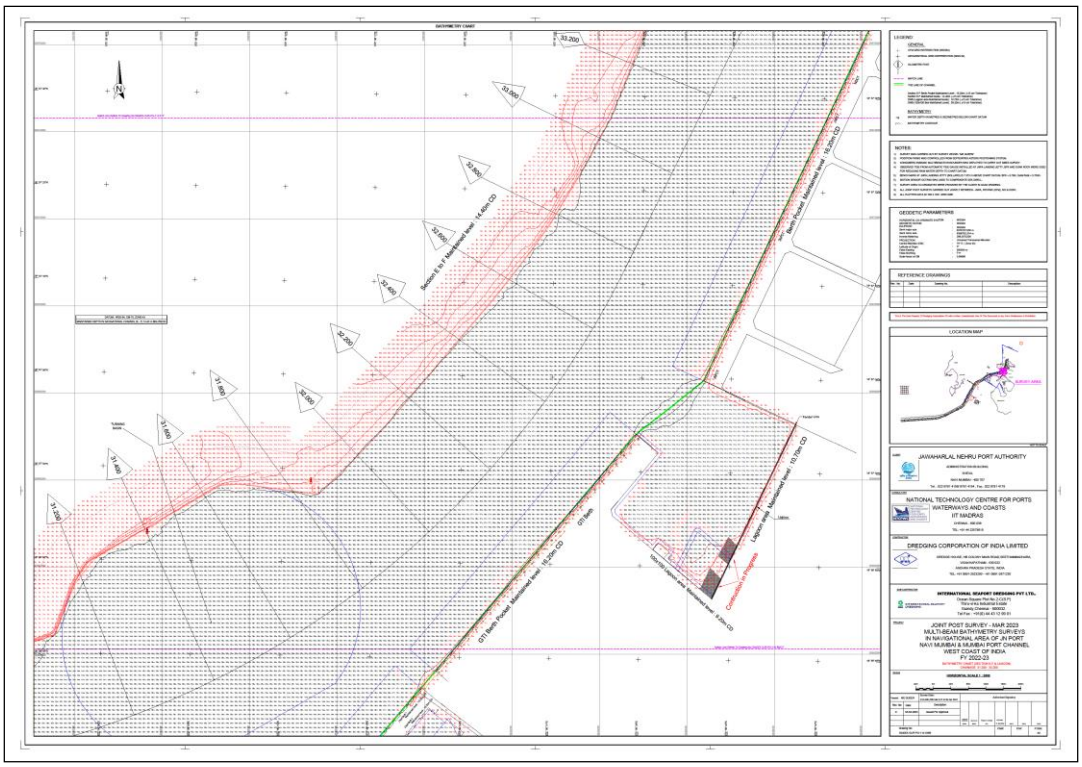


Figure: Bathymetric plan

2.14 OIL SPILL

Oil pollution is considered as one of the major threats to the marine coastal environment, as it causes a variety of deleterious effects across a wide range of habitats and species. The oil possesses a multi-pronged lethality, being a complex mixture of many hydrocarbon compounds with varying physical and chemical properties such as water-solubility, toxicity, and environmental persistence. Most 105 common accidental spills at port and harbour are caused during loading/unloading operations. The bursting of transfer hoses or pipes is another cause. Extreme cases of collision of vessels also are a reason for oil spills.

The extent of damage caused by an oil spill depends upon the quantity of oil spilled, the type of oil involved in the spillage and the oceanographic and meteorological conditions prevailing in the location where the spill has occurred. When the oil spills in large quantities, 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 is 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 benthic organisms such as clams and mussels. The other amenities that are affected include mangrove forests and several marine resources.

Oil spills can also have a serious economic impact on coastal activities and the resources of the sea. In most cases, such damage is temporary and is caused primarily by the physical properties of oil creating nuisance and hazardous conditions. The impact on marine life is compounded by toxicity and tainting effects resulting from the chemical composition of oil, as well as by the diversity and variability of biological systems and their sensitivity to oil pollution.

2.15 PROJECT COST

Project Cost for widening of project is estimated as Rs. 196.82 Crore.

2.16 PROPOSED SCHEDULE FOR APPROVAL AND IMPLEMENTATION

The pre-project activities to be completed before the physical execution of the project are briefly enumerated below:

I. Approval of the project by SEIAA, Maharashtra.
II. Obtaining CRZ clearance from the Coastal Zone Management Authority (CZMA) and Consent to establish from the State Pollution Control Board.
III. Appointment of Engineering Procurement Consultant (EPC).
IV. Firming up of list for procurement.
V. All the activities mentioned above should be completed before the 'zero date' of the project i.e. before the commencement of the widening phase of the project

2.16.1 HTL/LTL DEMARCATION

The entire project alignment falls under **CRZ IV (A)** Area as Per Approved CZMP Prepared By IRS, Chennai, As Per CRZ Notification 2011.

(IRS REPORT REF NO. AU/IRS/MS/231-2022 DATED 22.11.2022)

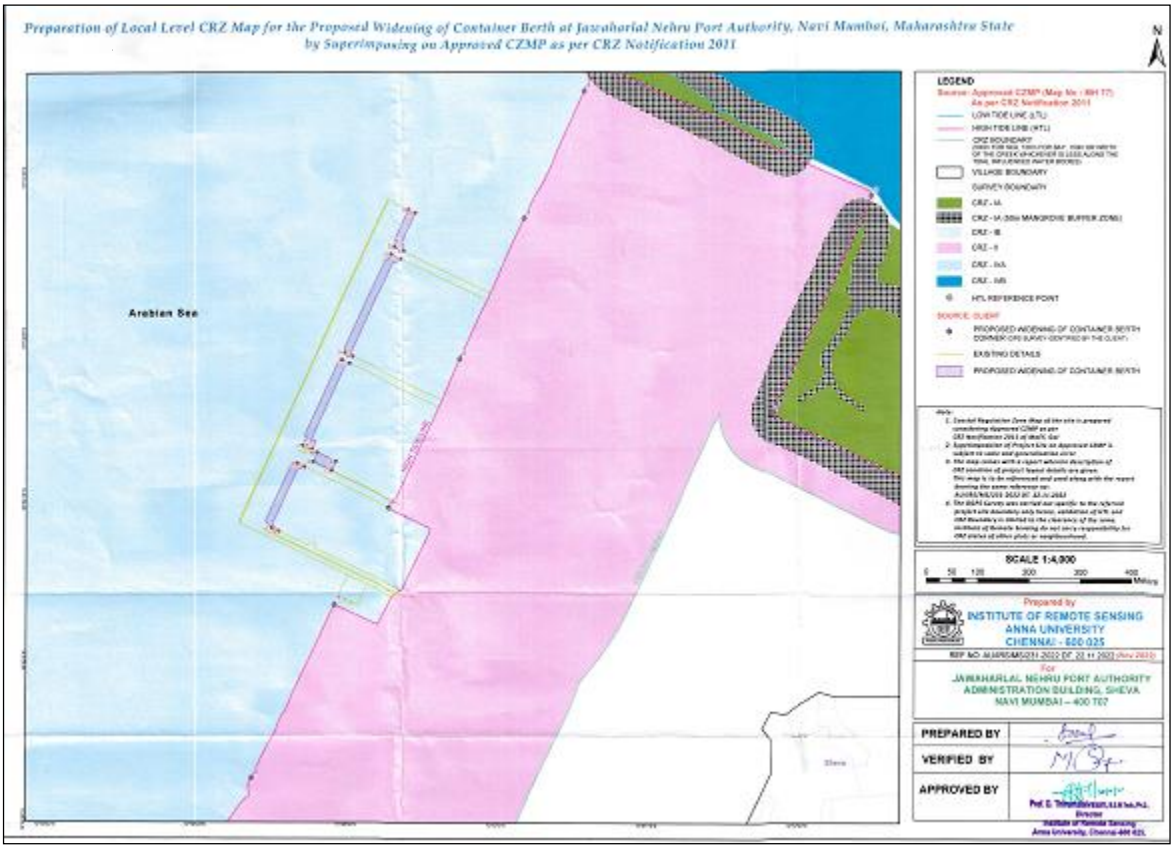


Figure: 2.12 HTL/LTL DEMARCATION

CHAPTER-3 : DESCRIPTION OF THE ENVIRONMENT

3.1 GENERAL

This chapter illustrates the description of the existing environmental status of the study area with reference to the major environmental attributes. The existing environmental setting is considered to establish the baseline conditions, which are described with respect to physical environment, air environment, water environment, noise environment, traffic pattern and density, land environment, biological environment and socio economic environment.

The monitoring of environmental parameters was conducted within the study area of 10km around the project site in accordance with the guidelines issued by the MoEF&CC, CPCB, and SPCB during the study period (Post Monsoon- September 15th 2022 to December 05th 2022).

Baseline Environmental status in and around the site, depicts the existing quality of Air, Noise, Water (terrestrial & marine), Soil, Ecology & Biodiversity and Socio-economic environment. Based on the baseline data, environmental impact assessment is carried out and Environmental Management Plan is prepared.

This baseline environmental study reveals information on existing environmental scenario.

- Delineation of project site and study area
- Delineation of the environmental components and methodology
- Delineation of study period
- Delineation of the location of the site and description of its surroundings based on primary & secondary data. After delineation of the above for the present case the following studies were conducted:

i) Baseline data generation/establishment of baseline for different environmental components

ii) Baseline status of the existing site operating facilities

iii) Traffic density at the inter-phase of project site and study area

3.2 STUDY AREA

Studies of various environmental parameters have been done within the study area of 10km around the project site. The impact identification always commences with the collection of baseline data such as Ambient Air Quality, Micro-Meteorology, Ground and Surface Water

Quality, Noise levels, Soil Quality, Land use pattern, Biological Environment, Socio-economic Environment, Geology and Hydrology within the study zone of 10 km radius.

3.2.1 STUDY PERIOD

The baseline environmental study was done during post monsoon season i.e. September 15th 2022 to December 05th 2022 by Mantec Laboratory, NABL Accredited Lab and Certificate No. TC-6440 dated 11.06.2022 valid until 10.06.2024 in accordance with the Guidelines for EIA issued by the Ministry of Environment Forests and Climate Change, Govt. of India and CPCB, New Delhi. Secondary data was also collected from different government sources/Authorities.

3.2.2 SITE AND SURROUNDINGS

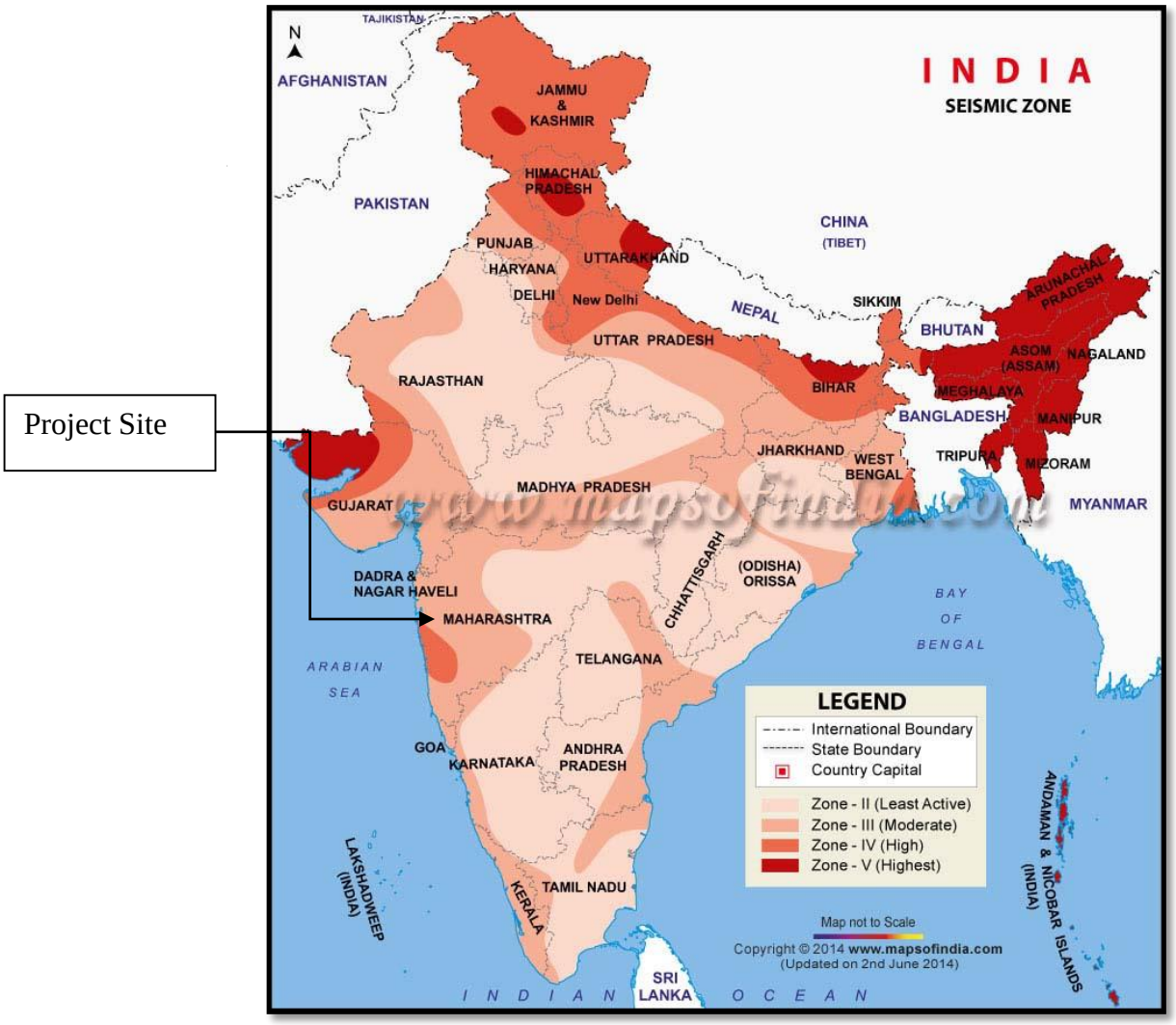
The proposed widening project of existing container berth at Jawaharlal Nehru Port falls in the project is located between NSICT existing container berth and existing Shallow water Berth of JNPA.

3.3 GEOLOGY

The region is seaward part of the geology of the Deccan traps that formed by the eruptions to rapidly cover a large part of the Indian Peninsula (at present extends over 500,000 sq. kms.) the volcanic eruptions around the Mumbai area occurred in shallow lagoon conditions and thus most of the lava flows. Due to sub-aqueous eruptions of the lava, the basalt was converted to spilite, as a result of the metasomatic changes. Some of the lava flows developed pillow structure and some became brecciated to form volcanic breccia. Such sub-aqueous volcanic breccia may be described as Hyaloclastic. There were intermediate and acid rocks formed as trachyte intrusive and rhyolie flows.

At the project site the soil profile was composed of gravely silty clay (murrum), sand, marine clay and boulders lying on the highly weathered tuff and berrica layers of inter trappean shale. The rock type encountered out there is spilite with upper theolitic basalt. The rock type encountered in the adjacent harbour area is hyaloclasite.

The area lies is seismic zone III (Earthquake moderate damage risk zone- MSK VII).



3.4 ENVIRONMENTAL ASPECTS

The scope of establishing pre-project environmental setting is as per standard TOR. As part of the study, description of biological environment and human environment such as environmental settings, demography & socio-economics, land-use/ land cover, ecology, biodiversity have been carried out within 10km from project site.

- Land Environment
- Air Environment
- Noise Environment
- Soil Environment
- Water Environment
- Biological Environment
- Socio-economic Environment

3.4.1 Components & Methodology

The data was collected from both primary and secondary sources. Micrometeorological data at site was also recorded using Automatic Weather Station. Apart from these, secondary data

have been collected from Census Handbook, Revenue Records, Statistical Department, Soil Survey and Land use Organization, District Industries Centre, Forest Department, Central Ground Water Authority, etc.

The studies involved in conducting field studies and analyzing various parameters that might be affected due to the industry and conducting socio-economic survey among the people. For reconnaissance survey the sampling locations were identified based on:-

i) Existing topography and meteorological conditions
ii) Location of human habilitation and other sensitive areas present in the vicinity of the project site.
iii) Representative areas for baseline conditions
iv) Accessibility for sampling

The scoping and the extent of data generation were formulated based on interdisciplinary team discussions, and professional judgment. The various parameters surveyed and studied for the baseline study are tabulated below-

Table- 3: Environmental components and their methodologies

S.N.	Environmental components	Parameters	Methodology
1	Air	Meteorology (Temp., RH, WS, WD, RF)	USEPA (Meteorological Monitoring guidance for regulatory modeling applications)
		Ambient Air Quality (PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO)	IS-5182 part-14, CPCB (guidelines for measurement of Ambient Air Pollutants).
2	Water	Water Quality (Surface & Ground)	Standard limits: Surface- CPCB Water quality criteria Ground-IS 10500:2012 Sampling Methodology- IS:3025 Part-1
3	Noise	Ambient Noise Quality (Lmax, Lmin, Leq)	IS:9989 (Assessment of noise with respect to community response)
4	Soil	Soil Quality (pH, EC, BD, Texture, SAR, Key nutrients, OM, OC)	Sampling Methodology and Analysis- IS: 2720/soil chemical analysis by M.L Jackson
5	Land Use	Land use types, Land schedules, Satellite imagery	Bhuvan, NRSA
6	Ecology	Ecology studies (Floristic diversity, Terrestrial ecosystem sustainability, Green belt development, sinking capacity of pollutants)	Field Study / Secondary Data

S.N.	Environmental components	Parameters	Methodology
7	Socio Economic	Demography and Occupational details, agricultural situation etc.	Census, District report, Public Consultation by Questionnaire survey.
8	Hydrology & Geology	Geological, Hydrological, Geo-morphological studies	Geological Survey of India, NRSC
9	Traffic Study	PCU/hr, LOS	IRC 64:1990, ARAI, CPCB.

3.4.2 Meteorological conditions

3.4.2.1 Climate

The region experiences a tropical monsoon climate and has four distinct seasons as follows:

i) Southwest monsoon season (June to September) - Main rainy season with very high humidity, low clouds and several spells of moderate to heavy rains.

ii) Post-monsoon season (October to November) - Frequency of severe cyclonic storms is the highest during this season.

iii) Winter season (December to February) - Fine weather and occasional morning mist or fog.

iv) Summer season (March to May) - A rise in air temperature with incidence of thunderstorms and cyclonic storms during the later part of the season.

3.4.2.2 Humidity

The humidity is moderate to high throughout the year with the mornings being more humid than Evenings. The mean relative humidity for each month in a year measured during mornings and evenings. The monthly average relative humidity (RH) for September 2022 was recorded to be 69.0 %. The monthly average relative humidity (RH) for October 2022 was recorded Average to be 68.0. The monthly Average relative humidity (RH) for November 2022 was recorded to be 51.0%. *(Source: CPCB)*

3.4.2.3 Temperature

India Meteorological Department (IMD) records indicate that the area experiences tropical coastal climate. The moderating effects of the nearby sea and the fairly high amount of relative humidity in the atmosphere have restricted the variability. The seasonal variations of temperature follow closely the course of the sun. 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.

The maximum and minimum monthly temperature of 38.00°C and 25°C was recorded for September 2022 month. The maximum and minimum monthly temperature of 31.00°C

and 26°C was recorded for October 2022 month. The maximum and minimum monthly temperature of 33.00°C and 25°C was recorded for November 2022 month. *(Source: CPCB)*

3.4.2.4 Wind flow pattern

The monthly Average wind speed of 8.5 was recorded for September 2022 month. The monthly Average wind speed of 9.7 was recorded for October 2022 month. The monthly Average wind speed of 10.5 was recorded for November 2022 month. Comparative account of study period shows higher Transport and dispersion of air pollutants are mainly governed by wind speed. Higher the wind speed significant amount of pollutants will transport away from source.

The prominent wind direction was from the West (W) accounting for about 42.58% of wind reaching at the JN Port during the month October, 2022. *(Source: CPCB)*

3.4.2.5 MICRO-METEOROLOGICAL DATA

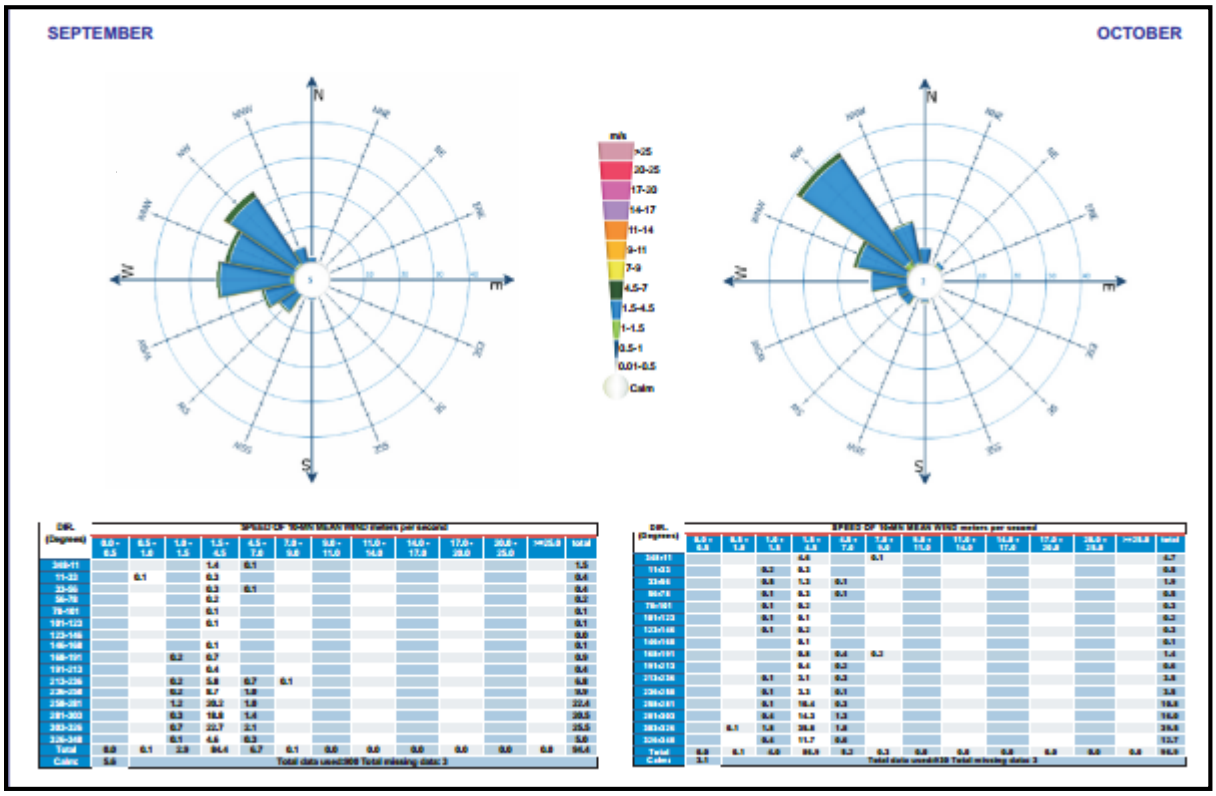
3.4.2.6 Primary Data

The meteorological data recorded during study period is very useful for proper interpretation of the baseline information as well as for input to predictive models for air quality impacts for collection of Primary data. An Automatic Weather Station was installed at the site, for three months (September 15th 2022 to December 05th 2022) and it has recorded hourly observations for the parameters like Maximum and Minimum Temperature (°C), Relative Humidity (%), Wind Speed (Km/hr), Wind direction and Rainfall (mm). The hourly-recorded observations (wind velocity and wind directions) during 12weeks study period are used in computing percentage frequencies and are depicted in the form of "wind roses" (Figure. 3.1). The summarized meteorological data is provided in Table 3-2.

Table-4: Onsite Meteorological Data (September 15th 2022 to December 05th 2022)

Months	Temp (°C)		Relative Humidity (%)	Average wind speed (Km/h)	Total Rainfall (mm)
	Max	Min	Average	Average	
September	38	25	69	8.5	25.4
October 2022	31	26	68	9.7	20.3
November 2022	33	25	51	10.5	0

During the study period wind rose diagram indicates predominant wind direction is from NW to SE.



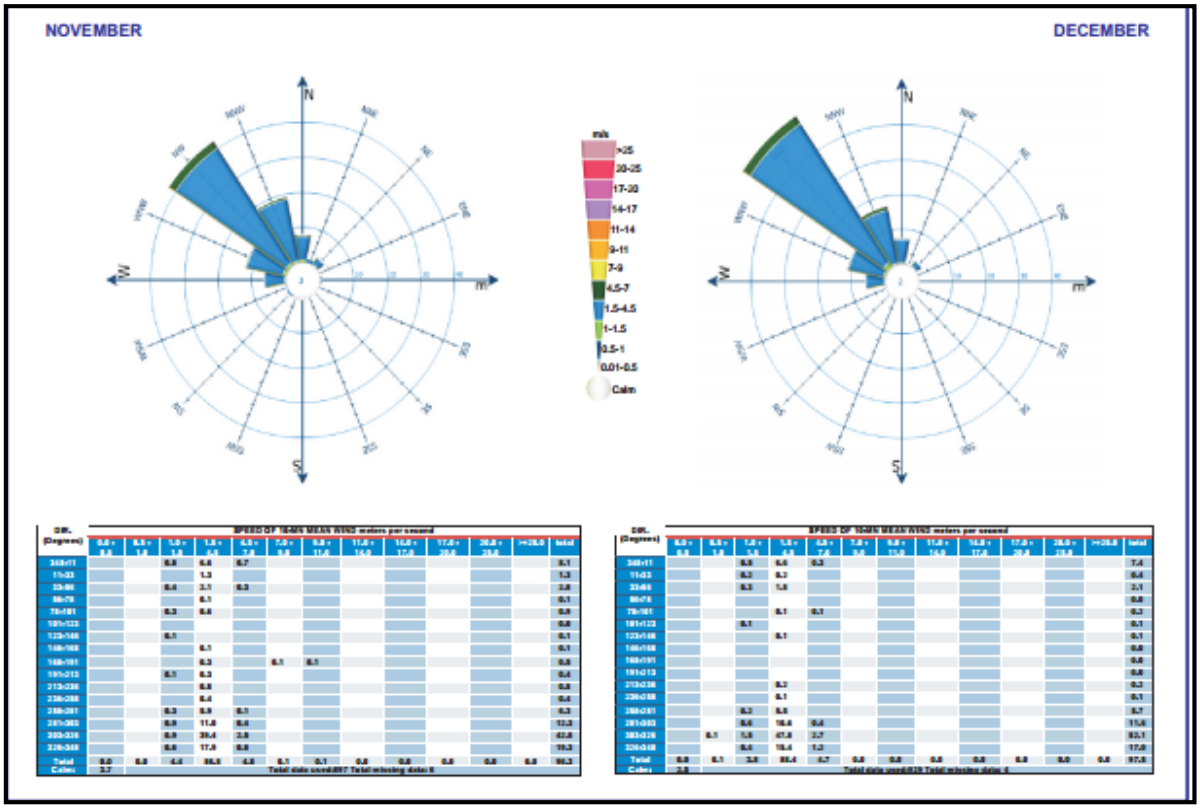


Figure -7: Wind Rose Diagram of Study Period

3.5 AMBIENT AIR QUALITY

Ambient air quality monitoring is done to determine the general background concentration levels of pollutant. The prime objective of the ambient air quality study is to assess the existing air quality of study area and to establish the existing ambient air quality within the study area and its conformity to NAAQS.

3.5.1 SELECTION OF SAMPLING LOCATIONS

The sampling equipment was placed at a height of 3 to 3.5 meters above ground level at each monitoring station, thus neglecting the effects of wind blow ground dust. The equipment was placed at open space free from trees and vegetation which otherwise act as a sink of pollutants resulting in lower levels in monitoring results. At locations close to internal roads, the equipment was placed at least 10m away from such roads to avoid influence of traffic exhaust emissions. The Ambient Air Quality Monitoring locations have been presented in Figure. 3.3.

Table -5: Showing Ambient Air Monitoring Locations

S.N.	Monitoring Locations	Distance (Km)	Direction	Latitude	Longitude
AQ-1	Project Site	-	-	18° 56' 43.000" N	72° 56' 24.000" E
AQ-2	Lady Khatun Marium School, Nhava	3.54Km	NE	18° 57' 54.560" N	72° 57' 59.014" E
AQ-3	SBI, Naval Station, Karanja	5.53Km	SW	18°53'58.90"N	72°54'48.36"E
AQ-4	Bhawra Shafi Jama Masjid	5.27Km	SW	18° 53' 54.822" N	72° 55' 48.090" E
AQ-5	Zpd School, Sonari	6.04Km	SE	18° 54' 43.012" N	72° 59' 7.535" E
AQ-6	Angalaparameshwari (Periyayi) Temple, Trombay	9.69Km	NNE	19° 1' 56.324" N	72° 57' 0.950" E

3.5.2 METHODOLOGY

As per the scope of work, 6 ambient air quality monitoring stations were monitored for specific air pollutants during the study period. All the instruments (samplers) were installed between 1 to 4 m above ground level which was free from any obstructions. The sampling and analysis of required parameters were carried out as per IS: 5182 and NAAQS Monitoring & Analysis Guideline, Volume 1.

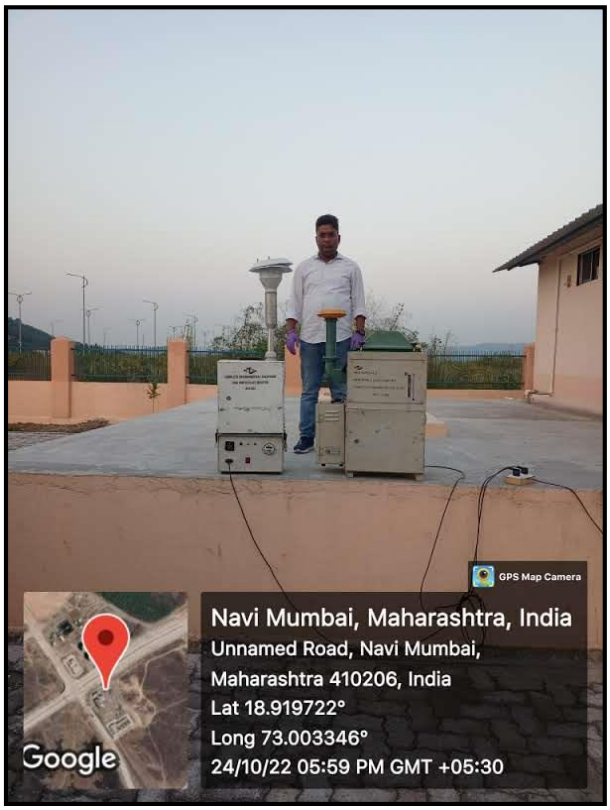
The following air pollutants were monitored on 24-hourly/8-hourly basis for consecutive two days in a week for a period of twelve/thirteen weeks:

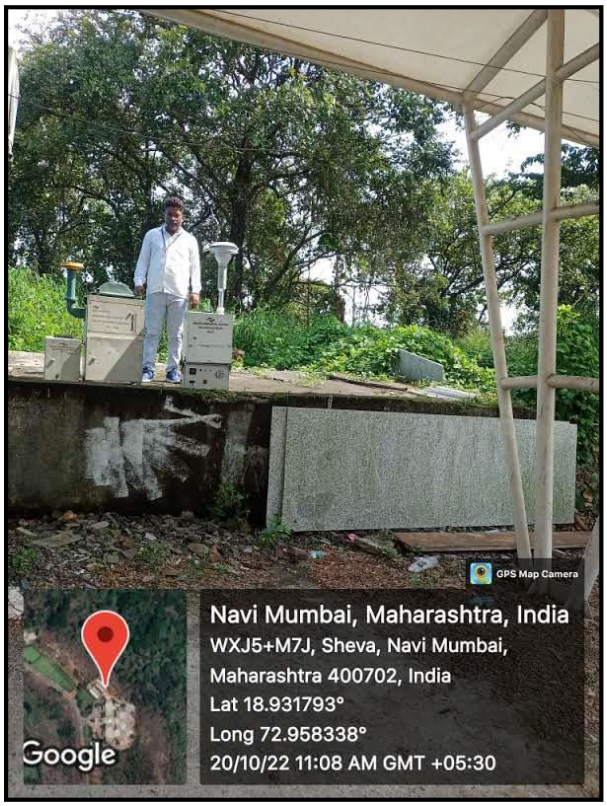
- Particulate matter(PM_{10})
- Particulate matter($PM_{2.5}$)
- Sulphur dioxide (SO_2)
- Oxides of nitrogen (NO_2)
- HC (Methane, Non- Methane)
- VOC (Volatile Organic Compounds)

Table -6: National Ambient Air Quality Standards

S. No	Parameters	Techniques	Technical Protocol
1	Sulphur Dioxide (SO_2)	West & Geake	IS:5182(P2)
2	Nitrogen Dioxide(NO_2)	Jacob & Hochheiser	IS:5182(P6)
3	ParticulateMatterPM_{10}	Gravimetric	IS:5182(P15)
4	ParticulateMatter$PM_{2.5}$	Gravimetric	IS:5182 Part-24
5	Carbon-monoxide as CO	NDIR	IS:5182(P-10)

3.1.1.1 Photographs of Air Sampling

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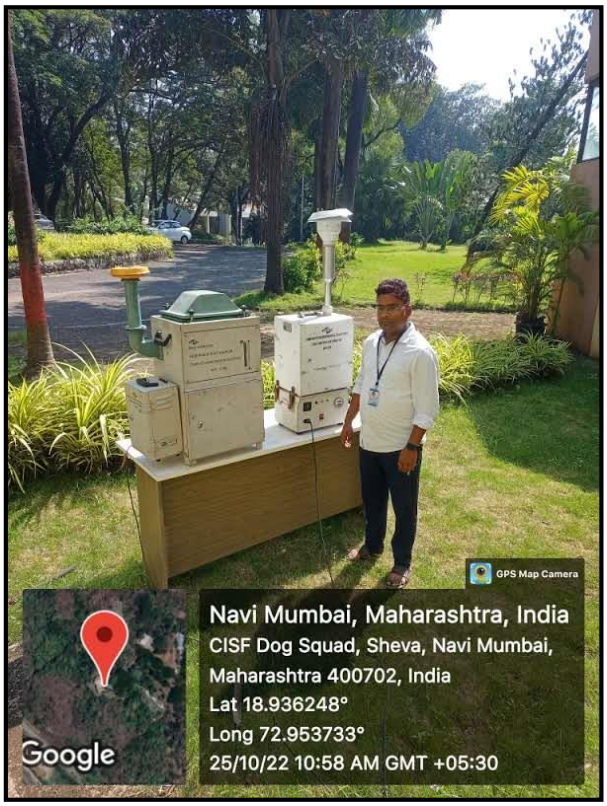
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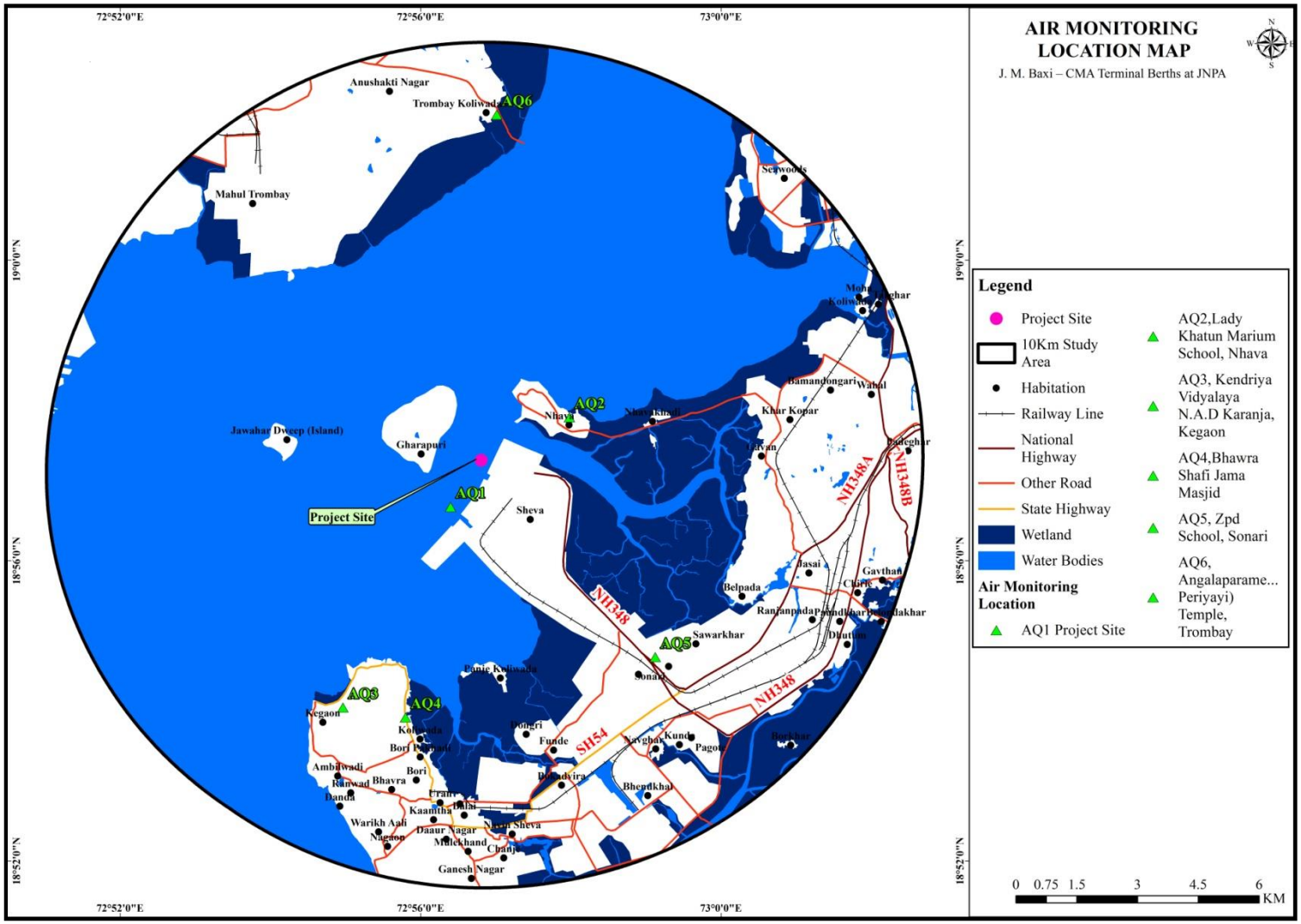


Figure -8: Ambient Air Quality Monitoring Location

3.5.3 Air Quality Standards

The National Ambient Air Quality Standards for the above mentioned pollutants, notified vide NAAQS Notification dated 18th November, 2009, are presented in Table 3.8.

Table-7: Ambient Air quality Standards

S. No.	Pollutant	Time weighted Average	Concentration in air	
			Industrial, residential, rural and other areas	Ecologically sensitive area (notified by Central Govt.)
1.	Sulphur dioxide (SO_2), µg/m³	Annual*	50	20
		24 Hours**	80	80
2.	Nitrogen dioxide (NO_2), µg/m³	Annual*	40	30
		24 Hours**	80	80
3.	Particulate matter PM_{10}, µg/m³	Annual*	60	60
		24 Hours**	100	100
4.	Particulate matter $PM_{2.5}$, µg/m³	Annual*	40	40
		24 Hours**	60	60
5.	Carbon monoxide (CO), mg/m³	8 Hours**	02	02
		1 Hour**	04	04
6.	Ammonia (NH_3), µg/m³	Annual*	100	100
		24 Hours**	400	400
7.	Benzene (C6H6), µg/m³	Annual*	05	05
8.	Nickel (Ni), ng/m³	Annual*	20	20

* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly or at uniform interval.

** 24 hourly, 8 hourly or 1 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

3.5.4 Data Analysis

The Ambient Air Quality survey has been carried out at 6 locations within 10km radius of the project. Measurement of Particulate pollutant (PM_{10} & $PM_{2.5}$) and gaseous pollutants (SO_2, NO_X and CO, HC, VOCs) levels helps to understand the existing environmental scenario. The results of all the locations were further computed for statistical parameters like Minimum,

Maximum concentrations and Arithmetic mean (AM). The results are shown in Table No. 3-6.

Table-8: Ambient Air Quality Data

Pollutant	Location Codes	Max.	Min.	Avg.	NAAQS
PM_{10} ($\mu g/m^3$)	A-1	82	86	74.83	100
	A-2	78	58	68.50	
	A-3	72	50	62.50	
	A-4	77	57	66.83	
	A-5	74	48	59.67	
	A-6	72	50	62.50	
$PM_{2.5}$ ($\mu g/m^3$)	A-1	45	34	40	60
	A-2	46	34	39.21	
	A-3	42	32	36.50	
	A-4	42	26	33.16	
	A-5	43	24	33.71	
	A-6	42	32	36.50	
NO_2 ($\mu g/m^3$)	A-1	26	15	20.33	80
	A-2	24	14	19.50	
	A-3	32	17	23.75	
	A-4	34	20	20.63	
	A-5	24	16	20.13	
	A-6	32	17	23.75	
SO_2 ($\mu g/m^3$)	A-1	13	6	8.96	80
	A-2	16	6	9.15	
	A-3	18	7	11.67	
	A-4	18	8	13	
	A-5	14	5	9.17	
	A-6	18	7	11.67	
CO (mg/m^3)	A-1	0.86	0.64	0.75	02
	A-2	0.89	0.56	0.69	
	A-3	0.88	0.62	0.76	
	A-4	0.90	0.62	0.74	
	A-5	0.89	0.54	0.70	
	A-6	0.88	0.62	0.76	

(Source: Mantec Laboratory)

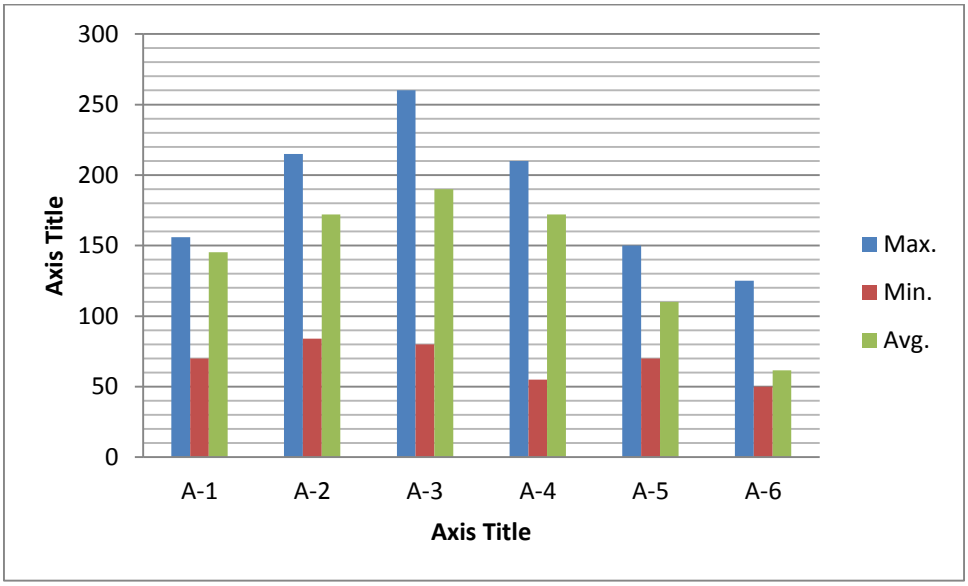


Figure -9: Graphical representations of PM_{10}

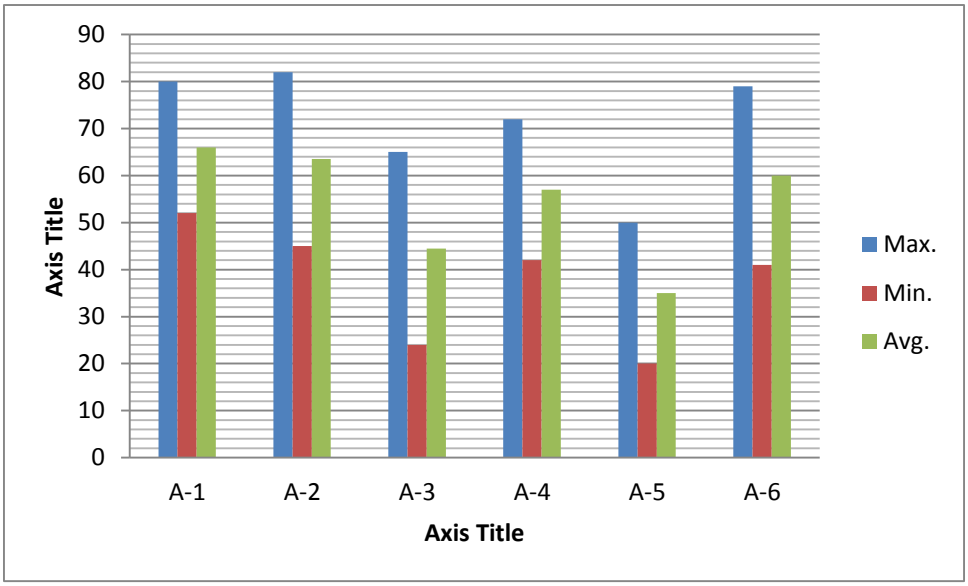


Figure -10: Graphical representations of $PM_{2.5}$

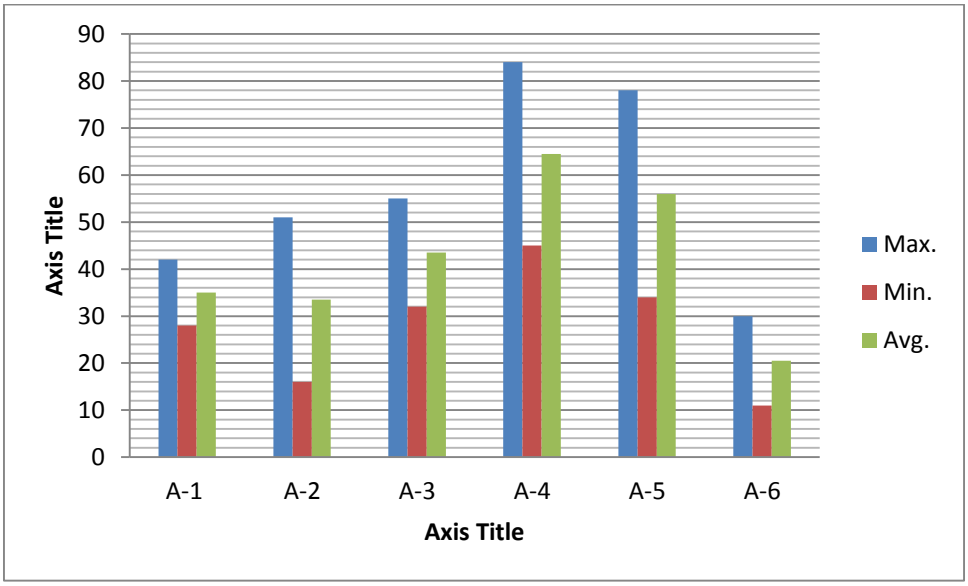


Figure -11: Graphical representation of NO_2 pollutant

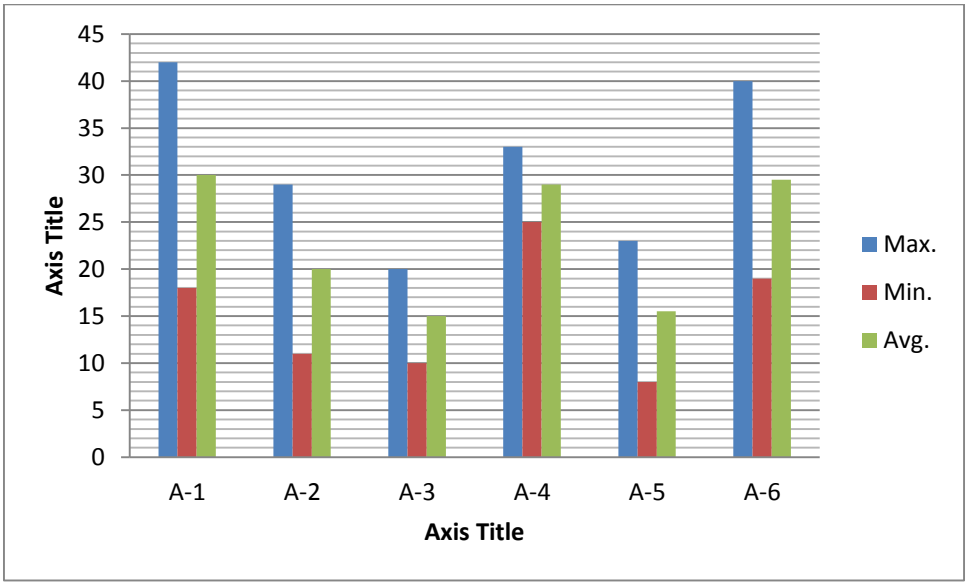


Figure -12: Graphical representation of SO_2 pollutant

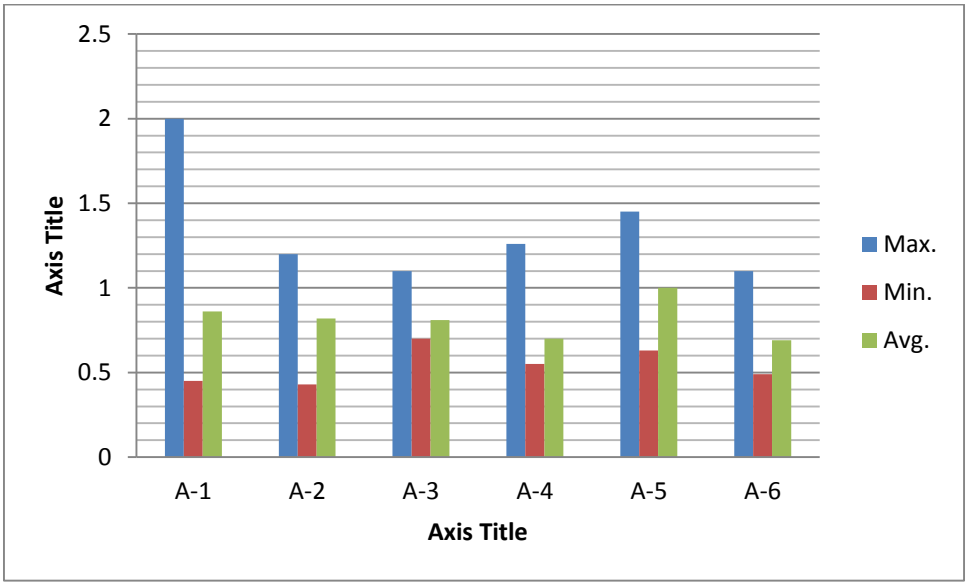


Figure -13: Graphical representation of CO pollutant

3.5.5 Interpretation:

Ambient Air Quality Monitoring reveals that the minimum and maximum concentrations of PM_{10} for all the 6 Air Quality monitoring stations were found to be 48.0µg/m^3 and 82.0 µg/m^3 respectively, while for $PM_{2.5}$ varies between 24.0µg/m^{3}and 46.0µg/m^3. As far as the gaseous pollutants SO_2, NO_2, & CO are concerned, the prescribed limits under NAAQ Standards for residential and rural areas has never surpassed at any station. The minimum and maximum concentrations of NO_2 were found to be 14.0µg/m^3 and 34.0µg/m^3 respectively. The minimum and maximum concentrations of SO_2 were found to be 5.0µg/m^3 and 18.0 µg/m^3 respectively. The minimum and maximum concentrations of CO were found to be 0.54mg/m^3 and 0.90 mg/m^3 respectively.

To maintain the ambient air quality of the area, the latest/modern air pollution control measurements along with suitable EMP has been adopted, which has been elaborated in Chapter-4 of the report.

3.6 NOISE ENVIRONMENT

3.6.1 General

Noise can be defined as unwanted sound or sound in the wrong place at the wrong time. Noise can also be defined as any sound that is undesirable because it interferes with speech and hearing, is intense enough to damage hearing, or is otherwise annoying. It has an adverse effect on human beings and their environment, including land, structures and domestic animals. Noise can also disturb natural wildlife and ecological systems.

Environmental noise can have several effects varying from hearing loss to annoyance. Sufficiently loud noise may

- cause hearing loss or health damage;
- interfere with work tasks, specially those involving concentration of mind;

- interfere with speech communication;
- affect inter-room privacy;
- interfere with sleep; and
- Cause annoyance.

3.6.2 Standards for Ambient Noise Level

The Ministry of Environment, Forests and Climate Change has notified the ambient air quality standards in respect of noise for different area categories vide gazette notification dated February 14th, 2000 under the Environment Protection Act (1986). These standards are given in Table-3.7.

Table-9: Ambient Noise Quality Standards

Area Code	Category of Area	Noise dB(A) Leq	
		Daytime*	Night time*
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

Note:

1. *Day Time is reckoned between 6AM and 10PM*
2. *Night Time is reckoned between 10PM and 6AM.*
3. *Silence Zone is defined as area up to 100 metres around such premises as hospitals, educational institutions and courts. The silence zones are to be declared by the competent authority. Use of vehicular horns, loudspeakers and bursting of crackers shall be banned in these zones.*
4. *Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.*
   - *dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is related to human hearing.*
   - *"A", in dB(A), denotes the frequency weighing in the measurement of noise and corresponds to frequency response characteristics of the human ear.*

3.6.3 Noise monitoring locations

The statistical analysis (Table-3.8) is done for recorded noise levels at 6 locations. The location of Noise Quality Monitoring stations are depicted in Figure. 3.10.

Table-10: Ambient Noise Quality Monitoring Station

S.N.	Monitoring Locations	Distance (Km)	Direction	Latitude	Longitude
NQ1	Project Site	-	-	18° 56' 43.000" N	72° 56' 24.000" E
NQ2	Lady Khatun Marium School, Nhava	3.54Km	NE	18° 57' 54.560" N	72° 57' 59.014" E

NQ3	SBI, Naval Station, Karanja	5.53Km	SW	18°53'58.90"N	72°54'48.36"E
NQ4	Bhawra Shafi Jama Masjid	5.27Km	SW	18° 53' 54.822" N	72° 55' 48.090" E
NQ5	Zpd School, Sonari	6.04Km	SE	18° 54' 43.012" N	72° 59' 7.535" E
NQ6	Angalaparameshwari (Periyayi) Temple, Trombay	9.69Km	NNE	19° 1' 56.324" N	72° 57' 0.950" E

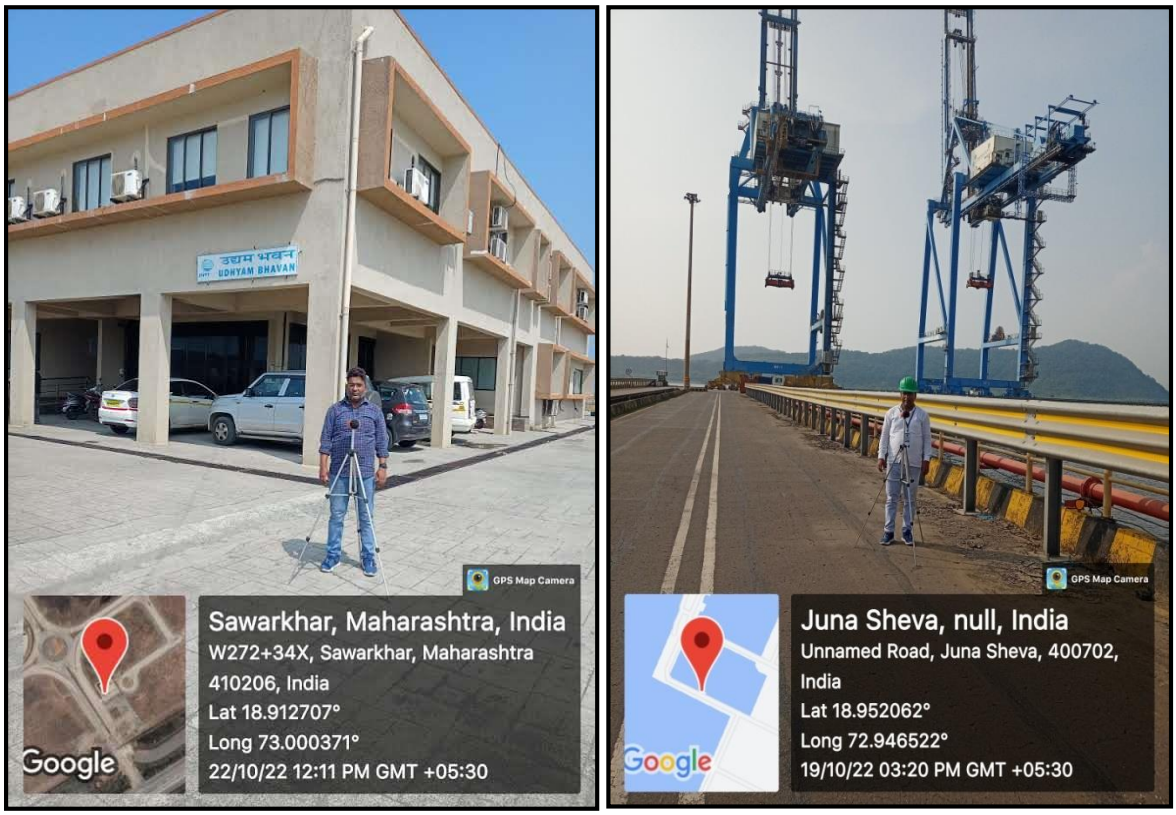


Figure-14: Noise monitoring photographs

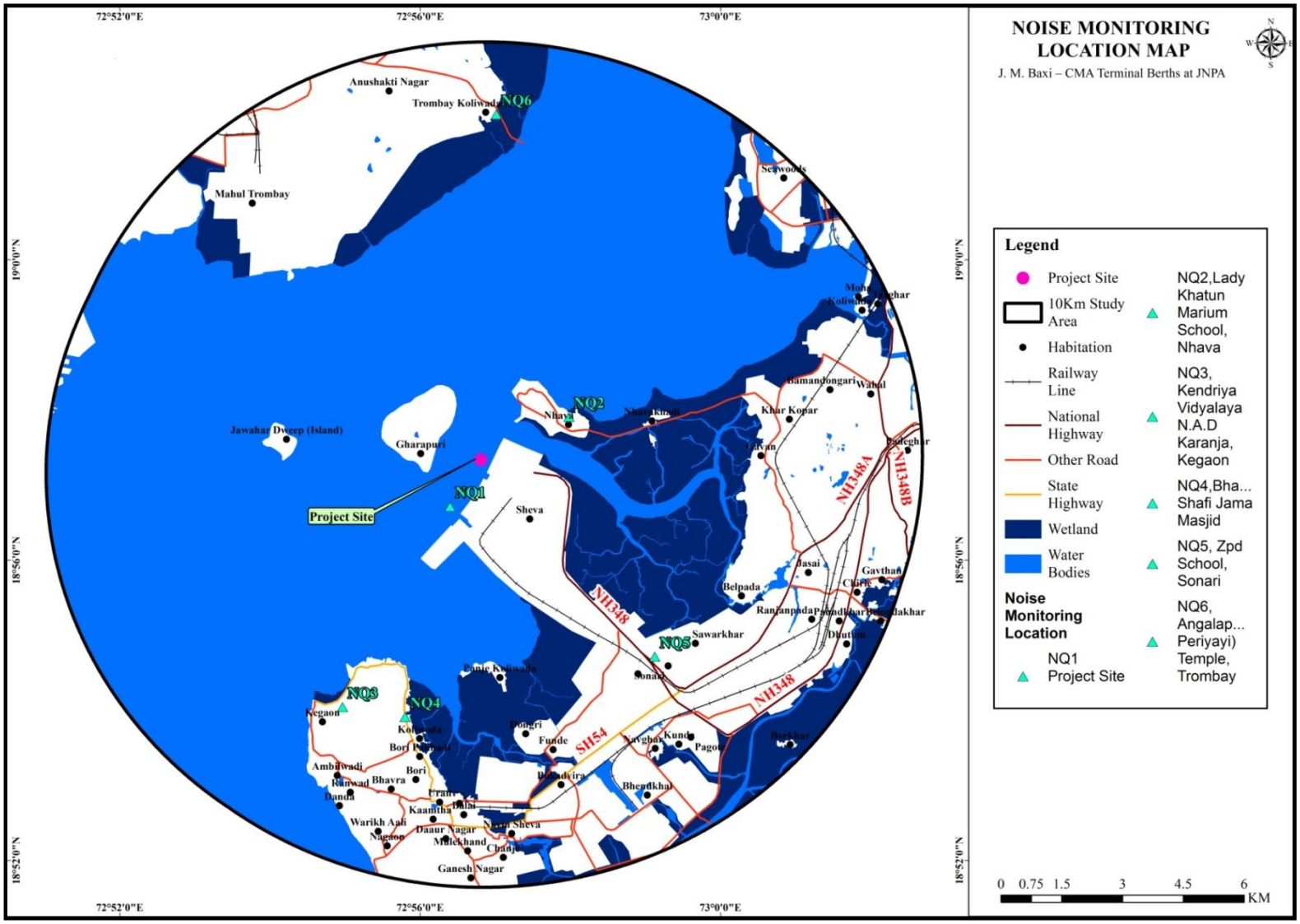


Figure -15: Noise Quality Monitoring Locations

3.6.4 METHODOLOGY

The intensity of sound energy in the environment is measured on a logarithmic scale and is expressed in a decibel (dB) scale. Ordinary sound level meter measures the sound energy that reaches the microphone by converting it into electrical energy and then measures the magnitude in dB. In a sophisticated type of sound level meter, an additional circuit (filters) is provided, which modifies the received signal in such a way that it replicates the sound signal as received by the human ear and the magnitude of sound level in this scale is denoted as dB(A). The sound levels are expressed in dB(A) scale. Noise levels were measured using an Integrating sound level meter, with 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" weighting set the sound level meter was run for one hour time and Leq was measured at all locations. Day time Leq and night time Leq values were computed from these measured 1 hour Leq values. The day noise levels represent the value during 6.00am to 10.00pm and night noise levels, during 10.00pm to 6.00am at all the eight locations covered under the study.

3.6.5 Results and discussion

The values observed during the study have been presented separately for day-time and night-time. The observed values have also been presented graphically in Figure 3.11.

Table 3-7: Noise level data

S. No.	Noise	Standards of Noise Level			Measured Noise Level db(A)	
	Location	Category of Area	Day dB (A)	Night dB (A)	Day (Ld)	Night (Ln)
1	Project Site	Industrial	75	70	55.2	45.8
2	Lady Khatun Marium School, Nhava	Silence	50	40	40.2	36.5
3	SBI, Naval Station, Karanja	Residential	55	45	42.6	38.2
4	Bhawra Shafi Jama Masjid	Residential	55	45	44.6	39.2
5	Zpd School, Sonari	Silence	50	40	41.5	37.2
6	Angalaparameshwari (Periyayi) Temple, Trombay	Residential	55	45	48.5	41.5

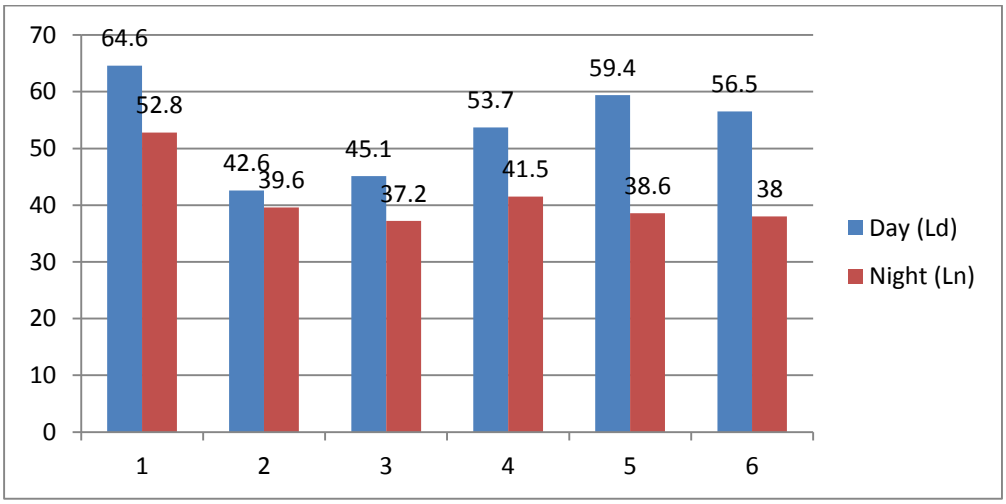


Figure -16: Equivalent Noise Levels at all locations

3.6.6 Interpretation

- The noise levels are found between 40.02 to 55.2 and 36.5 to 45.8 for day and night time respectively.
- The high levels of noise in day at Project Site can be attributed due to, construction operation and vehicular activities. The night levels of Noise are low since the more activities are carried out in day time.
- The noise levels at all location are well below the NAAQS standards w.r.t. noise.

3.7 WATER ENVIRONMENT

Water of high quality is essential to human life, and water of acceptable quality is essential for agricultural, industrial, domestic and commercial uses; in addition, most recreation is water based; therefore, major activities having potential effects on surface water are certain to be of appreciable concern to the consumers.

3.7.1 METHODOLOGY

Water samples were collected from 11 locations (6 Surface Water & 5 Ground water). Samples were collected as per IS: 3025 (Part 1) methodology. Necessary precautions were taken while collecting, preserving and transporting the samples. The parameters like pH, temperature and DO were measured at the site while collecting the sample. For analyzing other parameters the samples were brought to Head Laboratory situated in Noida. All the parameters were analyzed as per "Methods of Sampling and Test (Physical and Chemical) for water and waste water" IS: 3025 and 'Standard Methods for the Examination of Water and Waste water' APHA. The results are then compared with the CPCB Water Quality Criteria of water. Water samples were collected from the study area to assess the water quality during the study period. The locations of surface water and ground water sampling stations are described in Table-3.9 and Table-3.10, respectively.

Table -11: Monitoring Location of Surface Water

S.N.	Monitoring Locations	Distance (Km)	Direction	Latitude	Longitude

SW1	Project Site	-	-	18° 56' 42.555" N	72° 56' 23.634" E
SW2	Bhawara Talab, Near Masjid	5.25Km	SW	18° 53' 55.715" N	72° 55' 47.905" E
SW3	Near Shiv Mandir, Nhava	3.28Km	NE	18° 57' 51.592" N	72° 57' 50.047" E
SW4	Sonari Talav	6.23Km	SE	18° 54' 36.435" N	72° 59' 10.567" E
SW5	Near Trombay Fish Market	9.93Km	NNE	19° 2' 2.855" N	72° 57' 12.166" E
SW6	Near Nhava Playground	2.79Km	NE	18° 57' 37.046" N	72° 57' 40.854" E

Table-12: Monitoring Location of Ground Water

S.N.	Monitoring Locations	Distance (Km)	Direction	Latitude	Longitude
GW1	Near Project Site	0.76km	SE	18° 56' 25.449" N	72° 56' 42.459" E
GW2	Angalaparameshwari Temple, Trombay	9.69Km	NNE	19° 1' 56.485" N	72° 57' 0.865" E
GW3	Kendriya Vidyalaya, Kegaon	5.48Km	SW	18° 54' 4.011" N	72° 54' 59.044" E
GW4	Near Agriculture Office, Uran	8.01Km	S	18° 52' 23.717" N	72° 56' 50.562" E
GW5	Zpd School, Sonari	6.04Km	SE	18° 54' 43.012" N	72° 59' 7.535" E

Table-13: Surface water quality criteria for different uses

Sl. No.	Water quality parameter	Characteristic surface of water body				
		A *	B *	C *	D *	E *
1.	Dissolved oxygen, mg/l, minimum	6	5	4	4	3
2.	Biochemical Oxygen Demand, mg/l (max)	2	3	3	-	-
3.	Total Coliform organisms ** MPN/100ml (max)	50**	500	500	-	-
4.	Total Dissolved Solids (TDS)mg/l (max)	500	-	1500	-	2100
5.	Chlorides (as Cl^-) mg/l (max)	250	-	600	-	600
6.	Colour, Hazen units (max)	-	10	300	300	-
7.	Sodium Absorption Ratio(max)	-	-	-	-	20
8.	Boron (as B), mg/l (max)	-	-	-	-	-
9.	Sulphates (as $SO4^{-2}$), mg/l (max)	400	-	400	-	1000
10.	Nitrates (as $NO3^-$) mg/l (max)	20	-	50	-	-
11.	Free Ammonia (as NH3) mg/l(max)	-	-	-	1.2	-
12.	Conductivity at 25°C micromhos/cm (max)	-	-	-	1100	2500
13.	pH value	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.0-8.5
14.	Arsenic (as As), mg/l (max)	0.05	0.2	0.2	-	-
15.	Iron (as Fe), mg/l (max)	0.3	-	-	0.5	-

16.	Fluoride (as F), mg/l (max)	1.5	1.5	1.5	-	-
17.	Lead (as Pb), mg/l (max)	0.1	-	0.1	-	-

Note:

** Classes of water use*
A: Drinking water source without conventional treatment but after disinfection
B: Outdoor bathing (organised)
C: Drinking water source with conventional treatment followed by disinfection.
D: Propagation of wild life, fisheries.
E: Irrigation, industrial cooling, controlled waste disposal.

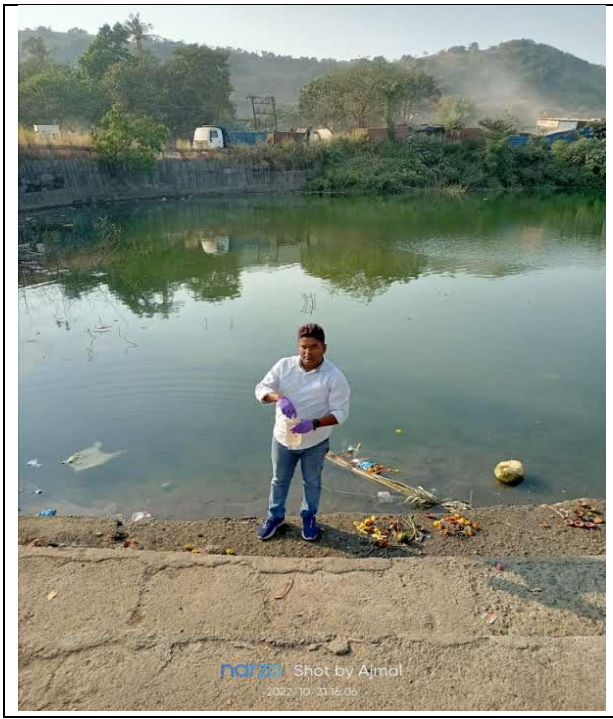


Figure -17: Water sampling photographs

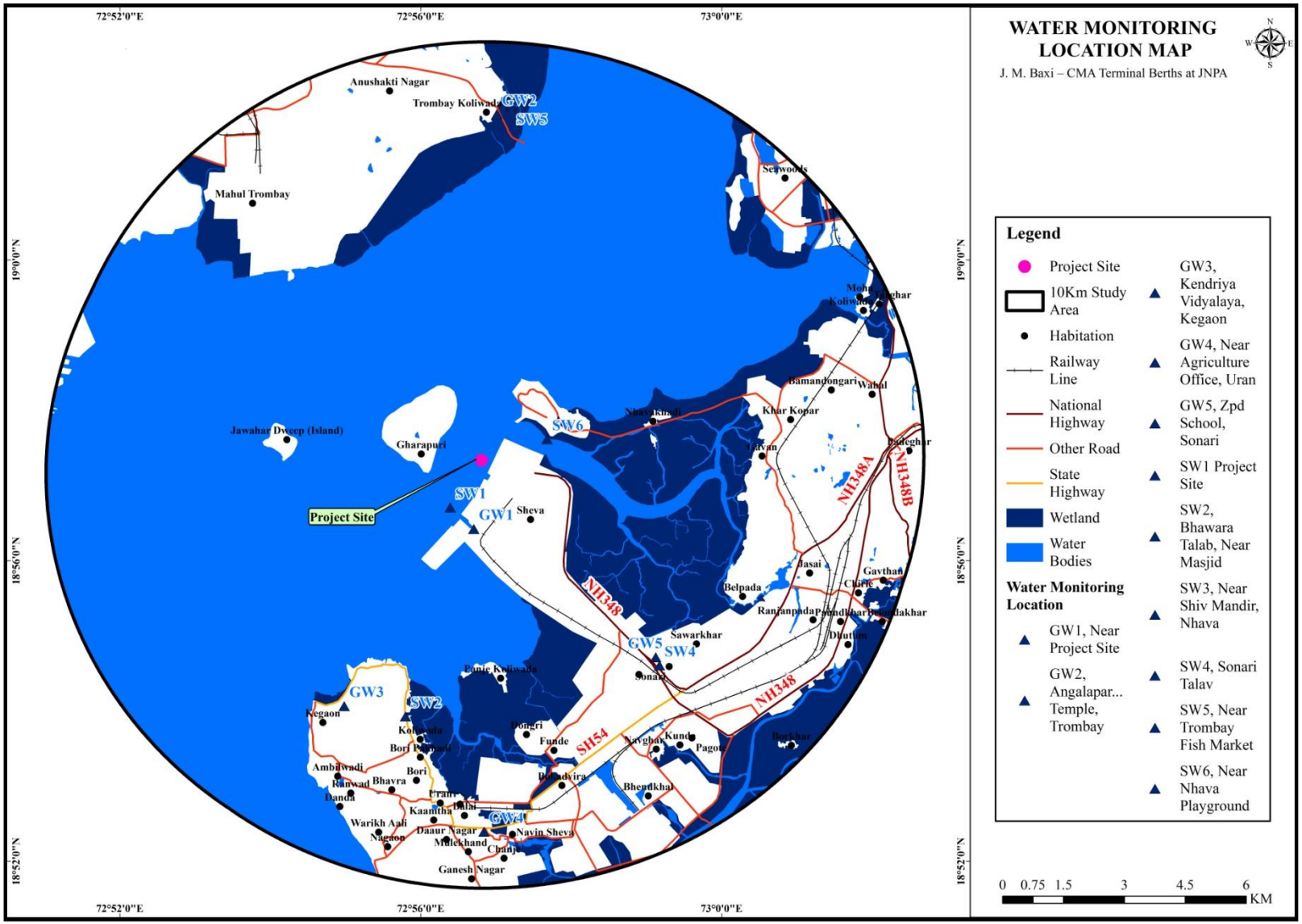


Figure -18: Map showing Water Sampling Location

Table -14: Surface water quality data

			Project Site	Bhawara Talab, Near Masjid	Near Shiv Mandir, Nhava	Sonari Talav	Near Trombay Fish Market	Near Nhava Playground
Sl. No.	**Parametera**	**Units of Measurements**	**Value**	**Value**	**Value**	**Value**	**Value**	**Value**
1	Colour	Hazen Units	<5	<5	<5	<5	<5	<6
2	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	Taste	-	Not done	Not done	Not done	Not done	Not done	Not done
4	pH	-	7.54	7.86	7.82	7.62	7.95	7.36
5	Temperature	°C	22	22	24	23	20	22
6	Turbidity	NTU	0.3	0.5	0.2	0.8	0.9	3
7	Conductivity	µmhos/cm	2437	207	179	573	155	2995
8	Alkalinity as $CaCO_3$	mg/l	88	54	54	138	42	118
9	Total Dissolved Solids	mg/l	1584	135	117	372	101	1947
10	Total Suspended Solids	mg/l	164	6	2	4	6	202
11	Total Hardness as $CaCO_3$	mg/l	184	70	72	124	36	342
12	Calcium as Ca	mg/l	114	48	56	94	24	218
13	Magnesium as Ca	mg/l	70	22	16	30	12	124
14	Chloride as Cl	mg/l	756	32	20	94	20	1024
15	Total Phosphorus	mg/l	0.35	0.56	0.45	0.51	0.37	0.62
16	Nitrate as NO_3	mg/l	8.6	3.6	5.2	4.2	3.6	3.4
17	Sulphate as SO_4	mg/l	88	12	12	34	10	10

18	Fluoride as F	mg/l	0.09	0.31	0.23	0.29	0.33	0.25
19	Arsenic as As	mg/l	<0.005	<0.005	0.006	<0.005	<0.005	<0.005
20	Lead as Pb	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
21	Zinc as Zn	mg/l	<0.02	<0.02	<0.02	0.303	<0.02	<0.02
22	Boron as B	mg/l	0.107	<0.1	<0.1	<0.1	<0.1	3.910
23	Nickel as Ni	mg/l	0.03	0.019	0.015	0.013	0.012	0.021
24	Chromium as Cr	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
25	Aluminium as Al	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	0.261
26	Manganese as Mn	mg/l	<0.005	<0.005	<0.005	0.266	<0.005	<0.005
27	Copper as Cu	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
28	Cadmium as Cd	mg/l	0.003	0.002	<0.002	<0.002	<0.002	<0.002
29	Barium as Ba	mg/l	0.018	0.009	0.014	0.041	0.007	0.013
30	Iron as Fe	mg/l	<0.02	<0.02	0.069	0.087	0.07	0.188
31	Silver as Ag	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
32	Selenium as Se	mg/l	0.032	0.037	0.014	0.035	0.026	0.029
33	Sodium as Na	mg/l	456	18	10	80	20	502
34	Potassium as K	mg/l	54	2	2	6	2	88
35	Dissolved Oxygen	mg/l	5.4	6.8	7	5.5	7.4	6.3
36	BOD	mg/l	16	<2	6	<2	8	19
37	COD	mg/l	136	10	30	<4	10	154
38	Total Coliform	MPN/100ml	884	2398	2926	3248	3624	942
39	Faecal Coliform	MPN/100ml	530	1438	1756	1950	2158	562

Table -15: Ground water quality data

SL. No.	Parameters	Units of Measurements	Project Site	Lady Khatun Marium School, Nhava	SBI, Naval Station, Karanja	Bhawra Shafi Jama Masjid	ZPD School, Sonari
			Value	Value	Value	Value	Value
1	Colour	Hazen Units	<5	<5	<5	<5	<5
2	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	pH	-	7.34	7.82	7.94	7.72	7.92
5	Temperature	°C	24	25	25	24	26
6	Turbidity	NTU	0.6	0.9	1.6	0.9	0.3
7	Conductivity	µmhos/cm	9719	2288	352	307	481
8	Alkalinity as $CaCO_3$	mg/l	88	94	64	54	142
9	Total Dissolved Solids	mg/l	6317	1488	229	199	313
10	Total Hardness as $CaCO_3$	mg/l	1888	378	136	102	154
11	Calcium as Ca	mg/l	409.6	99.2	37.6	35.2	43.2
12	Magnesium as Mg	mg/l	209.9	31.5	10.2	3.4	11.1
13	Chloride as Cl	mg/l	3542	780	82	62	74
14	Total Phosphorus	mg/l	0.24	0.37	0.35	0.23	0.46
15	Nitrate as NO_3	mg/l	5.4	6.4	4.2	5.4	4.6
16	Sulphate as SO_4	mg/l	9.9	24	14	18	20
17	Fluoride as F	mg/l	0.24	0.16	0.22	0.38	0.15
18	Arsenic as As	mg/l	<0.005	<0.005	<0.0025	<0.0025	<0.0025
19	Lead as Pb	mg/l	<0.005	<0.005	<0.0025	<0.0025	<0.0025

20	Zinc as Zn	mg/l	<0.02	<0.02	<0.02	0.134	<0.02
21	Boron as B	mg/l	2.609	<0.01	<0.01	<0.01	<0.01
22	Nickel as Ni	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005
23	Chromium as Cr	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005
24	Aluminium as Al	mg/l	<0.005	<0.005	0.0177	<0.005	<0.005
25	Manganese as Mn	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005
26	Copper as Cu	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005
27	Cadmium as Cd	mg/l	<0.002	<0.002	<0.002	<0.002	<0.002
28	Barium as Ba	mg/l	0.0108	0.0211	0.005	0.014	0.028
29	Iron as Fe	mg/l	<0.02	<0.01	0.151	0.358	<0.02
30	Silver as Ag	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005
31	Selenium as Se	mg/l	<0.005	<0.005	<0.005	0.011	<0.005
32	Sodium as Na	mg/l	1026	368	24	26	48
33	Potassium as K	mg/l	642	22	2	3	4
34	Total Coliform	MPN/100ml	Absent	Absent	Absent	Absent	Absent
35	Faecal Coliform	MPN/100ml	Absent	Absent	Absent	Absent	Absent

3.7.2 Interpretation of surface water Results

- The analysis results indicate that the pH value is 7.36 to 7.95.
- The TDS was observed as 101 to 1947 mg/L.
- The Sulphate were found as 10 to 88 mg/L.
- Total hardness ranges between 36 to 342 mg/L.
- COD ranges between 4 to 154 mg/L
- BOD ranges between 2.0 to 19 mg/L

Analysis results of ground water reveal the following:

- The analysis results indicate that the pH value is 7.34 to 7.94 which is well within the specified standard of 6.5 to 8.5.
- The TDS was observed as 199 to 6317 mg/L.
- The chlorides were found as 62 to 3542 mg/L.
- The Sulphate were found as 9.9 to 24 mg/L.
- Total hardness ranges between 102 to 1888 mg/L.
- Metals: Iron is found as <0.01 mg/L.

3.8 MARINE WATER QUALITY

The physico-chemical properties of the creeks and marine water were studied to understand the water quality of the region. This would also help to adopt the mitigation measures during the project activities. The procedures adopted for analysis of water are as per APHA and IS. The details of the procedure are given as below:

Sr. No.	Parameter	Units	Method
1	Temperature	°C	--
2	pH	–	IS:3025(Part 11)
3	Turbidity	NTU	IS:3025(Part 10)
4	Dissolved Oxygen (DO)	mg/l	APHA 4500 -O -B
5	Chemical Oxygen Demand (COD)	mg/l	APHA 5220 -B
6	Biological Oxygen Demand	mg/l	APHA 5210- -B
7	Total Suspended Solids (TSS)	mg/l	APHA 2540-D
8	Total Dissolved Solids (TDS)	mg/l	APHA 2540-C
9	NH4	mg/l	IS:3025(Part 34)
10	Phenol	mg/l	IS:3025(Part 43)
11	Salinity	ppt	IS:3025(Part 32)
12	Oil & Grease	mg/l	APHA 5520 -B
13	TPC	CFU/ml	--
14	Total fecal coliform	MPN/ml	--

WATER STUDIES- PHYSICOCHEMICAL PROPERTIES

Detailed marine ecological survey was conducted as a part of EIA study to establish the existing status of the marine water around the proposed project site. The survey included the analysis of physico- chemical and biological characteristics of marine water and sediment samples.

OBSERVATIONS

It has been observed the values of various parameters such as pH, Dissolved Oxygen, BOD, Oil & Grease and Faecal coliforms obtained for water samples collected from JNP Harbour area are within the prescribed limits, as given in Primary Water Quality Criteria for Class IV Waters [Harbour Water by CPCB for Physico-Chemical parameters and Bio Chemical parameters].

PH

The marine water in the project area is slightly alkaline. The pH value in the surface and subsurface water samples ranged from 7.36 to 7.95. The pH values did not show any spatial

variations. The pH values of sub-surface and surface water samples at all the stations were more or less same. This could be due to the continuous mixing of the water columns.

SALINITY

The salinity varied from 25.5 to 42.5 mg/l in sub-surface water samples. The salinity in sub surface water samples was observed to be marginally higher than surface water samples at all the stations.

BIOCHEMICAL OXYGEN DEMAND (BOD)

The BOD levels observed at various sampling stations are around <2.0-19 mg/lit. The index of organic pollution as reflected by the BOD values was found to be slightly high in the stations adjacent to the terminal.

SEDIMENTS QUALITY

Determination of trace pollutants such as heavy metals and organic compounds in water often reveals fluctuations as the concentrations depend on the location and time of sampling, the nature of pollutant and chemical characteristics of water. Moreover, several pollutants get rapidly fixed to particulate suspended matter and/or hydrolysed and thus removed from the water column. In several instances, it is observed that even close to a location of effluent release, the metal content in receiving water often decreases to a normal value making assessment of contamination through analysis of water, a difficult task. The pollutants adsorbed by the particulate matter are ultimately transferred to the bed sediment on settling. Evidently, concentrations of pollutants in sediment increase over a period of time in regions receiving their fluxes. Hence, sediment can serve as a useful indicator of certain trace pollutants such as heavy metals and PH.

CONCLUSION

Considering the activities in the Harbour area and the results, it can be concluded that the Port's working does not affect the Quality of the Marine water. The overall Marine Water Quality of the Port's Harbour and Creek waters is in good category.

3.9 LAND ENVIRONMENT

3.9.1 Topography

The entire area near the site is already in use for carrying out port related activities by JNPA and is proposed in JNPT waters along Nhava Creek.

3.9.2 Land use/ Land cover

Data Used:

Indian Remote Sensing satellite IRS-P6, LISS III, multi-spectral digital data has been used for the preparation of land use/ land cover map of present study. Survey of India reference map

on 1:50,000 scale have been used for the preparation of base map and geometric correction of satellite data. Ground truth has been carried out to validate the interpretation accuracy and reliability of remotely sensed data, by enabling verification of the interpreted details and by supplementing with the information, which cannot be obtained directly on satellite imagery.

Methodology:

The methodology used for the study consists of following components.

- **Base Map Preparation**

  Base map was prepared using Survey of India reference map on 1:50,000 scale. Interpreted thematic details were transferred on the base map. Besides, other supporting data like project reports and statistical data published by various Government departments have also been used.

- **Ground Truth Data Collection**

  Ground data on geo-environmental components of the study area was collected for verification of information about the different features on the study areas, which are responsible for the occurrence of specific spectral reflectance behavioral patterns. During the ground truth detailed information on agricultural practices, wastelands, industrial area etc. was collected along with other land features.

- **Interpretation of Remote Sensing Data:**

  A hybrid technique has been used i.e. visual interpretation and digital processing for identification of different land use /land cover classes based on the image characteristics like tone, size, shape, pattern, texture, location and association etc. An image interpretation key was developed based on such image characteristics, which enables interpretation of satellite images for land use/land cover features. Further, the land use / land cover and other baseline layers was put in GIS database for integration, analysis, statistics generation and final out in the form of land use land cover map.

- **Observation of Land Use Study**

  In the present study, both digital image processing and using visual interpretation technique were used to generate output of Land use / Land cover map of study area on 1:50,000 scale and Land use pattern of the study area & Land Use/Land Cover Chart.

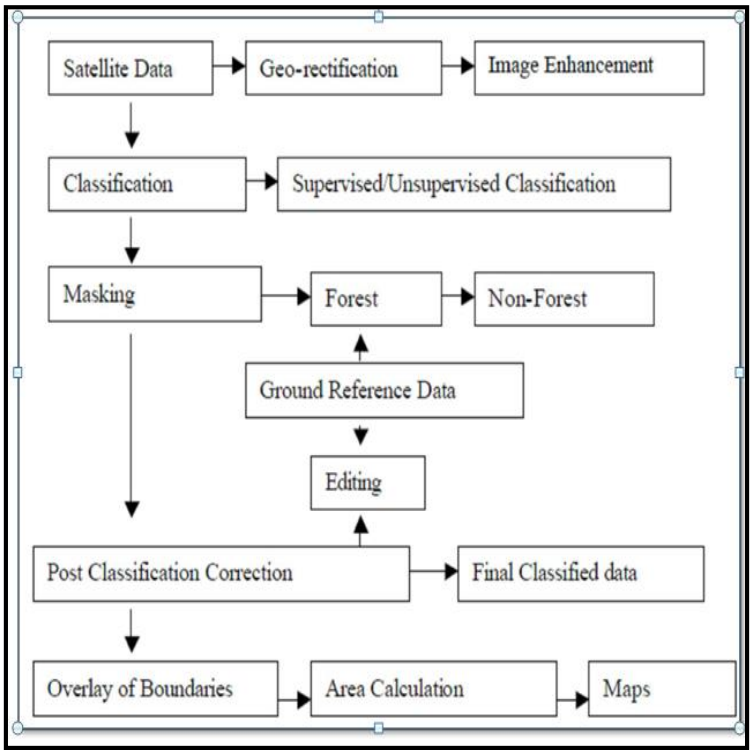


Figure-19: Methodology Used for Land use Classification and Mapping

3.9.3 RESULTS:

A standard False Color Composite (FCC) image has also been generated on 1:50000 scale and given in Figure 3-14. The project site is located on land with scrub land use class. Results are given in Table 3-14.

Table-16: Detail of Land use/Land cover

S. No	Classes	Area in ha	Area in %
1	Agriculture	376.29	0.83
2	Settlement	8650.05	19.12
3	Vegetation	3601.06	7.96
4	Wetland	6616.23	14.63
5	Waste Land	3099.47	6.85
Total		**45230.05**	**100.00**

3.9.4 INTERPRETATION

- The study area is dominated by settlement which is approximately 19.12% of study area.
- The vegetation area is 7.96 %.
- The land use covers waste land which makes up to 6.85 % of total land use area.
- 14.63% of total land use area covered by Wetland.
- 0.83 % of total land use area covered by vegetation.

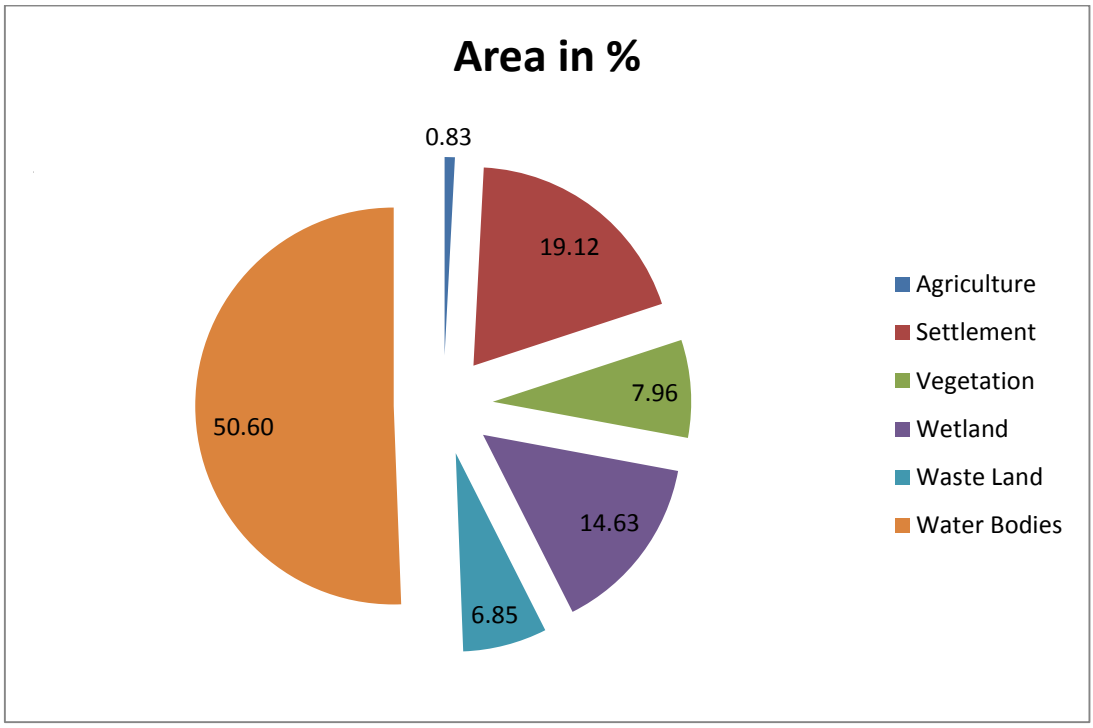


Figure-20: Land-use classification of the study area

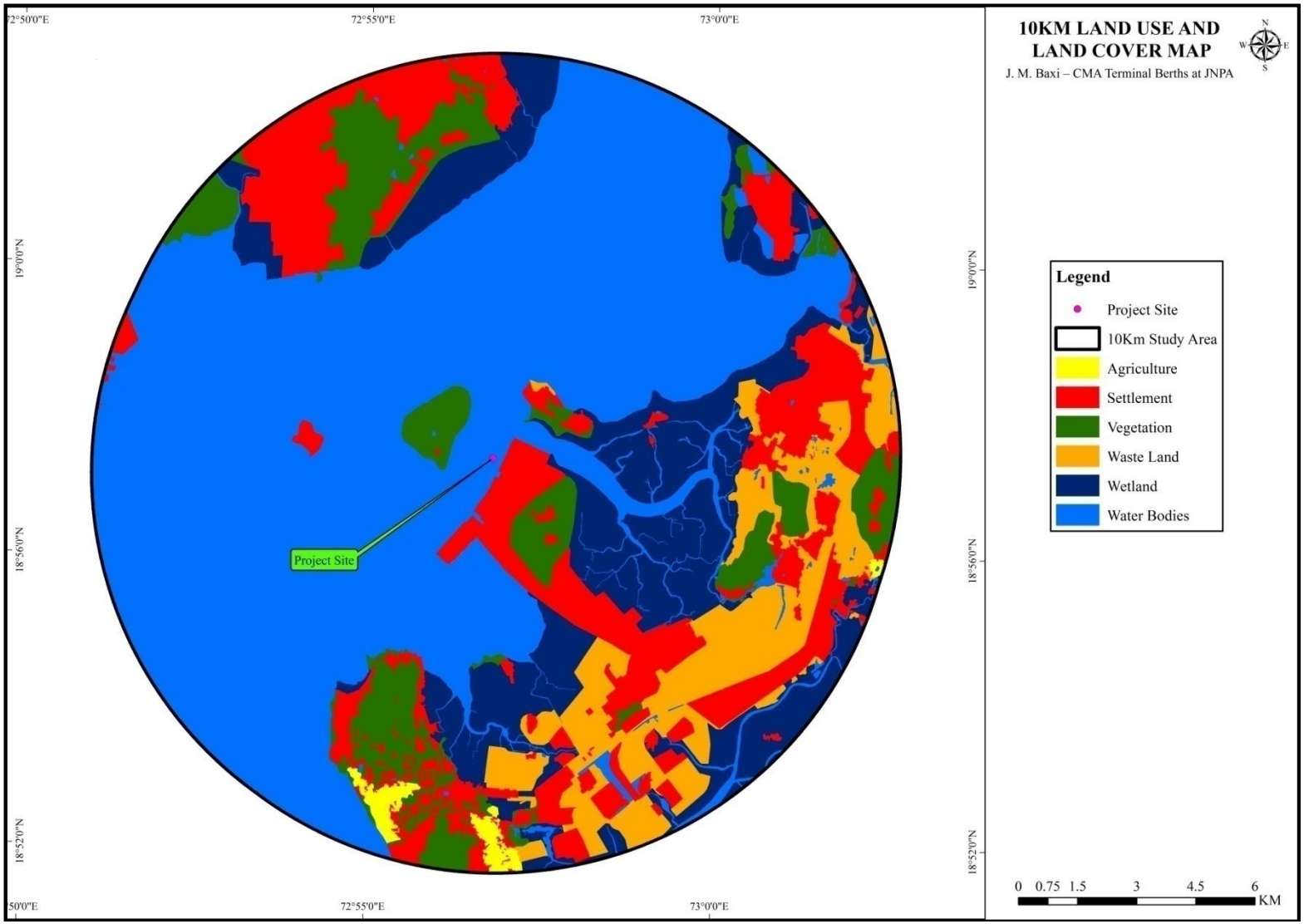


Figure-21: Land Use Map of the Study Area

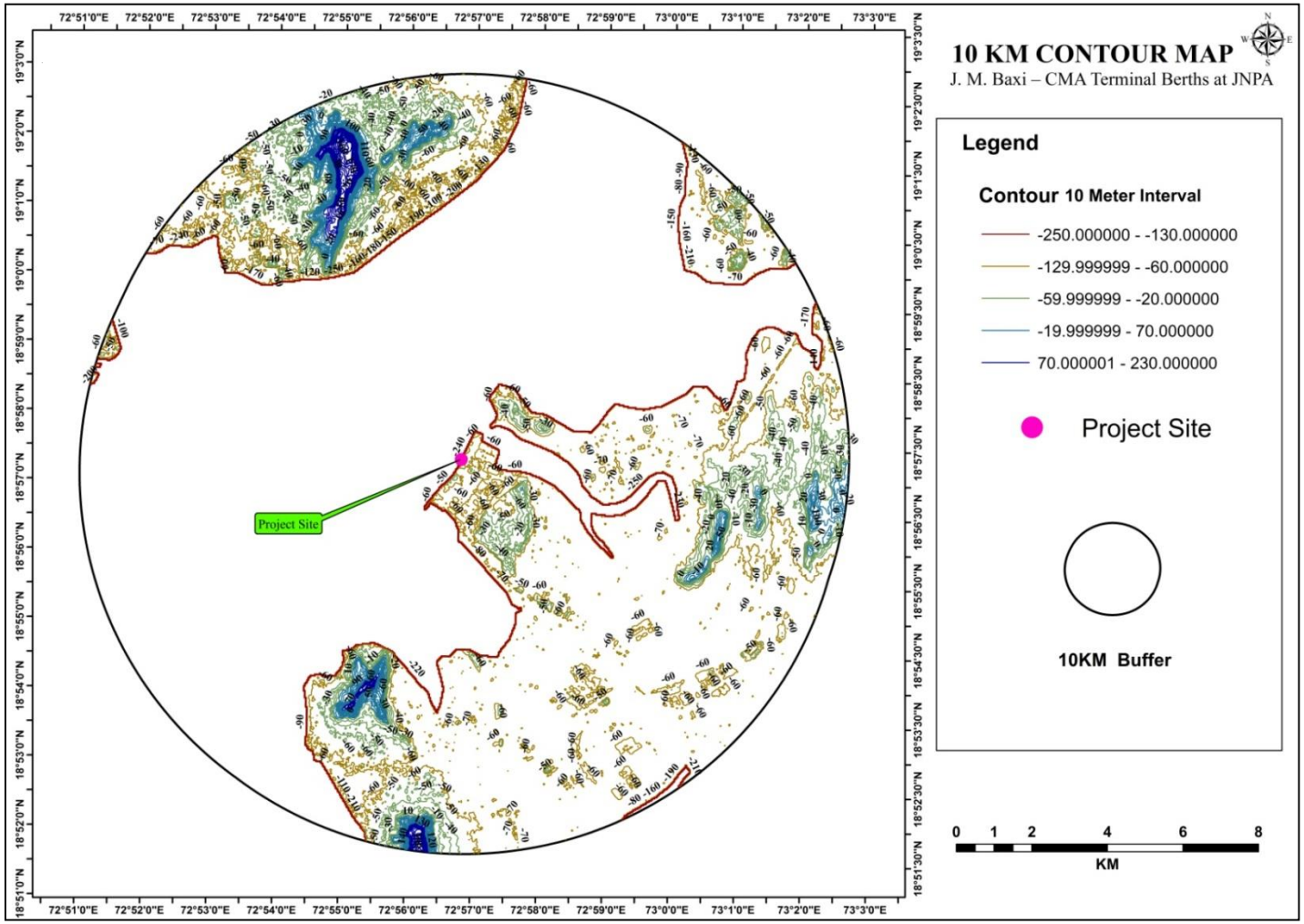


Figure-22: Contour map of the Study Area

3.10 SOIL CHARACTISTICS

3.10.1 Methodology adopted for soil characterization

A number of parameters were determined, which are indicative of physical, chemical and fertility characteristics. Sampling and analysis was conducted as per established standard methods and procedures prescribed in IS 2720 and ASTM. Soil samples were collected by ramming a hand auger into the soil upto a depth of 90 cm. At each of the sampling location, soil samples were collected from three different depth viz. 30 cm, 60 cm and 90 cm below the surface and homogenized. The homogenized samples were then packed in a polythene plastic bag and sealed. The sealed samples were sent to the Laboratory for analysis. The physical and chemical characteristics were determined for all the samples.

3.10.2 Soil sampling locations

The Soil characterization determining the various parameters at 6 different locations within the study area, including project site and at other locations in the study area. The locations of the Soil Quality Monitoring are described in Table 3.15 and shown on the study area map in Figure 3-16. The sampling locations are chosen based on the proximity of the location to the project site.

Table -17: Soil Sampling Locations

S.N.	Monitoring Locations	Distance (Km)	Direction	Latitude	Longitude
S1	SQ1, Near Project Site	0.76km	SE	18° 56' 25.449" N	72° 56' 42.459" E
S2	SQ2, Kendriya Vidyalaya, Kegaon	5.48Km	SW	18° 54' 4.011" N	72° 54' 59.044" E
S3	SQ3, Divisha Medical & General Stores, Navin Shewa	8.06Km	S	18° 52' 21.445" N	72° 56' 46.049" E
S4	SQ4, Shivaji Maharaj and Ramdas swami statue, Dastan Phata Bus StationNavi Mumbai	8.20Km	SE	18° 55' 31.844" N	73° 0' 54.349" E
S5	SQ5, Angalaparameshwari Temple, Trombay	9.65Km	NNE	19° 1' 54.982" N	72° 57' 1.759" E
S6	SQ6,Agri Katta Dhaba, Ganesh Nagar	9.03Km	S	18° 51' 49.775" N	72° 56' 44.318" E

3.10.3 Photographs of Soil Sampling:

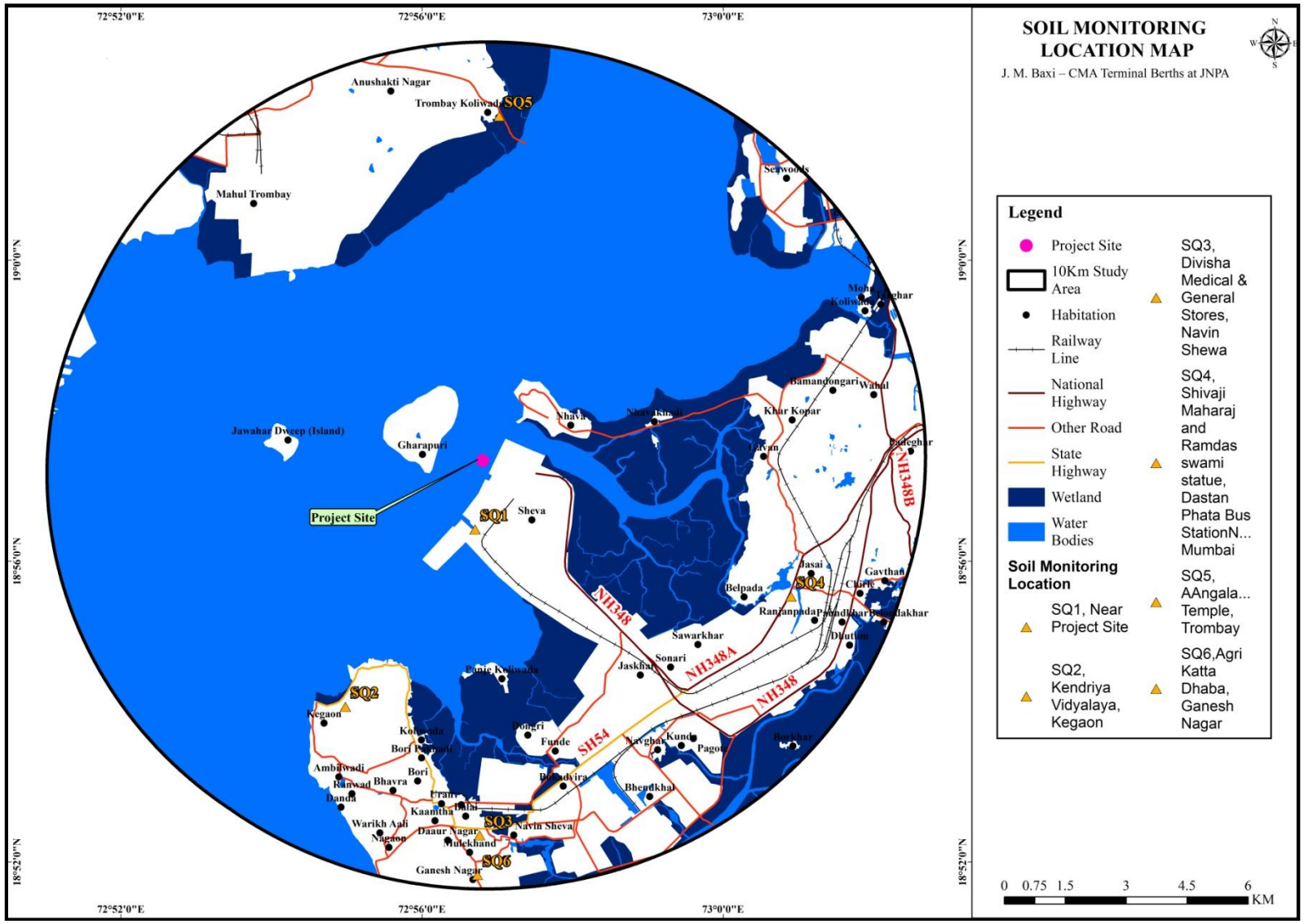


Figure 23: Map showing Soil sampling locations

3.10.4 Analytical results:

The characteristics of soil samples collected from the 6 locations are presented in Table 3.16.

Table-18: Soil sampling results

S.No.	Parameters	Location	Location 1	Location 2	Location 3	Location 4	Location 5	Location 6
			Project Site	Lady Khatun Marium School, Nhava	SBI, Naval Station, Karanja	Bhawra Shafi Jama Masjid	ZPD School, Sonari	Angalaparameshwari(Periyayi) Temple, Trombay
		Units	Value	Value	Value	Value	Value	Value
1	pH	-	7.42	7.36	7.52	7.44	7.62	7.32
2	Bulk Density	gm/cm3	2.58	1.72	2.14	1.86	2.34	1.62
3	Conductivity	Micro mhos/cm	240	306	264	314	282	264
4	Moisture	%	8.4	7.8	9.6	8.8	6.8	9.2
5	Texture	-	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
6	Sand	%	68	64	70	64	62	66
7	Clay	%	18	16	14	18	18	14
8	Silt	%	14	20	16	18	20	20
9	CEC	meq/100gm	13.68	12.16	10.88	14.64	14.32	11.28
10	Nitrogen	mg/100gm	14.09	13.73	16.23	12.75	14.45	15.78
11	Phosphorous	mg/100gm	0.71	0.62	0.80	0.93	0.84	0.75
12	Potassium	mg/100gm	8.29	9.09	8.65	8.38	9.27	8.83
13	Sodium	mg/100gm	5.8	6.4	4.6	6.8	5.6	4.8
14	Organic Matter	%	2.34	2.08	1.94	2.82	2.66	2.14

15	Organic Carbon	%	1.36	1.21	1.13	1.64	1.54	1.24
16	Ca	meq/100gm	3.26	3.42	2.86	3.14	2.94	4.11
17	Mg	meq/100gm	2.84	2.64	1.84	2.54	1.73	3.16
18	SAR	-	0.56	0.63	0.52	0.69	0.64	0.43

3.10.5 Interpretation

- The analysis results show that soil is basic in nature as pH value ranges from 7.32 to 7.62 with organic matter 1.74% - 1.96%.
- The concentration of Nitrogen (13.73 mg/100gm to 16.23 mg/100gm) Phosphorus (0.62 to 0.93mg/100gm) and Potassium (8.27 to 9.09 mg/100gm) has been found to be in good amount in the soil samples. The soil is found to be suitable for agricultural purpose.
- The soil will not be affected by proposed project since the project & its allied activities will not affect the nearby soil quality of area.

3.11 BIOLOGAL ENVIRONMENT

Flora is basically the plant, and fauna the animal life that are present in a particular region or habitat. Flora and fauna form a major part of biodiversity. In the last few decades, it has been observed a steady increase in the extinction rate of flora and fauna. Biodiversity sustains human livelihoods and life itself. Study of biological environment is one of the most important aspects in EIA in view of the need for conservation of environmental quality and biodiversity. Biodiversity makes up the structure of the ecosystems and habitats that support essential living resources, including wildlife, fisheries and forests. This section describes the biological environment of the project site and its surrounding study areas.

Biological study was carried out in post monsoon season, 2022 by conducting field sampling in 10km study area around the project site. The occurrence of rare, threatened, or endangered species at the project site and within a minimum of 500m area have been recorded.

The proposed expansion project falls under CRZ-IV.

3.11.1 OBJECTIVES OF BIOLOGICAL STUDY

The main objectives of biological study comprise of the following:

- To collect the baseline data of the existing flora and fauna within 10km study area around the project site.
- To assess the scheduled (rare, endangered, critically endangered, endemic and vulnerable) species found within 10km study area around the project site.
- To identify the anticipated Impacts on the prevailing ecology and biodiversity.
- To suggest mitigation measure for sustainable development.

3.11.2 STUDY AREA

The project is located between NSICT existing container berth and existing Shallow water Berth of JNPA. of Navi Mumbai, Maharashtra. The state falls under the Deccan Peninsula-Chotta-Nagpur, East Coast, Lower Gangetic plain and Central Himalaya category as far as the Indian Biogeographical Zones (*Rodger, Panwar, Mathur 2000*) are concerned.

3.11.3 METHODOLOGY TO ASSESS THE BIOLOGICAL ENVIRONMENT

Biodiversity and community structures are recognized to be important determinants of ecosystem functioning. Monitoring of species diversity is a useful technique for assessing damage to the system and maintenance of good species diversity is a positive management objective.

The productivity of an area is determined by the biological characteristics. As a part of the study, phytoplankton, zooplankton and benthic organisms were studied. The sample for phytoplankton was preserved in Lugol's solution. The sample was concentrated by decantation and the sample was screened under the microscope and species name, number diversity was noted. The phytoplankton cell count was done using Sedgwick rafter slide.
Zooplankton was collected and stored in plastic bottles. They were preserved in 4% buffered formaldehyde. The qualitative and quantitative analysis was carried out under microscope.
Biological parameters are very important in the aquatic ecosystem since they determine the productivity of a water body, Primary productivity is an important indicator of pollution level an any aquatic ecosystem and the primary productivity depends upon the presence of phytoplankton and zooplanktons. Fish production depends on the phytoplankton population or primary productivity. All these are related to Physico-chemical characteristic of the water.

3.11.4 Floral Study

Plants species were identified based on their specific diagnostics characters of family, genus and species using available plant taxonomy manual, published literatures and reports and Websites of BSI, ZSI and State/District Forest Departments. Besides, the identification of plant species, information on the vernacular names was also collected.
Various plant species have been grouped in different classes *i.e.,* herbs, shrubs, trees, and climbers etc.

3.11.5 Faunal Study

Ground survey was carried out by trekking the study area for identification of important animal groups such as mammals, avifauna and reptiles through the following methods:

A list of the faunal species (terrestrial, aerial and aquatic) of the study area have been prepared through direct sighting, through secondary sources and discussion with local people, etc. The water bodies in the area were also assessed for the status of the aquatic life and fishes.

Identification and classification of species recognized as critically endangered, endangered, threatened *etc.* has also been carried out as per IUCN Red List and Scheduled Species as per WPA (1972).

Moreover, authentic secondary sources of the information *i.e.*, Govt. publications, published research papers and web search have also been referred which are given below in the **Table 3.17.**

Table-19: Authentic Secondary Sources referred for Biodiversity Assessment

- *BSI (2016). State wise Distribution of Endemic and Threatened plant taxa of India. http://www.bsienvis.nic.in/Database/E_3942.aspx.*
- *Champion, H.G. & Seth, S.K. (1968). A Revised Survey of the Forest Types of India. Government of India, New Delhi.*
- *Editor-Director. (2012). Fauna of Maharashtra, State Fauna Series, 20 (Part 1: 480) and (Part 2: 673). Zoological Survey of India, Kolkata.*
- *ENVIS Threatened Fauna; http://wiienvis.nic.in/Database/ScheduleSpeciesDatabase_7969.aspx.*
- *https://fsi.nic.in/isfr19/vol2/isfr-2019-vol-ii-maharashtra.pdf*
- *https://bsi.gov.in/uploads/documents/Public_Information/publication/books/district_flora/Flora%20of%20Raigad%20District,%20Maharashtra%20State.pdf*
- *Rajbhar, Anil & Bapat, Ujwala. (2020). Addition to the flora of Raigad District. Bioscience Discovery. 9. 126-130.*
- *PAWAR, P. R. (2011). Floral Diversity of Mangrove Ecosystem From coastal Environment of Uran (Raigad), Navi Mumbai, Maharashtra. Electronic Journal of Environmental Sciences Vol. 4, 113-117*
- *Prabhakar, R. Pawar. Species diversity of birds in mangroves of Uran (Raigad), Navi Mumbai, Maharashtra, West coast of India. Journal of Experimental Sciences 2011, 2(10): 73-77*
- *https://www.inaturalist.org/check_lists/35113-Raigarh-Check-List*
- *http://faunaofindia.nic.in/PDFVolumes/records/091/03-04/0399-0416.pdf*
- *Studies On The Impact Of Widening Of Existing Container Berth On The Marine Ecology And Biodiversity Around Jawaharlal Nehru Port by CSIR-NATIONAL INSTITUTE OF OCEANOGRAPHY*

3.11.6 Presence of Ecologically Sensitive Area

The major environment sensitive areas have been studied in 10 km radius of the project site using Google earth images. No Eco-Sensitive Zone exists within the 10 km radius of the project site.

3.11.7 Ecology and Biodiversity sampling location of the Study Area

The Biodiversity sampling locations are presented in Table -18 and depicted in Figure-17:

Table-20: Biodiversity sampling locations

Location Name	Distance (Km)	Direction	Latitude(DMS)	Longitude(DMS)
EB 1 Gharapuri	1.359	W	18° 57' 26.179" N	72° 56' 2.339" E
EB 2 JNPT Admin Building	2.835	SE	18° 55' 57.508" N	72° 57' 31.448" E
EB 3 Near Project Site	1.677	SW	18° 56' 31.344" N	72° 56' 22.686" E
EB 4 The Galaxy BMCT Admin Building	2.332	S	18° 56' 4.344" N	72° 56' 45.137" E
EB 5 Near Someshwar Mandir	1.28	WSW	18° 57' 9.505" N	72° 56' 6.054" E
EB 6 Near NSICT Dp World - Container terminal	0.882	NE	18° 57' 39.103" N	72° 57' 11.000" E

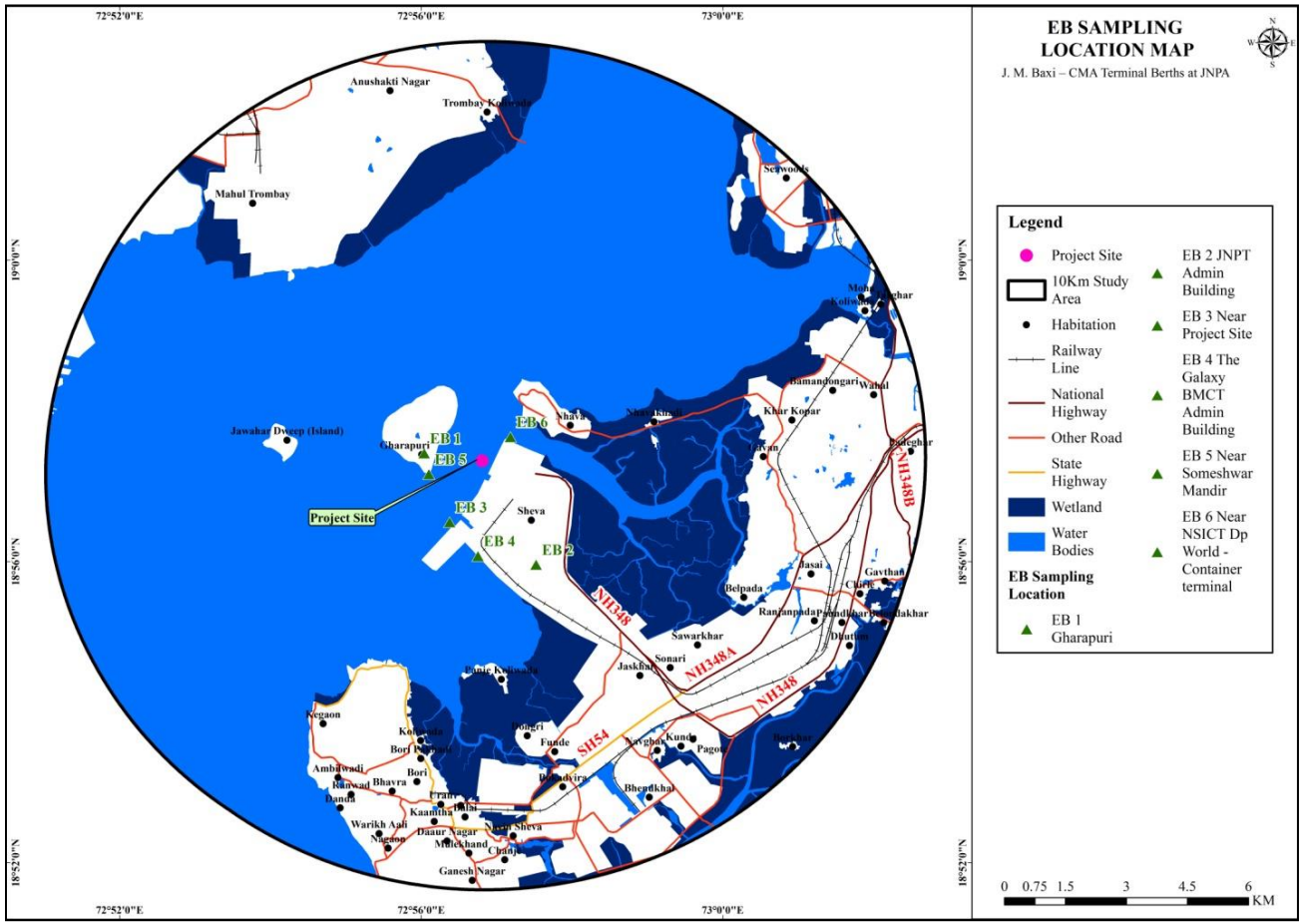


Figure -24: Map Showing sampling locations for biodiversity assessment

3.11.8 Forest types and natural vegetation at regional level and in the study area

As per the Champion & Seth Classification of Forest Types (1968), the forests in Maharashtra belong to six Forest Type Groups i.e., Group 2- Tropical Semi-Evergreen Forests, Group 3- Tropical Moist Deciduous Forests, Group 4- Littoral and Swamp Forests, Group 5- Tropical Dry Deciduous Forests, Group 6- Tropical Thorn Forests and Group 8- Subtropical Broadleaved Hill Forests. The vegetation in the study area is of Tropical Dry Deciduous type.

3.11.9 Biogeographic zone

As far as Bio-geographic Zones and Bio-geographic Provinces are concerned (Roger, Panwar and Mathur, 2000), the state falls under Western Ghats, Deccan peninsula and Coast. The study area classified under Bio-geographic province 5A: Western Ghats- Malabar Plains.

Aquatic Ecology

Marine Biodiversity Study

Biological parameters are very important in the aquatic ecosystem, since they determine the productivity of a water body. Primary productivity is an important indicator of pollution level in any aquatic ecosystem. Fish production is dependent on production of zooplanktons which in turn is dependent on the phytoplankton production or primary productivity. All these are related to the physico-chemical characteristics of the water.

Phytoplankton and Zooplankton

Phytoplankton presence has long been used as indicator of water quality. Some species flourish in highly atrophic waters while others are very sensitive to organic and/or chemical waste. These organisms are atrophic in nature. The growth and multiplications of phytoplanktons primarily depends on solar illuminations, temperature, silicates, trace elements etc. Phytoplankton's are suspended in the euphotic zone and their population varies from season to season and this variation is responsible for the organic production. The productivity of phytoplankton is directly responsible for the growth of zooplanktons in the water.

Phytoplankton

A list of Phytoplankton has been prepared based primary site survey is given below;

Table -21: Phytoplankton in the Study area

Class	Genus
Bacillariophyceae	*Skeletonema sp.*
Bacillariophyceae	*Coscinodiscus sp.*
Biddulphiaceae	*Biddulphia sp.*

Bacillariophyceae	*Rhizosolenia sp.*
Bacillariophyceae	*Pleurosigma sp.*
Bacillariophyceae	*Cyclotella sp.*
Bacillariophyceae	*Navicula sp.*
Fragilariaceae	*Asterionella sp.*
Dinophyceae	*Ceratium sp.*
Bacillariophyceae	*Triceratium sp.*
Bacillariophyceae	*Nitzschia sp.*
Bacillariophyceae	*Ditylum sp.*
Bacillariophyceae	*Hemidiscus sp.*
Cyanophyceae	*Trichodesmium sp.*
Cyanophyceae	*Protoperidinium sp.*
Dinophyceae	*Noctiluca sp.*
Coscinodiscophyceae	*Thalassiosira sp.*
Coscinodiscophyceae	*Thalassionema sp.*
Bacillariophyceae	*Chaetoceros sp.*
Cyanophyceae	*Spirulina sp.*
Bacillariophyceae	*Eucampia Sp.*

Zooplankton

Zooplankton is an important constituent of pelagic ecosystems. Zooplankton feed on the phytoplankton, bacteria, microorganism and all fresh water fishes feed on zooplankton at some stages in their life history. A list of Zooplankton has been prepared based primary site survey is given below;

Table-22: Zooplankton Species in the Study area

Phylum	**Species**
Arthropoda	*Paracalanus indicus*
Arthropoda	*Nauplius sp.*
Ciliophora	*Tintinnopsis orientalis*
Ciliophora	*Tintinnopsis gracilis*
Arthropoda	*Lucifer Hanseni*
Ciliophora	*Favella sp.*
Annelida	*Polychaete larvae*
Mollusca	*Gastropod larvae*
Arthropoda	*Decapod Larvae*
-	*Echinoderm Larvae*

Arthropoda	*Ostracod*
Mollusca	*Pelecypods*
Rotifera	*Rotifers*

Fish Species in Study Area

The common fish in the study area are listed below in Table: 3-21

Table -23: Fish Species reported from the Study Area

S. No	Scientific Name	Common Name	Family	IUCN Status
1.	*Devario aequipinnatus*	Balooki	Cyprinidae	LC
2.	*Mugil cephalus*	Boi	Mugilidae	LC
3.	*Lutjanus johnii*	Chavri-tamb	Lutjanidae	LC
4.	*Indoreonectes evezardi*	Chikli	Nemacheilidae	LC
5.	*Gambusia affinis*	Gambusia	Poeciliidae	LC
6.	*Poecilia reticulata*	Guppy	Poeciliidae	LC
7.	*Scatophagus argus*	Kaski	Scatophagidae	LC
8.	*Arius sonaI*	Khagya	Ariidae	-
9.	*Lates calcarifer*	Khajuri	Latidae	LC
10.	*Glossogobius giuris*	Kharbi	Gobiidae	LC
11.	*Puntius sophore*	Khavli	Cyprinidae	LC
12.	*Channa punctata*	Maral	Channidae	LC
13.	*Garra mullya*	Mullya	Cyprinidae	LC
14.	*Labeo rohita*	Rohu	Cyprinidae	LC
15.	*Hexanematichthys sagor*	Shingara	Ariidae	-
Abbreviations: LC= Least Concerned, CR= Critically Endangered, VU= Vulnerable, DD= Data Deficient, NT= Near Threatened, EN= Endangered.				

Mangroves

Mangrove ecosystem, the most common natural marine wetland, consists of perennial plants of potentially high productivity and biomass, which have extensive root system that may be effective in trapping soil and nutrients. The plants are also specially adopted to the stressed environmental condition characterized by relatively high temperature, fluctuating salinities and shifting anaerobic/ aerobic substrata. In Thane creek mangroves occur at Pir Pau, Elephanta, Butcher, Uran, Nhava, Sheva, Thane-Panvel, Panje-Mora-Karanja and Dharamtar covering an area of about 48 km2. The region represents 23 species of mangroves and 3

species of associated mangroves species like *Avicennia marina*, A*. Alba, A. officinalis and Sonneratia apetala* are dominant.

Mangroves from designated sites were assessed for population density (no/100m2), height (m) and diameter at breast height (cm) (DBH) of plant, seedling density (SD) (no/m2) and species diversity using quadrat method (5 x 5m). The studies were conducted at BMCT (M1), Panje (M2), Mora (M3), Nhava Sheva (M4), and Elephanta (M5).

Figure -24: Mangrove transect sampling locations

A. Mangroves at BMCT

The mangrove vegetation from the BMCT area was observed to be healthy and was dominated by the *Avicennia marina* species. Two locations (M1a and M1b) were selected for monitoring of mangroves. Monitoring was carried out during June 2022 and November 2022. Plant density of A. marina varied from 28 to 36 no/100m 2 with 100% frequency of occurrence in this location. The height of *A. marina ranged* in between 4.0 to 6.3 m indicating healthy plants. The mangroves in this region did not indicate any deterioration.

Figure 4.3.14: Mangroves at BMCT

B. Mangroves at Panje

Mangroves at Panje were assessed from 2 locations (M2a and M2b) during June 2022 and November 2022. Panje area is dominated by *A. marina* and *Ceriops tagal*. The plant density of *A. marina* varied from 48 to 52 no/100m2 and C. tagalof 68-72 no/100m2. *Acanthus ilicifolius, Aegiceras corniculatum* and *Brugiera cylindrica* were also recorded from this site.

Figure 4.3.15: Mangroves at Panje

C. Mangroves at Mora

Mangroves of the species *A. marinaand S. apetalawere* identified from the intertidal regions of Mora. *A. marina* were found to be dominant with a 75% frequency of occurrence. Plant density of *A. marina* varied from 128 to 132 no/100m2.

Figure 4.3.16: Mangroves at Mora

D. Mangroves at Nhava Sheva

The intertidal expanse along the Nava Sheva area was very small and rocky with sandy bottom. The mangrove vegetation from the upper intertidal region was observed to be healthy and mostly dominated by *A. marina*. Two locations (M4a and M4b) were selected for monitoring of mangroves during the present study. The plant density of *A. marina* varied from (64- 120 no/100 m2) in June 2022 to November 2022 with *A. marina* recording 80 to 100% frequency of occurrence. The height of plants varied from 1.2 to 4.9 m with M4a location indicating better plant height than location M4b. The DBH varied from 8 to 28cm at the monitoring locations during the study periods. The seedling density ranged from 3 to 7 no/m2 for the study area where location M4b sustained better seedling density than location M4a.

Figure 4.3.17:Mangroves at Nhava Sheva

E. Mangroves at Elephanta

Around Elephanta Island, stray and adult plants prevail and the open mudflats around this potential for mangrove afforestation. Young plants of *A. marina, A. Alba, A. officinals* and *Sonneratia apetala* are dominant. The lower intertidal zone especially adjacent to the port area was rocky with muddy. The mid and upper intertidal zone sustained vast mangrove coverage.

Figure 4.3.18: Mangrove at Elephanta

Table -25: Mangroves reported from the Study Area

S. No	Scientific Name	Common Name	Family	IUCN Status
1	*Avicennia marina*	Grey Mangrove	Avicenniaceae	LC
2	*Avicennia officinalis*	Indian Mangrove	Avicenniaceae	LC
3	*Acanthus ilicifolius*	Sea Holly	Acanthaceae	LC
4	*Ceriops tagal*	Tagal Mangove	Rhizophoracae	LC
5	*Sonneratia apetala*	Sonneratia Mangrove	Lythraceae	LC
6	*Aegiceras corniculatum*	Black Mangrove	Myrsinaceae	LC
7	*Carallia brachiata*	Freshwater Mangrove	Rhizophoraceae	-
8	*Rhizophora mucronata*	Asiatic Mangrove	Rhizophoraceae	LC
Abbreviations: LC= Least Concerned, CR= Critically Endangered, VU= Vulnerable, DD= Data Deficient, NT= Near Threatened, EN= Endangered.				

Terrestrial Ecology

Floral composition of the study area

During field survey, the floral list was prepared based on site observations along with public consultation. The floral composition along with common name, family, life form and IUCN status of the study area is listed below in Table-23

Table-26: List of Floral species of the study area

S. No.	Scientific Name	Common Name	Family	IUCN Status
Tree				
1	*Acacia catechu*	Khayar	Mimosaceae	LC
2	*Alangium salviifolium*	Ankol	Cornaceae	LC
3	*Albizia lebbeck*	Ahirish	Mimosaceae	LC
4	*Bombax ceiba*	Kate-Saver	Malvaceae	LC
5	*Caesalpinia bonduc*	Gajaga	Caesalpiniaceae	LC
6	*Cordia dichotoma*	Bhokar	Boraginaceae	LC
7	*Gmelina arborea*	Sivan	Verbenaceae	LC
8	*Memecylon umbellatum*	Anjani	Melastomataceae	-
9	*Olea dioica*	Karamba	Oleaceae	-
10	*Salvadora persica*	Khakan	Salvadoraceae	LC
11	*Syzygium cumini*	Jamun	Myrtaceae	LC
12	*Vitex negundo*	Chaste Tree	Verbenaceae	LC
13	*Ziziphus ziziphus*	Baher	Rhamnaceae	LC
Shrub				

1	*Clerodendrum inerme*	Sangam	Verbenaceae	
2	*Lantana camara*	Tantani	Verbenaceae	
3	*Homonoia riparia*	Raan Kaner	Euphorbiaceae	LC
4	*Tamarix ericoides*	Kadsherni	Tamaricaceae	-
5	*Calotropis gigantea*	Safed Aak	Apocynaceae	LC
6	*Rotula aquatica*	Machim	Boraginaceae	LC
7	*Suaeda monoica*	South-Indian Seepweed	Amaranthaceae	-
Herb				
1	*Fimbristylis ferruginea*	West Indian Fimbry	Cyperaceae	LC
2	*Argemone mexicana*	Kante Dhotra	Papaveraceae	-
3	*Capillipedium huegelii*	Stinking Scented-Top	Poaceae	-
4	*Indigofera cordifolia*	Badaga	Fabaceae	-
5	*Rotala serpyllifolia*	Slender Rotala	Lythraceae	LC
6	*Ageratum conyzoides*	Ghanera Osaadi	Asteraceae	LC
7	*Ammannia baccifera*	Aginbuti	Lythraceae	LC
8	*Sesuvium portulacastrum*	Dhapa	Aizoaceae	LC
9	*Aeluropus lagopoides*	Dola Gavat	Poaceae	LC
10	*Cressa cretica*	Lona	Convolvulaceae	LC
11	*Cyperus bulbosus*	-	Cyperaceae	LC
12	*Pedalium murex*	Gokharu	Pedaliaceae	-
13	*Spinifex littoreus*	Kolanti Tan	Poaceae	-
Climber				
1	*Derris scandens*	Garudvel	Fabaceae	LC
2	*Ipomoea pes-caprae*	Maryada-Vel	Convovulaceae	LC
3	*Ipomoea strigosa*	Masbel	Convvoulaceae	LC
4	*Derris trifoliata*	Karanj Vel	Fabaceae	-
5	*Tribulus terrestris*	Kate Gokharu	Zygophyllaceae	-
Abbreviations: LC= Least Concerned				

Faunal Species Reported from the Study Area

During field survey, the faunal species list was prepared based on site observations along with public consultation. The list of total number of different faunal species (mammals, avifauna, reptilian, and butterflies) are listed in Table 3-24. All the listed species were compared with IUCN Red Data Book and Indian Wildlife Protection Act, 1972.

Table -27: Faunal Species reported from the Study Area

S. No.	Scientific Name	Common Name	Family	IUCN/WLPA Status
Mammals				
1	*Anathana ellioti*	Madras Treeshrew	Tupaiidae	LC
2	*Funambulus palmarum*	Three-striped Palm Squirrel	Sciuridae	LC
3	*Lepus nigricollis*	Indian Hare	Leporidae	LC/ Sch IV
4	*Lyroderma lyra*	Greater False Vampire	Megadermatidae	LC
5	*Macaca mulatta*	Rhesus Macaque	Cercopithecidae	LC/ Sch II
6	*Megaderma spasma*	Lesser False Vampire Bat	Megadermatidae	LC
7	*Semnopithecus hypoleucos*	Malabar Gray Langur	Cercopithecidae	LC/Sch II
8	*Urva auropunctata*	Small Indian Mongoose	Herpestidae	LC
Amphibians				
1	*Duttaphrynus melanostictus*	Asian Common Toad	Bufonidae	LC
2	*Duttaphrynus stomaticus*	Indus Valley toad	Bufonidae	LC
3	*Polypedates maculatus*	Common Indian Tree Frog	Rhacophoridae	LC
Avifauna				
1	*Vanellus indicus*	Red-wattled Lapwing	Charadriidae	LC
2	*Ardeola grayii*	Indian Pond Heron	Ardeidae	LC
3	*Bubulcus ibis*	Cattle Egret	Ardeidae	LC
4	*Egretta garzetta*	Little Egret	Ardeidae	LC
5	*Columba livia*	Blue Rock Pigeon	Columbidae	LC/Sch IV
6	*Streptopelia chinensis*	Spotted Dove	Columbidae	LC/Sch IV
7	*Coracias benghalensis*	Indian Roller	Coraciidae	LC
8	*Centropus sinensis*	Crow Pheasant	Cuculidae	LC
9	*Milvus migrans*	Black Kite	Accipitridae	LC
10	*Amaurornis phoenicurus*	White-breasted Water hen	Rallidae	LC

11	*Dicrurus macrocercus*	Black Drongo	Dicruridae	LC
12	*Corvus splendens*	House Crow	Corvidae	LC
13	*Phalacrocorax niger*	Little Cormorant	Phalacrocoracidae	LC
14	*Acridotheres tristis*	Common Myna	Sturnidae	LC
15	*Copsychus saularis*	Oriental Magpie Robin	Muscicapidae	LC
Reptiles				
•	*Boiga trigonata*	Common Cat Snake	Colubridae	LC
•	*Calotes versicolor*	Oriental Garden Lizard	Agamidae	LC
•	*Hemidactylus brookii*	Spotted House Gecko	Dekkonidae	LC
•	*Hemidactylus frenatus*	Common House Gecko	Dekkonidae	LC
•	*Naja naja*	Common Indian Cobra	Elapidae	LC
•	*Ptyas mucosa*	Rat Snake	Colubridae	LC
Butterflies				
1	*Acraea terpsicore*	Tawny Coster	Nymphalidae	LC
2	*Danaus chrysippus*	Plain Tiger	Nymphalidae	LC
3	*Danaus genutia*	Common Tiger	Nymphalidae	LC
4	*Euploea core*	Common Crow	Nymphalidae	LC
5	*Euploea sylvester*	Double-branded Crow	Nymphalidae	LC
6	*Eurema hecabe*	Common Grass Yellow	Pieridae	LC
7	*Junonia almana*	Peacock Pansy	Nymphalidae	LC
8	*Pareronia hippia*	Common Wanderer	Pieridae	LC
9	*Prioneris sita*	Painted Sawtooth	Pieridae	LC
10	*Talicada nyseus*	Red Pierrot	Lycaenidae	LC
11	*Tarucus indica*	Indian Pointed Pierrot	Lycaenidae	LC
Abbreviations: LC= Least Concerned, CR= Critically Endangered, VU= Vulnerable, DD= Data Deficient, NT= Near Threatened, EN= Endangered.				

3.10 SOCIO-ECONOMIC IMPACT ASSESSMENT

Socio-Economic Impact Assessment (SEIA) refers to systematic analysis of various social and economic characteristics of human being living in a given geographical area (study area/impact area). The prime objective of SEIA is to identify and evaluate potential socio-economic and cultural impacts of a proposed development project on the lives & conditions of people, their families and communities. If the potential impacts are significant and adverse, SEIA assist the developers and other stakeholders to reduce, remove or prevent these impacts from happening. Also, it examines how a development project changes the lives of local residents. The outcome of the study relies on both quantitative and qualitative measure of impacts. The impacts are evaluated in terms of changes in community demographics, housing, employment, market effects, public services, retail business, quality of life and artistic qualities of the community. Further, assessing proposed developments in socio-economic context help the community leaders and local people identify potential social equity issues, evaluate the adequacy of social services and determine whether the project has adverse effects on overall social well-being or not.

SEIA also provides a forum for planning how to maximize the beneficial impacts of a proposed development. Beneficial impacts can include:

a) A better standard of living due to increased access to employment, business opportunities, training, education & health,
b) Greater access to and from a community, and
c) Increased funding to improve social infrastructure and cultural maintenance.

3.10.1 Objectives of the Study

The objectives of Socio-Economic Impact Assessment of the project are as follows:

a) To comprehend socio-economic status of the people living in the defined study area.
b) To assess probable impact of the project on social and economic aspects.
c) To measure the impact of the project on quality of life of the people.
d) To ensure sustainability of positive impacts.
e) To suggest mitigation measures and agency responsible for taking action in case of adverse impact.

3.10.2 Steps taken to prepare the SEIA Report

- Literature Review.
- Identification of the study area and important landmarks therein.
- Preparation of list of habitations located in the study area.
- Firming up of approach and methodology.
- Collection of Secondary Data from Census Report, district profile, published and un-published literatures, administrative records etc.

- Data Entry and Data Validation.
- Generation of Tables.
- Data Analysis and preparation of report.

3.10.3 Methodology

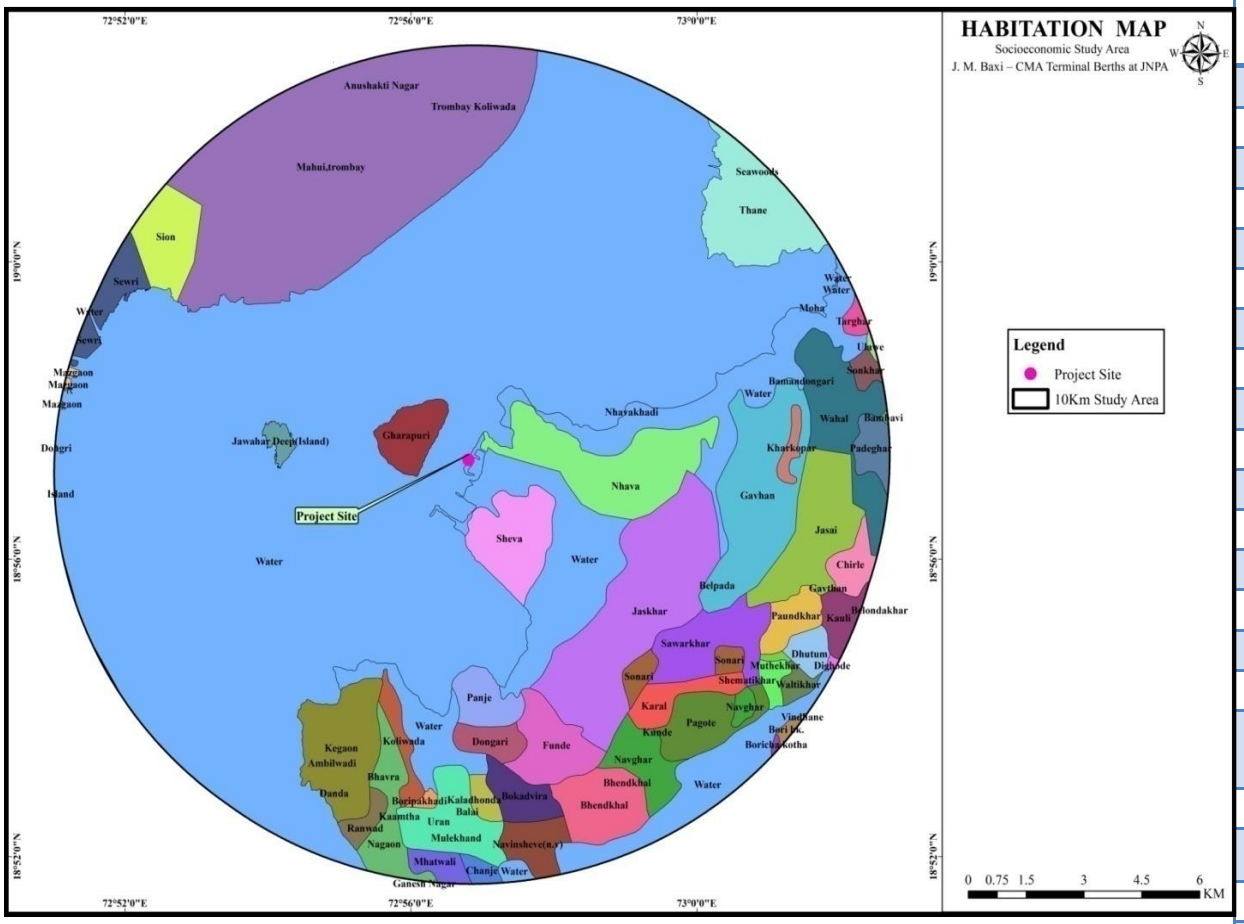
For Socio-economic Impact Assessment of the proposed project systematic analysis of habitations level studies of various socio-economic characteristics, both in terms of quality and quantity was carried out. Accordingly, both qualitative and quantitative data of the study area was collected through various sources.

For collection of information, Census of India was approached for published data/information, state & district portals were visited and administrative records were referred of the state & district administration. Codes were extensively used during collection of qualitative data. They were decoded after data processing to facilitate data analysis and report writing.

3.10.4 Study Area

The study area defines the circle, radius of 10 km around the project site. The berth facility is coming up in Nheva village in sub district Uran, Raigarh district, Maharashtra. There are 45 identified habitations in the study area 44 of which are villages and there is one urban area. The habitations of the study area are spread over the sub districts Uran, Panvel of Raigarh district and Palghar sub district of Thane district, Maharashtra. There are 5 uninhabited habitations in the study area.

The habitations are shown in the map and the table below:



Habitations in the Study Area

Sl. No.	Village	Sl. No.	Village
1	Bambavi	24	Navin Sheva
2	Bhendkhal	25	Nhave
3	Bokadvira	26	Padeghar
4	Bori Bk.	27	Pagote
5	Boricha Kotha	28	Panje
6	Boripakhadi	29	Paundkhar
7	Chirle	30	Ranwad
8	Dighode	31	Sawarkhar
9	Dongari	32	Shematikhar
10	Funde	33	Sonari
11	Gavhan	34	Sonkhar
12	Gharapuri	35	Targhar
13	Hanumanpada	36	Ulawe
14	Jaskhar	37	Vindhane
15	Kaladhonda	38	Wahal
16	Karal	39	Waltikhar
17	Kauli Bandhankhar	40	Danda
18	Kharkopar	41	Belpada
19	Mazgaon	42	Belondakhar
20	Mhatwali	43	Mahuli
21	Muthekhar		Urban Area
22	Nagaon	44	Thane
23	Navghar		

3.10.5 Baseline Data

The baseline data with respect to population and amenities available in the study area has been shown below:

I. Demographic particulars/population details:

S. No.	Description	Number	Percentage to Respective Total
1	**Total Population**	**90349**	**100**
	Male	47977	53.1
	Female	42372	46.9
	Sex Ratio	883	
2	**Population (0-6 age group)**	**10417**	**100**
	Male	5383	51.7
	Female	5034	48.3
	Sex Ratio	935	
3	**Population- Scheduled Caste**	**3924**	**100**
	Male	2109	53.7
	Female	1815	46.3
	Sex Ratio	860	
4	**Population Scheduled Tribe**	**8985**	**100**
	Male	4601	51.2
	Female	4384	48.8
	Sex Ratio	952	
5	**Total Literates**	**68485**	**100**
	Male	38611	56.4
	Female	29874	43.6
	Gender Gap in Literates	12.8	
6	**Overall Literacy Rate**	**85.7**	
	Male	90.6	
	Female	80.0	
	Gender Gap in Literacy Rate	10.6	
7	**Total Workers**	**32517**	**100**
	Male	25884	79.6
	Female	6633	20.4
	Gender Gap in Work Participation	59.2	
8	**Main Workers**	**26686**	**100**

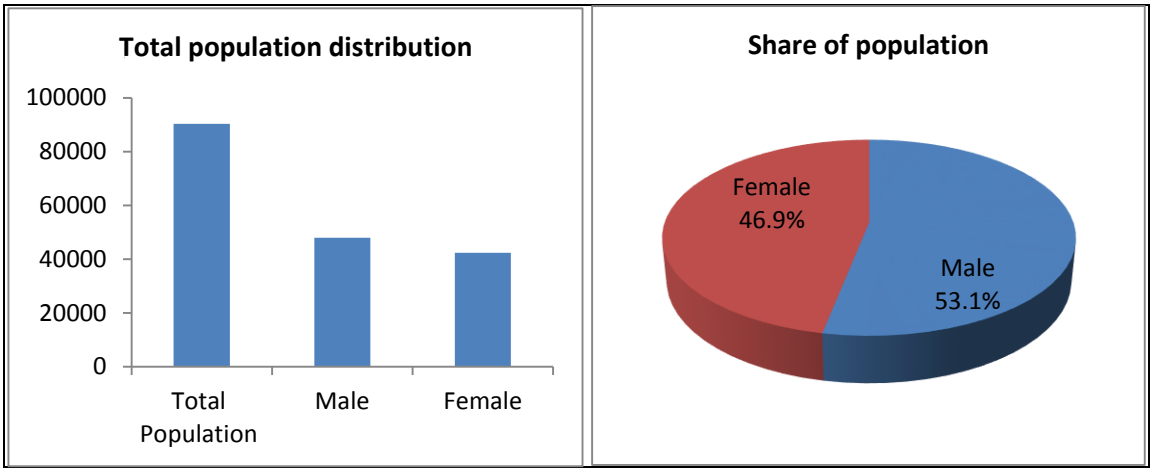
	Male	22264	83.4
	Female	4422	16.6
	Gender Gap in Work Participation	66.8	
9	**Marginal Workers**	**5831**	**100**
	Male	3620	62.1
	Female	2211	37.9
	Gender Gap in Work Participation	24.2	
10	**Main Household Industrial Workers**	**909**	**100**
	Male	577	63.5
	Female	332	36.5
11	**Total Main Agricultural Workers**	**2158**	**100**
	Male	1616	74.9
	Female	542	25.1
12	**Main Cultivators**	**1555**	**100**
	Male	1178	75.8
	Female	377	24.2
13	**Main Agricultural Labour**	**603**	**100**
	Male	438	72.6
	Female	165	27.4
14	**Main Other Workers**	**23619**	**100**
	Male	20071	85.0
	Female	3548	15.0

Source: Census of India, 2011

3.10.6 Population Composition

According to Census 2011, total population of the study area has been worked out to 90349 out of which 47977 (53.1 per cent) are males and remaining 42372 (46.9 per cent) are females. The overall sex ratio in the study area has been worked out to 883 females per 1,000 males.

Total Population Distribution

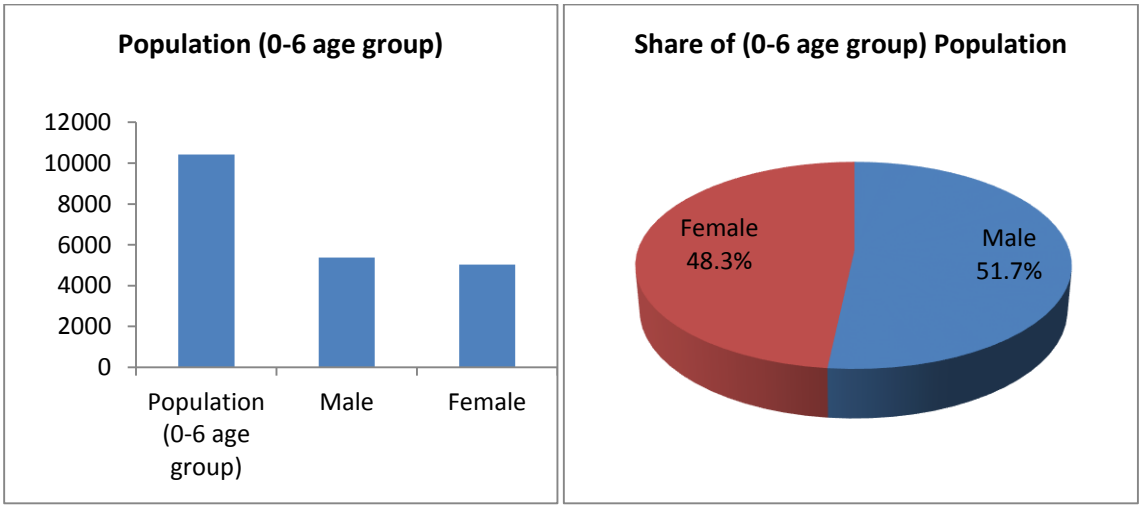


Source: Primary Census Abstract, 2011

3.10.7 Child Population Distribution

In the study area, the total child population of age group of 0-6 year has been worked out to be 10417 which constitute about 11.5 per cent of the total population. Of the total child population, 5383 (51.7 per cent) are boys and remaining 5034 (48.3 per cent) are girls. The sex ratio in this age group is 935 girls per 1,000 boys.

Child Population Distribution

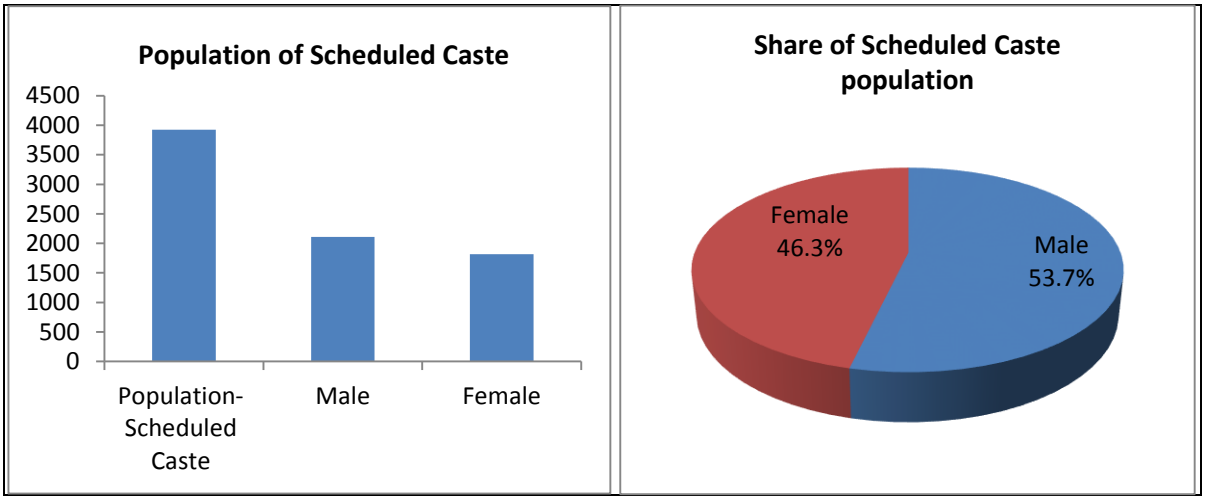


Source: Primary Census Abstract, 2011

3.10.8 Social Group Population Distribution

In the study area, Scheduled Caste population is 3924 which constitute 4.3 per cent of the total population of the study area. Of the total Scheduled Caste population, 2109 (53.7 per cent) are males and remaining 1815 (46.3 per cent) are females. The sex ratio among Scheduled Caste population has been worked out to 860 females per 1,000 males.

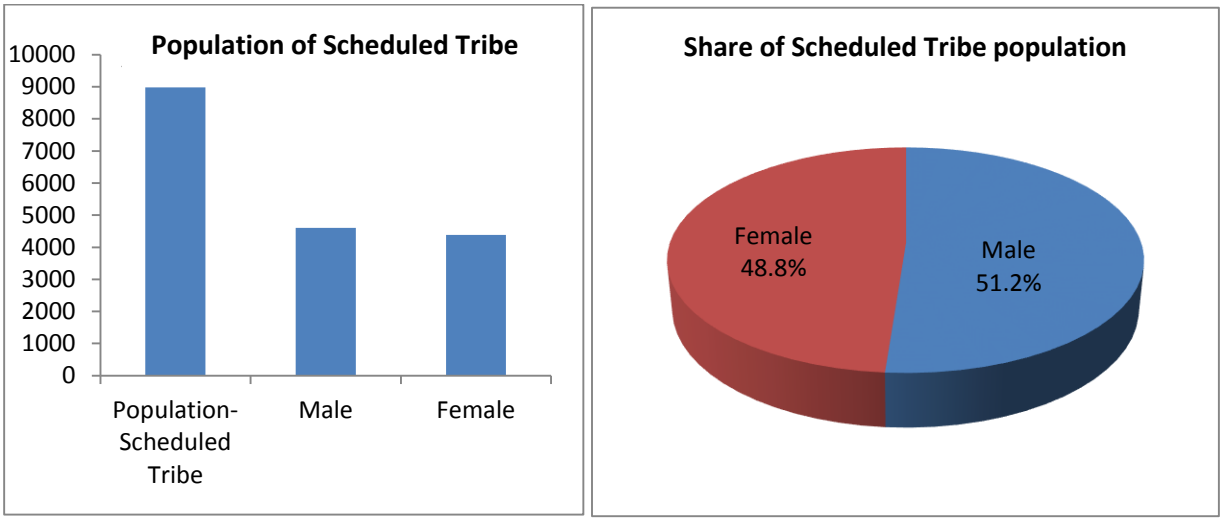
Scheduled Caste Population Distribution



Source: Primary Census Abstract, 2011

There are 8985 people belonging to Scheduled Tribe population in the study area which constitutes 9.9 per cent of the total population. Of the total Scheduled Tribe population, 4601 (51.2 per cent) are males and remaining 4384 (48.8 per cent) are females. The sex ratio among this population group has been worked out to 952 females per 1,000 males.

Scheduled Tribe Population Distribution



Source: Primary Census Abstract, 2011

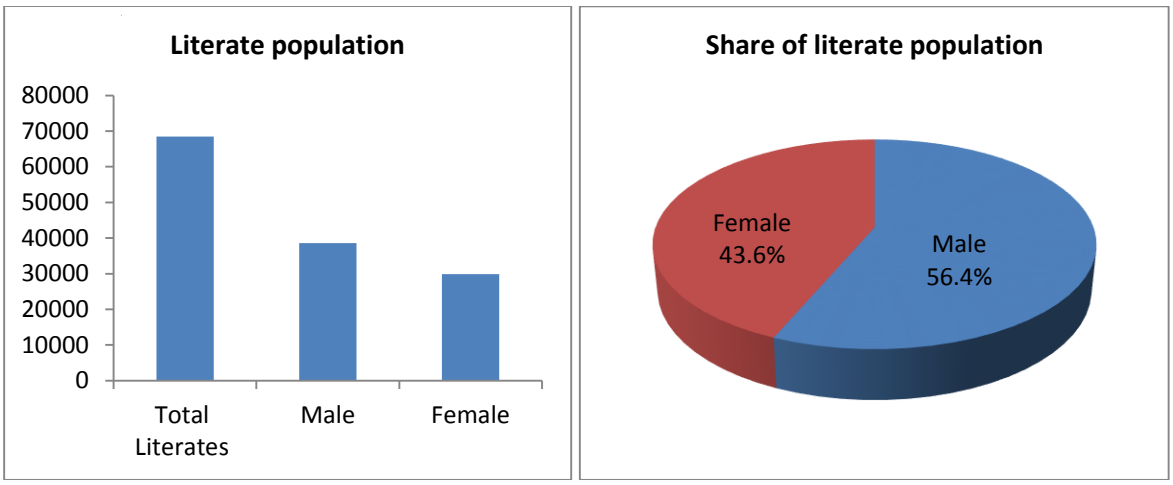
3.10.9 Households and Household Size

The entire population of the study area is distributed into 20760 households and the average household size is 4.

3.10.10 Literates, Literacy Rate and Gender Gap in Literacy Rate

In the study area, 68485 (75.8 per cent) of the population is literate in which 38611 (56.4 per cent) are male literates and remaining 29874 (43.6 per cent) are female literates. There is a gender gap of 12.8 per cent in the literate population. The overall literacy rate has been worked out to 85.7 per cent. The male literacy rate is 90.6 per cent and female literacy rate is 80.0 per cent, creating a considerable gender gap in literacy rate of 10.6 per cent.

Distribution of Literate Population

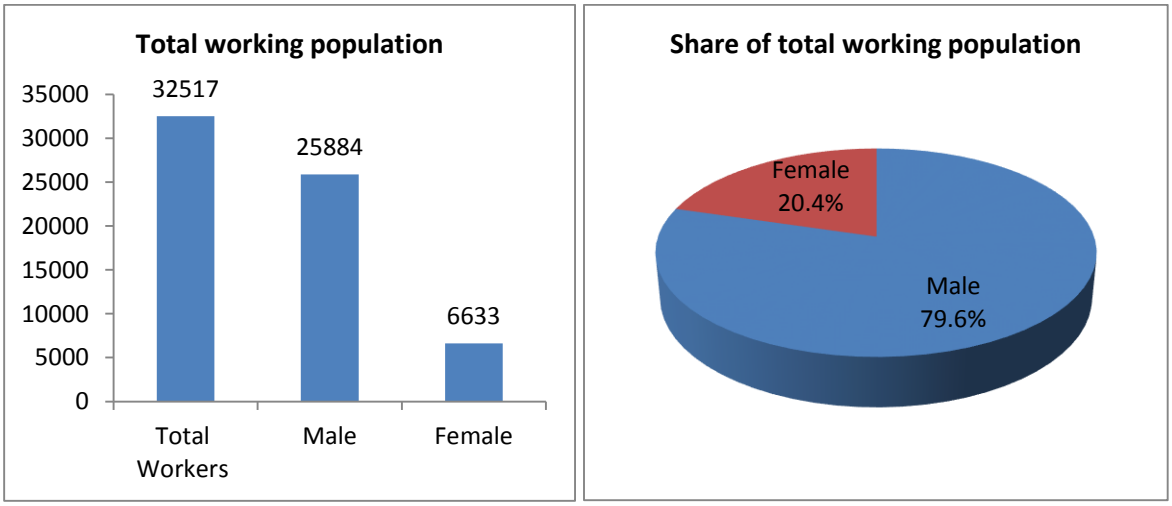


Source: Primary Census Abstract, 2011

3.10.11 Working Population Details

Based on Census 2011, total number of workers in the study area has been worked out to be 32517 which constitute 36.0 per cent of the total population. Of the total workers, 25884 (79.6 per cent) are males and the remaining 6633 (20.4 per cent) are females. There is a significant gender gap of 59.2 per cent in work participation.

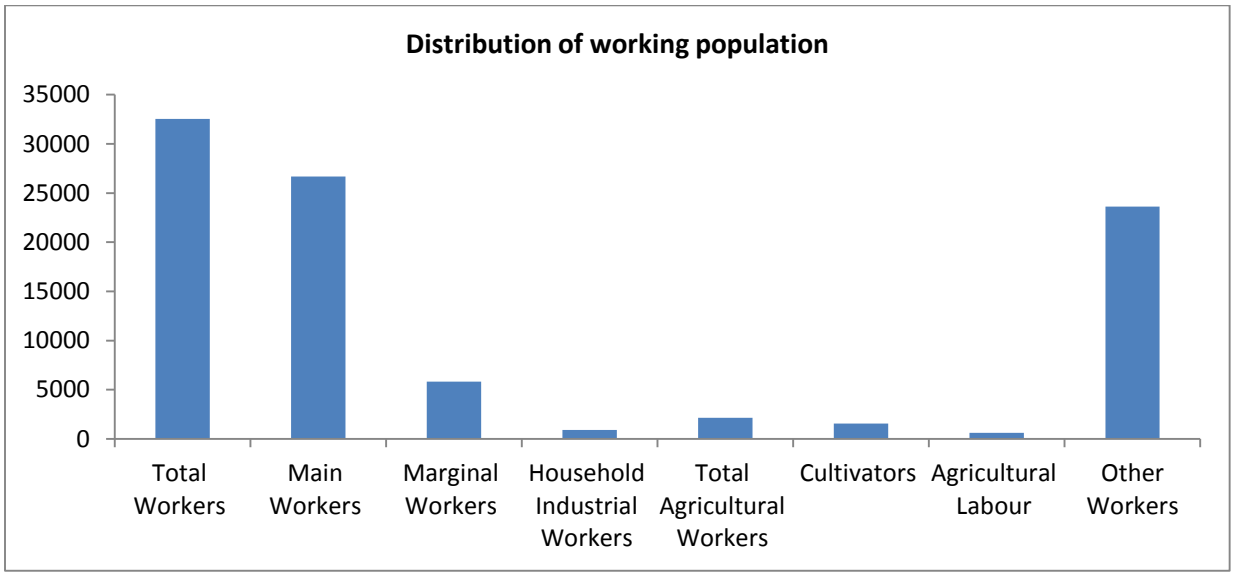
Distribution of Total Worker



Source: Primary Census Abstract, 2011

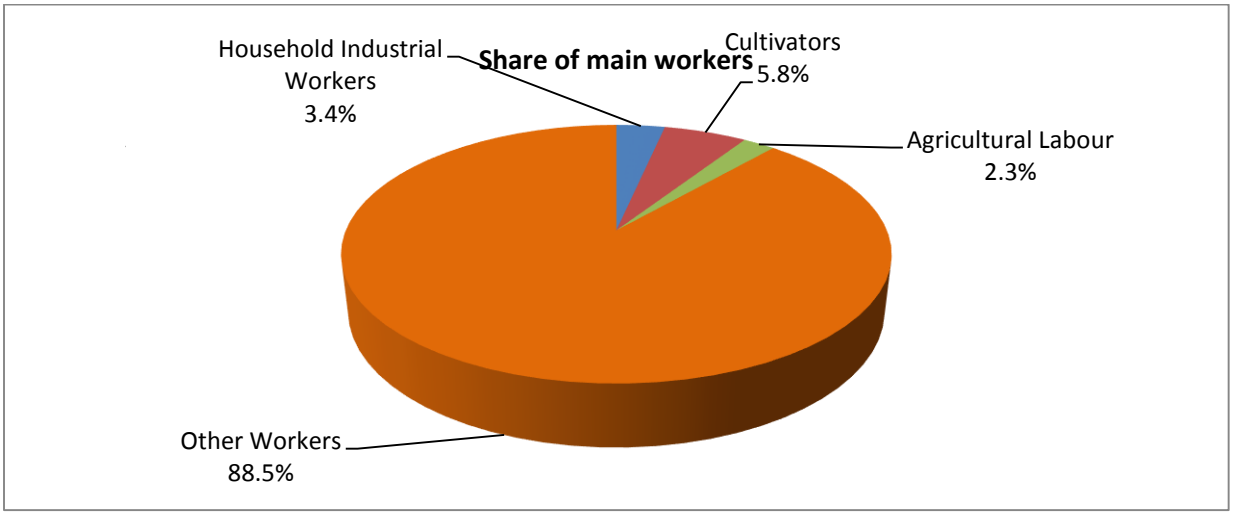
Further, out of the total workers, 26686 (82.1 per cent) are main workers and the remaining 5831 (16.6 per cent) are marginal workers. Of the total main workers 22264 (83.4 per cent) are males and remaining 4422 (16.6 per cent) are females which creates a considerable large gender gap of 66.8 per cent in this segment of work participation. In case of marginal workers, 3620 (62.1per cent) are males and remaining 2211 (37.9 per cent) are females that creates a gender gap of 24.2 per cent in this segment of work participation. The main workers are further divided into agricultural labourers, cultivators, household industrial workers and other workers. The sum of the cultivators and agricultural labourers is termed as total main agricultural workers.

Working Population Details



Source: Primary Census Abstract, 2011

Share of Main Workers



Source: Primary Census Abstract, 2011

Out of the total working main population, 5.8 per cent are cultivators and 2.3 per cent is agricultural labourers. Workers belonging to other workers category are 88.5 per cent whereas, 3.4 per cent belongs to the household industrial workers category. From the above distribution of workers it is clear that the economy of the study area is mainly dependent on other workers.

3.10.12 BASIC AMENITIES:

The basic amenities available in the study area habitations have been shown in the table below. Only approximately 5 per cent of the amenities of Thane has been considered as 5% of the total area of Thane city is coming in the study area.

Basic Amenities Available in the Study Area

EDUCATION		
Educational Facilities	**Type of Institutions**	**Number**
	Government Pre - Primary School	106
	Private Pre - Primary School	01
	Government Primary School	98
	Private Primary School	14
	Government Middle School	47
	Private Middle School	13

	Government Secondary School	12
	Private Secondary School	13
	Government Senior Secondary School	07
	Private Senior Secondary School	03
	Private Degree College-Art,Science and Commerce	01
	Total	**315**

HEALTH		
Health Facilities	**Type of Facilities**	**Number**
	Primary Health Centre	01
	Primary Health Sub Centre	05
	Maternity And Child Welfare Centre	01
	Hospital Allopathic	02
	Dispensary	03
	Family Welfare Centre	03
	Non-Government Medical facilities Out Patient	47
	Non-Government Medical facilities In And Out Patient	19
	Total	**81**

WATER		
Drinking Water / Other Purpose Water Facilities	**Means of Drinking Water**	**No. of Habitations**
	Tap Water Treated	30
	Tap Water Untreated	09
	Covered Well	03
	Uncovered Well	40
	Hand Pump	18
	Tube Wells/Borehole	14

	River/Canal	02
	Tank/Pond/Lake	11
	Over Head Tank	01
ELECTRICITY		
Electricity Supply	Power for Domestic Uses	39
	Power for Agriculture Uses	38
	Power for Commercial Uses	35
DRAINAGE		
Sanitation Facility	Open Drainage	34
	Closed Drainage	01
	No Drainage	07
ROAD		
Approach Road	Major District Road	18
	Other District Road	27
	Black Topped (pucca) Road	34
	Gravel (Kuchha) Road	24
	All Weather Road	38
	Water Bounded Macadam	23
	Footpath	40
TRANSPORTATION		
Road Transportation Facility	Public Bus Service	37
	Private Bus Service	01
	Auto/Modified Autos	20
	Taxi	20
	Vans	20
BANKING FACILITY		
Credit Societies	Commercial Bank	04
	Cooperative Bank	05

	Agricultural Credit Societies	32
	Non-Agricultural Credit Society	02
	Nationalised Bank	01
OTHER AMENITIES		
Other Amenities	Public Distribution System (PDS) Shop	35
	Nutritional Centres-ICDS	39
	Post Office	10
	Sub Post Office	11
	Birth and Death Registration Office	34

Source: Desk Research & Census of India, 2011

3.10.12.1 Quality of Life*

According to census 2011, about 70% population of the country belong to rural areas. Majority of India's rural population lives with an insufficient social infrastructure and poor access to basic amenities like education, medical drinking water and electricity etc. Amenities are key to understanding quality of life because access to these basic amenities are crucial to rural development as they contribute to physical and material comfort. The availability of services supplied in a rural area is able to influence local resident's quality of life (Layard 2005, Nussbaum and Sen 1993; Alkire, 2002, Prescott-Allen 2001, Ura et al 2004, Stiglitz, et al 2009). The individual quality of life does not depend on utilities of services available, but on functioning and capabilities (Sen, 1980; 1982; 1988). In general, the concept of quality of life has socio- economic dimensions and monetarist measurements embracing social and environmental features. Therefore, a large set of indicators must be premeditated and evaluated to take all of these features into account. However, as Boncinelli and Casini (2014) pointed out that the quality of life includes not only the identification of a set of indicators, but also their aggregation. The development of a region can be identified with an increase in the employment opportunities, availability of infrastructural facilities, amenities and services, proper distribution of resources, increase in production, and investment

in consumption and so on (Sixl and Sixl, 1999). Thus, the development refers to an improvement of all the sectors of economic, social and cultural pursuits (Verma, 1993). Availability of modern household amenities and assets also has dominant significance in the human life. It is also being realized that key dependencies exist between water supply and sanitation and improvement in the overall human development (Dreze and Murthi 2001; Gupta and Mitra 2002). It is unadventurously believed that housing conditions, availability of drinking water, sanitation facilities, etc. might contribute to the health improvement of the people and determine the quality of life of the society (Nayar, 1997). Other theoretical work by Roback (1985, 1988) and Blanchflower and Oswald (1996) show the relationship between amenities, quality of life, and rural economic growth.

Quality of Life of the Study Area: The total population of the study area is rural in nature. The habitations of the study area are spread over the sub districts Uran, Panvel of Raigarh district and Palghar sub district of Thane district, Maharashtra. In view of the above mentioned concepts an analysis of the quality of life of the study area was done and was found that owning to the fact that the villagers have health, education, sanitation, drinking water facility and employment opportunities available in the study area villages according to the Census of India, 2011, the inhabitants have a average quality of life that will improve after the coming of the project into operation. There is further scope of development and improving the basic amenities which are being taken up by the various government schemes and under the provision of Corporate Social Responsibility by private and government companies registered under the Companies' Act, 2013 and under the provision of Corporate Environment Responsibility.

*(*Acknowledgement: Quality of Life in Rural Areas of Moradabad district: A Block-wise Study; Dr. Fatma Mehar Sultana, Assistant Professor (Women's College, Aligarh Muslim University, Aligarh, India); Zaid Alam; Research Scholar (Department of Geography, Aligarh Muslim University, Aligarh, India.)*

CHAPTER-4 : ANTICIPATED ENVIRONMENTAL IMPACT AND ITS MITIGATION MEASURES

4.1 INTRODUCTION

Prediction of impacts is the most important component in the Environmental Impact Assessment studies. Several scientific techniques and methodologies are available to predict impacts of developmental activities on physical, ecological and socio-economic environments. Such predictions are superimposed over the baseline (pre-project) status of environmental quality to derive the ultimate (post-project) scenario of environmental conditions. The prediction of impacts helps to minimize the adverse impacts on environmental quality during pre and post project execution. Generally, the environmental impacts can be categorized as either primary or secondary. Primary impacts are those, which are attributed directly by the project and secondary impacts are those, which are indirectly induced and typically include the associated investment and changed patterns of social and economic activities by the proposed actions.

The primary function of an environmental impact assessment is to ascertain the potential impacts of project on environmental components such as air, water, noise, soil, flora, fauna, land and Socio-economic and their magnitude during construction and operation for adoption of possible mitigation measure.

4.2 IDENTIFICATION OF IMPACTS

The Impacts of project are divided into two categories i.e. impacts during construction phase and impacts during operation phase. Major project impacts will occur during operation phase as construction work will be done in a staggered manner within a small area and for that duration.

Environmental parameters considered for impact analysis are:-

- Air Environment
- Water Environment
- Noise Environment
- Biological Environment
- Socioeconomic Environment

4.3 Air Environment

Prediction of Ground Level Concentrations (GLC's) due to proposed project has been made by Industrial Source Complex, Short Term (ISCST3) as per CPCB guidelines. ISCST3 is US-EPA approved model to predict the air quality. The model uses rural

dispersion and regulatory defaults options as per guidelines on air quality models (PROBES/70/1997-1998). The model assumes receptors on flat terrain

4.4 MODEL OPTIONS USED FOR COMPUTATIONS

- Plume rise has not been considered;
- Calm's processing routine is used by default;
- Flat terrain is used for computations;
- It is assumed that the pollutants do not undergo any physico-chemical transformation and that there is no pollutant removal by dry deposition;
- Washout by rain is not considered
- Meteorological inputs required are hourly wind speed and direction, ambient temperature, stability class, and mixing height.

4.5 MIXING HEIGHT

As site specific mixing heights were not available, mixing heights based on IMD publication, "Atlas of Hourly Mixing Height and Assimilative Capacity of Atmosphere in India", has been considered for Industrial Source Complex model to establish the worst-case scenario.

4.6 METEOROLOGICAL DATA

Data recorded at the continuous weather monitoring station on wind speed, direction, and temperature at one hour interval for the monitoring period was used as meteorological input.

4.7 PRESENTATION OF RESULTS

Model simulations have been carried out using the hourly Triple Joint Frequency data viz., stability, wind speed, mixing height and temperature. Short-term simulations were carried to estimate concentrations at the receptors to obtain an optimum description of variations in concentrations over the site in 10-km radius covering 16 directions. The maximum incremental GLCs for PM_{10}, $PM_{2.5}$, SO_2, and NO_2 due to operation are found to be 2.8 µg/m^3, 0.97 µg/m^3, 0.70 µg/m^3 and 1.15 µg/m3, respectively, within the study area. The maximum incremental GLCs are superimposed on the maximum baseline PM10 concentrations recorded during monitoring period i.e. post monsoon season 2022 to arrive at the likely resultant concentrations after implementation of the proposed project. The cumulative concentrations (baseline + incremental) after implementation of the project are tabulated below:

Table 4.1: Incremental Ground Level Concentration of PM_{10} in the Study Area

Sl.No.	Sampling Location	PM_{10} concentration (µg/m³)		
1		Baseline	Incremental	Cumulative
	Project site	82	2.8	84.8

Table 4.2: Incremental Ground Level Concentration of $PM_{2.5}$ in the Study Area

Sl.No.	Sampling Location	$PM_{2.5}$ concentration (µg/m³)		
1		Baseline	Incremental	Cumulative
	Project site	46	0.97	46.97

Table 4.3: Incremental Ground Level Concentration of SO_2 in the Study Area

Sl.No.	Sampling Location	SO_2 concentration (µg/m³)		
1		Baseline	Incremental	Cumulative
	Project site	18	0.70	18.70

Table 4.4: Incremental Ground Level Concentration of NO_2 in the Study Area

Sl.No.	Sampling Location	NO_2 concentration (µg/m³)		
1		Baseline	Incremental	Cumulative
	Project site	32	1.15	33.15

The resultant concentrations of PM_{10}, $PM_{2.5}$, SO_2, and NO_2 at all locations are well within the NAAQS standard limits. Isopleths were drawn for the pollutant distribution in the area and are shown in Figure 4.1, 4.2, 4.3 &4.4.

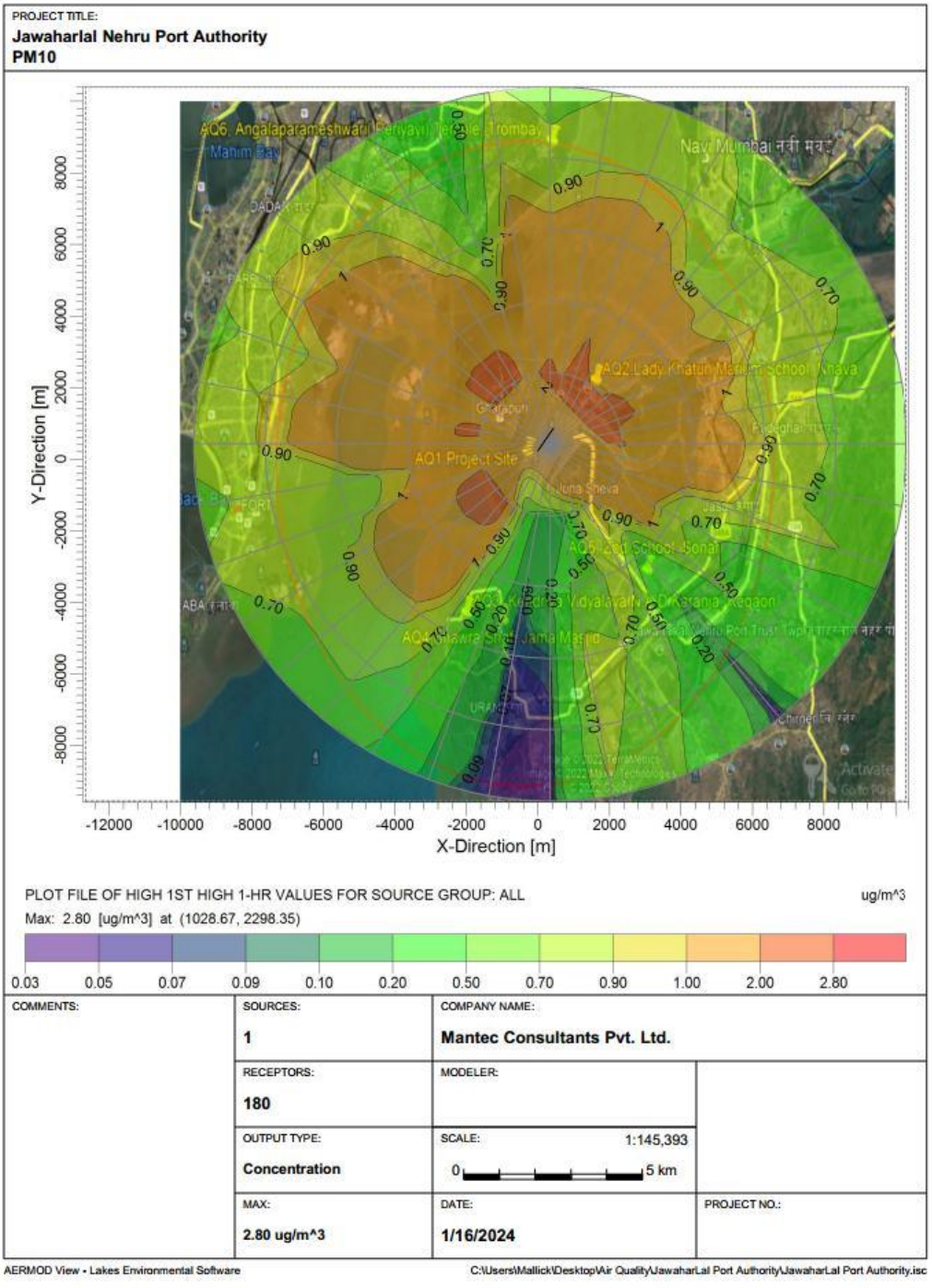


Figure 4.1: PM $_{10}$ Ground Level Concentration of study area

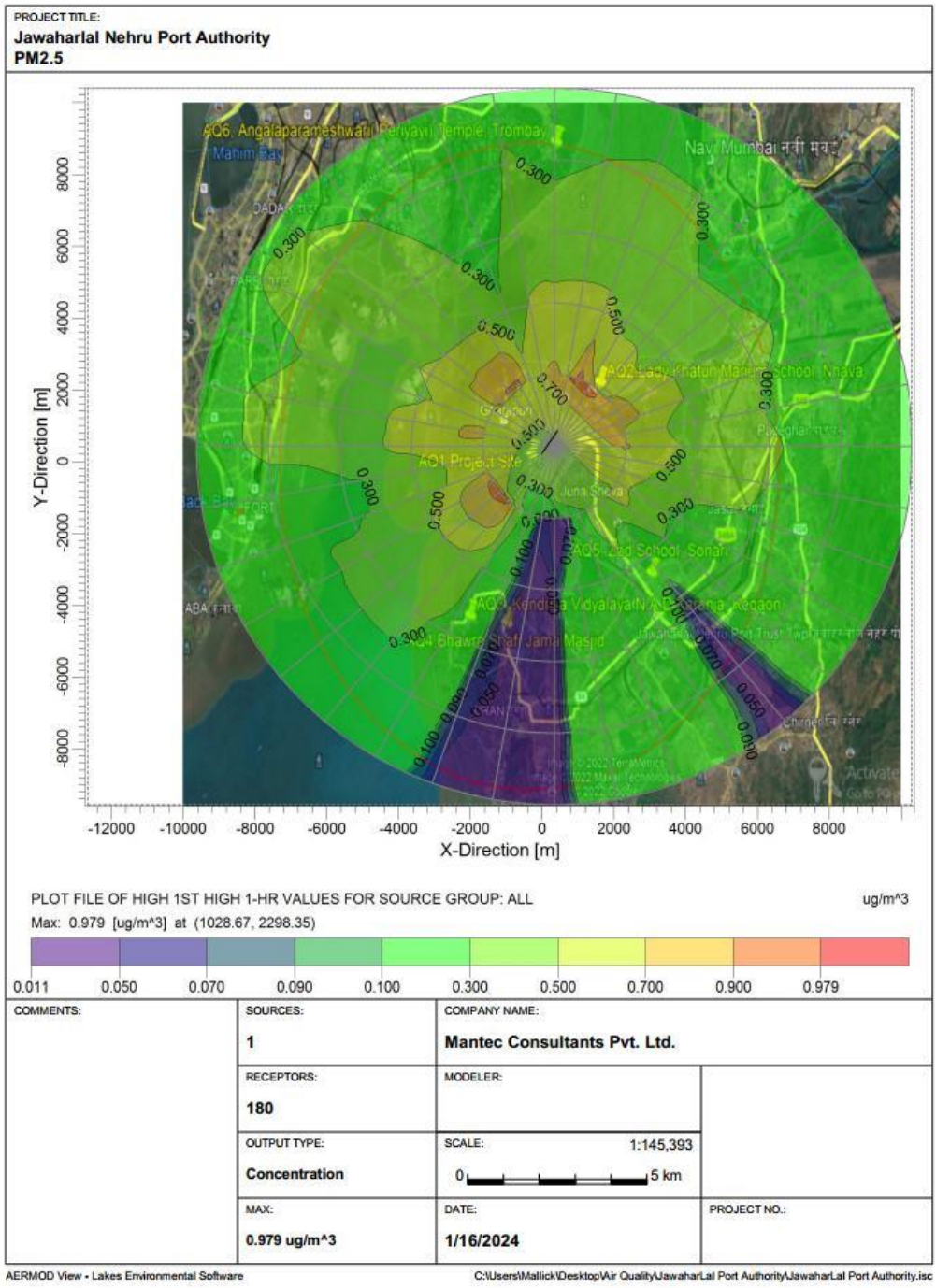


Figure 4.2:$PM_{2.5}$ Ground Level Concentration of study area

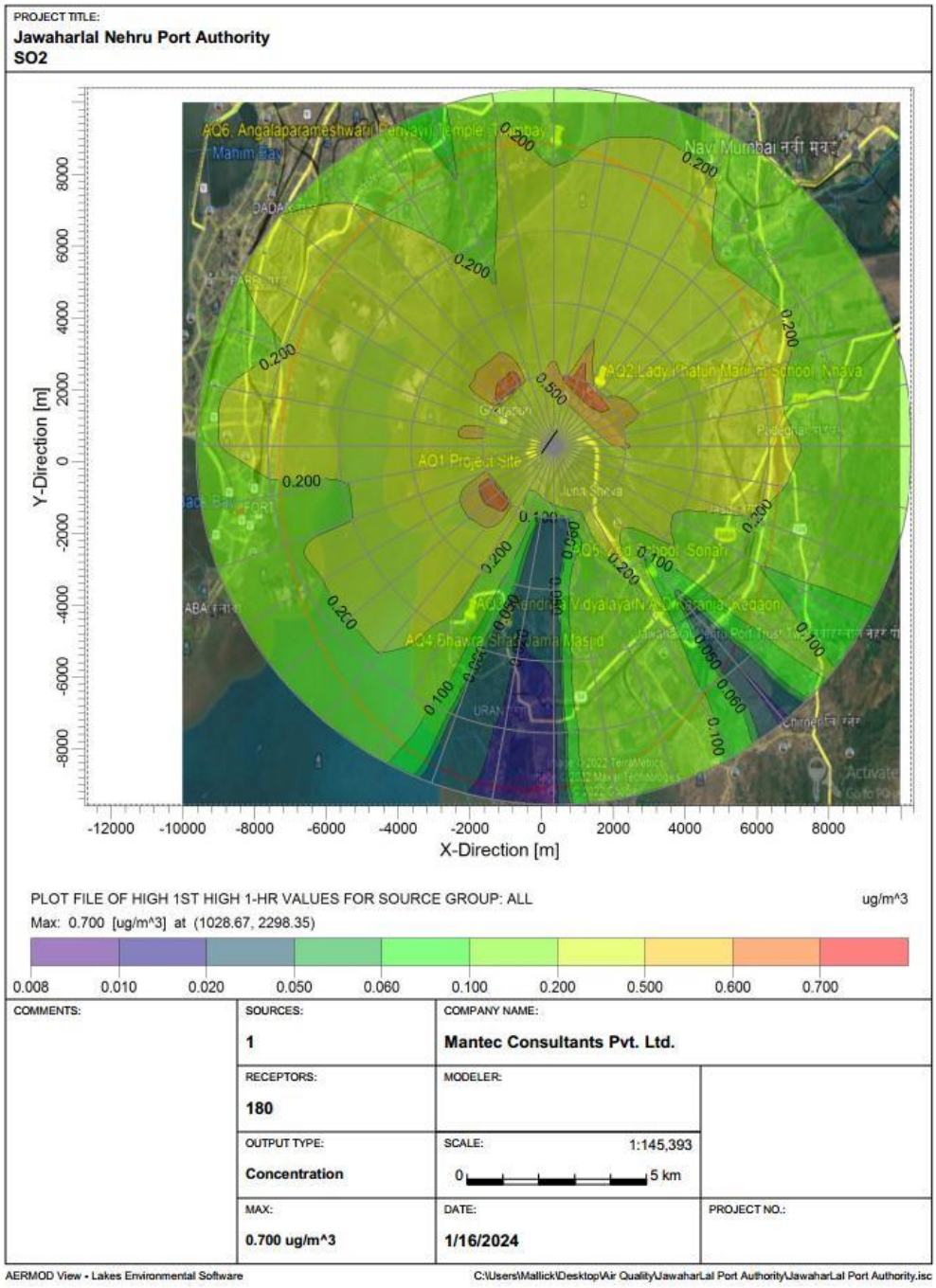


Figure 4.3:SO_2 Ground Level Concentration of study area

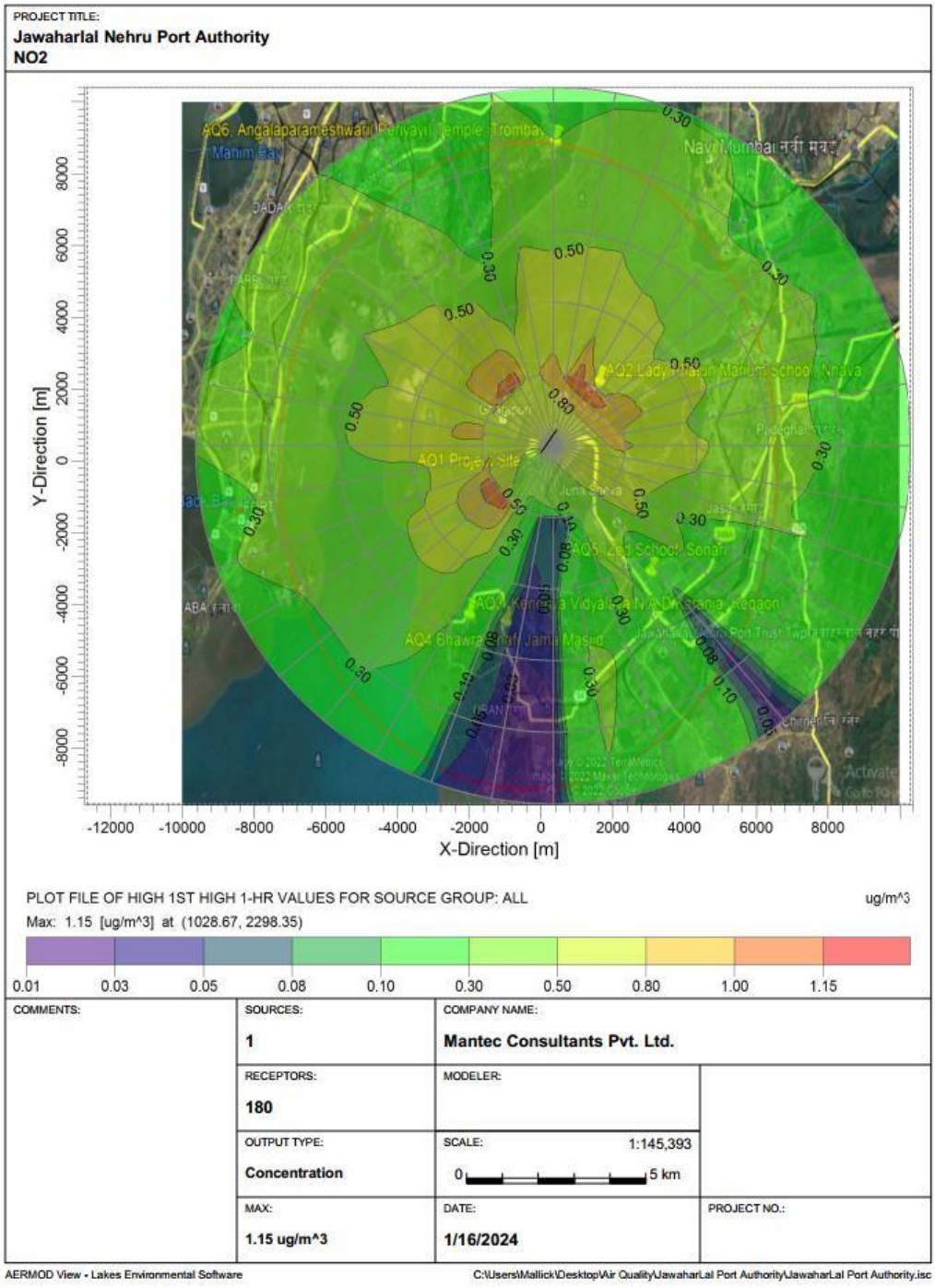


Figure 4.4:NO_2 Ground Level Concentration of study area

4.8 IMPACTS ON AIR ENVIRONMENT

The proposed widening of existing container berth will not involve any major impact on air quality of the area; however various activities related to proposed facility may cause negligible impact on air quality of the area. Ambient air quality at all the sites was monitored for baseline conditions.

The results are already presented in the report. The proposed project operations such as loading, unloading of ships, ship fuelling activities and ancillary activities shall generate dust emissions.

Particulate emissions will be generated from loading and unloading operations. Moving of vehicles shall also emit small amount of vehicular pollution.

Impacts

- Fugitive emissions from the cargo loading and unloading activities.
- The major activities envisaged in the proposed project emitting dust emission from cargo loading and unloading activity.
- Emissions from DG sets, movable cranes.
- During operation phase over-fueling or careless fuelling practices may also lead to impacts on air quality of the project site area**.**

Mitigation measures

- Regular monitoring of air quality as mentioned in EMP will enable to keep the air quality below permissible standards.
- Proper sprinkling of water during loading unloading activity as well as proper housekeeping shall be maintained so as to reduce the fugitive dust emission.
- The exhaust emissions from ships/vessels shall be controlled on the ship itself by providing long stacks with air emission control option such as sea -water scrubbing and fuel substitution.
- Day to day management and maintenance of the facility and the ancillary structures.
- D.G. Set will be used only in case of emergency with proper enclosures in order to reduce the impact of air emissions.
- Control and check will be kept on careless fuelling of the ships if any and excessive trafficking of the ships at one place.
- Approach roads will be covered with green belt on both the sides to avoid any air quality problems to the nearby residents.

- The impact of emissions from operational vehicles and equipments will be negligible to the nearby populations due to the longer distance of human settlements from the project area.

Suggestive mitigation measures

Dust Suppression: The most cost-effective dust suppressant is water. Water shall be applied using hand-held sprays and automatic sprinkler systems. Thus, Fugitive dust will be controlled by sprinkling of water at the site. While, for control of gaseous emission from the DG sets, wet scrubber will be installed. Apart from this, adequate stack height of DG sets would also be maintained as per the CPCB norms. During the installation of DG Sets, the conditions specified in The Environment Protection Act, 1986 third amendment rules 2002, vide GSR 489 (E), dated 9th July,2002 at serial no. 96 shall be complied with.

Emission Control from Construction Equipment's: Construction equipment and heavy transport vehicles shall met emission standards for vehicles. The operation and maintenance of all vehicles and equipment's deployed on site by different contractors shall be regulated and effectively monitored regularly. The Pollution under Control (PUC) certification shall be ensured for each and every vehicle for proper Operations & maintenance.

Improved Maintenance: The other measures to reduce the air pollution on site are:

- On-Road- Inspection shall be done for black smoke generating machinery.
- Promotion of use of clean fuel shall be done.
- Only Vehicles having pollution under control certificate shall be allowed to ply.
- Covering sheets/tarpaulin shall be used to prevent dust dispersion in the site.
- Covering sheets shall be used for trucks to prevent dust dispersion from the trucks, and to be implemented by district offices.
- Speed of the vehicles shall be kept limited to 20 km/h. This shall reduce emissions by a large extent.

Material Storage: Care shall be taken to keep all material storages adequately covered and contained so that they are not exposed to situations where winds on site could lead to dust / particulate emissions.

4.9 IMPACTS ON WATER QUALITY

During construction phase, water required for construction of structures, sprinkling on roads for dust suppression, that too only during daytime. Minimum construction water shall be used for the said project. Adequate water supply facilities are available on site from the port related activities that are ongoing on existing container berth.

Mitigation measures

To prevent degradation and maintain the quality of the water source, adequate control measures have been proposed to check the surface run-off, as well as uncontrolled flow of water into any water body.

- Proper construction methodologies will be adopted in order to avoid turbidity problem.
- No discharge of waste water to soil and ground water body.
- Care will be taken to avoid layer of suspended solids and spillage of oil and grease in the seawater during transportation as well as during shifting of girders.
- Under no circumstances treated or untreated liquid waste will be discharged into marine water.

4.10 OIL SPILL

CAUSES OF OIL SPILL

The common causes of spill are

• Cargo operations- loading, discharge
• Ship collision, or grounding
• Bunker/ fuelling operations
• Ship distress / sinking
• Pipeline ruptures /accidental spills from sub-sea/over the sea/shore approach (in the tidal zone) pipelines

LOCATION OF SPILL WITHIN THE SCOPE OF THIS PLAN

Based on the location of vessel at the particular time of incident within the area of operation, the likely spill could occur at any of the following locations.

(i) Sea or in channel due collision etc during passage
(ii) Close shore due grounding or
(iii) Alongside at jetty or at the terminal during cargo operations

Notwithstanding the above locations, it is possible that an eventuality occuring at sea like a collission or mechanical failure could lead to a situation where the consequences would be felt in some other location at a coastal location**.**

OIL SPILLS - HISTORIC DATA

Historic data, oil properties, climate, local meteorology and environmental sensitivities are important factors in assessing the risk, behavior, fate and potential consequences of spilled oil.

Historic data being secondary data available in public domain is a good measure of causes, probabilities and averages of the happening of any scenario.

Historic data is of great help to responders and Contingency Planners since thestudy of this data helps in identifying trends and causes of spills which in turn help in identifying and implementing remedial approaches as per the gravity and frequency of incidents and plan appropriate response

Impact

The oil spill may cause a layer of suspended oil on the water. The layer can affect the light penetration into the water and also hamper the gaseous exchange between the two environments that can cause asphyxiation of the organisms.

Oil spill Impact on Mangroves

Spilled oil if transported to the mangrove area may block the openings of air breathing roots of plants or interfere with salt balance, harming them. The recovery of mangroves would be slow and may take a few months to years depending on the damage

Mitigation measure

- Oil spill contingency plan shall be in place to deal with the eventualities of the oil spill.
- Mopping system shall be deployed for cleaning of the oil from the surface waters.

Impacts on Marine Water Quality

In the present survey sites pH varied between 7.36 to 7.95 and dissolved oxygen was 117 to 1947 mg/l which is ideal for a marine ecosystem. Dissolved oxygen levels are not reduced to anoxic conditions. Under these circumstances, there is no possibility of any of the chemicals or metals being leached into the water. Moreover, sediment samples collected from all the sites were uncontaminated. As such no adverse impact due to the construction of project on the chemical characteristics of water or sediment is expected.

Impacts on fisheries

The most important impact on fishes may be suspended solid load or changes in the food chain. The high turbidity due to heavy suspended solid load during construction of piles, which may result in clogging of gills of fishes thereby causing asphyxiation. But since fishes are free swimming they will avoid such areas and move to safer areas. Once the turbidity disperses due to current and wave disturbances, they come back to the area. Due to this capability of the fishes there is virtually no impact on fishes and fisheries due to construction of pile.

(SOURCE:- OIL SPILL RESPONSE CONTINGENCY PLAN MUMBAI & JNPT HARBOUR).

4.11 IMPACT AND MITIGATION MEASURES OF DREDGING AND DUMPING ON MARINE ECOLOGY

MARINE ENVIRONMENT

During the construction phase the main activities with potential for impact on the marine environment are: dredging of the approach channel, changes in the natural drainage patterns, modification of existing current patterns, construction of the berths, spending beaches and terminal, spoil disposal from the dredging activities and sanitary sewage disposal during the construction activity. These impacts are elaborated in the succeeding sections.

IMPACTS OF SHIPPING OPERATIONS ON THE MARINE ENVIRONMENT

Ship movements in the coastal region generate waves and propeller-induced turbidity in the water column. Propeller-induced turbidity is influenced by a number of variables like depth of water, levels of activity and sediment characteristics. The turbidity caused by these activities decreases the amount of light that penetrates the water column and therefore has a di. This reduction in primary productivity will affect the rest of the ecosystem. The re-suspension of sediments may cause disturbance to sensitive marine animals, particularly due to a smothering effect as the sediments settle. Depending on the quality of the sediments, organic matter, nutrients, and contaminants may be re-released, affecting water quality, by the removal of oxygen, for example, can adversely affect the marine animals and plants in the vicinity.

There is an inherent risk of marine accidents occurring where goods are transported by sea. Such accidents may occur if a ship is unsuccessful in its attempt to avoid another vessel or obstruction or by due to a natural calamity. Collision with Dolphins, in rare cases is an issue when these animals actively seek out moving vessels and swim close alongside in the bow wave, which may make them vulnerable to injury from collision.

CONSTRUCTION PHASE IMPACTS OF WIDENING THE EXISTING CONTAINER BERTH ON THE MARINE ENVIRONMENT (MARINE WATER, SEDIMENT QUALITY AND BIOTA)

Various activities during the project's widening, repairing, and operation phase are likely to impact various environmental components. Impacts related to the widening of the existing container berth, repairing & strengthening of the existing damaged portion of the berth structures at Jawaharlal Nehru Port on the intertidal and near-coastal environment during the construction and reclamation period can be generally classified into impacts on water quality, sediment quality and impacts on various flora and fauna present around the Thane creek region.

Water Quality

Piling in the sub tidal area for expanding the berth has a high potential to disperse the bed sediment into the water column, thereby increasing the suspended sediments in the water and degrading the water quality locally. Due to the permanent damage caused to bottom biota, there is a potential risk to fishery resources which may lead to an increase in some undesirable species of biota. This can lead to water quality deterioration and adversely affect the marine and coastal ecology locally.

The texture of sub tidal sediment at the proposed berth expansion site (Station T4) mainly consists of silt (Av. 91.8%) followed by clay (Av. 6.2%) and sand. Hence, when the bed sediment is disturbed due to piling activities, the fine particles may remain in suspension, though locally, for some period. The SS generated due to piling activities could render the water muddy and turbid. The changes in salinity due to bed disturbance are not expected.

The results of heavy metals, organic carbon, phosphorus and PHc in sediments. The risk of release of pollutants entrapped in the sediment to the water when the bed is disturbed thereby mixing interstitial water rich in contaminants with the overlying water is expected. The possibility of DO levels being suppressed and the increase in BOD because of the release of this polluted interstitial water which also includes oxidisable organic compounds, is also anticipated.

Different types of floating platforms such as barges, cranes etc. will be deployed in the area during construction. An accident involving such platforms may lead to the loss of onboard construction material and fuel. Without mitigation and containment measures, the materials may sink to the bed and the fuel spill would deteriorate the region's water quality. Thus, apart from local transient pulses of SS and deterioration due to accidental spillages, the water quality of the region will not be influenced adversely during the construction phase.

SEDIMENT QUALITY

The sediment dispersed in the water column during the piling time will be localised and temporary, consider if JNPA adopts advanced piling technologies. The water quality of the Thane creek, sustains moderately polluted sediment with respect to heavy metals. Hence, the possibility of releasing the pollutants bounded with the sediments, due to the disturbance of the seabed during piling activities in the creek water is expected. Misuse of the intertidal area by the workforce employed during the construction phase, can locally degrade the intertidal sediment by increasing BOD and populations of pathogens if proper sanitation is not made available to them.

DREDGING

Construction of the Nhava Sheva port will not*require any further dredging of access channel currently serving the port of Bombay. A new approach channel to the Nhava Sheva Port will be made from the Butcher Island turning circle. Approximately 8 million cubic metres will

have to be dredged to deepen this 250 metre wide channel to a depth of ll-. O metres. At the Sheva terminal itself the berths will initially have and dredged depth of 13,5 m. with potential for further deepening to 14.5 m. As these areas have natural depths of this order, very little dredging will be required near shore.

From an environmental consideration, dredging may have potential impact on ocean currents and fishery resources. The impact on currents is separately discussed in Section 2.1.2. It has been shown that the currents will not be greatly modified by the port constructions (dredging).

If any significant fishery operation is present, the possible ill effects on it could be

a) Increased turbidity which can act as a barrier to fish movement.

b) Transporting the suspended particles to shallow areas and settling them there cana destroy the bottom organisms on which the fish feed on, and the spawning activity of the fish.

However, the Deputy Director of Fisheries, Government of Maharashtra has confirmed that the Bombay Harbour and the Sheva area are neither good fishing grounds nor are they major spawning grounds. Although the village of Mora is a fish landing area for varieties such as Bombay Duck, shrimps and prawns, these species are caught commercially outside the harbour area. The small amount of fishing activity by local villagers observed during a field visit to the site is strictly day fishing and does not account fora significant local source for the local villages.

It is thus clear that the dredging activity for the new port has no. significant effect on the environment and hence no special mitigation measures are required.

Modification of Existing Current Patterns

The proposed Sheva berth terminal facilities will be built in the natural deep channel between Sheva and Elephanta Island. The berthing facilities will be constructed between12 to 15. metre depth approximately parallel to the existing shoreline. Specific Note 2004 on the Model Studies conducted by the Central Water and Power Research Station at Poona in connection with this DPR shows that currents in the vicinity of Sheva parallel the shoreline during both flood and ebb conditions with maximum velocities of 1.0m/sec at the entrance to the Elephanta deep. The Model Studies indicated that the construction of the terminal would not.

Significantly change the current directions nor velocities. The design of berths is such that flow can occur through the open type structures extended out from shore to the actual berths Available survey charts and the survey done specifically for this project indicate that the Elephanta deep is fairly well maintained by the natural ebb and flow of the tides. Model Studies conducted indicate that no significant change in current pattern or velocity is expected after the proposed developments take place. The approach channel to the new port

Therefore, is expected to maintain itself without significant siltation taking place. However, a reduction in velocity of flow may occur in the deepened pocket adjacent to the bulk berths at the southern end of the terminal resulting in comparatively more siltation. This will be taken care of by the maintenance dredging that the port will be doing periodically.
In Nhava Sheva Creek the Model Studies indicated that tidal current volumes and velocities would not be significantly modified by construction of phase Land then guide bunds partially across the entrance. Siltation pattern will not change in the Nhava Sheva Creek or any other part of the port area. In later construction stages when the berths are constructed in the creek tidal dock, siltation will occur because of density currents and tidal influx which will be cleared by special, maintenance dredging plant. ***(SOURCE- DETAILED PROJECT REPORT NHAVA SHEVA PORT:- November 1981).***

4.12 NOISE ENVIRONMENT

(i) Impact due to noise generated by construction equipment's

The noise will be generated due to operation of equipment's used in construction of marine structures. The noise generated during this activity will not affect the human population/ settlements as project site is sufficiently away from habitation. To avoid noise impact on marine fauna and avifauna acoustic enclosures will be provided.

Mitigation measure

Some noise is expected from loading and unloading operations of construction materials, equipment's, piling operations etc. However, those are not significant.

No significant impact is envisaged due to the operation of the noise generating equipment at the project site, if suitable mitigation measures are adopted.

- During construction phase noise impact will be addressed by putting barrier tin sheets around the construction site.
- Signboards along the existing berths to avoid unusual use of horns and also for avoiding idling noise.
- Wherever required the workers will be provided with personal protective equipment such as by providing mufflers and earplugs to the persons working at the project site.
- The machinery used will be properly maintained to avoid noise pollution. All equipment for construction shall be fitted with silencers/mufflers. Damaged silencer to be promptly replaced by the concessionaire.
- All the construction vehicle deployed during construction phase will have BS6 engines with proper maintenance which will have less impact on background noise
- DG set: as per CPCB norms, acoustic enclosure for noise control.
- Care shall be taken to maintain the standards set by CPCB/MoEF&CC for noise level.

- The work at site will be carried out as per the guidelines so as not to disturb the ecosystem and any nearby habitation.

4.13 IMPACT ON BIOLOGICAL ENVIRONMENT

(i) Increase in Turbidity and suspended solids

Impact

The increase in the turbidity decreases the depth of the light penetration in the water column. Thu the transparency of the water column is reduced thereby reducing the primary production of the water body. The increase in the suspended sediments can also affect filter feeding organisms such as shellfish through clogging their feeding and breathing apparatus. The sediments trapped in the gills can be fatal to young fish.

Mitigation measure

- It is observed that background suspended solid and turbidity levels in the marine environment are highly variable.
- The use of grabs in handling bottom sediment shall also limit the impact by avoiding dispersal of suspended material in surrounding water.
- The background turbidity levels are usually high. The organisms in these environments have adapted themselves to the tolerate exposure to high suspended sediment concentration for a longer time. Therefore organisms are less prone to disturbance by construction activities that would increase the suspended solid content in the water column.

(ii) Flora and fauna

Impact

The flora shall be covered with the sediments that will be suspended and dispersed due to construction activities. The fish and other nektonic organisms shall move away from the area to avoid the change in the environment. The benthos includes the organisms that live on or in the sediment at the bottom of the sea. The benthic community is complex and is composed of a wide range of plants, animals and bacteria from all levels of the food chain. It can be differentiated by their habitat: in fauna are animals and bacteria of any size that live in bottom sediments, such as worms and clams. They form their own community structures within bottom sediments, connected to the water by tubes and tunnels. Epifauna are animals that live either attached to a hard surface (for example, on rocks or pilings) or move on the surface of bottom sediments.

Epifauna include oysters, mussels, barnacles, snails, starfish, sponges and many other marine invertebrates.

The construction work phase would increase temporarily the water turbidity. The organisms in these environments have adapted themselves to the tolerate exposure to high turbidity for a longer time. Therefore, organisms are less prone to disturbance by construction activities.

The Benthic organisms found in the study area include commonly occurring local species that does not fall under the category of endangered species. Thus minimum impact is envisaged on the local benthic species at the project site. No new or alien species are expected to be introduced during or after the completion of project construction.

(iii) Impact on Mangroves

The studies on dispersion of suspended sediment due to construction activity indicate that the sediment is not likely to get dispersed in harbour area. There is no removal of mangrove involved in the project.

Mangrove Vegetation

Mangroves are woody plants that inhabit the upper intertidal zones of saltwater areas, primarily in tropical and subtropical regions within 30° of the equator. The mangrove forests have been shown to sustain more than 70 direct human activities, ranging from fuel wood collection to fisheries. The Indian Forest Act, of 1927 and the Wildlife (Protection) Act, of 1972 provide protection to flora and fauna. The Environment (Protection) Act, of 1986 has an important part in the conservation and management of mangrove ecosystems. Mangroves provide critical habitat for diverse marine and terrestrial flora and fauna. Mangroves have a multifaceted role in our environment, these are as follows:

- Economic benefits (Supports livelihoods of indigenous people)
- Ecological services (carbon sequestration, providing habitat for a wide range of fauna. etc.)
- Reducing the intensity of Cyclones, Tsunami and Flood
- Coastal protection
- Trapping the sediments

The project area falls in the mid-segment of Thane Creek. There is thick luxuriant growth of mangroves near the project site. Locations like Nhava, Sheva creek, Elephanta Island, Panje, Boripakhadi, Mora and upper Thane creek has good dense mangrove presence.

The activities proposed to be carried out at the berth are confined to the earmarked site and not falling any mangrove areas; therefore, a direct impact on the mangroves is not anticipated. There are dense mangroves present near the berth (Figure 5.1), so the possibility of indirect impact on the nearby mangrove ecosystem cannot be ruled out, and

the major impact is dust deposition. Dust generated during the construction and operational phase of the berth could result in deposited on surrounding mangroves, which is adversely affected on mangrove photosynthesis process. The exhaust emissions from drilling rig engines can contribute to air pollution by releasing harmful particulate matter and pollutants which may affect the nearby mangrove patches.

Mangroves are also threatened by the disposal of wastes, oil spills, berth activities, erosion trends, cutting for firewood, grazing by livestock etc. The Forest Department and industries around Thane Creek, including JNPA can take up mangrove afforestation programmers, which will result in the protection of the mangrove coverage in Thane creek. JNPA should further support the mangrove restoration programme near the project site, along the creeks and adjacent mud flats.

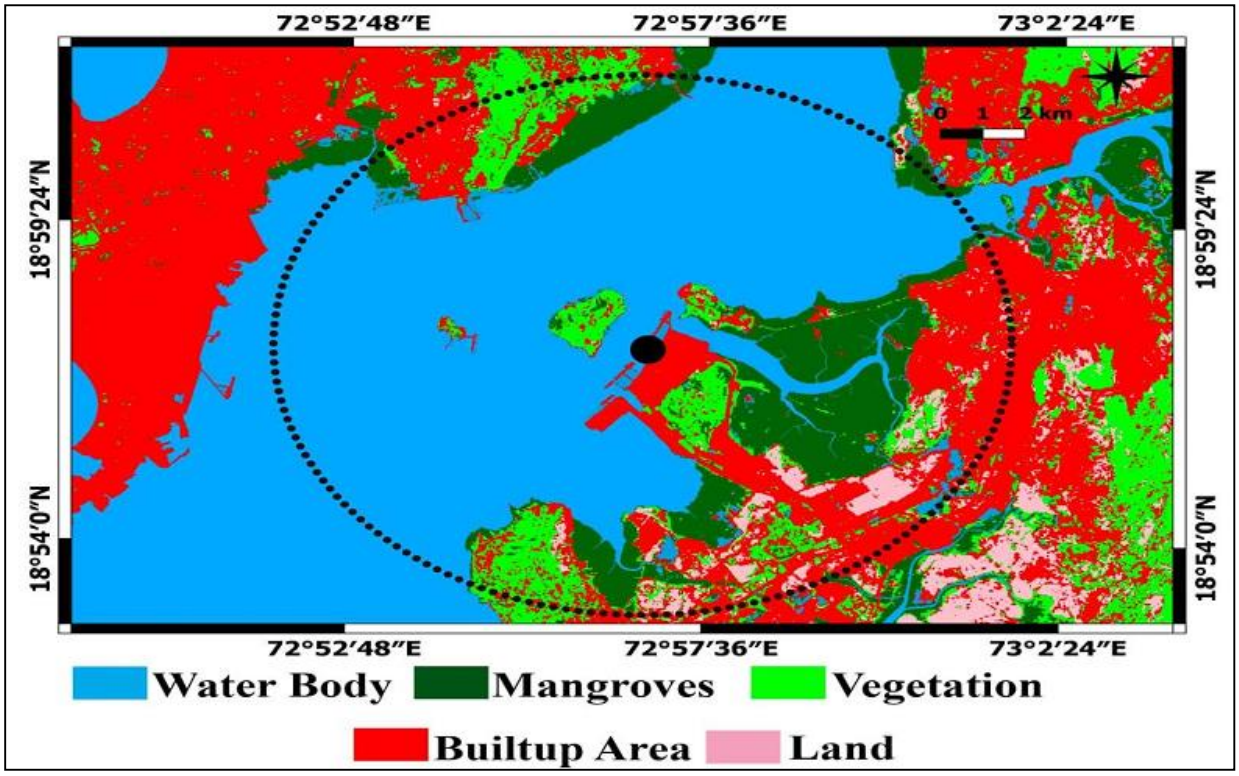


Figure 5.1: Land use / land cover (10km) around the berth showing mangrove vegetation

(iv) Impact on Fisheries

The impact on fisheries may be either due to physical impacts of suspended solids or due to changes caused in the food chain. As the fishes are capable of free movement in water they avoid areas with very high turbidity levels. The fishes return to the area, once turbidity reduces after the cessation of construction activities. Due to continuous ship movement,

fisheries are not well developed in the area. Hence no significant impacts on fisheries are anticipated.

SHORELINE

Environmental Sensitivity Index (ESI) maps provide a summary of coastal resources that are at risk if an oil spill occurs in vicinity. Examples of at-risk resources include birds, shellfish beds, sensitive shorelines (such as coral reefs), and public beaches and parks.

Shorelines are color-coded to show their sensitivity to oil. Warm colors indicate the most sensitive shorelines, and cool colors indicate less sensitive shorelines. Large habitat areas (such as tidal flats and wetlands) are shown as polygons filled with a pattern of appropriate color. Symbols mark locations important to spill responders, such as areas where birds or sea mammals congregate or breed areas where different kinds of birds concentrate for feeding or nesting, and areas used by people.

Three kinds of information shown on the ESI maps are based on:

1. **Shoreline ranking:** Shorelines are ranked according to their sensitivity to oil, the natural persistence of oil, and the expected ease of cleanup after an oil spill. The ranking scale goes from 1 to 10.

   Lower rankings represent shorelines that are less susceptible to damage by oiling; higher rankings become more likely to experience damage by oiling. A rank of 1 represents shorelines with the least susceptibility to damage by oiling. Examples include steep, exposed rocky cliffs and banks. The oil cannot penetrate into the rock and will be washed off quickly by the waves and tides.

   A rank of 10 represents shorelines most likely to be damaged by oiling. Examples include protected, vegetated wetlands, such as mangrove swamps and saltwater marshes. Oil in these areas will remain for a long period of time, penetrate deeply into the substrate, and inflict damage to many kinds of plants and animals.

   Shorelines on Environmental Sensitivity Index (ESI) maps are color-coded based on sensitivity to oil. Shorelines that are least susceptible to oil are ranked as 1 and are color-coded dark purple on ESI maps. Shorelines that are most likely to be damaged by oil are ranked as 10 and appear in red.

   ESI shoreline rankings are defined using factors that influence sensitivity to oil including:

   • Relative exposure to waves and tidal energy
   • Biological productivity and sensitivity
   • Substrate type (grain size, permeability, traffic ability, and mobility)
   • Shoreline slope
   • Ease of cleanup

- Ease of restoration

2. **Biological Resources:** Categorizes and displays oil-sensitive animals and their habitats that are themselves sensitive to spilled oil (such as coral reefs). Each kind of animal has a designated color. Accordingly, the locations where each species is found is indicated using point symbols and/or polygons marked with appropriate colour.
   Species that are especially vulnerable to the effects of oil spills are classified into seven general categories, such as Bird, Fish, and Marine Mammal. The categories are then further divided by grouping species together by similar taxonomy, morphology, life history, and/or sensitivity to spilled oil.
   When a biological resource exists in a small area (such as a bird nesting site), it is indicated by asymbol. Whena biological resource encompasses a larger area, it is represented by a polygon with a specific pattern and colour.
3. **Human Use Resources:** Human-use resources that may be either negatively impacted by an oil spills or used as access points for oil spill cleanup are typically marked with a symbol. Most human-use features (such as public beaches and aquaculture facilities) exist in a small area and are represented by human –use point symbols. Larger areas such as parks, preserves, protected areas, and wildlife refuges are shown as polygons.

IMPACTS OF CARGO HANDLING

During cargo handling operations in ports & harbours, discharges and emissions do occur. Sources of atmospheric pollution can stem from cargo vapour emissions. Release of cargo into the marine environment may have direct environmental effects, such as the loss of toxic substances, or indirect effects, such as the loss of non-toxic organic-rich substances which may result in oxygen depletion on their breakdown. Some dry bulk cargoes have high concentrations of organic material and/or nutrients, such as fertilizers and animal feed, with high biological oxygen demands, large spillages of these may cause localized nutrient enrichment and oxygen depletion. This may result in the suffocation of marine life in the vicinity

IMPACT ON SOCIO ECONOMIC ENVIRONMENT

1. Impact on Demographic Composition

There will be no significant increase in overall population of the study area as preferably local people will be recruited for employment during the construction phase of the project. The in migration of the work force (if any) will be temporary in nature. Hence, there will be no significant impact on the overall population composition of the study area. Since, there will be no significant change in population, the overall sex ratio will remain almost the same.

2. Impact on Employment Opportunities

It is expected that local people may get direct employment opportunities including skilled and unskilled workers. During construction phase permanent employment generated will be 10 whereas, contractual employment will be 360. During the operational phase existing permanent employment is 125 whereas, proposed permanent employment is 15 and proposed contractual employment is 360.

The benefits of employment to the job seekers are expected to include, at a household and individual level, with improvement in socio-economic and health status, improvement in their living condition, and the benefits from greater household expenditure on education & healthcare resources.

3. Impact on Law & Order

No major law & order problem is envisaged due to the proposed project. It is expected that the workers will attend to their duties and return to their homes after the day's work.

Corporate Environment Responsibility (CER)

As per the OM F. No. 22-65/2017-IA.III dated 30th September, 2020 on CER and subsequent amendments by Ministry of Environment, Forest and Climate Change Impact Assessment Division have stated that the Expert Appraisal Committee or State Level Expert Appraisal Committee shall deliberate on the commitments made by the project proponent to address the concerns raised during the public consultation and prescribe specific condition(s) in physical terms while recommending the proposal, for grant of prior environment clearance instead of allocation of funds under Corporate Environment Responsibility. Further, in the OM it is said that all the activities proposed by the project proponent or prescribed by the Expert Appraisal Committee or State Level Expert Appraisal Committee, as the case may be, shall be part of the Environment Management Plan. Accordingly, for this project after the public consultation is conducted the social commitments has been clearly marked out in the Environment Management Plan.

4.14 Corporate Social Responsibility (CSR)

The following development activities are proposed as the Corporate Environmental Responsibilities (CER) which can impart significant positive impact on socio-economic environment:

- Providing Drinking Water Facility in the schools located in the nearby villages.
- Health Camps for workers and villagers in the nearby villages.
- Skill development training to the local youths.
- Installation of dustbins for collecting waste materials for maintaining cleanliness in the areas.
- Distribution of Sanitary Pads for women in the village.
- Plantation in the community areas of the study area.

4.15 Conclusion

The proposed project activity would be providing employment opportunities. The benefits of employment to the job seekers are expected to include, at a household and individual level with improvement in their living condition. Further, welfare activities can be taken up for the overall development in the field of health and other infrastructure facilities in the study area habitations.

CHAPTER-5 : ANALYSIS OF ALTERNATIVES (TECHNOLOGY & SITE)

5.1 INTRODUCTION

Jawaharlal Nehru Port Authority, hereinafter referred as JNPA or "Port" is one of the major Indian Ports located on the east side of Mumbai Harbour adjoining the main land of the West Coast of India and was commissioned on 26thMay 1989. It is about 6 nautical miles by water route from Gateway of India. It is a fast growing and ISO 9001: 2000 certified Port with single window operations, round the clock pilotage, good vessel traffic management system and dedicated facilities for handling containers, dry bulk and liquid bulk.

It is the only Indian Port built with international standards with a high level of automation and computerized functioning. Constructed in a record time of just three and half years, JN Port today is the major catalyst for country's trade and commerce and vanguard of multinational transport. It is the greenest Port in India and ranks among top 30 container Ports in the world.

Presently, JN Port handles 55-60% of total containerized cargo in India. The Jawaharlal Nehru Port Authority (JNPA) 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.

The traffic at these terminals is being handled with cargo handling equipment like, Rail Mounted Quay Cranes (RMQCs), Rubber Tyred Gantry Cranes (RTGCs), and Rail Mounted Gantry Cranes (RMGCs), Reach Stackers, Tractor Trailer, Fork Lifts etc. which are also having power backup facility.

5.2 ANALYSIS OF ALTERNATIVE SITE

The existing route is required for widening of existing container berths as optimized one based on the following considerations.

- Alignment in horizontal plane parallel and along the Roads/Railway, as far as possible.
- Ground profile for pipeline hydraulics and avoidance of steep rising and falling ground, hills and valleys having sloping right of way.
- Availability of infrastructure and access to the pipeline route during construction and maintenance.
- Minimum crossing of existing pipelines, transmission lines, parallel alignment etc.
- Minimum Road, rail, river and nalas crossings.

- Avoidance of rugged and intricate grounds with hard strata, exposed rocks, boulders and queries.
- Avoidance of populated areas to a large extent.

CHAPTER-6 : ENVIRONMENTAL MONITORING PROGRAMME

6.1 INTRODUCTION

Regular monitoring of the various environmental parameters is necessary to evaluate the effectiveness of the management programme so that the necessary corrective measures can be taken in case there are some drawbacks in the proposed programme. Since environmental quality parameters at work zone and surrounding area are important for maintaining sound operating practices of the project in conformity with environmental regulations, the post project monitoring work forms part of Environmental Monitoring Program. Environmental Monitoring Program will be implemented once the project activity commences. Environmental Monitoring Program includes: (i) environmental surveillance (ii) analysis and interpretation of data (iii) preparation of reports to support environmental management system and (iv) organizational set up responsible for the implementation of the programme.

6.2 ENVIRONMENT MONITORING PROGRAM

The Continuous monitoring of Environmental parameters like air, water, noise, soil, and meteorological data and performance of pollution control facilities and safety measures for the project are vital for Environmental management of any project.

JNPA will carry out environmental monitoring facilities by the environmental and safety department to monitor air and water pollutants as per the guideline. Moreover, air, noise, drinking water, and soil is being monitored by outside agencies authorized by Pollution Control Board at regular frequencies.

JNPA's Vision and Mission:

J N Port believes in suitable development in all spheres of its working, which reflects on the Port's vision and mission.

The port is committed in meeting the needs and expectations of its customers and the nation by:

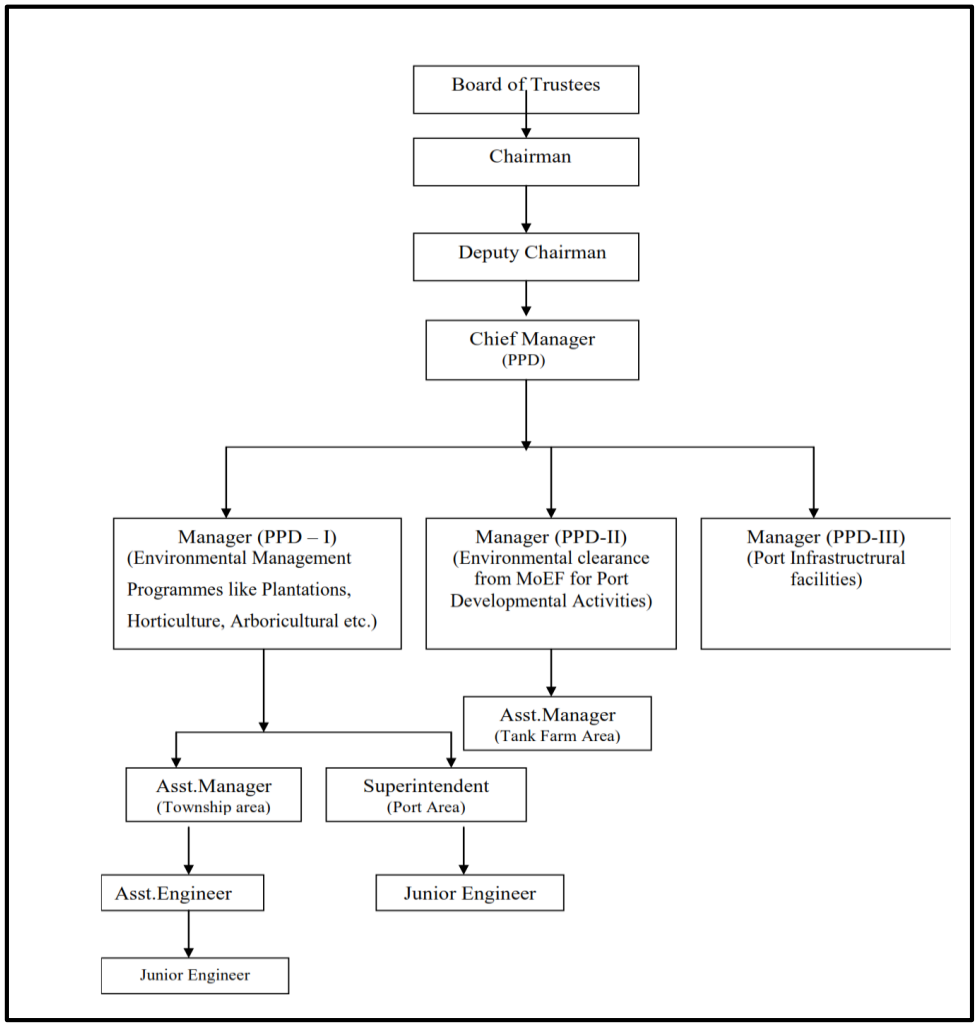
- Equipping itself with state-of-the-art equipment and technology and efficient, professional and computer integrated terminal operation systems.
- Conforming to international standards and offering cost effective integrated logistics solutions.
- Ensuring security and safety of life, equipment and cargo.
- Pursuing the principles of eco-friendly sustainable development.

- Constantly upgrading the competence, awareness, skills and motivation of the port personnel for continual improvement in all efficiency parameters.

6.3 FORMATION OF ENVIRONMENTAL MANAGEMENT CELL (EMC)

In order to maintain the environmental quality within the standards, regular monitoring of various environmental components is necessary. In Jawaharlal Nehru Port Authority, an Environment Management Cell (EMC) for environment monitoring and control already exists. Groups of qualified and efficient engineers with supporting staff are deputed for maintenance, up keeping and monitoring the pollution control equipment, to keep them in working at the best of their efficiencies.

The environment monitoring and ambient air quality monitoring is being done by authorized laboratories approved by MoEF&CC as well as State pollution control board.



Environment Management Cell

6.4 RESPONSIBILITIES OF EMC

The responsibilities of the EMC include the following:

i. Environment monitoring of the surrounding area
ii. Timely commissioning of pollution control equipment's and facilities
iii. Specifications and regulations of maintenance schedules for pollution control equipment's
iv. Ensuring that standards are maintained
v. Developing the green belt
vi. Ensuring optimum water usage
vii. Carrying out the Environment Management Plan
viii. Organizing meetings of environment management committee and preparation of report and submission of such reports to management

6.5 ENVIRONMENTAL MONITORING AND REPORTING PROCEDURE

Monitoring shall confirm that commitments are being met. This may take the form of direct measurement and recording of quantitative information, such as amounts and concentrations of discharges and wastes, for measurement against corporate or statutory standards, consent limits or targets. It may also require measurement of ambient environmental quality in the vicinity of a sit using ecological/biological, physical and chemical indicators. Monitoring may include socio-economic interaction, through local liaison activities or even assessment of complaints.

The key aims of environmental monitoring are:

- To ensure that results/ conditions are as forecast during the planning stage, and where they are not, to pinpoint the cause and implement action to remedy the situation.
- To verify the evaluations made during the planning process, in particular with risk and impact assessments and standards and target setting and to measure operational and process efficiency.
- Monitoring will also be required to meet compliance with statutory and corporate requirements.

Finally, monitoring results provide the basis for auditing, *i.e*. to identify unexpected changes.

6.6 ENVIRONMENTAL MONITORING SCHEDULE

Table 6-28: Monitoring Methodologies and Parameters

Attributes	**Sampling**		**Measurement Method**	**Test Procedure**
A. Air Environment	**Network**	**Frequency**		
Meteorology Wind speed Wind direction Dry bulb temperature Wet bulb temperature Relative humidity Rainfall	Minimum 1 site in the project impact area	Regularly twice in a week by Weather Monitoring Station	Mechanical/ automatic weather station	-
Pollutants PM_{10}	Ambient air quality is being monitored at 4 stations, 1 located at the port and 2 nearby areas and 1 at nearby jetties	Revised National Ambient Air Quality Standards (NAAQS) vide MoEF&CC circular, dated 16.11.2009	Gravimetric method	-
SO_2			EPA Modified West and Geake method	Absorption in Potassium Tetra Chloromercurate followed by Colorimetric estimation using P-Rosaniline hydrochloride and Formaldehyde (IS: 5182 Part - II).
NO_2			Arsenite modified Jacob and Hochheiser	Absorption in dill NaOH and then estimated colorimetrically with sulphanilamide and N (I-Nepthyle) Ethylene diamine Dihydrochloride and Hydrogen Peroxide (CPCB Method).

CO			Non Dispersive Infra-RED (NDIR) Spectroscopy	EPA 40CFR part-50
VOCs			GC- method	EPA 21 PID
B. Water Environment				
pH, Turbidity, Colour, Odour, Taste, TDS, Total Hardness, Calcium hardness, Magnesium hardness, Chloride, Fluoride, Sulphate, Nitrates, Alkalinity, Iron, Copper, Manganese, Mercury, Cadmium, Selenium, Arsenic, Cyanide, Lead, Zinc, Chromium, Aluminum, Boron, Phenolic compounds	Set of grab samples for surface water location and Ground water location within 100km study area.	Once in the study period	As per IS 3025 (Part-I)	Samples for water quality should be collected and analyzed as per :IS : 10500 methods for sampling and testing of Industrial effluents Standard methods for examination of water and wastewater analysis published by American Public Health Association.
C. Noise				
Noise levels at Day and night time -Leq dB (A)	Project boundary, High noise generating areas within the lease.	Quarterly	As per CPCB norms	As per CPCB norms
D. Soil				
pH, Bulk Density, Soil texture, Nitrogen, Available Phosphorus, Potassium, Calcium, Magnesium, Sodium, Electrical Conductivity, Organic Matter, Chloride	2-3 locations in the project impact area	Quarterly	As per CSSRI, IISWC Method	As per CSSRI, IISWC Method

E. Socioeconomic Status	Network	Frequency	Measurement Method	Test Procedure
• Demographic structure • Infrastructure resource base • Economic resource base • Health status: Morbidity pattern • Cultural and aesthetic attributes • Education	Socio-economic survey is based on proportionate, stratified and random sampling method	Yearly	Primary data collection through questionnaire	Secondary data from census records, statistical hard books, toposheets, health records and relevant official records available with Govt. agencies.
Ecological Impact				
• Green Belt Development • Conservation of Wild Life	Survey	Yearly	Primary data collection.	Secondary data from statistical hard books, topo-sheets and relevant official records available with Govt. agencies

6.7 MONITORING SCHEDULE

Regular Monitoring of all the environmental parameters *viz.*, air, water, noise and soil as per the formulated program based on CPCB and MoEF&CC guidelines are being carried out every year in order to detect any changes from the baseline status.

Table 6-29: Monitoring Schedule

S. No	Item	Parameters	Frequency
1.	Ambient Air quality	PM_{10}, $PM_{2.5}$, SO_2, NO_x, CO, VOC etc.	Monthly
2.	Stationary Emission from Stack	PM, SO_2, NO_x	Monthly
3.	Process emission	Fugitive (PM) and gaseous pollutant expected	Monthly
4.	Water and Wastewater	pH, Temperature, EC, Turbidity, Total Dissolved Solids, Calcium, magnesium, Total hardness, Total Alkalinity, Chlorides, Sulphates, Nitrates, DO, COD,	Monthly

		BOD, oil and Grease, Metals expected in effluent.	
5.	Treated Sewage / Effluent	pH, BOD, COD, TSS, TDS, oil and Grease, Metals expected in effluent.	Monthly
6.	Noise	Equivalent noise level- dB (A)	Monthly
7.	Soil and Solid wastes	pH, Humidity, Texture, Organic matter, N, P, K, Sulphate, Calcium, Magnesium, C:N ratio	Quarterly
8.	Greenbelt	Number of plantation (Units), Number of Survived plants/ trees, Number of poor plants/ Trees	Ongoing- round the year
9.	Environmental Audit	As per Direction of ISO 14001	Once in a Year

6.8 Reporting and Documentation

The records of the monitoring program are being kept on regular basis for all aspects of the monitoring. Separate records for water, wastewater, solid wastes, air emission, soil and manure / compost is being prepared and preserved regularly. Immediately upon the completion of monitoring as per the planned schedule, report is being prepared and necessary documents are being forwarded to the concerned person. Methodology of monitoring (sampling and analysis) is being prepared as separate documents as SOP (Standard Operating Procedure) wherever required. The records showing results/outcome of the monitoring programs is being prepared as per the requirement of the schedule mentioned above. Regularly, these documents and records is being reviewed for necessary improvement of the monitoring plan/ mitigation measures/environmental technologies as well as for necessary actions of Environmental Management Cell.

CHAPTER-7 : ADDITI0NAL STUDIES

7.1 CRZ STUDY

As per the Ministry of Environment & Forests and Climate Change (MOEF&CC) guidelines, the Study Area for the EIA study has been considered as the 10 km radius around the project site.

Coastal Regulation Zone for proposed widening of Existing container berths:

The project for widening of existing container berth at Jawaharlal Nehru Port Authority at Sheva, Navi Mumbai superimposed in 1:4000 Scale CRZ map. This proposed widening part falls within the CRZ category such as CRZ IV- A (The water area and the sea bed area between the Low Tide Line up to twelve nautical miles on the seaward side shall constitute CRZ-IV A). The CRZ map of 1:4000 scale is prepared in accordance with the approved CZMP maps as per CRZ Notification, 2011 for Navi Mumbai.

Complete CRZ Report along with CRZ Maps is attached Annexure-III.

An advertisement for scheduled public hearing in English was published in "**Indian Express"** and in Marathi in **"Sakal" on 29.10.2023 for Raigad district**.

The public hearing was conducted on **1st December, 2023 at 12:00 hrs.** at Bahuuddeshiya Sabhagruha, Sec. -02 and J.N.P.T colony, Jawaharlal Nehru Port Authority, Tal-Uran and Dist. Raigarh.

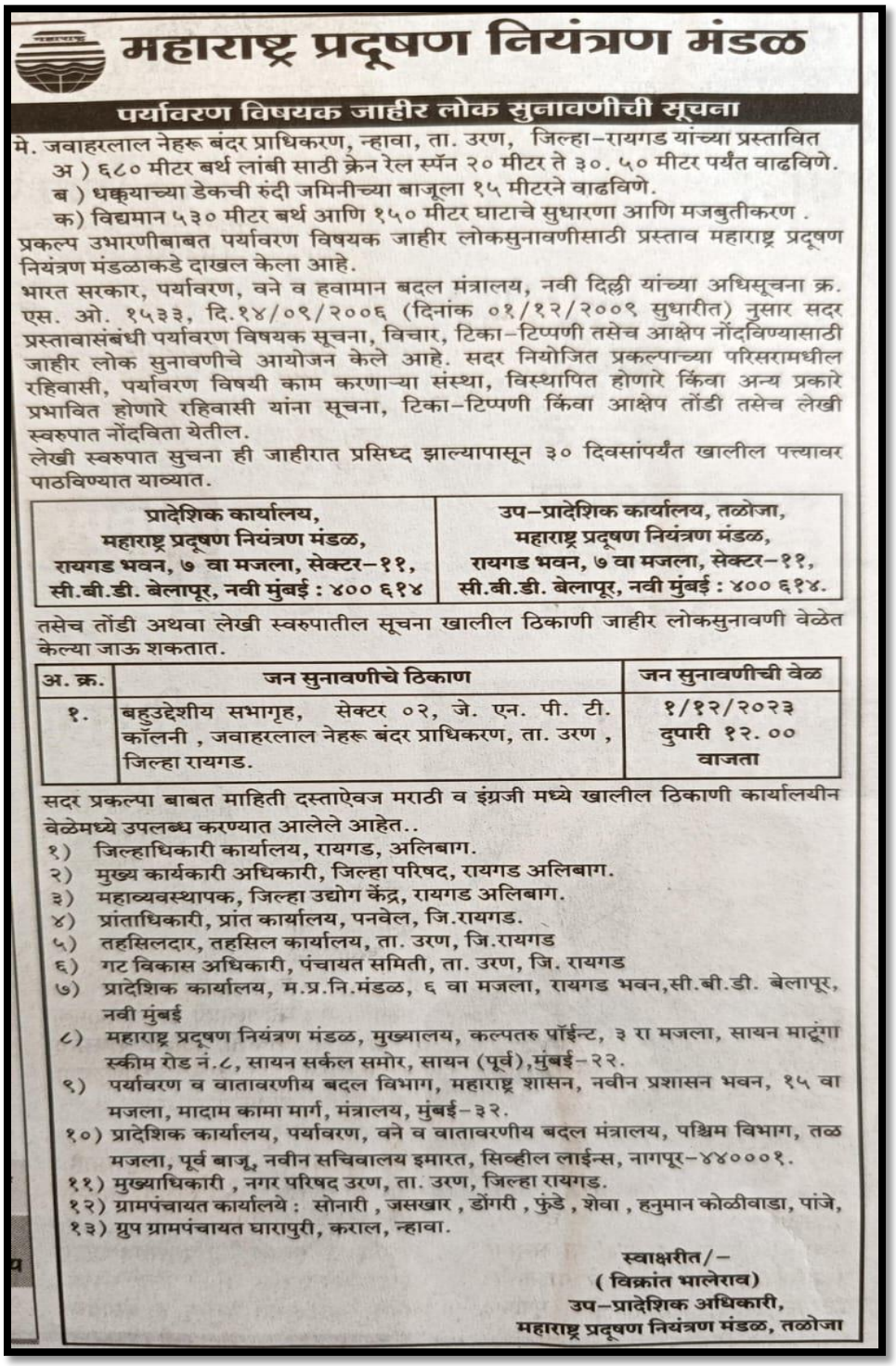
The hearing was preside by Sub Regional Officer, Maharashtra (PCB) Taloja District and the panels present were:

1. Shri Sandesh Shirke (ADM) Raigarh.
2. Shri Satish Padwal (RO) Maharashtra (PCB)

Shri Sandesh Shirke (ADM) Raigarh welcomed the public and inaugurated the event. At the outset, Shri Satish Padwal (RO) Maharashtra (PCB) welcomed the panel member, official of JNPA official from Mantec Consultancy assembled the public and gave a brief introduction regarding the project and event. He gave a brief description about the importance of the public hearing, which is as per the EIA notification of MoEF&CC.

Mantec Consultant presented a power point presentation from JNPA. The presentation emphasized on the study done by Mantec Consultancy on the environmental impact on air, water, soil & noise and the mitigation measures for the field activites

Figure-1 News Paper in Marathi



महाराष्ट्र प्रदूषण नियंत्रण मंडळ

पर्यावरण विषयक जाहीर लोक सुनावणीची सूचना

मे. जवाहरलाल नेहरू बंदर प्राधिकरण, न्हावा, ता. उरण, जिल्हा–रायगड यांच्या प्रस्तावित

अ) ६८० मीटर बर्थ लांबी साठी क्रेन रेल स्पॅन २० मीटर ते ३०. ५० मीटर पर्यंत वाढविणे.

ब) धक्क्याच्या डेकची रुंदी जमिनीच्या बाजूला १५ मीटरने वाढविणे.

क) विद्यमान ५३० मीटर बर्थ आणि १५० मीटर घाटाचे सुधारणा आणि मजबुतीकरण .

प्रकल्प उभारणीबाबत पर्यावरण विषयक जाहीर लोकसुनावणीसाठी प्रस्ताव महाराष्ट्र प्रदूषण नियंत्रण मंडळाकडे दाखल केला आहे.

भारत सरकार, पर्यावरण, वने व हवामान बदल मंत्रालय, नवी दिल्ली यांच्या अधिसूचना क्र. एस. ओ. १५३३, दि.१४/०९/२००६ (दिनांक ०१/१२/२००९ सुधारीत) नुसार सदर प्रस्तावासंबंधी पर्यावरण विषयक सूचना, विचार, टिका–टिप्पणी तसेच आक्षेप नोंदविण्यासाठी जाहीर लोक सुनावणीचे आयोजन केले आहे. सदर नियोजित प्रकल्पाच्या परिसरामधील रहिवासी, पर्यावरण विषयी काम करणाऱ्या संस्था, विस्थापित होणारे किंवा अन्य प्रकारे प्रभावित होणारे रहिवासी यांना सूचना, टिका–टिप्पणी किंवा आक्षेप तोंडी तसेच लेखी स्वरुपात नोंदविता येतील.

लेखी स्वरुपात सुचना ही जाहीरात प्रसिध्द झाल्यापासून ३० दिवसांपर्यंत खालील पत्यावर पाठविण्यात याव्यात.

प्रादेशिक कार्यालय, महाराष्ट्र प्रदूषण नियंत्रण मंडळ, रायगड भवन, ७ वा मजला, सेक्टर–११, सी.बी.डी. बेलापूर, नवी मुंबई : ४०० ६१४	**उप–प्रादेशिक कार्यालय, तळोजा, महाराष्ट्र प्रदूषण नियंत्रण मंडळ, रायगड भवन, ७ वा मजला, सेक्टर–११, सी.बी.डी. बेलापूर, नवी मुंबई : ४०० ६१४.**

तसेच तोंडी अथवा लेखी स्वरुपातील सूचना खालील ठिकाणी जाहीर लोकसुनावणी वेळेत केल्या जाऊ शकतात.

अ. क्र.	जन सुनावणीचे ठिकाण	जन सुनावणीची वेळ
१.	बहुउद्देशीय सभागृह, सेक्टर ०२, जे. एन. पी. टी. कॉलनी , जवाहरलाल नेहरू बंदर प्राधिकरण, ता. उरण , जिल्हा रायगड.	१/१२/२०२३ दुपारी १२. ०० वाजता

सदर प्रकल्पा बाबत माहिती दस्ताऐवज मराठी व इंग्रजी मध्ये खालील ठिकाणी कार्यालयीन वेळेमध्ये उपलब्ध करण्यात आलेले आहेत..

१) जिल्हाधिकारी कार्यालय, रायगड, अलिबाग.
२) मुख्य कार्यकारी अधिकारी, जिल्हा परिषद, रायगड अलिबाग.
३) महाव्यवस्थापक, जिल्हा उद्योग केंद्र, रायगड अलिबाग.
४) प्रांताधिकारी, प्रांत कार्यालय, पनवेल, जि.रायगड.
५) तहसिलदार, तहसिल कार्यालय, ता. उरण, जि.रायगड
६) गट विकास अधिकारी, पंचायत समिती, ता. उरण, जि. रायगड
७) प्रादेशिक कार्यालय, म.प्र.नि.मंडळ, ६ वा मजला, रायगड भवन,सी.बी.डी. बेलापूर, नवी मुंबई
८) महाराष्ट्र प्रदूषण नियंत्रण मंडळ, मुख्यालय, कल्पतरु पॉईन्ट, ३ रा मजला, सायन माटूंगा स्कीम रोड नं.८, सायन सर्कल समोर, सायन (पूर्व),मुंबई–२२.
९) पर्यावरण व वातावरणीय बदल विभाग, महाराष्ट्र शासन, नवीन प्रशासन भवन, १५ वा मजला, मादाम कामा मार्ग, मंत्रालय, मुंबई–३२.
१०) प्रादेशिक कार्यालय, पर्यावरण, वने व वातावरणीय बदल मंत्रालय, पश्चिम विभाग, तळ मजला, पूर्व बाजू, नवीन सचिवालय इमारत, सिव्हील लाईन्स, नागपूर–४४०००१.
११) मुख्याधिकारी , नगर परिषद उरण, ता. उरण, जिल्हा रायगड.
१२) ग्रामपंचायत कार्यालये : सोनारी , जसखार , डोंगरी , फुंडे , शेवा , हनुमान कोळीवाडा, पांजे,
१३) ग्रुप ग्रामपंचायत घारापुरी, कराल, न्हावा.

स्वाक्षरीत/–
(विक्रांत भालेराव)
उप–प्रादेशिक अधिकारी,
महाराष्ट्र प्रदूषण नियंत्रण मंडळ, तळोजा

Figure-2 News Paper in English

MAHARASHTRA POLLUTION CONTROL BOARD

NOTICE FOR ENVIRONMENTAL PUBLIC HEARING

M/s. Jawaharlal Nehru Port Authority, Nhava, Tal. Uran, Dist. Raigad has submitted proposal for

(a) Increase of crane rail span from 20 m to 30.50 m for berth length of 680 m.
(b) Increase of deck width of the berth by 15 m on land side.
(c) Up gradation and strengthening of existing 530 m berth and 150 m wharf.

The Public Hearing is proposed to be conducted regarding environmental angle about the said projects as per the EIA Notification No. S. O. 1533, dated 14/09/2006 (As amended on 01/12/2009) issued by MoEFCC. All persons including bonafide residents, project affected citizens, environmental groups and others located near the project site,can participate in the public hearing. Suggestions, views, comments and objections of the public can be filed at the following address in writing within 30 days from the date of publication of this notice.

Regional Office,Maharashtra Pollution Control Board, Raigad Bhavan, 7th Floor, Sector 11,C.B.D Belapur, Navi Mumbai – 400614.	**Sub-Regional Office, Taloja Maharashtra Pollution Control Board,** Raigad Bhavan, 7th Floor, Sector 11,C.B.D Belapur, Navi Mumbai – 400614.

Oral / Written Suggestions, views, comments, recommendations can also be presented during the public hearing.

Sr.No	Venue	Date and Time
1.	Bahuuddeshiya Sabhagruha, Sector – 02, J.N.P.T colony, Jawaharlal Nehru Port Authority, Tal Uran, Dist.Raigad	**1/12/2023 12:00 Noon**

Copies of the executive summary containing the salient features of the project both in english and marathi and EIA report, are available at the following offices

1) District Collector Office, Alibag, Dist. Raigad.
2) Chief Executive Officer (CEO), Zilla Parishad, Raigad, Alibag.
3) General Manager, District Industries Centre, Dist. - Raigad, Alibag.
4) Sub Divisional Officer, Panvel, Dist. Raigad.
5) Tahasildar, Tahasil Office, Uran, Tal- Uran, Dist-Raigad.
6) Block Development Officer, Panchayat Samiti, Tal- Uran, Dist-Raigad.
7) Regional Office, M.P.C. Board, 7 th Floor, Raigad Bhavan, C.B.D. Belapur, Navi Mumbai.
8) Joint Director (WPC), M.P.C. Board, Kalpataru point, 3rd & 4th floor, Opp. Cine Planet, Sion Circle, Sion (E), Mumbai-22.
9) Director, Environment Department, & Climate Change Department Govt. of Maharashtra, New Administrative Building, 15th floor, Madam Kama Marg, Mantralaya, Mumbai-32.
10) Regional Office, MoEF, Ministry of Environment, Forest and Climate Change, Regional Office (WCZ), Ground Floor, East Wing, New Secretariat Building Civil Lines, Nagpur-440001.
11) Chief Officer, Nagar Parishad, Uran, Dist.raigad.
12) Gram Panchayat Offices: Sonari, Jaskhar, Dongri, Funde, Sheva, Hanuman Koliwada, Panje,
13) Group Grampanchayat Gharapuri, Karal, Nhava,

Sd/-
(Vikrant Bhalerao)
Sub-Regional Officer, Taloja

Figure-3 Photographs of the public hearing are given below:

RAIGARH DISTRICT

महाराष्ट्र प्रदूषण नियंत्रण मंडळ
Maharashtra Pollution Control Board
पर्यावरण विषय जाहीर जनसुनावणी
प्रस्तावक
जवाहरलाल नेहरू बंदर प्राधिकरण
प्रकल्प : विद्यमान कंटेनर धक्क्याचे रुंदीकरण

पर्यावरण विषय जाहीर जनसुनावणी
प्रस्तावक

धन्यवाद

Table-30: Action plan of the Public hearing consultation in Raigarh District

S. No.	Name & Address of the Person	Detail of query statement/in formation/clarification sought; by the person present at the venue of hearing	Reply of the query/statement/information/clarification given by the project proponent.	Action Plan
1.	Shri Bhushan Patil. Leader of Workers. Representative of Project Affected Persons	Earlier there was a container terminal, it was called Nhava Sheva Port. Jawaharlal Nehru Port Authority (JNPA) has awarded the existing terminal to Nhava Sheva Free Port Terminal Private Limited to increase crane rail span from 20.0 m to 30.50 m for 680 m berth length, shock deck width 15.0 Meters extension and improvement and strengthening of existing 530.0 meter berth and 150.0 meter wharf is proposed for which public hearing is now conducted. So one has to study and know what is the socio-economic effects of any project will be. Our city of Uran is the Most Polluted City in the World. Also, Uran city has become Most Accident Prone Zone. Most of the accidents are happening in Uran city. After few days, the container handling capacity will be one crore i.e. ten million per annum. So what effect it will have on environment, human life and what is expected from JNPA should be noted. The first effect is that there are many casualties. When we obtained information under Right To information (RTI), 2005, more than two hundred people died in the year 2020,2021 and2022,2023 only due to accidents. A large number of two-	JNPA is providing socio economical support to develop infrastructure under CSR and supported PP villages for infrastructure up gradation i.e. schools, water supply, drainage, road, contracts to PAP societies etc. Pollution level of different parameters will remain within permissible standard in this region. There would be no health impact on local residents due to upcoming project. The employment provided by JNPA to the local people.	**During Constructional Phase-** Permanent Employment- 10 nos. Contractual Employment- 360 nos. **Operational phase-** Existing Permanent Employment- 125 nos. Proposed Permanent Employment- 15 nos. Contractual Employment- 360 nos. Allocated EMP fund is reserved in the project as follows- Rs. 17.9 Lakhs (During Construction phase) Rs. 6.3 Lakhs (During Operation phase)

		wheeler accidents take place here and no one takes responsibility for it. Many lives are being lost due to this container transport. So, the important question here is who should rehabilitate the family after the breadwinner of the family leaves. The pollution that occurs here -the Air Quality index here is the highest. So it is getting difficult to breathe here. By watching the containers, journalists brothers says- containers are Uran's death. Here, responsibility for the accident should be fixed. Another thing is that the wetlands here will be destroyed due to pollution. Various birds used to come here. They will not come, so indirectly it will affect human life. Here comes the important question - i.e. the question of rehabilitation. So, in this container terminal which was transferred to Nhava Shewa Free Port Terminal Private Limited, 600 of our workers were working in permanent cadre. There is an investment of 900 crores. lf Rupee One Crore is ear-marked for every person, then nine hundred local people affected by the project should get employment in permanent cadre. A few days ago, JNPA has called applications for the jobs, while applications from 1,200 local and Project Affected People (PAPs) have been received, the list has been prepared by JNPA. This project will be developed in two phases. So, how many PAPs and local people will be employed in regular and contractual service? Though there are so many		

		projects in Uran Taluka, job opportunities have not been given to the PAPs and local people, the original local people here. However, they should get employment as they used to get regular service earlier. Two villages were displaced. Two villages viz-Navin Sheva and Hanuman Koliwada were displaced. They were not given job opportunities. Hanuman Koliwada village is still not legally rehabilitated. They say they are still in the transit camp. Both those villages and other project affected villages should be rehabilitated and should be given compensation also. Employment / job opportunities should be created. We are not against development, but the local people must get employment. Effective measures must be taken to control the pollution caused by the project. Also, the jobs which are available in contractual cadres should be given exclusively to local people and PAPs. However, it is our humble request that these demands should be considered by the Environmental Public Hearing Committee		
2.	Shri. Manoi Koli. Residence – Gavhan villaqe. Taluka - Panvel. District –Raiqad.	Despite being an affected village, the name of Gavhan village is not in the list of project affected gram panchayats. However, this point should be noted. Gavhan village is a village of Koli community. Maharashtra Pollution Control Board published a public hearing a notice in vernacular language (here Marathi) and one in national newspaper for English. There is no mention of the name of Gavhan Gram Panchayat. However, this should be clarified,	Project Proponent thirty days prior to the public hearing day, Maharashtra Pollution Control Board had published a public notice in a vernacular I newspaper (here in Marathi) and in a national newspaper in English for the information	

		then only I will raise my suggestions. Because 1,035 people of Gavhan village have received compensation from JNPA. So, it should be informed why Gavhan village was neglected, because you will take any decision without our knowledge. Project Proponent said that thirty days prior to the public hearing day, Maharashtra Pollution Control Board had published a public notice in a vernacular I newspaper (here in Marathi) and in a national newspaper in English for the information of the public. So. We assume that it reached to the local people. We welcome your arrival. However, if you have any environmental suggestions or objections regarding the proposed project, you can raise them. JNPT was started in 1978. There was no mention of Gavhan village at that time. Gavhan village is "Project Affected Village". So when we demanded to give a certificate as "Project Affected Persons (PAPs)", we said that only those whose land was acquired will be given "project affected certificate." So why this is? Why person is not considered as PAP, whose trees are acquired? Won't you give him a job? When we apply for jobs in JNPA, a question is asked whether there is a project affected certificate. Hence, whom should we ask for a certificate? I turn forty, I won't have a job, but what will our next generation do? Whom should fishermen contact for a PAP certificate? There are 1,035 natives fishermen in our village, why are they not given project affected	of the public. So. We assume that it reached to the local people. We welcome your arrival. However, if you have any environmental suggestions or objections regarding the proposed project, you can raise them. The employment provided by JNPA to the local people. The project proponent take care to the development of the project the take the help of specialist for the construction of PORT area.	**During Constructional Phase-** Permanent Employment- 10 nos. Contractual Employment- 360 nos. **Operational phase-** Existing Permanent Employment- 125 nos. Proposed Permanent Employment- 15 nos. Contractual Employment- 360 nos.

		certificates? So, the explanation should be given immediately. If the land is acquired for the project, he is the victim of the project, then if the fishing of the fishermen is lost due to the project, then why are they are not considered as Project Affected Persons? So, we should be informed about who will declare us as PAP. The next point is our Gavhan village creek will be affected. So how many channels are going to be kept for boats to go there? Many of our boats have sunk. Similarly, the silt there has also not been removed by the Project Proponent – JNPA. Fertilization of fish does not take place without removal of sediment. We have to write complaints to the Konkan Commissioner. Our boats hit the rocks there. Till date, our demands have not been considered. The silt in our Gavhan Creek is not removed. Just like Kalamboli Creek, the water there smells because of not removing the silt. People do not eat the crabs there. Hence, here also it will happen. Hence, the residents of Gavhan should get the "project affected certificate", the people of Gavhan should get priority in the jobs and by which method the project affected persons will be granted certificate, it should be informed. Also the affidavit which is taken from residents of Gavhan should be returned back to us. Project Proponent should be compensation to us. The houses of Hanuman Koliwada have been infested with termites. They are also our brothers. When they		

		will be rehabilitated? Copy of minutes of this meeting should be made available at each project affected Grampanchayats.		
3.	Shri. Paramanand Deo Koli, Sarpanch, Grampanchayat Hanuman Koliwada	My question to the Project Proponent – JNPA is Whether Rehabilitation first or Project first? He requested Environmental Public Hearing Committee to give an answer in this regard. Chairman, Environmental Public Hearing Committee informed that Project Proponent proposes to develop project in existing project only. Hence, here nobody will be affected. And this is Environment Public Hearing for the proposed project. At that time Shri. Parmanand Koli objected that Sheva and Koliwada Gavthan was totally acquired for the second phase of JNPA. In 1985 it was acquired. Now there is no project. Later many new projects have been started here. Since last 38 years, we are fighting for rehabilitation. Project Proponent do not implement rehabilitation work. So many projects have come up here, they are not giving jobs to the local people and to the PAPs. Hon. Collector-Raigad, Alibag had informed that on yesterday i.e. 29th November, 2023 that the public hearing would be postponed. But today the public hearing is going on here, which means that everything is going to be done by keeping the local people in the dark. At that time, Chairman, Environmental Public Hearing Committee inform that as per EIA Notification, 2006, thirty days prior to the public hearing, public notice was published by MPCB in a	Project Proponent proposes to develop project in existing project only. Hence, here nobody will be affected. And this is Environment Public Hearing for the proposed project The issues raised by you are not relevant to the project.	-------

		local newspaper in Marathi and in a national newspaper in English for the information of the public. Similarly, environmental documents about the proposed project were made available in Marathi and English at Gram Panchayat Offices in project affected villages. The said public hearing is an Environmental Public Hearing for the proposed project. Rehabilitation is a completely different subject. A rehabilitation meeting will be arranged soon. Shri Koli objected that we are fighting for rehabilitation since last 38 years. Shri Koli inquired whether joint site inspection of the proposed project was carried. He alleged that there was no joint inspection. A joint site inspection of the proposed project was required to be carried by the District Administration, other related government departments, Maharashtra Pollution Control Board along with the fishermen. He alleged that the government is working in favor of the project keeping the local people, fishermen in the dark. However, joint site inspection should be done first, then further action should be taken. Chairman, Environment Public Hearing Committee directed to record the suggestions raised by Shri Koli.		
4.	Shri. Lakhapati Asharam Patil, Sarpanch Panje Villge Grampanchayat, Taluka-	JNPA has developed a port as new terminal of BMCTPL. My village is next to it. JNPA has given a notice to our village that we should not carry fishing activities. Our village lives on the fishing. Even the people of our village have not been given jobs yet in the project.	Project Proponent proposes to develop project in existing project only. Hence, here nobody will be affected. Project proponent will be	**During Constructional Phase-** Permanent Employment- 10 nos.

	Panvel,District-Raigad	Young boys and girls of our village has not been included in any project. If the fish is going extinct, how can we live? We have to remain starve. This should be explained.	provided the employment to the local peoples.	Contractual Employment-360 nos. **Operational phase-** Existing Permanent Employment- 125 nos. Proposed Permanent Employment- 15 nos. Contractual Employment-360 nos.
5.	Shri. Dasharath Sitaram Magar, Residence – Vashi village, Navi Mumbai, Taluka – Thane, , District – Thane	I have already submitted my application. According to the Environmental Public Hearing Notice, the environmental impact of this project will be on Raigad District, Thane District and Mumbai District. There are three districts, many talukas, many villages near this project. There are many industrial estates. A large community living in this area lives on fishing. Hence, they owns the water, forest, land. Be it in the creek or in the forest. Then providing Environmental No Objection Certificate to the proposed project, these villages are indigenous tribes as per Land Acquisition Act as well as Forest Rights Act, 2006. Their livelihood rights are on water, land, forest. Therefore, before conducting this public hearing, it is necessary to study the social impact that is going to be caused by the proposed project through the Collector's office according to the above laws. However, according to the above laws, the Collector is expected to call the Gram Sabha of the affected	M/s JNPA thanked for the compliment. JNPA is providing socio economical support to develop infrastructure under CSR and supported PP villages for infrastructure upgradation i.e. schools, water supply, drainage, road, contracts to PAP societies etc. Pollution level of different parameters will remain within permissible standard in this region.	Allocated EMP fund is reserved in the project as follows- Rs. 17.9 Lakhs (During Construction phase) Rs. 6.3 Lakhs (During Operation phase)

		villages and inform about the Environmental Impact Assessment (EIA) report in the gram sabha. Also, Maharashtra Pollution Control Board should have pasted the EIA report at the entrance of each village informing about the effects of the proposed project on all the natural elements i.e. sea water, fish, silt as well as on the surrounding vegetation, human beings and birds. Further Municipal Councils and Municipal Corporations which falls in the affected area of the project, it is necessary to them to fulfill the guidelines by keeping the EIA report in their General Body Metings to approve it. Hence, my objection is that the directives of various laws have not been followed by the Project Proponent. Further the Municipal Corporation and Municipal Councils discharges its untreated sewage into the sea. It was necessary to call them in this meeting. However, we object that the first Environmental Impact Assessment report should have made available to the local people. District Collector has the guardianship of the district. Hence, Hon'ble Collector is requested to cancel this environmental public hearing first. Maharashtra Pollution Control Board has published a notice thirty days before the meeting. Thirty days should be official working days. Because if the five days of Diwali holiday and other holidays are calculated/considered, people get fewer days. Hence, it was necessary to give prior sixty working days	There would be no health impact on local residents for upcoming project.	

		public notice in the newspaper prior to the of public hearing on environment. We think there is some conspiracy here. We are not against the development, but it is necessary to create public awareness about the deadline for public notices and environmental public hearings in the circular. A Gramsabha was required to be held regarding the EIA report. Hence, it should be noted that process of this public hearing is incomplete. Similarly, public awareness has not been done in villages, so process of this public hearing is incomplete. Also, Project Proponent i.e. JNPA and the Maharashtra Pollution Control Board should inform the local people about how much oxygen in the water will decrease due to this project, how much fish will die due to it, air quality, its effect on people, crops, plants, and then planning ahead. Because expert agency here is MPCB. Awareness has not been created about this, so the process of this public hearing is incomplete. So, I object to this public hearing. Also, information about the number of fishermen who will be affected and how much they will be compensated must be told in the public hearing meeting. It is necessary to inform the local people about the amount of sludge that will accumulate and how it will be disposed of. At this time, some of the participants suggested the concerned person to talk briefly and give others the opportunity to speak.		

		Convener, Environment Public Hearing informed concerned participant to present their suggestions and objections in brief. Shri Dashrath Magar objected that I am speaking for all. He said I myself a fisherman and have carried fishing activities. I myself have experienced how much damage is done and how the government misguides it.		
6.	Shri. Sandip Patil, Residence – Mukutban, District – Raigad	Maharashtra has a very beautiful sea shore of 720 km. It has a beautiful beaches. JNPA has developed Ports 1, 2, 3, 4. But the development of this port has greatly affected the traditional fishing techniques and livelihood of the fishing community, whose life is on this coast. Land has 7/12 certificate, but fishing area/ground does not have 7/12 certificate. Just as a farmer grows grain on his farm, a fisherman does not. Farmers get compensation from the government in case of loss of crops due to drought or flood, but fishermen do not. The main thing to say here that there is tragic situation of the fishing communities at Hanuman Koliwada, Belpada village, Gavhan village, which has been presented by their representatives. There were thousands of traditional fishermen here. The creeks which have formed from the sea are also being buried in the name of development. So, it has a serious effect on the livelihood of fishing communities living there. We are not against development. But traditional fishing communities should not be destroyed in the name of development. However, our only demand in	JNPA is providing socio economical support to develop infrastructure under CSR and supported PP villages for infrastructure upgradation i.e. schools, water supply, drainage, road, contracts to PAP societies etc. Pollution level of different parameters will remain within permissible standard in this region. There would be no health impact on local residents for upcoming project.	**During Constructional Phase-** Permanent Employment- 10 nos. Contractual Employment- 360 nos. **Operational phase-** Existing Permanent Employment- 125 nos. Proposed Permanent Employment- 15 nos. Contractual Employment- 360 nos. Allocated EMP fund is reserved in the project as follows- Rs. 17.9 Lakhs (During Construction phase) Rs. 6.3 Lakhs (During Operation phase)

		this public hearing is that those who are doing traditional fishing should be considered and properly rehabilitated. Now considering the environment, now traditional fish is getting rare. Earlier 64 types of fish were available. It is also requested that the coast should be made safe for traditional fishermen and a permanent plan should be made for the rehabilitation of traditional fishermen.		
7.	Shri. Kamalakar Patil, Residence – Sheva, District – Raigad	The entire Seva village is affected and displaced for JNPA. No my question to JNPA and government officials as well. Let me answer whether our Sheva is 100% affected or not. At that time, Project Proponent replied that Sheva is totally affected and displaced. At that time, Shri Kamlakar Patil said that our Koli community has been cheated. We were given 33.64 hectares of land for Sheva. We were cheated that our village is built in 10 hectares and remaining land of 23 hectares is in the possession of JNPA. An answer should be given that when we will get that land back and we will be rehabilitated. Project Proponent- said that the land acquisition was originally done by CIDCO. So it would be appropriate to ask this question to CIDCO. If CIDCO hands over the land, the JNPA administration will definitely consider the further course of action. At that time Mr. Kamlakar Patil said that our village was displaced for JNPA, the money was given by JNPA, then it would be right for JNPA to ask CIDCO. So, we should also get the answer to the first	JNPA is providing socio economical support to develop infrastructure under CSR and supported PP villages for infrastructure upgradation i.e. schools, water supply, drainage, road, contracts to PAP societies etc. There would be no health impact on local residents for upcoming project. Also these type of issue is not related to this project because we are going for the project with fully documentation & permission of the Authority.	Allocated EMP fund is reserved in the project as follows- Rs. 17.9 Lakhs (During Construction phase) Rs. 6.3 Lakhs (During Operation phase)

		question. In this regard, we should get from both administrations i.e. CIDCO and JNPA. Second Question, Our Sheva was 100% fishing community village and import-exporter. Also, if other villages got compensation, why didn't Sheva get compensation? Why didn't you want to fill the form from us? Also we are not given priority in recruitment.We had given the land for the project of JNPA. It was not given for a private project. JNPA and District Administration are cheating us again, because the land is going to be used for a private project of JNPA. Also, not a single project victim has been given a job, instead people from other States have been recruited. Sheva is 100% affected and 35% of our Sheva land has been lost in the project. We are 100% displaced and we have also been denied employment contract in the project. However, we are completely against this proposed project and if the efforts are made to start the project, we will protest against any attempt to start the project. An answer should be given as to why we are not given justice.		
8.	Shri. Pradip Mhatre, Residence-Jaskhar, District- Raigad	I am saying for the first time that we are against this project. Jaskhar village is the nearest village to the project. Project Proponent is completely inactive regarding the safety of our village. For the last three years, Jaskhar village has been flooded during monsoons. Every house gets water, houses and domestic articles are getting damaged. No one pays attention to this.	There would be no health impact on local residents for upcoming project.	-----

		JNPA administration for the last three years only promises that the canal will be widened, the road will be constructed. But we are being cheated. Next Question JNPA has installed a garbage project in Jaskhar village limits. I don't know what its capacity is, but in that project, the waste is completely coming from the Uran. It is not handled by them. Every night, JNPA sets fire to garbage, and our village suffers because of it. 100-200 people in our village are sick with this cough.	Also these type of issue is not related to this project because we are going for the project with fully documentation & permission of the Authority.	
9.	Mrs. Pranayi Kishor Mhatre, Dy.Sarpanch, Jaskhar village, Taluka – Panvel, District – Raigad	As Pradeep Mhatre raised the issue of solid waste management, JNPA says that such a big project is coming and we are going to take responsibility of the surrounding villages. So the first question is to JNPA whether JNPA really takes responsibility. So our experience is that JNPA does nothing after project completion. Now the JNPA sets the garbage on fire, causing great distress to the elderly people of our village. No. People have increased, who suffer respiratory diseases. We are frequently sending letters, videos to JNPA. If they complain, they deny setting the fire and take the name of the garbage cleaning person. So if they can't handle the waste now, how will they handle the waste after the project is expanded? If the pending issues of our village are not resolved for the past several years, we will not give consent to their new project.		
10.	Sarpanch, Gharapuri Grampanchayat	Today our Gharapuri village is surrounded on all sides. You are blasting in the sea. The village has Elephanta Cave. If it collapses, what do we do? We		

		have a boat route. But there is no road to the village. Due to JNPA blasting, the houses of our village have developed cracks. People of Nhava-Sheva are going to get money, but we have not received anything even though we are within calling distance. Although the boys and girls of Gharapuri are educated, no one from our village has been recruited in such projects. There are many fishermen in our village, there is also plenty of fishing, but you have banned fishing. Hence, we should be given justice.	The employment provided by JNPA to the local people.	**During Constructional Phase-** Permanent Employment- 10 nos. Contractual Employment- 360 nos. **Operational phase-** Existing Permanent Employment- 125 nos. Proposed Permanent Employment- 15 nos. Contractual Employment- 360 nos.
11.	Female Person from Hanuman Koliwada, Native Village – Sheva Koliwada	For one, our rehabilitation has gone wrong. These new companies come in, they dump right into our fishing grounds. So where we should go for fishing? If they do not give us jobs, what will we do, our livelihood is affected and hence our survival has become a problem. Yesterday on 29-11-2023, there was a meeting with Hon. District Collector and he said that this public hearing will not be held. So how the hearing was started by defying the Order of District Collector, Raigad, Alibag, though Additional Collector and Tahsildar were present in that meeting, how is this public hearing going on? Our village is totally opposing this project and until all villages are rehabilitated, we will not allow any new project.	Also these type of issue is not related to this project because we are going for the project with fully documentation & permission of the Authority. The employment provided by JNPA to the local people.	**During Constructional Phase-** Permanent Employment- 10 nos. Contractual Employment- 360 nos. **Operational phase-** Existing Permanent Employment- 125 nos. Proposed Permanent Employment- 15 nos. Contractual Employment- 360 nos.

12.	Shri. Hanuman, President,Fishermen Society	Whether the project site has been inspected for which this environment public hearing is conducted. Give the answer. Member, Environmental Public Hearing Committee answered that the project is currently operational and the site where the project is to be carried out has been inspected. At that time, some of the attendees raised objections. At that time, Shri Kishore Mhatre said that what percentage of jobs will be given to the fishermen there? Chairman, Environment Public Hearing Committee said that the JNPA administration will give answer regarding job opportunities. Officials of the Project Proponent said that the suggestions and objections raised in the meeting are being recorded and will be discussed with the management of JNPA. Shri Hanumant and others present objected to this and said that the same answer was given in the last public hearing and they are not giving job opportunities to the local people in the project. Although, yesterday on 29-11-2023 Hon. District Collector, Raigad, Alibag said that there will be no public hearing, public hearing is going on here. That is, everything is going on keeping the public in the dark. At that time, one of the participants asked a question to Chairman, Environment Public Hearing Committee that he was also present in yesterday's meeting and had said that he would not be present.	The employment provided by JNPA to the local people.	**During Constructional Phase-** Permanent Employment- 10 nos. Contractual Employment- 360 nos. **Operational phase-** Existing Permanent Employment- 125 nos. Proposed Permanent Employment- 15 nos. Contractual Employment- 360 nos.

		At that time, Chairman of the Environment Public Hearing Committee said that I am attending the meeting on the Order of the Collector and after coming, I sent an SMS to him that I am here in the meeting. Chairman, Environment Public Hearing Committee said that the said public hearing is an environmental public hearing and we have come to record the thoughts, suggestions or objections about the proposed project. Some participants questioned that on 29-11-2023 Collector, Raigad, Alibag had told us that they do not want to hold public hearing. You are cheating us. Government has been cheating the locals for 38 years. However, this public hearing should be cancelled. The President said that this is a public hearing to hear your views. Some of the men and women present together demanded that permission should not be granted until complete rehabilitation was achieved. Many of the participants were calling for the public hearing to be illegal and to call it off. A woman was saying that our life is boring. They say that there will be no public hearing in the collector's office, but a public hearing is held here. Some said that here we have a conflict with the government. Shri Parmanand Koli, Sarmpach, Gram Panchayat Hanuman Koliwada reiterated the demand of the project only after the first rehabilitation and suggested to cancel the meeting. Many participants were shouting in union to make their point.	Also these type of issue is not related to this project because we are going for the project with fully documentation & permission of the Authority.	---

		Some of the participants were shouting that many such hearings and meetings have been going on for the last 38 years, but we have not been rehabilitated. Some of those present shouted back that you are the District Magistrate, and if you are the one who is cheating, then who should the people believe. We will bring this matter to the attention of the government. Some women were shouting together that they are against the project. Later, the majority of those present were chanting "We are opposing, we are opposing." Some were saying that the administration and the company must have decided something. He again demanded Chairman to cancel the public hearing. Some said that now we will go to the channel and inform about it. He again requested to cancel the public hearing. At that time, many fishing community members/Kolibandhus of Hanumankoli villlage walked out of the hall in protest.		
13.	Ex. Sarpanch, Dongari	My wife was Sarpanch of Dongrigaon, now my son is the Deputy Sarpanch. He said why our lands at Panje and Dongri have been taken by the Government of India, Government of Maharashtra for the project. But here the project officials lie so much that we feel they are getting paid to lie. I have been in politics for 32 years. There are 2-3 subjects. We do not get any tax from the project. So the civic facilities cannot be given to people. Our drinking water lines in villages Panje. Dongar have	Also these type of issue is not related to this project because we are going for the project with fully documentation & permission of the Authority.	-------

		been cut for JNPA compound wall. Wrote a letter to BPCL regarding this, they are not taking any notice. Local people are not given priority in employment in the project. Natives have no place in employment. However, the administration should take notice of this, otherwise we are against the project.		
14	Shri. Harshal Thakur, Jaskhargaon	For the last five years, rain and tide water has been accumulating in our Jaskhar village. So there are 250-300 houses in the village that get water 4-5 times in their houses, so they are suffering a lot. We have informed all District Administration about this. JNPA is also followed up. JNPA road is passing 50 feet from our village. There, a road has been made cutting the mangroves and by filling the materials. The road has passed 50 feet from the house in our village, hence houses in Jasaskar village are cracked. The temples and houses there are on the verge of collapse. Despite repeatedly telling the JNPA, they have given a false report to the government and constructed the road. We have surveyed every house in our village and every house is cracked. However, at present the road should be withdrawn from where it passed. Also, the project should give compensation for the loss that has been incurred for so many years. Only then will the project be approved. At that time Executive Director of the Project Proponent started to answer, at that time Chairman, Environment Public Hearing Committee suggested that the suggestions and objections raised by the	This issue is not related to this project and kindly inform to the responsible authorities.	------

		participants should be recorded, but you should not answer. At that time Mrs. Pranayi Kishore Mhatre, Dy. Sarpanch, Jassar Village, Taluka-Panvel, District-Raigad objected back that JNPA does not take any responsibility after the completion of the project.		
15.	Shri. Rajesh Mhatre, Dy. Sarpanch, Nhave, Taluka – Panvel, District – Raigad	Nhava village has not received anything from the CSR fund of the project. Another thing is that now the people's representatives of all the villages have expressed their grief that in the recruitment of workers, the locals are not being given employment contracts. Locals and project victims should be given priority in recruitment. No one is paying attention to the removal of the silt. This creates obstacles in fishing and other matters. However, the question should be resolved. Some of the participants brought a statement on behalf of the village to Chairman, Environment Public Hearing Committee, requested him to accept it and went on stage to present a written statement to him. J.N.P.A answered the questions raised by the persons which are present in the hearing. He reported that, issue of rehabilitation and land will be sorted out. Regarding employment they will discuss issue with higher authority and resolved the problem raised by villagers. Chairman, Environmental Public Hearing Committee said that many local people have registered their thoughts, suggestions and objections in the public hearing. If anyone still wants to register suggestions,	JNPA is providing socio economical support to develop infrastructure under CSR and supported PP villages for infrastructure upgradation i.e. schools, water supply, drainage, road, contracts to PAP societies etc. Pollution level of different parameters will remain within permissible standard in this region. Pollution level of different parameters will remain within permissible standard in this region.	Allocated EMP fund is reserved in the project as follows- Rs. 17.9 Lakhs (During Construction phase) Rs. 6.3 Lakhs (During Operation phase) **----** **during Constructional Phase-** Permanent Employment-10 nos. Contractual Employment-360 nos. **Operational phase-**

		objections, they can submit them in written form. This public hearing is for the potential environmental impacts of the proposed expansion project. Convener, Environment Public Hearing Committee informed that the suggestions, objections as raised by the participants have been noted and it will be included in the minutes of meeting and minutes of meeting along wih Revised EIA, written suggestions and objections after approval of Chairman, Environment Public Hearing Committee will be submitted through Head Office, Maharashtra Pollution Control Board to Environment, Forest & Climate Change, Govt. of India, New Delhi. An Expert Committee there will be take further decision. Convener said many participants have raised suggestions and objections in respect of rehabilitation, job opportunities to local and PAPs. They have been noted and will be included in the minutes of the meeting. Convener, Environment Public Hearing Committee thanked all and on behalf of Chairman, Environment Public Hearing Committee declared that the meeting is concluded.	The employment provided by JNPA to the local people. There would be no health impact on local residents for upcoming project.	Existing Permanent Employment- 125 nos. Proposed Permanent Employment- 15 nos. Contractual Employment- 360 nos.

7.2 RISK ASSESSMENT

Identification of potential physical hazards which could trigger loss causing events such as fire and explosion, leakage of flammable materials etc. from the proposed facility.
Identifying the Maximum Credible Loss Scenarios (MCLS) for the vulnerable areas such as severity of the impact of various failure scenarios in terms of damage to property and injury to personnel.
Recommendations for risk reduction shall be made on the basis of the above for minimizing, if not eliminating various hazards and providing information on improvement of safety systems, where necessary.
A complete Risk Assessment will be done and the mitigative measures as well as safety measures will be proposed for the same.

7.3 APPROACH TO THE STUDY

Risk involves the occurrence or potential occurrence of some accidents consisting of an event or sequence of events. The risk assessment study covers the following:

- Identification of representative failure incident;
- Visualization of the resulting scenarios in terms of property damage;
- Assess the overall damage potential of the identified hazardous events and the impact zones from the accidental scenarios;
- Assess the overall suitability of the site from hazard minimization and disaster mitigation point of view;
- Furnishing specific recommendations on the minimization of the worst accident possibilities;

Risk Analysis broadly comprises of the following steps:

- Project Description
- Identification of Hazards and Selection of Scenarios
- Risk Summation
- Risk assessment
- Risk Mitigation Measures

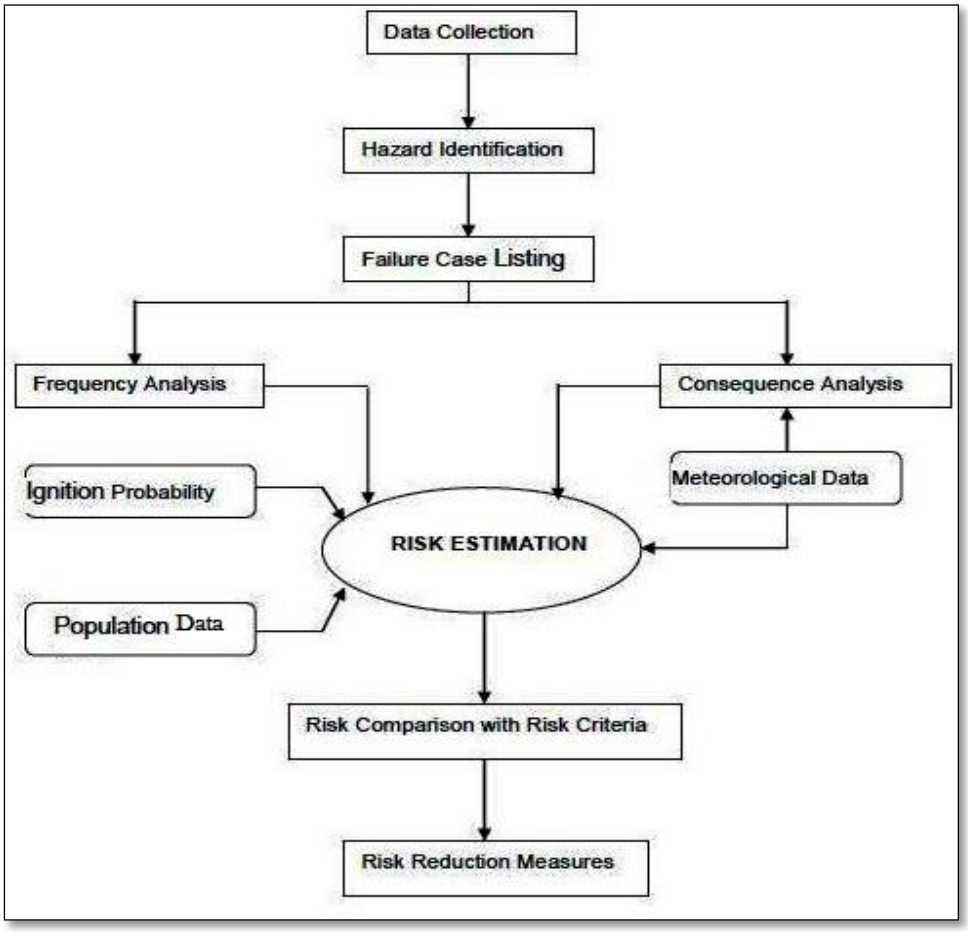


Figure -25: Risk Assessment Methodology

7.3.1 Property Damage due to any failure

- Confusion at work site my cause accident
- Accident due to unsupervised job
- Unwanted materials / remains inside the confined space may cause hindrance /interruption in operation. Unsafe area may also cause Fall / trip hazard during operation.

7.3.2 Electrical Maintenance Wok

- Accidents, injuries, losses due to contact with high energy moving parts or stored energy. Precautions not known to workers.
- Presence of harmful substances. Inadequate clothing and personal protective equipment not qualified to do the job. Potentially hazardous to co-workers.

7.3.3 Presence of materials/debris

- Debris shall not be allowed to be thrown from height. Remove all debris promptly,

using chutes or by using bags.

- Metal chutes may be provided for removal of materials. The chutes shall preferably be provided as per site requirement for efficient disposal of debris.

7.4 Consequence Analysis

Consequence analysis involves the application of the damages subsequent to a infrastructure damage/ accident.

- Construction for developing process equipment/widened road.
- Size & shape of the property.

Recommendations

The recommendations based on the risk analysis study of the identified representative failure scenarios are summarized below:

1. The location should have a necessary provision for emergency stop of critical equipment from control room in the event of any incident.
2. Routine checks should be carried to ensure proper working of firefighting equipment.
3. Clearly defined escape and evacuation routes along with proper sign board to guide personnel to escape in case of an emergency.
4. Well defined assembly points in safe locations shall be identified for personnel in case of any emergency.
5. Windsocks visible from all direction would be provided. This will assist people to escape in upwind or cross wind direction from fire.
6. Mock drills to be well rehearsed to ensure readiness to handle emergency.
7. Ensure periodic safety trainings in firefighting, escape, operation of emergency switches etc. to the officials.
8. Calibration of all instruments to be ensure periodically.
9. Proper lighting arrangements and CCTV should be provided at the suitable locations for better visuals.
10. Construction is considered as one of the accident-prone activities. Most of the accidents are caused by inadequate planning, failure during construction process and /or because of design deficiencies, unique nature of work, difficult work site. Besides property loss, accident also results in injuries and fatalities to the personnel, same needs to be prevented.
11. Implementation of safe practices during construction and ensuring good quality of materials, equipment and competent supervision along with compliance of standard engineering practices lead to achieve "**Zero Accident**".

7.5 DISASTER MANAGEMENT PLAN (DMP)

a. Objectives

The emergency DMP for onsite and offsite location will be inter-related. The overall objectives are;

- To identify type of major disasters which may occur
- To localize the emergency and if possible eliminate
- To minimize the effect of accidents
- Elimination of hazard will require equipment like firefighting equipment's, water sprays,
- Emergency shutoff valves and purposeful construction.
- Minimizing the effect will be prompt action by operating and emergency staff, rescue, first aid, evacuation, rehabilitation and giving information promptly to people living / working nearby.

b. Types of Possible Emergencies:

- Fire on berth / approach trestle / storage / buildings
- Spillage while bunkering by vessel
- Spillage due to collision in channel
- Natural calamities like cyclone / rough weather / earthquake/ Tsunami
- War situation/ Air strike.

c. Functions of Disaster Management

Controlling spread of accidental effects with minimum damage to men, material, machine and structures.

- To inform relevant agencies and request for help.
- To rescue victims and provide succor.
- To protect other and safely evacuate.
- To inform nearby inhabitations.
- To identify the affected persons and inform their relatives.
- To provide authentic information to news media and other.
- To preserve relevant records and equipment needed as evidence in any subsequent inquiry.
- To rehabilitate the affected areas and alot specific assignment to available manpower.

d. Classification of Accident

- Level I : Operator Level
- Level II : Local / Community Level
- Level III : Regional level
- Level IV : International level

e. Critical Targets

Disaster Management Plan is prepared after identifying the objects likely to be affected in the event of emergency. The target of fire includes personnel if emergency occurs at service platform during discharging of vessel and tank farm on shore.

f. Control Room (CR)

A control room will be established at a location away from likely spots of accidents and shall be easily accessible. Better location will be near the room from where all unloading operation are conducted and controlled. (*SOURCE: Details are given in disaster management plan)*

7.5.1 IDENTIFICATION OF MAJOR HAZARDS

The hazards occurring at Proposed Project can be broadly classified as natural and man-made hazards. Some of the hazards existing at site are as follows:

- Earthquakes
- Fire
- Tsunamis

7.5.1.1 Earth Quake

- An earthquake is a sudden, rapid shaking of the Earth caused by the breaking and shifting of rock beneath the Earth's surface.
- This shaking can cause buildings, bridges to collapse; disrupt gas, electric, and phone service; and sometimes trigger flash floods and fires; all these are possible scenarios at Proposed Project.
- The greatest danger for people in an earthquake exists directly outside buildings, at exits, and alongside exterior walls.
- Ground movement during an earthquake is seldom the direct cause of death or injury. Most earthquake-related casualties result from collapsing walls, flying glass, and falling objects.

7.5.1.2 Fire

- Fire is the most probable emergency scenario at proposed project.

- Fire can be caused in installations as electrical fire, chemical fire, etc.
- To handle this scenario an onsite emergency plan has been developed by the security team and is currently operational.

7.5.1.3 Tsunamis

- Tsunamis are generated by large and rapid displacements of water, mainly from sudden and large scale changes in the configuration of the sea floor associated with fault displacement or gigantic underwater landslides, which could be mainly due to earthquakes.
- Earthquakes generate tsunamis by vertical movement of the sea floor as in normal faulting or thrust faulting. If the sea floor movement is horizontal, tsunamis are not generate d as in strike slip earthquake. Sometimes they are triggered by marine landslides into or under the water surface, also generated by volcanic activity and meteorite impacts, but such events are extremely rare.
- Tsunami hazard along a coastline is therefore a combination of all the potential sources of tsunamis that lie in the neighboring sea or ocean. Tsunami waves travel at a speed of approximately 700 km/ hr in 4000 m of water. In 10 m of water the velocity drops to about 36 km/hr.
- The project area falls under seismic zone III and there has not been any Tsunami reported near emergency plan has been developed by the security team to handle such situation, if arised.

7.5.2 EMERGENCY RESPONSE MEASURES FOR NATURAL HAZARDS

Natural Hazards cannot be prevented. However with mitigation measures the effects/damages could be reduced.

7.5.2.1 Response in case of Earthquake

Response procedures for worker

If indoors:

- Take cover under a piece of heavy furniture or against an inside wall and hold on.
- Stop the process and move away from machinery, equipment, etc.
- Avoid moving around until the shaking stops.

If outdoors:

- Move into the open, away from process area, office building and utility wires.
- Gather at the Evacuation point mentioned during the safety drill and await instructions.

If in a moving vehicle:

- Stop quickly and stay in the vehicle.

- Once the shaking has stopped, proceed with caution.

After be prepared for aftershocks.

- Although smaller than the main shock, aftershocks cause additional damage and may bring weakened structures down. Aftershocks can occur in the first hours, days, weeks, or even months after the quake.

Help injured or trapped co-workers.

- Give first aid where appropriate. Do not move seriously injured persons unless they are in immediate danger of further injury. Call for help. Use Emergency numbers.
- Stay out of damaged buildings, machinery, equipments.
- Get your entire process area checked with Safety officers
- Use the telephone only for emergency calls.

Emergency Response Procedure

1. Initiate the Quick Response Team and First aid team for earthquake response
2. Give a long siren for earthquake warning
3. Inform the necessary authorities for aid
4. Ensure no personnel or residents are stuck beneath any debris
5. Ensure that all residents and personnel standing outside near the buildings are taken to open areas.
6. Close the entry gate to restrict any incoming traffic
7. Inform Electrical department to shut off the utilities.
8. Ensure that the first aid ambulance and fire tender vehicles are mobilized
9. Ensure that emergency telephone number is only used for this purpose
10. Check the utilities and storage tanks for any damage.
11. Inform structural engineers to check for any damage to the Dam structure

7.5.2.2 Response in case of Fire

- On sighting a fire the first person should immediately inform the control room.
- If the fire is small engage in extinguishing the fire using the nearest fire extinguisher or retrieve the property that may be damaged.
- The control room will immediately inform the first aid centre and the quick response team, which has trained fire-fighting personnel. Mobilize the fire tender.
- The Quick Response team will immediately move to the point of fire and take all necessary steps to stop the fire. If the fire is not controllable and spreads to the other area then immediately inform the security post who would in turn inform the district authorities and call for external help.

- First aid team will provide immediate relief to the injured personnel at the scene of incidence. The patients would then be evacuated on priority to the dispensary or hospital based on their condition.
- Instructions for an Individual in case of fire Get out of buildings as quickly and as safely as possible. If outdoors stop all processes and inform the control room using emergency alarm system and Emergency numbers.
- Evacuate the boat/barge with the help of life boat.
- If possible, cover mouth with a cloth to avoid inhaling smoke and gases.
- Call the security from the nearest phone
- Stay out of damaged boat/barge
- Check that all wiring and utilities are safe.

7.5.2.3 Response in case of Tsunamis/Storm Surges

a) Structural measures:

1. Construction of cyclone shelters
2. Plantation of mangroves and coastal forests along the coast line acting as Bioshields
3. Development of a network of local knowledge centers (rural/urban) along the coast lines to provide necessary training and emergency communication during crisis time
4. Construction of location specific sea walls and coral reefs in consultation with experts
5. Development of well-designed break waters along the coast to provide necessary cushion against cyclone and tsunami hazards
6. Development of tsunami detection, forecasting and warning dissemination centres
7. Development of a "Bio-Shield" - a narrow strip of land along coastline. Permanent structures, if any in this zone with strict implementation of suggested norms. Bio -Shield can be developed as coastal zone disaster management sanctuary, which must have thick plantation and public spaces for public awareness, dissemination and demonstration.
8. Increasing the river dike height, increasing the height of the coast by filling up of coastal sand of the same place.
9. Identification of vulnerable structures and appropriate retrofitting for tsunami/cyclone resistance of all such buildings as well as appropriate planning, designing, construction of new facilities like

- Critical infrastructures e.g. power stations, warehouses, oil and other storage tanks etc. located along the coastline.
- All other infrastructure facilities located in the coastal areas.
- Public buildings and private houses.
- All marine structures.
- Construction and maintenance of national and state highways and other coastal roads.

b) Non-Structural Measures

1. Coastal regulations Zone Act – Strict implementation.
2. Aggressive capacity building requirements for the local people and the administration for facing the disasters in wake of tsunami and cyclone, 'based on cutting edge level'.
3. Developing tools and techniques for risk transfer in highly vulnerable areas
4. Conserving and developing Natural Bio shields (Mangroves) and shelterbelt plantations (Casuarina).
5. Launching a series of public awareness campaign throughout the coastal area by various means.
6. Training of local administration in forecasting warning dissemination and evacuation techniques.
7. Awareness generation and training among the coast guards, officials from fisheries department and port authorities and local district officials etc., in connection with evacuation and post tsunami storm surge management activities. Regular drills should be conducted to test the efficacy of the DM plans.

7.6 ORGANIZATION STRUCTURE

The Incident Controller tackling the emergency in real terms requires support from various other services e.g. fire & safety, medical services, security, engineering, administration, technical services covering communication, transport and personnel functions, etc. A KEY PERSON for each one of these services, therefore, should be nominated.

The "SITE MAIN CONTROLLER" (SMC) will be the Unit In-charge the various controllers selected to carry out the work will co-ordinate with the SMC through the functional KEY PERSONS at the incident site. The KEY PERSONS will generally be at the site of incident and the CONTROLLERS will report at the EMERGENCY CONTROL CENTRE. The duties and responsibilities of various KEY PERSONS AND CONTROLLERS will be written down ensuring no grey areas or overlapping responsibilities. Various Controllers will be drawn from the organization and clear-cut responsibilities will be spelt out for the following controllers:

- Operation Controller
- Maintenance Controller
- Fire and Safety Controller
- Communication Controller
- Environment Controller

A Succession chart will be developed as above nominating second-line controller who would act as controller in the absence of any of the above officials. An emergency organization chart is shown in figure below;

7.6.1 Roles and Responsibilities of Emergency Team

1) Site Main Controller (In-charge):

- To access the extent and magnitude of the damage and by maintaining communication with the Site Incident Controller (SIC).
- To determine how far the emergency control plan can be extended
- Prepare action for monitoring and controlling the emergencies
- To decide whether any section I process I area to be shut down I isolated in the event of any accident
- To finalize the means of evaluation and explore the possibilities of taking help from offsite sources.
- Review the firefighting operations in consultation with Safety Coordinator
- Co-ordination with the safety officer regarding evacuation and shelter rehabilitation aspects
- Arrange for restoration and normalcy in consultation with Incident Controller
- Announcement of conclusion of emergency
- Issuance of authorized statements and ensures that all evidences of the incident are preserved.

(ii) Site Incident Controller (Shift in-charge)

- Establish Emergency Control Centre and inform SMC
- Ensure availability of Controllers/Team members
- Priority decisions for strategy for development of resources for incident control
- Periodic assessment of actual disaster zone and resource deployment (own I external)
- Periodic status report of SMC
- Seek help for
- Fire Fighting
- Medical Aid
- Rescue
- Transport
- Traffic Arrangement
- Law and Order

Inform the following authorities about the incident through zonal/sector authorities

- District Collector
- Superintendent of Police
- District Environmental Engineer

• District Health Officer
• Inspector of Factories
• Neighboring Installations

Establish contacts with the following, through Controllers:

• Superintendents of nearby hospitals
• Chief Fire Officer of nearby fire services
• Insurance company
• Establish first aid centre through safety coordinator
• Establish information centres
• Emergency Co-ordinators

Logistics Coordinator: The duties and responsibilities in the event of any emergency include:

• Report at the affected area to the SMC & SIC
• Arrange to attend all maintenance jobs as instructed by SIC
• Ensure that all essential services like power, water etc. are maintained without interruption.
• Ensure adequate manpower availability at the affected area
• Reporting all the incidents to SIC
• Arrange for all the tools, materials at the site of emergency Communication Coordinator (Responsibilities include):
• Report to SMC & SIC
• Removal of non-essential personnel from the emergency area in consultation with SIC
• Contact with SIC and arrange for necessary facilities
• Control over entry and maintain law & order and arrange for police help in consultation with SMC.
• Liaison with external agencies in consultation with SMC
• Coordination of transportation requirements for moving personnel for first aid, evacuation, rehabilitation etc.
• Maintenance of inventory systems in the Emergency Control Centre

Safety Coordinator (Responsibilities include):

• Immediate Reporting to SIC
• Co-ordination with Security officer and security personnel
• Ensure availability of all safety equipments at site
• Co-ordination of all rescue operations
• Co-ordination of availability of first aid to all injured personnel
• Advice to SIC on firefighting operations
• Ensure availability of necessary antidotes/ medicines in case of toxic release

7.6.2 Communication

An essential component of any emergency preparedness programme is the communication links for gathering information needed for overall co-ordination. Emergency control centre with in-house as well as outside emergency services. Too much reliance on the telephone system fixed lines/mobile phones are risky as it can soon be overloaded in an emergency situation. A computer with internet and printer facility and photocopying machine, wireless networks, fax, intercom units are recommended for higher reliability. Help line numbers will be setup for emergency related queries.

CHAPTER-8 : PROJECT BENEFITS

8.1 GENERAL

The execution of the project brings overall improvement in the locality, neighborhood and the State by bringing industry, roads, employment and hence improving living standard and economic growth.

Jawaharlal Nehru Port Authority now involves various aspects to be considered for expansion project.

1. Increase of crane Rail span from 20 m to 30.50 m for 680 m berth length.
2. Increase of deck width of the berth by 15 m on land side for smooth vehicle maneuvering & for keeping vessels hatch covers
3. Up-gradation and strengthening of existing 530 m berth and 150 m wharf to accommodate design vessels of size 12200 TEU for which the facility was originally designed & commissioned.
4. Up-gradation of Fenders and Bollards as may be necessary.
5. Repairs and strengthening of existing damaged portion of the berth structures as may be necessary.
6. Underdeck repairs of the existing structure wherever necessary.

The said widening will enable;

Customer Requirement: Shipping Lines are up-scaling vessels to necessitating terminals to upgrade infrastructure to accommodate larger LOA vessels and to operate extreme bays safely.

Operational Constraints: Constraints:

An electrical sub-station is located on south end of the quay, obstructs smooth truck movement.

Mooring space reduces the operational berth length.

The following benefits are expected due to the implementation of the said project:

- Implementation of this project will adopt latest, reliable, reproducible technology of BS6 engines to reduce the pollution due to vehicular exhaust.
- The project will also create an environment for development in the region and create employment opportunities directly or through ancillary requirement for construction, operations and maintenance.
- The proposed widening project will help to achieve the national carbon reduction strategy.

8.2 IMPROVEMENT IN THE SOCIAL INFRASTRUCTURE

Economic infrastructure is essential for improving the productive capacity of the nation but infrastructure is also required to improve the quality of human resources. It consist of services like education, medical facilities, sanitation, housing, drinking water supply etc. these all together constitute the social infrastructure of an economy. Various CSR activities are being done every year to satisfy the basic requirements of the social infrastructure by JNPA.

8.3 EMPLOYMENT POTENTIAL –SKILLED, SEMI-SKILLED AND UNSKILLED

The project will provide employment potential for construction labor during implementation phase.

This project will also generate Indirect employment in the form of contractors, workers, transporters, marketing and ancillary facilities and general utility services.

8.4 JNPA Green Port Initiates

- **Usage of E-Vehicles inside the port area:** Nine e-vehicles are zero-emission vehicle that will enable JNPA transition to green and energy-efficient mobility solutions. Estimated savings of 47 tonnes equivalent CO_2 per year.
- **Solar Power Generation:** 4.10 MWp. 38% of avg. power requirement is from renewable energy. Upcoming solar plants of 1.5MWp storage type.
- **Rejuvenation of Water Body near Sheva Temple and Sheva Foothill at JNPA:** In order to encourage green projects in port area it is decided to preserve the water bodies located in JNPT area. The existing water bodies which are located at Sheva temple and Sheva foothill are filled with rain water and remain wetted for entire season. The rejuvenation of water bodies also included in Maritime India Vision 2030.
- **Solid Waste Management:** 10 MT/Day Solid Waste Management Facility commissioned in the month of February 2021 as per SWM rule 2016 for port users, Port Township and certain villages within port estate. All ships bound for JNPA are registering in Swachh Sager Portal and Port Reception Facility are being provided as requested. Reception facilities for MARPOL annex - 1, 2, 5 & 6 are provided to vessels calling JNPA.
- **Sustainability Report:** The Port First Sustainability Report is completed as per Global Reporting Initiative (GRI) standards. The Sustainability Report reflects JNPA's commitments and achievements in fostering leadership in sustainability and creating value for the trade – depicted across the economic, social, and environmental parameters of the Global Reporting Initiative (GRI) Standards 2020.

- **LEDs lamps replaced in Port area and township:** Total 3,979 nos. LEDs lamps replaced in the port Estate, from this 7, 12,058 kwh energy saving per annum. JNPA has taken job of replacement of 400 Nos of 800 W HPSU by 400 W LED light fittings saving from this project will be 6,91,200 units per annum.

- **E RTGCS:** JNPA has total 31 numbers of electrically operated RTGCs. Carbon footprint savings per year at the rate of 1.5842 kg equivalent per move. Carbon footprint saving per year approximately 1500 tonnes per year.

- **Shore power supply:** JNPA is providing shore power supply to tugs and port crafts.

- **Initiative for ease of Traffic Congestion:** Total distance per TEU has reduced to 2.5 KM from earlier 5.0 KM. ITRHO Traffic has reduced to approx. 60% with green channel, reducing average from 45 TT to 15 TT performing the ITRHO operation on daily basis.
- **Centralized Parking Plaza:** JN Port's Centralized Parking Plaza is equipped with a huge parking capacity to help park 1,538 tractor trailers in one go, hereby integrating document processing by Customs and streamlining traffic movement using Real Time Parking Management system. Reduce congestion on road.
- Use of recycled sewage water: The treated sewage water of STP is being used for the gardening purpose of JNPA township and about 1 MLD treated water is being used which reduced the burden on use of drinking water. The port has further planned to increase use of recycled water for tank farm area.

  Ministry of Ports, Shipping and Waterways, GoI has formulated "Harit Sagar" Green Port Guidelines, to reduce carbon intensity and to develop an environment friendly ecosystem at Major Ports, same will be followed at JNPA. JNPA is putting maximum efforts to become JNPA as green Port by implementing Green Port initiatives in planned manner.

CHAPTER-9 : ENVIRONMENTAL COST BENEFIT ANALYSIS

9.1 INTRODUCTION

Environmental cost-benefit analysis, or CBA, refers to the economic appraisal of policies and projects that have the deliberate aim of improving the provision of environmental services or actions that might affect (sometimes adversely) the environment as an indirect consequence. Vital advances have arisen in response to the challenges that environmental problems and environmental policy pose for CBA. Perhaps most notably this includes continuing progress in techniques to value environmental changes. Growing experience of these methods has resulted in, on the one hand, ever greater sophistication in application and, on the other hand, scrutiny regarding their validity and reliability. Distributional concerns have led to a renewal of interest in how appraisals might throw light on questions about equity as well as efficiency, and there have been substantial new insights for discounting costs and benefits in the far-off future. Uncertainty about what is lost when environmental assets are degraded or depleted has resulted in a number of distinct proposals although precaution is the watchword in each. Just as importantly, there is a need to understand when CBA is used in practice and why environmental decisions are often made in a manner apparently inconsistent with cost-benefit thinking.

9.2 ENVIRONMENTAL COST

The proposed facilities for widening project will cause following environmental costs:

- Negligible impact on ambient air quality due to emission and other air pollutants that only in construction phase, which will be well within the specified limits for emission at stations.
- The project will not deteriorate the water quality because no water is discharged nor is any solid matter carried over to the surface or ground water bodies.

9.3 ENVIRONMENTAL BENEFITS

The proposed project will benefit the environmental in following ways:

- It will facilitate without causing change in its designated land use.
- The proposed project will ensure smooth vehicular movement on widened berths.

9.4 CONCLUSION

It may be observed from the above-mentioned text that the benefits to the environment exceed the anticipated costs. Therefore, in view of larger number of environmental benefits as compared to nominal costs, the proposed project shall provide positive impact on environment.

CHAPTER-10 : ENVIRONMENTAL MANAGEMENT PLAN

10.1 INTRODUCTION

Environmental Management Plan (EMP) reviews the adequacy of various pollution control measures envisaged for the project mitigating various environmental impacts identified and assessed. Additional mitigation measures, if required to ensure sustainable power generation are also suggested. EMP has been prepared separately for construction and operation phases. It describes administrative aspects of ensuring that mitigation measures are implemented and their effectiveness is monitored. It also includes green belt development plan. Environmental Monitoring Programme is included in the chapter-6.

Each of the mitigation measure has been assessed with respect to:

- Adoption of state of art technological measures
- Identification of human resources for its effective implementation
- Allocation of financial resources for its effective implementation and
- Effectiveness of mitigation measure in mitigation of impacts

EMP specifies various technological measures for pollution prevention, waste minimization, end-of-pipe treatment, attenuation etc. proposed to be undertaken to mitigate the environmental impacts on each sector of environment during each phase of the project, i.e. construction phase and operation phase.

10.2 OBJECTIVES OF ENVIRONMENTAL MANAGEMENT PLAN

The Environmental Management Plan describes in brief, the management's plan for proper and adequate implementation of treatment and control system for pollutants and for maintaining the environment. It also includes development of green belt around the pipeline section, Safety measures taken for the proposed pipeline, safety of the workers, fire protection systems, noise control and measures. The main objectives in formulating this environmental management plan are:

- To treat all the pollutants viz. liquid and gaseous those contribute to the degradation of the environment with appropriate technology.
- To comply with all regulations stipulated by the Central/ State Pollution Control Boards related to air emission and liquid effluent discharge as per Air Act, Water Act, and Environment (P) Act related laws.
- To handle hazardous wastes as per the Hazardous and other Waste Rules 2016.

- To encourage, support and conduct developmental work for the purpose of achieving environmental standards and to improve the methods of environmental management.
- To create good working conditions (avoidance of air and noise pollution) for employees.
- To reduce fire and accident hazards.
- Perspective budgeting and allocation of funds for environment management expenditure.
- Continuous development and search for innovative technologies for a cleaner and better environment.

10.3 ENVIRONMENT MANAGEMENT SYSTEM

10.3.1 General

Organizations of all kinds are increasingly concerned with achieving and demonstrating sound environmental performance by controlling the impacts of their activities, products and services on the environment, consistent with their environmental policy and objectives. They do so in the context of increasingly stringent legislation, the development of economic policies and other measures that foster environmental protection, and increased concern expressed by interested parties about environmental matters and sustainable development. Environment Management System is a tool used by an organization for managing the impacts of its activities on the environment. The EMS offers a structured way to incorporate environmental considerations into day-to-day operations; and promotes continual improvement of the environment and human health. EMS monitors and checks the environmental performance, integrates and implements the environmental management and its performance with and along the routine operations of the organization's long and short term planning and quality management system and takes positive steps in case of any deviation with a view to ensure better and enhanced performance. Continual improvement is an integral part of any environmental management system.

In view of these facts, JNPA has implemented an Environmental Management Policy and Health, Safety & Environment Policy (ISO /14001:2015) at JNPA.

Jawaharlal Nehru Port Authority, hereinafter referred as JNPA or "Port" is one of the major Indian Ports located on the east side of Mumbai Harbour adjoining the main land of the West Coast of India and was commissioned on 26th May 1989. It is about 6 nautical miles by water route from Gateway of India. It is a fast growing and ISO 9001:2000 certified Port with single

window operations, round the clock pilot age, good vessel traffic management system and dedicated facilities for handling containers, dry bulk and liquid bulk.

It has a detailed Environmental Management Programme and it meets all statutory requirements. For its excellent Environment Management System, it has been accredited with Integrated Management Systems and conferred several awards as a manifestation of its commitment towards achieving the continual improvement in its Environmental Management System.

The management action plan aims at controlling pollution at the source level to the possible extent with the best techno-economically feasible and available methodology before they are discharged. The EMP for the proposed project is divided into two phases i.e. Construction and Operational phase. The planning phase lists out the control strategies to be adopted during the design considerations. The construction and operational phase details the control/abatement measures to be adopted during these phases.

10.4 ENVIRONMENTAL MANAGEMENT

Environmental pollution is inevitable during the construction phase. The project proponent will take appropriate steps to control pollution during this stage. The following are the factors requiring control during construction phase.

10.4.1 Site Preparation

At the time of construction there will be a substantial quantity of soil and debris and construction activities would produce large quantities of unstable material. The disturbed slopes shall be well stabilized before the onset of monsoon. The leveling operation would also involve piling up of backfill materials. Use of dust suppressant spraying to minimize fugitive dust during construction activities is recommended. Dust masks will be provided to all workers working in the dust prone areas. Good housekeeping and proper maintenance will be practiced which will help in further controlling the dust emissions during construction phase.

10.4.2 Water Supply and Sanitation

The employees for the proposed project will be provided with water for their requirement and for the construction activities. The proposed construction site will be provided with sufficient and suitable toilet facilities to allow proper standards of hygiene. These facilities would preferably be connected to a septic tank and will be maintained properly to have least environmental impact. The existing facilities will be used during construction phase.

Cleaning and washing water for vehicle and equipment maintenance area.

During construction phase, used construction water is the only increase in water requirement due to construction activities and most of the effluent generated will be in the form of sanitary waste, which shall be so small that can be accommodated in the existing system of treatment.

10.4.3 Noise Environment

The noise generated during the constructed phase will be due to the movement of vehicles and construction equipment. Proper care shall be taken to contain the noise level within premises and attempts shall be made to keep the maximum noise level within the permissible limits by adopting following:

- Construction equipment's and transport vehicles would be properly maintained so that noise generation is minimized.
- Use of new generation construction equipment
- Unnecessary engine operations shall be minimized (e.g. equipment with intermitted use switched off when not working)
- DG sets shall be provided with acoustic enclosures and exhaust mufflers.

10.4.4 Solid Waste Management

Waste management is crucial for ensuring a clean, safe, and healthy environment. Proper waste management also significantly contributes to a better economy owing to judicious land use planning and improved infrastructure that can keep pollution at bay and help sustain favorable living conditions. Ensuring that industrial development doesn't happen at the cost of the living environment must always be on top of the priority list for any industry.

The generated waste will be collected, segregated and will be disposed off as per the guidelines specified under Hazardous & other waste (management & trans-boundary) Rules-2016 & 2018 of MoEF&CC.

10.4.5 Sanitation, Welfare and Safety Measures for Construction Workers

Construction workers will be made aware of possible hazards and safety measures that need to be taken during construction activities through routine training. Personal Protective Equipments (PPEs) such as dust masks, goggles, earplugs/earmuffs, safety gloves, safety belts, shoe with toe protection, gumboots will be made available at construction site. Construction workers and vehicle drivers will be provided with drinking water, canteen and toilet/washroom facility. Rest room facility for truck drivers will be provided.

10.4.6 Air Environment

In order to prevent deterioration of air environment during construction activities, following will be adopted: -

- Preventive maintenance of vehicles and equipment
- Vehicles with valid Pollution under Control certificates to be used
- Unnecessary engine operations to be minimized
- Implementing dust control activities such as water sprinkling with or without de-dusting agent in the construction area
- Controlled vehicle speed on site
- Vehicle to be covered during transportation of material
- Providing dust collection equipment at all possible points

10.4.7 Biological Environment

Opportunities will be explored for conservation of endangered species, if any. However, there are no endangered species of flora/fauna exist in the study area.

10.4.8 Socio-Economic Environment

Proposed project will require number of workers to be employed by the contractor. The contractor shall mobilize local manpower and provide them clean and sanitation facilities. Supply of clean fuel such as PG/Kerosene to labourers for cooking shall also be encouraged so as to avoid loss of green cover and better occupational health of the workers during construction.

During the operation phase, a small number of skilled and unskilled workers may get direct and indirect employment, which will have positive impact on society.

The other indirect employment opportunities in the area are also likely to be generated after the project implementation.

10.5 THE PORT'S ENVIRONMENTAL EFFORTS FOR SUSTAINABLE DEVELOPMENT

In order to develop the port in a sustainable way, Port's developmental plans are synchronized with the Coastal Zone Management and Land Use plans. The Coastal Zone Management Plan (CZMP) of JNPA is based on the MoEF&CC's CRZ notification. The port has taken up various developmental plans on the basis the CZMP. The developmental projects are taken up after detailed Environmental Impact assessment and due approvals of the

MoEF&CC or MCZMA as per the applicability. The environmental monitoring is done during execution of the projects and compliance report is submitted to the concerned authorities. Macro and micro monitoring of the Coastal Zone Management at the JN Port. The Port is monitoring the effects of its activities on the environmental parameters. This is being done on two levels i.e Macro level and Micro levels.

Macro level monitoring

The Macro Level monitoring includes:

- Master planning for augmentation of the port facilities and capacities including developmental activities with respect to CZMP and land use planning.
- The port's Integrated Management System (IMS), which includes ISO-14001 Environment Management System,
- Obtaining statutory permissions like Consent to Operate from the State Pollution Control Board and obtaining approvals from MOEF&CC & MCZMA for the developmental projects.

Micro level monitoring

The port further carries out monitoring of environmental parameters on actual site and other activities in order to protect the Port's environment, as a micro level monitoring. The micro monitoring gives the actual environmental effects taken at the ground level and also provides a long term data. This ultimately helps in analyzing the effects of the port's working and development on the environmental attributes. To achieve this, the Port has prepared an Environmental Management and Monitoring Plan based on the guidelines given by National Environmental Engineering Research Institute (NEERI).

10.6 GOALS FRAMEWORK FOR THE IMPLEMENTATION OF THE EMMP:

EMMP is a plan developed to ensure that, the port should work in an efficient way and developmental plans are taken up based on sustainability principles. It also ensures that, all necessary measures are identified and implemented in order to protect the JN Port's environment and to comply with the environmental legislation. Short, Mid and Long Term measurers are defined in the table given below as part of EMMP implementation in the port premises.

Activity	Potential Impact	Mitigative Measures	Remarks	Responsibility
Air and Noise Environment				
Short Term Measures				
Fabrication (Welding) **(S)**	Welding Heat, Fumes/ Emission of gases	Preventives measures must be taken to reduce any risk	Guidelines for occupation hazards should be strictly implemented	PPD & M&EE
Sweeping of road dust & Carrying landfilling material from Vehicle **(S)**	Generation of dust	• Controlling the suspension of dust through sprinkling` of water dispersants etc. • Land filling truck should be covered with tarpaulin	A chemical dust suppression spray should be carried out to prevent dust particle getting blown away due to wind effect during transportation	PPD, Admin & Traffic Dept.
Civil works / constructions & repair of roads **(S)**	Dust formation & vehicle emission	Use dust control device near the construction area	Control of re-suspension of dust by water sprinkling during construction work at Pavement of roads.	
Vehicles and Material Handling Equipment **(S)**	Vehicular Emission	- JNPA's Vehicles: • All vehicles should be covered under comprehensive preventive maintenance schedule • Proper engine tuning and air-fuel ratio (as recommended by manufacturer of vehicle) • Contractor's Vehicle: Only vehicle having valid PUC certificate. will be allowed to enter in JNPA premises.	• Frequent inspection of and maintenance of vehicular exhaust. • Phasing out old vehicles Retrofitting the diesel vehicles latest technologies. • Use of Alternative Fuels • CNG/ Electrical vehicle for internal transport	PPD & Admin, M&EE, & Traffic Dept.
Mid Term Measures				
Handling & Storage of Reefer cargo Equipment**(M)**	Leakage of gaseous emission, smoke from RTGC	Installation of leakage detection and control devices for gases emission and follow the emission control norms for handling and storage	Daily monitoring	Traffic Dept.
Cement handling on Vessel at Bulk Terminal **(M)**	Spillage of Cement	By stopping Pneumatic Control of Vessel	Measurement of Air Quality (VOC) during a spillage	Traffic Dept.
Stacking of Containers in yard **(M)**	Unhygienic condition due to perished cargo	Follow the IMS & ISP guidelines for container handling while loading and unloading activities	Dust and odour control devices to be provided as required	Traffic& M&EE
Berthing of vessel & Operation of tugs **(M)**	Smoke Emission	International guidelines should be followed for halting time ships operation, travel period for the ships and Port Crafts.	Emissions dispersion studies need to be worked out	Traffic and Marine

S= Short Term (6 Months to 1 Yr), M = Mid Term (2.5 to 3 Yrs.), L = Long Term (4.5 to 5 Yrs.)

Activity	Potential Impact	Mitigative Measures	Remarks	Responsibility
Water Environment				
Short Term Measures				
Vehicle / Material Handling Equipment Washing **(S)**	Leakages and spillages of oil at marine environment	• As a part of maintenance activities, vehicles are washed and runoff water contains certain amount of oil and grease.to be collected in gravity type oil trap • Oil should be collected from oil trap regularly. Collected oil should be disposed off as per Ports rules and regulations.	Modern techniques for oil separation should be implemented. Toxicity assessment for nearby ecosystem should be evaluated	M&EE & Traffic, PPD.
Maintenance of Buoy in channel - Touch up Painting/ light repairs/ batteries replacement, light, charges wiring etc. **(S)**	Spillage of paint Buoy may sink in its position due to poor conditions, Fall of battery in to water	• Maintenance work should be carried out at designated workshop. • Training awareness to workers with regular inspection • Frequency of repairs for wastage from batteries and paint control should be supervised under authority • Filling distilled (battery water) regularly • Replacement of battery during reasonable Time	Procedure shall be included in IMS manual	Marine & M&EE
Supply of fuel to tugs **(S)**	Spillage of fuel in water	• Inspection of tugs, containers carrying fuel supply, pipelines, should be carried out with respect to the fuel capacity, frequency etc. • Supervision for Fuel consumption and to avoid adulteration if any is required.	• Proper oil dispersants shall be provided whenever spillage occurs. • Hazardous and flammability impact should be taken in to consideration. • SOP shall be prepared	Marine
Water supply to Township. & Port area **(S)**	Quality of water	• Availability of fresh water without any contamination to port and ships shall be ensured • Wastage of water shall be controlled.	• Disinfection of the water to be supplied to the user from the port reservoirs • Undertake water conservation plan and frequently audit the water balance.	PPD Dept.

S= Short Term (6 Months to 1 Yr), M = Mid Term (2.5 to 3 Yrs.), L = Long Term (4.5 to 5 Yrs.)

Activity	Potential Impact	Mitigative Measures	Remarks	Responsibility
Water Environment (Contd..)				
Short Term Measures				
Sewage **(S)**	Collection & disposal of sewage	• The quantity and quality of effluent should be measured before discharge. • Quality of treated sewage water is to be monitored with assistance of govt. approved lab, once every month to ensure compliance to discharge standards for land for irrigation as per schedule-VI of The Environmental Protection Rule, 1986.	• The existing STP is in bad condition and need to be modify • Treated water should be used for flushing and dust suppression after treatment • Inspection and maintenance of sewerage underground pipe line for leakage. • Sludge should be used as manure in plantation etc. or can be given to farmers of nearby village	PPD Dept.
Mid Term Measures				
- Removal of Sludge oil by Road Tankers, Pipeline - Bunkering by Barges**(M)**	- Spillage of oil in channel/ sea - Leakage due to hose failure	• Frequent awareness programme, through mock drill, training, inspection, and penalty should be worked out. • Readiness of pollution response equipment including tug boats. • In addition to above appropriate check list should be implemented to avoid spillage or leakage of oil.	• Oil spillage into the marine ecosystem should be strictly avoided which disturb the ecosystem. • Conservation and restoration plant of mangrove ecosystem in case of accidental spillage near mangroves area. • Proper disposal of discarded material like drums, cans etc. • SOP should be developed	Marine, PPD & Traffic
Removal of Garbage from Vessels/ Port crafts/ launches **(M)**	Throwing of garbage into water	Strict vigilance and restriction should be imposed on visiting ships/vessels/launches	Separate collection system be developed for garbage collection and disposal	Marine

S= Short Term (6 Months to 1 Yr), M = Mid Term (2.5 to 3 Yrs.), L = Long Term (4.5 to 5 Yrs.)

Activity	Potential Impact	Mitigation Measures	Remarks	Responsibility
Water Environment (Contd..)				
Mid Term Measures				
Passenger launch service between JNPA and Mumbai **(M)**	Spillage of oil/oily water during aeration, Capsizing of launch, Throwing of garbage into water	• Frequent inspection of ferry boats should be undertaken by port authorities. • Awareness, training with guidelines needs to be developed for boat drivers	• Provision of dustbin for onboard passenger • Display of cautionary boards	Marine
Spillage of sludge oil/liquid cargo including chemical oil spillage in channel during transfer of sludge oil / bunkering by barges **(M)**	Contamination of water due to spillage	• All possible measures should be taken to avoid oil spillage in water • PR (Pollution Response) equipment should be kept as stand by Priority should be given for collecting oil spill by physical means such as boom and skimmers. • Implementation of work instruction for the same	• In addition appropriate check 'list should be implemented to avoid spillage or leakage of oil. • Precautionary measures should be kept ready in case of emergency • A set of procedures shall be prepare to handle the incidence	Marine
Handling of Liquid Cargo **(M)**	Leakage/ Spillage of harmful gases form cargo /chemical	• Cargo Handling Operation at BPCL Berths & Shallow Water Berths should be supervised and control the spillage and emission exhausts. • Monitoring of gases pollutant and VOCs should be carried out.	• Safety awareness • Proper disaster management plan need to be drawn and communicated to all concerns • A set of procedures shall be prepared • SOP for handling to be implemented	Marine, Traffic Dept
Hospital activity **(M)**	Disposal of glass/ used cans, Garbage waste in polyethylene bags	Water discharged from hospital activities is treated in STP. All necessary precautions and procedures need to be followed, such as wiping any spilt sample after decontamination with dettol/hypochlorite- Disposal through biomedical waste mechanism etc.	• Implement the proper Bio Medical Waste (BMW) guidelines. • Separate incinerator should provide for discarding material.	Admin Dept.

S= Short Term (6 Months to 1 Yr), M = Mid Term (2.5 to 3 Yrs.), L = Long Term (4.5 to 5 Yrs.)

Activity	Potential Impact	Mitigation Measures	Remarks	Responsibility
Water Environment (Contd..)				
Long Term Measures				
Dredging activity - Silt deposition and their removal to dumping ground **(L)**	Generation of sludge oil leakage from dredging Threat to flora /fauna	• Control measures should be adopted for formation of plumes of suspended sediments around dredgers • Draw demarcation line and limit considering the coastal regulation zone guidelines	Designated area for disposal and Estimation dispersion studies should be carried out. Toxicity assessment should be carried out with LC50/ LD50 studies for marine environment	PPD & Marine
Discharge of Ballast water **(L)**	Mixing of ballast water with sea water	Ballast water management shall be taken up as per the IMO guidelines after signing convention by India, However as a green port activity the port can take up ballast water reception and treatment facility as a pilot project.	Draw guidelines in consultation with Directorate General of Shipping	Marine

S= Short Term (6 Months to 1 Yr), M = Mid Term (2.5 to 3 Yrs.), L = Long Term (4.5 to 5 Yrs.)

10.7 GREEN PORT INITIATIVES OF JNPA

The "Green Port" initiative by JN Port is to give utmost importance to the protection of the Environment while developing the Port's infrastructure facilities and Port's operation.
The Port has following objectives for achieving Green Port status:

- Long term vision which strives towards an acceptable ecological footprint.
- Transparent stakeholder participation and stakeholder approved strategies to operate and grow.
- Shift from sustainability as a legal obligation to sustainability as an economic driver
- (Economic development and sustainable development as complementary factors).
- Actively sharing knowledge with and from other ports and stakeholders.
- Continuous strive towards innovation in process and technology.

Green port Initiatives are part of the continual Improvement techniques and also a part of JNPA's mission "Pursuing the principles of sustainable development".

10.8 ENVIRONMENTAL MANAGEMENT CELL

The persons-in-charge of the proposed project shall look after environmental management. At the site, they interact with respective State Pollution Control Boards (SPCBs) and meet the regulatory requirements.
Technical officers will regularly carry out the following:

- Sampling and analysis of noise and water samples.
- Systematic and routine housekeeping at the project site.

- Creation of awareness of pollution hazards among all JNPA personnel related to the project,

Apart from the regulatory requirements, officials conduct environment auditing to improve the performance. As part of company's endeavor, JNPA has been accredited with national and international certification of repute such as ISO: 14001 and ISO: 9002. Under this following aspects are covered.

- Reviewing the whole operation of port, once in every two years, to identify the environmental aspects.
- Following the changes/amendments to central/state legislation pertaining to environment management.
- Assessing the level of experience, competence and training to ensure the capability of personnel, especially those carrying out specialized environmental management functions.
- Conducting environmental awareness programme for the employees at the site.
- Measurement of pollution emissions levels through an external agency approved by SPCBs.
- Bi-annual reporting to MoEF&CC/SEIAA on status of compliance with terms and conditions of environmental clearance for proposed project.

- Annual reporting on environmental status to state pollution control boards for consent to operate under air/water act.

10.9 OCCUPATIONAL HEALTH & SAFETY

JNPA has a well-established OHS management plan in place. Various elements of the program are given below.

10.9.1 OBJECTIVE OF OCCUPATIONAL HEALTH PROGRAMME

Occupational Health Programme at JNPA aims to preserve and promote the health of employees. This programme aspires to give better quality of life and happiness to the employees, which in turn will enhance productivity of employees. Occupational Health is not restricted to specific occupational diseases but takes care of all aspects of health -preventive, promotive, curative, and rehabilitative.

Occupational Health Programme is expected to provide a scientific basis for decisions aimed at protection of human health from any possible adverse consequences of exposure to the hazards in the occupational environment.

The main objectives should be:

1. Establishment/provision of occupational health care in or near to the place of work for

   - Protecting the employees against any health hazard arising out of work.
   - Adaptation of work to the employees.
   - Establishment and maintenance of the highest possible degree of physical and mental well-being of the employees.
   - If it is not practicable to establish Occupation Health Centre, alternative arrangement with local physicians/nominated hospitals will be made.
   - Comply all rules and regulations on Occupational Health.

2. The role of Occupational Health monitoring is essentially preventive.

3. Monitoring the factors which may affect the health of the employees through Occupational Hygiene monitoring, including periodic inspection and evaluation of workplaces to identify potential hazards, measure them when appropriate, suggest control measures as needed and advise in this respect to management and to employees or their representatives in the unit/installation.

4. Job analysis for best possible adoption of the job to the employee, in particular, handicapped employees, in accordance with their physical abilities, participation in the rehabilitation and retraining of employees.

5. Monitoring of the hygiene of sanitary installations and all other facilities, such as, kitchens, canteens, day nurseries and rest homes and, as necessary, monitoring of any dietetic arrangements made for the employees.

6. Pre-employment, pre-placement, periodic and special medical examinations including, where necessary, biological and radiological examinations.

7. To advice individual employees at their request regarding any disorder that may occur or be aggravated in the course of work.

8. Emergency treatment in case of accident or indisposition, and also, in certain circumstances and in agreement with those concerned (including the employee's own physician), treatment for minor illness of employees who have not been absent from work or who have returned after absence.

9. In the event of fire, explosion, escape of toxic gases, chemicals etc., Occupational Health Monitoring shall ensure the availability of the necessary infrastructure for emergency treatment to be administered.

10. Conduct surveys and investigations on potential occupational health hazards, for example by the sampling and analysis of the environment of work places, of the products and materials used, or of any other material suspected of being harmful.

11. Assist Training Department to impart initial and refresher training of employees in first-aid awareness programme on occupational health and hygiene & Supervision & maintenance of equipment.

12. Compilation and periodic review of statistics concerning hygiene conditions

13. Liaison with external services and bodies dealing with issues of health, safety, retraining, rehabilitation, reassignment and welfare of the employees.

Keeping in view the above objectives, full-fledged occupational Health Centers have been set up at JNPA. The main functions of occupational Health Centers should be:

- Identification of occupational health hazards and their control techniques.
- Screening of all employees exposed to chemical, toxic or any harmful substance for regular checkup at periodic intervals.
- Pre-employment medical check-up.
- Carry out biological and toxicological checkup of personnel engaged in handling of chemicals at periodic intervals.
- Pulmonary lung function testing for identified groups.
- Audiometry of employees working in high noise areas.
- Vision testing of all employees.
- Work environment and personal exposure monitoring.
- Maintaining records of health-status for each employee undergoing periodic examination and analysis of the same.

OH-MS Elements	**Requirement**
Leadership and Commitment	Commitment of the top management to good OH practices

Policy and Strategic objective	Organization's appreciation of all significant OH hazards for planning, hazard identification, risk assessment and risk control
Organization and resources	Organization of people, resources and documentation for good OH performance
Health Risk Assessment	Identification and evaluation of OH risks for the activities, products and services and development of risk reduction measures

BUDGET FOR ENVIRONMENTAL MANAGEMENT PLAN

Sr. No.	Items	Cost (in lakhs) During Construction	Cost (in Lakhs) During Operation	Recurring Cost (in Lakhs)
1	Air Environment	3.5	1.3	0.20
2	Water Environment	3.5	1.5	0.20
3	Noise Environment	2.5	1.2	0.10
4	Ecology Management	2.9	1.3	0.20
5	Training and Education	2.5	--	0.10
6	Social Awareness	3.0	1.0	0.10
	Total EMP Cost	**17.9**	**6.3**	**0.90**

CHAPTER-11 : SUMMARY AND CONCLUSION

11.1 PROJECT NAME, LOCATION AND ENVIRONMENTAL SETTINGS

Jawaharlal Nehru Port Authority, hereinafter referred as JNPA or "Port" is one of the major Indian Ports located on the east side of Mumbai Harbour adjoining the main land of the West Coast of India and was commissioned on 26th May 1989. It is about 6 nautical miles by water route from Gateway of India. It is a fast growing and ISO 9001: 2000 certified Port with single window operations, round the clock pilotage, good vessel traffic management system and dedicated facilities for handling containers, dry bulk and liquid bulk.

Jawaharlal Nehru Port Authority now involves various aspects to be considered for expansion project.

1. Increase of crane Rail span from 20 m to 30.50 m for 680 m berth length.
2. Increase of deck width of the berth by 15 m on land side for smooth vehicle maneuvering & for keeping vessels hatch covers
3. Up-gradation and strengthening of existing 530 m berth and 150 m wharf to accommodate design vessels of size 12200 TEU for which the facility was originally designed & commissioned.
4. Up-gradation of Fenders and Bollards as may be necessary.
5. Repairs and strengthening of existing damaged portion of the berth structures as may be necessary.
6. Underdeck repairs of the existing structure wherever necessary

Table -31: Project and Environmental Settings

S. No.	Particulars	Details
	Type of Project	**7(e) Ports, Harbours, breakwaters, dredging**
A.	**Nature and Size of the Project**	Widening of Existing Container Berth at Jawaharlal Nehru Port Authority, Navi Mumbai, and Maharashtra.
B.	**Location**	
	Village	Nhava
	City	Navi Mumbai
	District	Raigad
	State	Maharashtra
	Geographical Coordinates	Latitude from 18°57'9.50" N to 18°57'28.38" N

		Longitude from 72°56'43.99"E to 72°56'53.46"E
	Manpower Requirement	**Constructional Phase-** Permanent Employment- 10 nos. Contractual Employment- 360 nos. **Operational phase-** Existing Permanent Employment- 125 nos. Proposed Permanent Employment- 15 nos. Contractual Employment- 360 nos.
	Water Requirement	Total water requirement for widening purpose for existing would be 50 KLD and 30 KLD for expansion phase which will be sourced from M/s City and Industrial Development Corporation of Maharashtra Limited (CIDCO)/ Maharashtra Jeevan Pradhikaran through JNPA.
C.	**Cost of the project**	Existing- Rs. 675.34 Crores Proposed- Rs. 196.82 Crores Total- Rs. 872.16 Crores
	Cost for EMP	Rs. 17.9 Lakhs (During Construction phase) Rs. 6.3 Lakhs (During Construction phase)
D.	**Environmental Settings of the area**	
	Location of National Park/ Wild life sanctuary/ Reserve Forest within 10Km radius of the project.	No national park/ Wildlife Sanctuary/ Reserve Forest within 10 Km radius of the project site is envisaged
	Inter-state boundary within 5 Km radius.	No Interstate Boundary is present within 10 km radius of the study area.
	Nearest Town/ Major City with 200000 population	Navi Mumbai is at approx. 20 kms in ENE direction.
	Nearest State Highway/ National Highway	National Highway- NH 348 is at approx 5.0 kms in East direction.
	Nearest Airport	Chatrapati Shivaji International Airport ~ Approx. 50 kms in NNW direction.
	Seismic Zone	Zone III

(Source: Baseline Data, DPR/ Pre-feasibility Report)

11.2 RAW MATERIAL REQUIREMENT

11.2.1 WATER REQUIREMENT

Total water requirement for expansion purpose would be 50 KLD which will be sourced from M/s City and Industrial Development Corporation of Maharashtra Limited (CIDCO) / Maharashtra Jeevan Pradhikaran through JNPA.

11.2.2 POWER REQUIREMENT

200 KVA/KW will be required for expansion purpose. This power shall be provided from MSEDCL through JNPA.

11.2.3 MANPOWER REQUIREMENT

As this is an existing project, there is a great opportunity for employment during Construction Phase and Operation Phase. The JNPA area is very well developed with all kind of infrastructure, power, water, storm water disposal management, sewage management facilities, educational & healthcare facilities, recreational facilities, housing & logistics required for existing JNP area:

During construction phase, no. of permanent employment will be approx. 10 no.s and no. of contractual employment will be approx. 360 no.s.

During Operational phase, no. of existing permanent employment will be approx. 125 and no. of proposed permanent employment will be approx. 15 no. of contractual employment will be approx. 360 nos. Total 500 no. of people will be benefitted during operation phase of the project.

11.2.4 LAND REQUIREMENT

The project is located between NSICT existing container berth and existing Shallow water Berth of JNPA.

11.2.5 CONNECTIVITY

JNPA has very good road and rail linkages with hinterland as well as important business centers like Thane, Pune, Nasik, Aurangabad and Ahmadabad, which facilitate excellent port -industry interface.

Quantity of wastes to be generated (liquid and solid) and scheme for their management/disposal.

- 6.0 TPA domestic waste will be generated and further treated by handing over to MPCB authorized vendors.

• 6.0 TPA Wastes & Residues containing oil will be generated and further treated by handing over to MPCB authorized vendors.
• Used or spent oil will be generated and further send to MPCB authorized vendors

11.3 RAW MATERIALS

Raw material required for the widening of existing container berth is given below:

1. Concrete
2. Bricks
3. Sands
4. Cement
5. Aggregate
6. Pipes
7. Filler rod for welding pipe

11.4 PROJECT COST

Project Cost for proposed project is estimated as Rs. 196.82 Crore.

11.5 ENVIRONMENTAL BASELINE STUDY

Various Environmental factors as existing in the study area which are liable to be affected by the activities have been assessed both quantitatively and qualitatively. Baseline environmental data generation of study area was carried out during the period from September 15th 2022 to December 05th 2022.

Parameters	No. of Sites	Description	Permissible Level
Air Quality	6	PM_{10} - 82 µg/m³ and 48.0µg/m³ $PM_{2.5}$ - 46.0 µg/m³ to 24.0 µg/m³ SO_2 – 18.0 µg/m³ to 5.0 µg/m³ NO_2 –34.0 µg/m³ to 14.0µg/m CO – 0.90µg/m³ to 0.56µg/m³	100 µg/ m³ 60 µg/ m³ 80 µg/ m³ 80 µg/ m³ 2 mg/ m³
Ground Water Quality	5	pH - 7.34 to 7.94 Hardness - 102 to 378 mg/l TDS - 193 to 6317 mg/l.	6.5-8.5 200-600 mg/l 500-2000 mg/l
Surface Water Quality	3	pH - 7.36 to 7.95 Hardness - 36 to 342mg/l. TDS - 101to 1947 mg/l BOD - <2 to 19 mg/l. COD - <4 to 154 mg/l.	---
Soil Quality	4	pH - 7.32 to 7.62	---

Parameters	No. of Sites	Description	Permissible Level
		Nitrogen - 12.75 to 14.23 mg/100gm Organic Matter - 2.08% - 2.92%.	
Noise Level	6	Noise Level (Day) – 40.02-75.0 Leq dB (A) Noise Level (Night) – 36.5- 70.0 Leq dB(A)	75 Leq dB (A) 70 Leq dB (A)

11.6 MARINE WATER QUALITY

i) pH

The marine water in the project area is slightly alkaline. The pH value in the surface and sub-surface water samples ranged from 82 μg/m^3 and 48.0μg/ m^3. The pH values did not show any spatial variations. The pH values of sub-surface and surface water samples at all the stations was more or less same. This could be due to the continuous mixing of the water columns.

ii) Salinity

The salinity varied from 25.5 to 42.5 mg/l in sub-surface water samples. The salinity in sub surface water samples was observed to be marginally higher than surface water samples at all the stations.

iii) Biochemical Oxygen Demand (BOD)

The BOD levels observed at various sampling stations are around 2.4 to 6.5 mg/l. The index of organic pollution as reflected by the BOD values was found to be slightly high in the stations adjacent to the terminal.

Conclusion

Considering the activities in the Harbour area and the results, it can be concluded that the Port's working does not affect the Quality of the Marine water. The overall Marine Water Quality of the Port's Harbour and Creek waters is in good category.

11.6.1 SEDIMENTS CHARACTERISTICS

i) Textural Analysis

The texture of sediments of the area to be dredged was silty clay. The texture observed in the sediment samples collected from the JNP area indicates the limited inputs of fresh water.

ii) Heavy metals

The concentration of heavy metals in sediments is detailed in Chapter -3. It may be seen that there is a good correlation between the heavy metal concentration in sediments and that in water.

11.7 MARINE BIODIVERSITY STUDY

i) PHYTOPLANKTON

Phytoplankton population and diversity was comparatively good during this sampling. The phytoplankton was represented by 21 genera. Phytoplankton of the sampling stations at sub surface layer was varying from 40-2715 units/cells/L in harbour area. In the present investigation, the diatoms were found to be the dominant group. *Biddulphiasp., Pleurosigma sp., Coscinodiscus sp., Cyclotella sp., Hemodiscus sp., Thallasiosira sp., Skeletonema sp. and Navicula sp.* etc. were prominent genera. Harrison et al (1991) reported that the rapid proliferation of Skeletonema in nutrient rich areas is due to the input of organic waste. Indiscriminate disposal of sewage and industrial waste have been the major cause for the nutrient enrichment in coastal waters leading to reduction in diversity but with increase in total biomass, promoting some opportunistic algal species to dominate and suppress others (Dedegren, 1992 and Kimor, 1991).

ii) Zooplankton

Zooplankton is an important constituent of pelagic ecosystems. Zooplankton feed on the phytoplankton, bacteria, microorganism and all fresh water fishes feed on zooplankton at some stages in their life history. Zooplankton population and diversity was comparatively good during this sampling. The zooplankton was represented by 13 genera.

iii) Mangroves

Mangrove ecosystem, the most common natural marine wetland, consists of perennial plants of potentially high productivity and biomass, which have extensive root system that may be effective in trapping soil and nutrients. The plants are also specially adopted to the stressed environmental condition characterized by relatively high temperature, fluctuating salinities and shifting anaerobic/ aerobic substrata. In Thane creek mangroves occur at Pir Pau, Elephanta, Butcher, Uran, Nhava, Sheva, Thane-Panvel, Panje-Mora-Karanja and Dharamtar covering an area of about 48 km2. The region represents 23 species of mangroves and 3 species of associated mangroves species like *Avicennia marina, A. alba, A. officinalis and Sonneratia apetala* are dominant.

11.8 ECO-SENSITIVE ZONE IN THE STUDY AREA

There is no ecologically sensitive (RF/PF/ National Park /Wildlife sanctuary and also Corridor) area in the 10km study area.

11.9 SOCIOECONOMIC CONDITION

Socio-economic status has been studied through secondary sources. The social requirements identified such as Drinking water requirement, Promotion of Educational institutions and Medical facilities to the villagers (especially Senior Citizens and infants or pregnant ladies). Community centers, recreation facilities etc is being developed as part of social responsibility.

11.10 ENVIRONMENTAL MANAGEMENT PLAN

JNPA Green Port Initiates:

- **Usage of E-Vehicles inside the port area**: Nine e-vehicles are zero-emission vehicle that will enable JNPA transition to green and energy-efficient mobility solutions. Estimated savings of 47 tonnes equivalent CO2 per year.
- **Solar Power Generation**: 4.10 MWp. 38% of avg. power requirement is from renewable energy. Upcoming solar plants of 1.5MWp storage type.
- **Rejuvenation of Water Body near Sheva Temple and Sheva Foothill at JNPA**: In order to encourage green projects in port area, it is decided to preserve the water bodies located in JNPA area. The existing water bodies which are located at Sheva temple and Sheva foothill are filled with rain water and remain wetted for entire season. The rejuvenation of water bodies also included in Maritime India Vision 2030.
- **Solid Waste Management**: 10 MT/Day Solid Waste Management Facility commissioned in the month of February 2021 as per SWM rule 2016 for port users, Port Township and certain villages within port estate. All ships bound for JNPA are registering in Swachh Sager Portal and Port Reception Facility are being provided as requested. Reception facilities for MARPOL annex - 1, 2, 5 & 6 are provided to vessels calling JNPA.
- **Sustainability Report**: The Port First Sustainability Report is completed as per Global Reporting Initiative (GRI) standards. The Sustainability Report reflects JNPA's commitments and achievements in fostering leadership in sustainability and creating value for the trade – depicted across the economic, social, and environmental parameters of the Global Reporting Initiative (GRI) Standards 2020.

- **LEDs lamps replaced in Port area and township**: Total 3,979 nos. LEDs lamps replaced in the port Estate, from this 7, 12,058 kwh energy saving per annum. JNPA has taken job of

replacement of 400 Nos of 800 W HPSU by 400 W LED light fittings saving from this project will be 6,91,200 units per annum.

- **E RTGCS**: JNPA has total 31 numbers of electrically operated RTGCs. Carbon footprint savings per year at the rate of 1.5842 kg equivalent per move. Carbon footprint saving per year approximately 1500 tonnes per year.

- **Shore power supply**: JNPA is providing shore power supply to tugs and port crafts.

- **Initiative for ease of Traffic** Congestion: Total distance per TEU has reduced to 2.5 KM from earlier 5.0 KM. ITRHO Traffic has reduced to approx. 60% with green channel, reducing average from 45 TT to 15 TT performing the ITRHO operation on daily basis. The carbon footprint has drastically reduced to 50% with green channels,
- JNPA is putting maximum efforts to become JNPA as green Port by implementing Green Port initiatives in planned manner.
- **Use of recycled sewage water:** The treated sewage water of STP is being used for the gardening purpose of JNPA township and about 1 MLD treated water is being used which reduced the burden on use of drinking water. The port has further planned to increase use of recycled water for tank farm area**.**
- **Centralized Parking Plaza:** JN Port's Centralized Parking Plaza is equipped with a huge parking capacity to help park 1,538 tractor trailers in one go, hereby integrating document processing by Customs and streamlining traffic movement using Real Time Parking Management system. Reduce congestion on road.
- Use of recycled sewage water: The treated sewage water of STP is being used for the gardening purpose of JNPA township and about 1 MLD treated water is being used which reduced the burden on use of drinking water. The port has further planned to increase use of recycled water for tank farm area.

Ministry of Ports, Shipping and Waterways, GoI has formulated "Harit Sagar" Green Port Guidelines, to reduce carbon intensity and to develop an environment friendly ecosystem at Major Ports, same will be followed at JNPA. JNPA is putting maximum efforts to become JNPA as green Port by implementing Green Port initiatives in planned manner

11.11 CRZ STATUS

As per the CRZ notification 2011, JNPA has duly obtained project layout superimposed on existing CZMP from Institute of Remote Sensing (IRS), Chennai. **The entire project alignment falls under CRZ IV (a) area.**

11.12 CONCLUSION

The Jawaharlal Nehru Port is one of the largest container ports in India, located in Navi Mumbai, Maharashtra. India's international trade has been steadily growing and has led to rising cargo volume. JNPA plays a crucial role in handling a significant portion of the country's import and export cargo. As trade volume increases, there is a need to expand the port's capacity to handle more goods efficiently.

Jawaharlal Nehru Port will follow a comprehensive environmental management plan (EMP) to ensure safe and clean environment which meets all statutory requirements.

Widening of Container birth by 15 meters from the existing width of 45.5 meters to a width of 60.5 meters will help to improve the operational efficiency of the Port which is an urgent requirement of Jawaharlal Nehru Port for meeting the growing need of EXIM trade.

CHAPTER-12 : DISCLOSURE OF CONSULTANT

12.1 INTRODUCTION OF ORGANIZATION

Mantec Consultants Pvt. Ltd., established in 1979, is a multi-disciplinary consulting firm offering infrastructural, environmental, management, technical and IT services.

Our team consists of technical and management experts coming from the top echelons of various professional services. The in-house capabilities are augmented and strengthened by our panel of associates who are well known experts in their respective fields.

We provide a complete range of environmental and social impact assessment services with an expert In-house team of professionals and associates. Mantec is an ISO9001:2015 & OHSAS certified company, having a full-fledged Environmental Laboratory duly recognized by the Ministry of Environment Forest & Climate Change (MoEF&CC) and accredited by NABL (National Accreditation Board for Testing Calibration Laboratory). We are accredited by NABET/QCI for conducting the EIA studies.

Commitment to excellence has been the company's credo since the day of its inception and forms the central emphasis in all our operations.

12.2 SERVICES OFFERED

We, Mantec is providing various environmental services in more than 15 industries/sectors including infrastructure, mining, irrigation, river valley projects, power plants, refineries, ports, airports, highways, residential colonies, hazardous waste sites, forestry and rural development projects etc.

1. Environmental Impact Assessment Studies
2. Environment Management Plans
3. Social Impact Assessment Studies
4. Rehabilitation and Resettlement Studies and Resettlement Action Plans
5. Safety Audits & Environmental Audits
6. Risk Analysis and Disaster Management Plans
7. Environmental Monitoring of Air, Water, Noise, Soil, Solid and Wastes
8. Environmental Monitoring of Industrial emissions, industrial effluents, ambient air etc.
9. Waste Water Management Both domestic (sewage) and industrial
10. Ground & Surface Water Treatment and Supply
11. Design and implementation of Wastewater Treatment Plants as well as Common Effluent Treatment Plants
12. Studies on River, Lake and Forest ecosystems

13. Watershed and Waste land management
14. Solid Waste Management including Hazardous and Biomedical Waste Management
15. Oil Spill Response
16. Rehabilitation of Mines
17. Remote sensing and GIS survey

12.3 LABORATORY FACILITY & EQUIPMENTS

Mantec Environmental Laboratory (Recognized by MoEF&CC and Accredited by NABL)

Monitoring & Analytical Capabilities for;

- Ambient Air
- Stack Gas emissions
- Process and work zone
- Indoor Air
- Volatile organic compounds (VOC's)
- PAH's in Ambient Air
- Hydrocarbon in Ambient Air and Stack
- Heavy metals in Ambient Air, water, Soil
- Ultimate and proximate analysis. (C.H.N.S.O)
- Air Modeling
- Drinking Water, Raw Water and Process Water Analysis
- ETP and STP Water Analysis
- Soil, Sludge and Hazardous Waste Analysis

Lab Equipments

- Dust Samplers and $PM_{2.5}$ Sampler
- Stack Monitoring Kit
- Organic Vapor Sampler
- Non Dispersive Infrared Spectrophotometer (NDIR)
- Atomic Absorption Spectrophotometer
- Gas Chromatograph
- UV Spectrophotometer
- Flame Photometer
- Mercury Analyser
- COD Digester
- Micro meteorological Station
- ICP OES
- ORSAT
- CO Analyzer
- Bacteriological Chamber
- Digital Ultrasonic
- Multigas Analyzer

12.4 ADDRESS & CONTACTS

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Environment Division,
D-36, Sector-6, Noida- 201301
Email: envmantec@gmail.com,
Ph: 0120 – 4215804, 4215000 Fax: 0120-4215809

12.5 ESTEEMED CLIENTELE

1. BHARAT HEAVY ELECTRICALS LIMITED
2. BHARAT ELECTRONICS LIMITED
3. FCI ARAVALI GYPSUM AND MINERALS INDIA LIMITED
4. HINDUSTAN PETROLEUM CORPORATION LIMITED
5. INDIAN OIL CORPORATION LIMITED
6. NTPC LIMITED
7. NATIONAL HYDROELECTRIC POWER CORPORATION
8. INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION
9. ISHIKA FERTILIZER LIMITED
10. JAI PRAKASH ASSOCIATES
11. JUBILANT AGRI AND CONSUMERS PVT. LTD.
12. TATA CHEMICALS LIMITED
13. NATIONAL HIGHWAY AUTHORITY OF INDIA
14. NATIONAL FERTILIZERS LIMITED
15. PUNJAB ALKALIES AND CHEMICALS LTD.
16. RAJASTHAN STATE MINES AND MINERALS INDIA LIMITED
17. MYSORE MINERALS LIMITED
18. KANDLA PORT TRUST
19. KARNATAKA POWER CORPORATION LIMITED
20. KUMAON MANDAL VIKAS NIGAM LIMITED
34. LOUIS BERGER GROUP
35. AMBUJA CEMENT
36. WAPCOS LTD.
37. INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION
38. IL&FS TRANSPORTATION NETWORK LTD.
39. THDC INDIA LTD.
40. MADHYA PRADESH ROAD DEVELOPMENT CORPORATION
41. VEDANTA RESOURCES
42. RAVI TAWI IRRIGATION COMPLEX, GOVT. OF J&K
43. INSTITUTE OF CHEMICAL TECHNOLOGY
44. JHARKHAND ISPAT PVT LTD
45. KARNATAKA VETERINARY ANIMAL AND FISHERIES SCIENCES UNIVERSITY
46. ESSAR STEEL INDIA LTD.
47. WELCOME FOOTWEAR
48. COIM INDIA PVT. LTD.
49. HARYANA STATE ROADS AND BRIDGES DEVELOPMENT CORPORATION LIMITED
50. ULTRATECH CEMENT LTD.
51. AXISCADES ENGINEERING TECHNOLOGIES LTD.

21. SAURASHTRA CHEMICALS LIMITED, GUJARAT 22. UTTARAKHAND FOREST DEVELOPMENT CORPORATION 23. SUMAN ENTERPRISES 24. JAI YAMUNA JI DEVELOPERS 25. MARKANDESHWAR CONSTRUCTION COMPANY 26. M.P. STATE MINING CORPORATION LTD. 27. JINDAL MECTEC PVT. LTD. 28. HARYANA MINING CO. 29. ELDECO INFRASTRUCTURE 30. ANSAL PROPERTY & INFRASTRUCTURE 31. DELHI STATE INDUSTRIAL AND INFRASTRUCTURE DEVELOPMENT CORPORATION (DSIIDC) 32. EXOTICA HOUSING LTD. 33. SATLUJ JAL VIDYUT NIGAM (SJVN)	52. INVESTIGATION DESIGN & RESEARCH BOARD (IDRB), KERALA 53. WATER RESOURCE DEPARTMENT, RAJASTHAN 54. BHARAT PETROLEUM CORPORATION LIMITED 55. ADOR FONTECH LTD. 56. PUBLIC WORKS DEPARTMENT DELHI 57. THE INDIAN EXPRESS 58. WATER RESOURCES DEPARTMENT, GOVT. OF JHARKHAND 59. SUN PETRO CHEMICALS PVT.LTD. 60. TANCEM 61. FCI ARAVALI

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Certificate of Accreditation

Mantec Consultants Pvt Ltd, Noida

D-36, Sector – 6, Noida, Uttar Pradesh-110019

*The organization is accredited as **Category-A** under the QCI-NABET Scheme for Accreditation of EIA Consultant Organization, Version 3: for preparing EIA-EMP reports in the following Sectors –*

S. No	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1	Mining of minerals- Open cast only	1	1 (a) (i)	A
2	River Valley projects	3	1 (c)	A
3	Thermal power plants	4	1 (d)	A
4	Petroleum refining industry	10	4 (a)	A
5	Chemical Fertilizers	16	5 (a)	A
6	Pesticides industry and pesticide specific intermediates	17	5 (b)	A
7	Isolated storage & handling of Hazardous chemicals	28	-	B
8	Ports, harbours, break waters and dredging	33	7 (e)	A
9	Highways	34	7 (f)	A
10	Building and construction projects	38	8 (a)	B
11	Townships and Area Development projects	39	8 (b)	B

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in RAAC minutes dated September 15, 2023 posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in QCI-NABET's letter of accreditation bearing no QCI/NABET/ENV/ACO/23/2942 dated October 11, 2023. The accreditation needs to be renewed before the expiry date by Mantec Consultants Pvt Ltd, Noida following due process of assessment.

NABET

Sr. Director, NABET
Dated: October 11, 2023

Certificate No.
NABET/EIA/2326/RA 0305

Valid up to
April 20, 2026

For the updated List of Accredited EIA Consultant Organizations with approved Sectors please refer to the QCI-NABET website.

National Accreditation Board for Education and Training

Ref. No. QCI/NABET/ENV/ACO/23/2942 October 11, 2023

To,
Mantec Consultants Pvt Ltd,
D-36, Sector – 6,
Noida, Uttar Pradesh-110019

Sub: Accreditation of EIA Consultant Organizations under NABET Scheme

Ref.: Your application dated March 13, 2023 subsequent correspondence on subject and Stage III (office assessment) dt July 20-22, 2023

Dear Sir/Madam,

QCI-NABET is hereby pleased to accredit Mantec Consultants Pvt Ltd, Noida as **Category- A** organization. Details of Sectors are mentioned in the Certificate of Accreditation.

The validity of accreditation is subject to continued compliance to the Scheme and the terms & conditions mentioned in Annexure I to IV.

NABET looks forward to your association and continued support.

With best regards,

(A K Jha)
Sr. Director, NABET

Institute of Town Planners India, 6th Floor, 4-A, Ring Road, I.P Estate, New Delhi-110 002, India
Tel. : +91-11-233 23 416, 417, 418, 419, 420, 421, 423 E-mail : ceo.nabet@qcin.org Website : www.qcin.org

NABL Certificate

National Accreditation Board for Testing and Calibration Laboratories

NABL

CERTIFICATE OF ACCREDITATION

MANTEC ENVIRONMENTAL LABORATORY

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

D-36, SECTOR -06, NOIDA, GAUTAM BUDDHA NAGAR, UTTAR PRADESH, INDIA

in the field of

TESTING

Certificate Number: TC-6440

Issue Date: 11/06/2022 Valid Until: 10/06/2024

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.
(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Entity : MANTEC CONSULTANTS PVT. LTD.

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer

Annexure - V

BY SPEED POST

920

सत्यमेव जयते

भारत सरकार / Government of India
जल शक्ति मंत्रालय / Ministry of Jal Shakti
जल संसाधन, नदी विकास और गंगा संरक्षण विभाग
Department of Water Resources, River Development and Ganga Rejuvenation
केन्द्रीय जल और विद्युत अनुसंधान शाला
खड़कवासला, पुणे - 411 024
CENTRAL WATER & POWER RESEARCH STATION
Khadakwasla, Pune – 411 024

संख्या: PH-III/2023/811 /1154

दिनांक:15/09/2023

20 SEP 2023

Dr. G. Vaidyanathan
Chief General Manager, (PP&D),
Jawaharlal Nehru Port Trust,
Administrative Bldg., Sheva,
Navi Mumbai – 400 707.

(Kind Attn: Shri. V.G. Gharat, Dy. GM, PPD)

Sub: Widening of existing container berth at Jawaharlal Nehru Port – reg.
Ref: 1) JN Port letter No. JNP/PPD/MOM/EAC/2023/872 dated 02.08.2023
2) JNPT E-mail dated 16th August 2023 and 28th August 2023

Sir,

This has reference to JNPA letter dated 02.08.2023 vide which it was communicated that JNPA has a proposal to widen the existing container berth of JNPA towards landside (Cargo handling capacity 22.1 MTPA). It was also mentioned that JNPA approached MoEF&CC for CRZ clearance on 14th February 2023 and proposal was recommended to grant TOR during 333rd EAC meeting held on 12th July 2023 with specific conditions. The minutes of the meeting of EAC INFRA-1 mentioned at point (7) about Hydrodynamics study on impact of dredging on flow characteristics shall be carried out. In this context, JNPA mentioned in their letter at Ref. 1 that there is no scope of dredging in present proposal and scope is only limited to widening of existing jetty towards land side for smooth vehicle maneuvering and for keeping vessels hatch covers. In this context JNPA vide their email dated 16th August and 28th August 2023 forwarded the development proposal and drawings to CWPRS. After scrutiny of these drawings/proposal and as communicated by JNPA, it seems that dredging is not envisaged for the development under consideration.

Considering the above, since the dredging is not proposed in the said development, there is no scope to carry out the hydrodynamic studies to assess the impact of dredging on flow characteristics. As such there are no comments to offer in this regard.

Thanking you,

Yours Sincerely,

15/09/2023

(A. A. Purohit)
Scientist-E

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जारी किया गया
ISSUED
20/9/23

Annexure - VI

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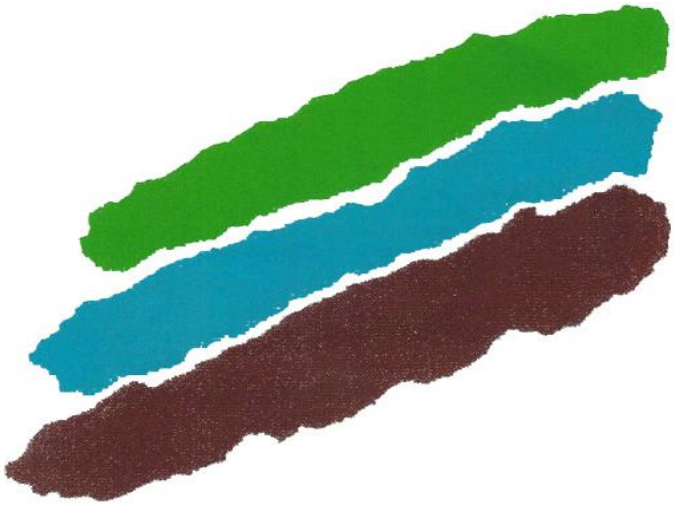
NIO/SP-22/2023
SSP3552

STUDIES ON THE IMPACT OF WIDENING OF EXISTING CONTAINER BERTH ON THE MARINE ECOLOGY AND BIODIVERSITY AROUND JAWAHARLAL NEHRU PORT

Prepared For:

Jawaharlal Nehru Port Authority (JNPA)

September, 2023



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STUDIES ON THE IMPACT OF WIDENING OF EXISTING CONTAINER BERTH ON THE MARINE ECOLOGY AND BIODIVERSITY AROUND JAWAHARLAL NEHRU PORT

Project Leader
Dr. P.S. Rakesh

Associate Project Leaders
Dr. Soniya Sukumaran
Dr. Umesh Kumar Pradhan

September, 2023

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EXECUTIVE SUMMARY

Introduction

Jawaharlal Nehru Port Authority (JNPA) was commissioned in May 1989 and is located at $18^0$56'43" N (latitude) & $72^0$56'24' E (longitude), covering a total land area of 2584 Hectares. JNPA is planning to widen the existing container berth located between Nava Sheva International Container Terminal (NSICT) container berth and the shallow water berth. JNPA would like to assess the impact of the widening of the existing container berth on the marine ecology around the project site. The proposed work includes an increase in crane rail span, increase in deck width by 15m on the land side, upgradation and strengthening of existing 530m berth and 150m Warf, upgradation of fenders and bollards, repairing of damaged berth structures etc.

The proposed project's impact on the marine biodiversity at Thane creek is assessed by the CSIR- National Institute of Oceanography (CSIR-NIO). The present report establishes the prevailing ecological status of the marine environment of the project area and analyses the probable environmental perturbations due to the proposed project. Based on the assessment, JNPA has to implement mitigation measures to reduce these impacts on marine water quality and ecology.

Project Information

Jawaharlal Nehru Port Authority (JNPA) is proposed to widen the existing container berth located between the NSICT container berth and the existing shallow water berth. The geographical location of the project site is between 18°57'9.50"N to 18°57'28.38"N and 72°56'43.99"E to 72°56'53.46"E. The proposed project involves increasing the crane rail span from 20 m to 30.50 m for 680 m berth length, increasing the deck width of the berth by 15 m on land side for smooth vehicle manoeuvring & for keeping vessels hatch covers, up-gradation and strengthening of existing 530 m berth and 150 m wharf to accommodate design vessels of size 12200 TEU for which the facility was originally designed & commissioned, up-gradation of Fenders & Bollards and repairing and strengthening of the existing damaged portion of the berth structures and underdeck repairs of the existing structure whenever necessary.

Prevailing Environment

The water, sediment quality and biological characteristics were assessed from 9 different stations (T1 to T9) of the Thane creek, Mumbai, from March 2022 to January 2023. The stations were categorized into three zones according to their geographical position. Stations T1 and T2 fall in the upper creek segment, and stations T3, T4, T5 and T6 in the middle creek, while stations T7, T8 and T9 lie in the lower creek segment of the study area.

Water Quality

The water temperature in the study area varied between 24.5 to 31.5 ºC (av. 28.0 ºC), with higher temperatures observed during March 2022 and lower during January 2023. The pH values ranged between 7.4 to 8.1 (av. 7.7). The salinity values ranged from 18.8 to 36.6 PSU (av. 30.9 PSU). The concentration of suspended solids (SS) in the study area varied over a wide range of 3.5 to 831.3 mg/L (av. 77.3 mg/L). High SS concentrations were observed during post-monsoon (January 2023) in the upper creek segment of the study area. The DO concentration ranged from 2.4 to 8.1 mg/L (av. 4.4 mg/L) during different seasons in the study area. The BOD concentration ranged from 0.2 to 8.5 mg/L (av. 2.06 mg/L) during different seasons in the study area, with low concentration during post-monsoon (January 2023). The phosphate concentration varied from 1.0 to 5.6 μmol/L (av. 2.8 μmol/L) with a decreasing trend from the upper to lower creek region. The concentrations of nitrate, nitrite, and ammonia ranged from 6.5 to 67.1 μmol/L, 0.4 to 51.8 μmol/L and 0.2 to 96.6 μmol/L respectively. The concentration of PHc varied in the range of 0.9 to 69.8 µg/L during the present study. Comparatively high concentrations of PHc were observed in the upper creek area of the study region during pre-monsoon. The concentration of Phenol varied in the range of 13.2 to 120.4 µg/L.

Sediment Quality

The sediment texture in Thane creek was dominated by silt content. The metal content varied widely between and within segments. Copper concentration varied from 76.5 to 149.0 μg/g and showed a particular trend among seasons and sampling stations. The higher values were observed during the pre-monsoon season and gradually decreased during the post-monsoon season. The concentration of Chromium varied between 147.0 and 184.2 μg/g, with higher values in the upper creek

region. The concentration ranges of Mercury (0.01 – 0.2 μg/g), Manganese (830 – 1498.2 μg/g), Zinc (96 – 186 μg/g), Cobalt (30.9 – 38.8 μg/g) and Nickel (78.3 – 118.5 μg/g) are varied widely without any trend along the stations of the study area during the study period. The total phosphorus in the study area varied in the range of 884 – 1351 μg/g. The total organic carbon in the study area varied in the narrow range of 1.6 to 3.3%, with higher values during the pre-monsoon period. The PHc content in the study area varied between 0.2 to 13.6 μg/g.

Flora and Fauna

Microbes

The average TVC in water in different segments ranged from 23 to 330 x 10^2 CFU/mL. The total viable count in water showed a decreasing trend from pre-monsoon to post-monsoon in the study area. The average TVC count in sediment ranged between 8 to 250 x 10^4 CFU/g, with a maximum at the upper creek region during the pre-monsoon period (March, 2022). Total Coliform (TC), Faecal Coliform (FC), *Escherichia coli* like organisms (ECLO) and *Streptococcus faecalis* like Organism (SFLO) were recorded in both the water and sediment samples.

Phytoplankton

The concentration of chlorophyll *a* during the study period varied in the range of 0.3 to 15.81 mg/m^3. The highest chlorophyll *a* concentration was observed in the upper creek region during the pre-monsoon period. The average concentration of phaeophytin at different segments from the study area also varied in the range 0.0 to 7.1 mg/m^3. The average phytoplankton population at various segments varied over a range of 0.9 to 43495 x 103 cells/L, revealing high and variable phytoplankton cell count, which follows the chlorophyll *a* variation. In general, the phytoplankton population was dominated by diatoms followed by dinoflagellates. During pre-monsoon and monsoon, the study area was dominated by *Thalassiosira* and *Skeletonema*. The post-monsoon showed the dominance of *Pseudo-nitzschia* and *Skeletonema* during the sampling period.

Zooplankton

The zooplankton biomass in the study area during the study period varied from 0.7 to 19.9 mL/100m^3. On average, higher biomass was observed in the upper creek region during the post-monsoon period. The zooplankton population in the different segments was averaged and varied between 5.4 and 160.6 x 10^3 ind/100m^3. The number of zooplanktonic groups was in the range of 9 to 17 Nos. Copepoda was the dominant taxa in the study area during monsoon and post-monsoon followed by decapod larvae.

Macrobenthos

Macrobenthic biomass ranged between 0.0 and 10.4 g/m2 from pre-monsoon to post-monsoon. The macrobenthic population varied from 0 to 925 no/m^2. The number of macrobenthic groups identified from the study area during the study period was 0 to 5 Nos. Polychaetes were found to be the dominant taxa in the study area throughout the study period.

Mangroves

The mangrove studies were conducted at five different sites in the study area: BMCT, Panje, Mora, Nhava Sheva and Elephanta. The mangrove vegetation from the BMCT area was healthy and dominated by the *Avicennia marina* species. Panje area is dominated by *A. marina* and *Ceriops tagal*. *Acanthus ilicifolius, Aegiceras corniculatum* and *Brugiera cylindrica* were also recorded from this site. Mangroves of the species *A. marina* and *Sonneratia apetala* were identified from the intertidal regions of Mora. In Nhava Sheva, the mangrove vegetation from the upper intertidal region was healthy and dominated mainly by *A. marina*. Young plants of *A. marina, A. Alba, A. officinals, and S. apetala dominate* at Elephanta Island.

Fishery

The data collected by CSIR-NIO from the study area and published literature shows the occurrence of 117 species in Thane creek. Species composition consists of 94 finfish species and 23 shellfish species. Shellfish species were comprised of shrimps/prawns (11), stomatopods (1), crabs (6) and cephalopods (5). Major species encountered in the study area are *Coilia dussumieri, Stolephorus commersonnii,*

Johnius belangerii, Johnius dussumieri, Thryssa mystax, Metapenaeus dobsoni, Metapenaeus brevicornis, Mierspenaeopsis sculptilis and *Portunus pelagicus.*

Seagrasses and Seaweeds

No seaweed and seagrass were recorded from the project site and surrounding area during the study period.

Marine Molluscs

The molluscan diversity was assessed from 4 locations of Thane creek viz, BMCT, Mora, Panje and Nhava Sheva during February 2023. A total of 14 species of gastropods representing 12 families were recorded from the study area. Species like *Telescopium telescopium*, *Pirenella cingulata* and *Nerita chamaeleon* were found to be dominant. In total, 6 species of bivalves represented 5 families, with the dominance of *Tegillarca aequilatera* and *Saccostrea cucullata*. 4 species of cephalopoda representing 3 families were also recorded from the study area. The mollusc *Placuna placenta*, listed in the Wild Life (Protection) Amendment Act, 2022: Schedule: II: Part (F) Mollusca were found in the BMCT transect.

Coral and associated flora and fauna

Thane Creek's subtidal and intertidal areas are largely silty and muddy, with high turbidity and zero visibility. During the survey, no scleractinian corals were recorded from the study area.

Marine turtles and mammals

Marine turtles are common along the Mumbai coast and are mainly represented by Logger head (*Caretta caretta*) and olive Ridley (*Lepidochelys olivacea*). Other turtles like Hawksbill (*Eretomochelys imbricate*), Leather back (*Dermochelys coriacea*) and green (*Chelonia mydas*) are occasionally sighted. The marine mammals are chiefly represented by dolphins and porpoises in the coastal waters of Mumbai, though whales are rare. Humpback dolphins (genus *Sousa*) are the most common nearshore cetaceans found along the Indian coast and are highly vulnerable to many anthropogenic pressures. Earlier surveys conducted by the NIO team recorded the presence of dolphins in the study area.

Birds

Thane creek, located between Mumbai and Navi Mumbai, inhabits a large diversity of avifauna and is regarded as one of the Important Bird Areas. Birds including species such as Black-eared Kite (*Milvus migrans lineatus*), Western Marsh Harrier (*Circus aeruginosus*), Booted Eagle (*Hieraaetus pennatus*), Greater Spotted Eagle (*Clanga clanga*), Black-winged Kite (*Elanus caeruleus*), Black Kite (*Milvus migrans*), Brahminy Kite (*Haliastur indus*), Shikra (*Accipiter badius*), Western Osprey (*Pandion haliaetus*), Indian Spotted Eagle (*Clanga hastata*). The upper regions of Thane Creek have recently been declared as a Thane Creek Flamingo Wildlife Sanctuary by the Maharashtra government.

Anticipated marine environmental impacts

The anticipated environmental impacts of the activities related to the proposed project's construction, operation and post-operational phases were identified and described in Chapter 5 (Section 5.1). The significant things covered under this are berth widening and repairing, the impact of shipping operations on the marine environment, air pollution from port operations, noise and light pollution, Impact of cargo handling, ship and boat generated wastes, introduction of non-native species into the marine environment and oil spill.

Mitigation measures

A number of management techniques and mitigation measures have been developed globally to reduce the impact of dredging activities on the marine environment. Detailed mitigation measures connected with each activity, like dredging, berth widening, sea wall construction, impact on flora and fauna, and impact on water and sediment quality, were identified and presented in section 5.4.

Marine biodiversity management plan

A detailed marine biodiversity management plan is presented in Chapter 6. The broader plan describes the management measures that need to be considered during the berth widening and operation phase. The management plan discusses about project activities, associated impacts and mitigation measures in the marine sector, site-specific marine biodiversity management, community/stakeholder involvement in conservation activities, institutional arrangements for marine environmental

management, mechanism for implementation of mitigative measures in the marine segment, approach towards voluntary compliance, management sections cover under MARPOL, legal framework, cost of Marine Environment Management Plan, Marine environment monitoring during construction and operational phase, disaster management plan and environmental sustainability in widening of the existing berth. The responsibility of implementing the marine biodiversity management plan lies with the JNPA and construction contractors, and the cost could be part of the construction contract.

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1 INTRODUCTION

1.1 Background

Jawaharlal Nehru Port Authority (JNPA) was commissioned in May 1989 and located at 18056' 43" N (latitude) & 720 56'24' E (longitude) covering a total land area of 2584 Hectares. JNPA ranked 24th among the top 100 container ports in the world. Jawaharlal Nehru Port is the number one seaport of India in terms of container handling and is well connected by rail and road. The port handles mainly containers, liquid bulk and cement ships. JNP handles about 55% of total containers handled by all Major Ports in India.

JNP has three dedicated container terminals namely JNPCT (Quay Length 680 Mtrs), NSICT (600Mtrs) and GTIPL (712 Mtrs). 23 Container Freight Stations in operation, 30 Inland Container Depots well connected with the port., JNPA is planning to widen the existing container berth located between Nava Sheva International Container Terminal (NSICT) container berth and shallow water berth. JNPA would like to assess the impact related to the widening of the existing container berth on the marine ecology around the project site. The proposed work includes an increase in crane rail span, increase in deck width by 15m on the land side, upgradation and strengthening of existing 530m berth and 150m Warf, upgradation of fenders and bollards, repairing of damaged berth structures etc. In this regard, JNPA has approached CSIR-NIO to prepare a report on the impacts of proposed project activities on the marine biodiversity and prepare a marine biodiversity management plan for the proposed project. Accordingly, the following objectives are proposed:

1.2 Objectives

a) To assess the impact of widening and upgradation activities of existing container berth on the marine ecology around the project site.

b) To Prepare an Environment Management Plan (EMP) for maintaining a healthy ecosystem in the marine area around the project site.

1.3 Approach Strategy

The severity of negative impacts of developments in the coastal zone on the associated marine ecology varied widely depending on many factors such as the extent, period and time of disturbance, anthropogenic perturbation, capacity of receiving water to assimilate contaminants and extent of its ecological sensitivity. Hence, one of the primary requirements for assessing such impacts is the baseline information for the Thane creek and Mumbai Harbour waters. CSIR-NIO conducted

seasonal marine water quality and biodiversity studies in the Thane creek and Mumbai Harbour waters during 2022-2023. The data collected during this period will be used for preparing the biodiversity management plan for the proposed project.

1.4 Scope of Work

The scope of the work is carefully framed through detailed discussion with JNPA, considering the data available with CSIR-NIO. Marine water quality and biodiversity data collected during the period of 2022-23 will be used to prepare the impact of the proposed work on the marine ecosystem and prepare a biodiversity management plan for the proposed project.

I) Sampling

Data collected during 2022-23 from the proposed project area will be used for preparing the biodiversity management plan, keeping in view of the prevailing marine activities of JNPA.

II) Parameters Studied

a) Water Quality

Water quality parameters like salinity, temperature, pH, oil and grease, SS, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), reactive phosphate (PO_4^{3-}P), nitrite (NO_2-N), ammonia (NH_4--N), sulphides, Petroleum Hydrocarbons (PHc) and phenol.

b) Sediment Quality

Texture, organic carbon (C_{org}), phosphorus, selected metals (aluminium, chromium, manganese, iron cobalt, nickel, copper, zinc, lead, cadmium and mercury) and PHc.

c) Biological Characteristics

The biological productivity in terms of chlorophyll a, phytoplankton population and generic diversity; biomass, population and faunal diversity of zooplankton, macro benthos (subtidal) and microbial counts [Total Viable Counts, Total Coliforms (TC), Faecal Coliforms (FC) etc].

d) Mangroves Monitoring

Mangroves from designated sites (2-3) would be assessed for population density, growth and species diversity as well as seeding density.

III) Assessment

Based on the data generated and available for water quality, sediment quality and flora and fauna, the probable impact of widening of the existing berth on seawater and marine ecology will be assessed.

1.5 Regional Environment

1.5.1 Mumbai Bay

The length of the Mumbai Bay from the mouth to the head, is about 27 km with a width of 15 km at the mouth (off Colaba) narrowing to a few hundred meters at the head represented by the inner Thane Creek.

Differential weathering of the inter layered soft tuffs and resistant basaltic flows (Deccan Traps) by seawater has created several bays and creeks around Mumbai including the Mumbai Bay. The Bay is V shaped semi-enclosed basin that opens to the Arabian Sea at its southwest approach and connected at its northern extremity to the Ulhas Estuary through a narrow channel (Kalva Creek). The Bay though broad is shallow, forcing frequent dredging to maintain the navigational depths in the channel and at the berths. The water depth decreases in the upstream due to the positive bed gradient and the creek is barely navigable beyond the Vashi bridge for medium size fishing crafts. The tidal inlets of Dharamtar, Nava Sheva and Panvel are the major tributaries to the Bay discharging into its eastern shore. Mumbai and Jawaharlal Nehru Ports located within the Bay are the major gateways for India's import - export and handle over 45 million t traffic annually which includes crude oil and its products, fertilizers, rock phosphate, sulphur, food grains, metals, chemicals, containerized cargo etc.

Mumbai City with a human population density of 25,000 persons/km^2 generates 2200 mld of domestic sewage out of which a considerable volume enters the Bay, largely untreated. The satellite city of Navi Mumbai and other townships in the Vashi-Panvel sector also release sewage to the Bay. Nearly 8% industries of the country are located around Mumbai in 2 large industrial clusters namely, Chembur-Thane-Belapur belt and Kalyan-Ulhasnagar-Ambarnath belt. These industries release their effluents into the Bay / Ulhas Estuary.

1.5.2 Thane Creek

The Thane Creek forms the upper reaches of the harbour and extends upto the junction with the Ulhas River - a distance of 20 km. The Bassein Creek/Ulhas estuary joins the Thane Creek at the vicinity of old Thana Creek bridge. From the

junction of the Thane Creek, the Bassein Creek extends to a distance of about 30 km before joining the Arabian Sea on the west coast. Thane creek-Mumbai harbour system (Bay), receives wastewater from industrial as well as sewage from the surrounding areas. The major industries around Thane Creek are fertilizers, petrochemicals, thermal power, nuclear, refineries, pharmaceuticals and chemicals.

Tidal flows are exchanged between the Thane Creek/Mumbai Harbour and the Bassein Creek. High tide conditions at this interchange resulting from tidal fluctuations in the Thane Creek occur before those resulting from tidal fluctuations in the Bassein Creek. As a result, during high tide conditions tidal flow may occur from the Thane Creek to the Bassein Creek or vice-versa depending on the relative high water levels of these creeks. During low tide conditions, a portion of the freshwater flow from the Bassein Creek is discharged to the Thane Creek. The Thane Creek indicates a temporary vertical gradient in salinity especially during monsoon.

The Thane Creek experiences semidiurnal tides with appreciable diurnal element producing unequal tides on most days and causing wide variations in high and low water levels. Current speeds and directions within the Thane Creek system are largely due to the tidal movements. The average current speed at the Thane Creek is 0.1 m/s during neap. The maximum current speeds in the regions off Panvel, Elephanta and Nhava Sheva are between 0.3 to 0.6 m/s with marked increase in the ebb velocity during monsoon due to the pronounced freshwater run-off into these regions. The difference between these two velocities is more marked during the monsoon season and reflects the influence of freshwater inflow to the marine system.

The waste assimilation capacity of the Thane Creek system is mainly influenced by the prevailing tidal conditions and current patterns. The polluted tidal water ebbs after each tide and certain amount of pollutants are retained by the creek system because of tidal oscillation.

1.5.3 Panvel Creek

The Panvel Creek is a medium size tributary to the Bay opening along its eastern shore north of the JN Port. The creek has number of small tributaries which periodically inundate the low lying areas along the creek segments.

The creek and its tributaries are influenced by tidal movements propagating through the Bay which induce flushing and dispersion of pollutants entering the system through land-based as well as marine sources. The monsoonal freshwater flow though important in flushing the system is not high enough to cause significant changes in its

hydrography. The creek experiences a tidal range varying between 1.5 and 4.0 m. The currents in the creek are largely tide induced with maximum speed varying from 0.2 to 1.0 m/s depending on the tidal state.

The creek has good circulation of water mass between the creek and the Bay. The water quality of the creek is closely comparable with that of the Bay. The creek sustains high and variable suspended load mostly generated by the tidal currents. The significant variations in salinity suggest freshwater influx to the creek system especially at the upstream segments. Temporal and spatial variations in DO with an under-saturation state are noticed. The concentrations of nutrients are widely varied with high average values indicating that the creek waters are under environmental stress. Significant enhancement of heavy metals in sediment is also noticed.

The biological potential of the creek is typically characterised by

(i) variable levels of phytopigments,

(ii) good standing stock of phytopopulation and generic diversity,

(iii) mangroves in varying densities with dominance of *Avicennia marina,*

(iv) variable and moderate zooplankton standing stock with good diversity,

(v) fairly good intertidal and subtidal benthos and

(vi) normal fishery potential with absence of commercial fishing activities.

1.6 Hydrography

The quality of water-spread area of the Bay is mainly influenced by tides which induce flushing and dispersion of pollutants entering the system. The monsoonal freshwater flow, though important in flushing the inner zone, is not high enough to cause significant changes in the hydrography of the outer Bay.

Tides (1.2-5 m) in the region are semi-diurnal type with an appreciable diurnal inequality. The flood tidal front advances in north-easterly direction and ebbs to south-west. The tidal variations of the Mumbai Bay are as follows:

Location	Range (m)		Time lag from Apollo Bunder (min)
	Spring	Neap	
Apollo Bander	5.0	1.6	-
Pir Pau	4.3	1.4	10-15
Vashi	4.2	1.2	10-30
Airoli	4.9	1.6	12-45
Thane	4.9	1.5	15-60

It is evident that the tidal ranges markedly decrease upto Vashi as compared to that at the Apollo Bander but increase in the inner creek and the ranges at Thane are only marginally lower than that at the Apollo Bander. This increase appears to be due to the funnel shape geometry of the Bay that is conducive for accumulation of seawater with the advance of the tidal front in the lower creek. The tide at Thane lags by 30 to 45 min with respect to the tide at the Apollo Bander with the lag more pronounced for the neap tide.

Current speeds and directions within the Bay and associated tributaries are largely due to the tidal movements and show little variation from non-monsoon to monsoon. The maximum current speed in the outer Bay exceeds 1 m/s and the variation in the water column at any given time is not significant. Lateral variations in the speed however occur with current in the eastern area being marginally stronger. The maximum current speeds decrease in the inner Bay and are typically around 0.8 m/s, decreasing markedly during neap tide. As expected for a tide dominated system, the alongshore components are fairly strong with the dominance of seaward component while cross-shore components are relatively weak. Their relative magnitude and directions are indicative of net seaward movement over a tidal cycle though shoreward drift can be significant around the change of tide.

Excursion lengths and average current speeds observed for the Bay based on the available drogue trajectories are as follows:

Tide	**Excursion length (km)**		**Av current speed (m/s)**	
	Flood	**Ebb**	**Flood**	**Ebb**
Spring	11.5	11.5	0.5	0.55
Neap	5.5	6.0	0.25	0.3

Excursion lengths during flood and ebb are more or less of a similar magnitude as expected for tidal creeks devoid of large volumes of external water inputs. The overall circulation pattern suggests that the pollutants entering the creek upstream of the bridge at Vashi tend to oscillate within the creek system and flushing to the sea is a delayed process. These pollutants would however be considerably diluted under the influence of tide induced turbulence and advection.

During monsoon however, the creek receives voluminous land run-off and the discharge of near freshwater through the Ulhas Estuary, which flushes the inner creek to a large extent.

1.6.1 Water Quality

The water quality of the Mumbai Bay would be a balance between the fluxes of pollutants received by the water body and their dispersion by tidal flushing as well as their decay and removal from the water column by processes such as degradation, adsorption on suspended solids, sedimentation and biotic uptake. Although the bulk contaminants through the domestic wastewater are organic matter and nutrients, substantial quantities of heavy metals and PHc are also associated with these releases.

The monthly variations of water temperature in the Bay exhibit a bimodal pattern with maximum during May and October, and minimum during August and February in accordance with the air temperature. Temporal variations are small as expected for tropical areas and changes in the vertical are minor suggesting a thermally well-mixed water body. The average pH in the Bay varies between 7.6 and 8.3 and the variations are random.

The average SS (23 - 53 mg/L) in the Bay is relatively high and renders the waters turbid and muddy. Spatial and temporal trends are not discernible though at a given sampling time the bottom water invariably sustains higher SS. This is because the SS is largely of natural origin and results from the dispersion of fine-grained material from the bed and the intertidal mudflats under the influence of tidal currents and turbulence during rough sea conditions. Markedly enhanced SS can occur during monsoon due to high wind induced turbulence and the values often exceed 200 mg/l in the outer Bay when the measurements coincide with the increased wave activity.

Salinity in the inner Bay is generally low (5 - 25 ppt) during July-September due to influence of freshwater runoff while at the port area it exceeds 30 ppt, except during the days of high precipitation. This results in a longitudinal salinity gradient increasing from Thane at the head to Colaba at the mouth of the Bay. There is a sharp increase in salinity in the inner Bay after the withdrawal of monsoon and values upto 35.7 ppt are common. Salinity then increases gradually in the following months and reaches 37 to 38 ppt from late May to early June. With the salinity in the middle and outer Bay areas remaining around 36 to 37 ppt, a weak salinity gradient, but in the reverse direction, develops along the length of the creek. Temporal changes in salinity

in the port area are minor during dry season though small random variations are possible.

Average DO of about 5 mg/L at the Bay mouth decreases progressively in the upstream direction and falls below 3.5 mg/L at the head of the Bay during August. This decrease is from about 4 mg/l to around 2 mg/L during May at the respective locations. This trend is attributed to the non-availability of oxygen rich monsoon flow during May for the oxidation of organic matter and the increase in temperature decreases the solubility of oxygen and also accelerates microbial mediated oxidation of organic matter. Under the influence of high organic load, the DO seldom exceeds 2.5 mg/L in the interior Bay and values falling below 1 mg/L have been recorded during March-May.

The average concentrations (μmol/l) of phosphorus and nitrogen compounds in the Bay vary as follows:

Segment	PO_4^{3-}-P	NO_3^--N	NO_2^--N	NH_4^+-N
Outer Bay	1.9	24.6	2.8	0.4
Mid-Bay	4.0	40.7	3.8	1.9
Inner Bay	11.0	34.9	22.8	15.3

The concentrations of PO_4^{3-}-P and NO_3^--N in the coastal waters along the Maharashtra coast are generally below 3 and 15 μmol/l respectively while those of NO_2^--N and NH_4^+-N are often below 1 μmol/L. Hence, there is marked enhancement of nutrient levels in the Bay. Their sources can be wastewaters from domestic sectors, fertilizer industries and spillages of fertilizers during unloading operations in the port. It is also evident that the inner Bay area often sustains abnormal levels of NO_2^--N and NH_4^+-N. This is typical of inshore waters under environmental stress. In toxic waters, the nitrite is an intermediate product of bacterial oxidation of ammonia to nitrate. The accumulation of nitrite in the Inner Bay is an indication of proliferation of *Nitrobactor* bacteria under stress conditions. These contents however are highly variable in monsoon depending upon the extent of drainage which has a ability to restrict the ingress of tidal seawater.

The concentrations of PHc and phenols in water do not indicate deterioration in water quality due to these contaminants and their levels are comparable to the nearshore waters along the coast of Maharashtra. The concentrations of PHc even in

the vicinity of the Marine Oil Terminal (MOT) at the Butcher Island are low. It is possible that by virtue of high SS and significant tide-generated turbulence the PHc is adsorbed and removed from the water column and swift currents transport the contaminants and distribute them over a wide area.

1.6.2 Sediment Quality

Sediment of the Bay is largely derived from weathering of surrounding basaltic landmass. The strong currents sweeping the Bay disperse the fine-grained and poorly sorted sediment from the bed and from extensive mudflats along the intertidal zone into the water column. This fine grained SS can scavenge the trace pollutants entering the Bay and ultimately transfer them to the bed on settling, thus enriching the bed material with pollutants.

The sediment is dominated by montmorillonite, degraded chlorite, illite and to some extent silica. The 10 to15 m thick acoustically transparent clay beds as revealed through shallow seismic reflections indicate recent sedimentation. A yearly load of 8.4 million m^3 of fine grained sediment is estimated to be transported to the central reaches of the Bay via Ulhas, Panvel and Dharamtar creeks. The oscillating tidal movements spread this material fairly uniformly over the 240 km^2 area of the Bay. Based on ^{210}Pb profiles a sedimentation rate of 1.9 cm/y has been established for the inner Bay which decreases to 0.4 cm/y in the outer zone.

The pollutants of major concern are heavy metals and some organic compounds, the concentrations of which even in waters receiving their fluxes are often low and variable making assessment of level of contamination difficult through analysis of water. However, most of such micro-pollutants are adsorbed by the SS in water and transported to the bed on settling of particles. Hence, the concentration of such pollutants progressively increases in sediments of areas receiving their fluxes. It is therefore possible to assess the status of marine environmental quality through analyses of sediment and comparing the observed levels with a suitable background. The constituents considered for the assessment of the sediment quality are heavy metals, C_{org}, phosphorus and PHc.

Natural sediments always carry heavy metals to a varying degree depending on the source rock as well as the environment of deposition. This lithogenic contribution may be taken as a background for assessment of sediment contamination by anthropogenic metals. As the sediment in the Bay is derived from basalts, which are generally rich in heavy minerals, the concentration of some metals may be

naturally high in the sediment of the Bay. Based on the concentrations of metals in marine sediment about 15 to 20 km off the mouth of the Bay and off Murud (about 110 km south of Mumbai) it is considered that the sediment in the open Bay area is largely free from accumulation of heavy metals excepting chromium, mercury and to some extent zinc. The concentration of mercury suggested an enhancement (by 3 to 4 folds) in sediment with respect to the baseline value (0.1 μg/g; dry wt) in some zones of the Bay.

The Bay receives 1.8 million kg/d of BOD load through domestic wastewater alone. Part of this organic load gets deposited on the bed when the particles settle. In view of the high BOD load entering the Bay – mainly through sewage, the surficial sediment is expected to sustain high concentrations of C_{org}. However, the C_{org} content in the sediment barely exceeds 2.5%. This load is marginally higher than expected (1 - 2%, dry wt) for nearby unpolluted marine sediments and is much lower than anticipated. It is possible that under tropical temperatures, the excess organic loads are rapidly oxidised and re-mineralised by rich bacterial populations at the sediment water-interface apart from being consumed by detritivorous benthic organisms such as polychaetes and molluscs which thrive in the Bay.

Domestic wastewater is also a potential source of phosphorus to the sediment. However, the observed concentrations indicate insignificant accumulation (770 - 1500 μg/g, dry wt) in basalts of the central west coast of India.

Nearshore sediments along the coast which is free from direct influence from oily wastes, sustain PHc of < 0.1 to 0.3 μg/g (wet wt). The concentrations in the Bay which vary in the range of 0.2 to 10.1 μg/g (wet wt) indicate patchy distribution. The average PHc levels are higher by about 3 times than expected for clean areas. In areas of high PHc contamination, the levels in excess of 10 μg/g (wet wt) and ranging upto 1000 μg/g (wet wt) have been reported particularly around oil terminals. However, even off MOT, the concentrations of 0.3 to 0.7 μg/g (wet wt) have been commonly observed. This may be because; the strong currents prevailing in the Bay may not allow settling the lighter residue which gets transported to a longer distance beyond the mouth of the Bay.

1.6.3 Flora and Fauna

The populations of pathogen-like organisms such as total coliforms are markedly high in the interior Bay perhaps due to the influence of sewage releases in the vicinity and their decrease in the eastern segment, as expected.

The availability of nutrients in high concentrations triggers high growth of phytoplankton resulting in an enhanced chlorophyll *a* content of the Bay with the average at different stations varying between 4.6 and 39.2 mg/m^3. Though the concentrations vary over a wide range, the overall trend suggests a decrease in their levels from the interior to the outer Bay. The levels of phaeophytin are generally lower than those of chlorophyll *a* and average is between 0.3 and 14.3 mg/m^3. Hence, the prevailing ecological condition in the Bay is conducive to the growth of phytoplankton even in the presence of high turbidity. Phytoplankton cell counts vary from 103 x 10^3 to 5024 x 10^3 no/L and indicate the population comparable to the trend exhibited by chlorophyll *a*. Generic diversity is high and varies from 11 to 20 genera averaging at 15 nos with the phytoplankton community dominated by *Skeletonema, Nitzschia, Thalassiosira* and *Rhizosolenia.*

Mangroves occur in varying density along the banks of the Thane, Dharamtar, Karanja and Panvel creeks. *Avicennia marina* and *Avicennia alba* are predominant and form thick stands in the more saline regions. The supralitoral regions support mangroves like *Salvadora persica* and obligate halophytes such as *Suaeda maritima* and *Sesuvium portulacastrum*. The mangrove habitats however have been destroyed or degraded in several areas due to human interference. Species like *Bruguiera parviflora, B.gymnorrhiza, Carapa obovata, Kandelia candel, Lumnitzera racemosa, Rhizophora mucronata* and *Sonneratia caseolaris* have either disappeared from many areas or under severe threat of extinction.

Zooplankton biomass varies widely (0.1 – 281.6 ml/100m^3) with high biomass confined to the inner and the middle Bay associated with high phytoplankton production. The average population also varies widely (100 - 779.4x10^3 no/100m^3) though not necessarily proportionate to the variations in the biomass. In line with the biomass and population, the group diversity also varies widely (4 - 17 no) and randomly. The populations are generally dominated by copepods, cladocerans and decapods often contributing more than 80% to the community. Decapods are higher in number, sometimes contributing more than 10% to the population. They are mainly represented by *Lucifer,* megalopa and zoea. Larvae of economically important

species like *Macrobrachium* sp, *Metapenaeus affinis, M.monoceros*, *M.dobsoni* and Palaemonids are only occasionally encountered. The contribution of fish eggs and larvae to the zooplankton population is low and seldom exceeds 0.2%. Within the Bay, *Stolephorus indicus* dominate the larval population followed by *Coilia dussumieri, Johnius dussumieri, Thryssa purava* and *Gobius planiceps*. Other economically important species like *Harpadon nehereus, Ilisha elongata* and Mugilidae are occasionally present.

Macrobenthic faunal standing stock in terms of population (0 – 2850 no/m^2) and biomass (0 – 19.3 g/m^2, wet wt) at the intertidal segment vary widely. The macrobenthos is dominated by polychaetes and crustaceans over other important groups like molluscs, in the Bay region. In all, about 103 species of polychaetes have been recorded in the intertidal regions of the Bay. In the subtidal zone, the high populations are confined to the interior Bay, while, the dredged areas sustain low macrobenthic standing stock. The faunal group diversity of the subtidal macrobenthos varies between 0 and 6 no with the populations dominated by polychaetes followed by amphipods. Sassoon Dock and Ferry Wharf located within the Bay together contribute more than 60 and 20% to the total fish landings of the Mumbai District and the Maharashtra State respectively.

The Mumbai coast offers assorted intertidal marine habitats (110.5 km^2) like rocky/sandy/muddy and mangroves for a variety of resident and migratory birds. Marine turtles are sometimes sighted along the Mumbai coast and are mainly represented by Logger head (*Caretta caretta*) and Olive Ridley (*Lepidochelys olivacea*). Other turtles like Hawksbill (*Eretmochelys imbricata*), Leather back (*Dermochelys coriacea*) and Green (*Chelonia mydas*) are occasionally sighted. The marine mammals are chiefly represented by Dolphin and Porpoise in the coastal waters of Mumbai though whales are rare.

1.7 Geology

The region is seaward part of the geology of the Deccan traps that formed by the eruptions to rapidly cover a large part of the Indian Peninsula (at present extends over 500,000 sq. kms.) the volcanic eruptions around the Mumbai area occurred in shallow lagoon conditions and thus most of the lava flows. Due to sub-aqueous eruptions of the lava, the basalt was converted to spilite, as a result of the metasomatic changes. Some of the lava flows developed pillow structure and some became brecciated to form volcanic breccia. Such sub-aqueous volcanic breccia may be

described as Hyaloclastic. There were intermediate and acid rocks formed as trachyte intrusive and rhyolie flows.

At the project site the soil profile was composed of gravely silty clay (murrum), sand, marine clay and boulders lying on the highly weathered tuff and berrica layers of intertrappean shale. The rock type encountered out there is spilite with upper theolitic basalt. The rock type encountered in the adjacent harbour area is hyaloclasite. The area lies is seismic zone III (Earthquake moderate damage risk zone- MSK VII) (Figure 1.1).

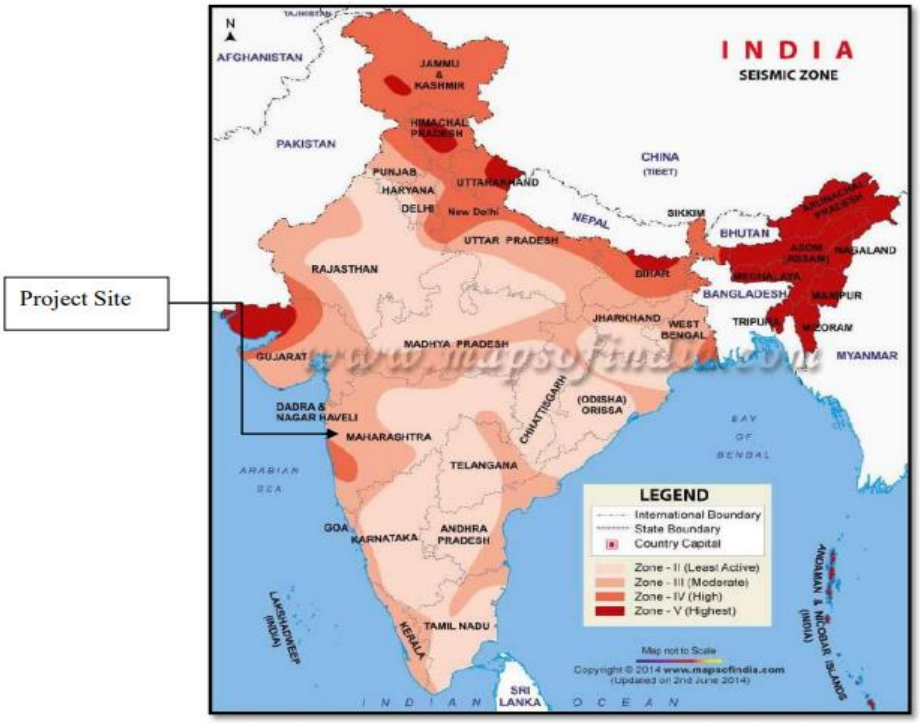

Figure 1.1: Seismic zonation map

1.8 Meteorological Conditions

1.8.1 Climate

The region experiences a tropical monsoon climate and has four distinct seasons as follows:

- **i)** Southwest monsoon season (June to September) - Main rainy season with very high humidity, low clouds and several spells of moderate to heavy rains.
- **ii)** Post-monsoon season (October to November) - Frequency of severe cyclonic storms is the highest during this season.
- **iii)** Winter season (December to February) - Fine weather and occasional morning mist or fog.

iv) Summer season (March to May) - A rise in air temperature with incidence of thunderstorms and cyclonic storms during the latter part of the season.

1.8.2 Humidity

The humidity is moderate to high throughout the year with the mornings being more humid than evenings. The mean relative humidity for each month in a year measured during mornings and evenings The monthly average relative humidity (RH) for October 2022 was recorded to be 73.75., the maximum daily average RH of 88.44% was recorded. The monthly average relative humidity (RH) for November 2022 was recorded to be 59.80%., the maximum daily average RH of 83.44% was recorded. The monthly average relative humidity (RH) for December 2022 was recorded to be 67.16 %. The maximum daily average RH of 87.33% was recorded (*Source: CPCB*).

1.8.3 Temperature

India Meteorological Department (IMD) records indicate that the area experiences tropical coastal climate. The moderating effects of the nearby sea and the fairly high amount of relative humidity in the atmosphere have restricted the variability. The seasonal variations of temperature follow closely the course of the sun. 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. The maximum monthly average temperature of 38.25°C and monthly average temperature of35.20°C was recorded for September 2022 month. The maximum monthly average temperature of 33.15°C and monthly average temperature of 30.54°C was recorded for October 2022 month. The maximum monthly average temperature of 32.95°C and monthly average temperature of 30.52° C was recorded for November 2022. The maximum monthly average temperature of 31.36°C and minimum monthly average temperature of 24.92°C was recorded for December 2022 (*Source: CPCB*).

1.8.4 Wind Flow Pattern

The monthly average wind speed for October & November 2022 was recorded as 2.57 m/s and maximum wind speed was 6.94 m/s. The monthly average wind speed for December 2022 was recorded as 0.82 m/s and the maximum wind speed was 1.27 m/s. Comparative account of study period shows higher. Transport and dispersion of air pollutants are mainly governed by wind speed. Higher the wind speed significant amount of pollutants will transport away from source. Gaseous dilutions will be more

in the atmosphere hence satisfactory air quality status @7.40% for October & November 2022 and @ 14.48 %of the total observations recorded by for December 2022 of the total observations at the met station were represented as calm period.The prominent wind direction was from the West (W) accounting for about 42.58% of wind reaching at the JN Port during the month October, 2022 (*Source: CPCB*).

2 Project Description

2.1 Project Overview

Jawaharlal Nehru Port is one of the major Indian ports, located on the east side of Mumbai harbour adjoining the mainland of the west coast of India and was commissioned on 26 May 1989. Jawaharlal Nehru Port 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.

Jawaharlal Nehru Port Authority (JNPA) is proposed to widen the existing container berth located between the NSICT container berth and the existing Shallow Water Berth (Figure 2.1). The geographical location of the project site is as follows:

Latitude from 18°57'9.50"N to 18°57'28.38"N

Longitude from 72°56'43.99"E to 72°56'53.46" E

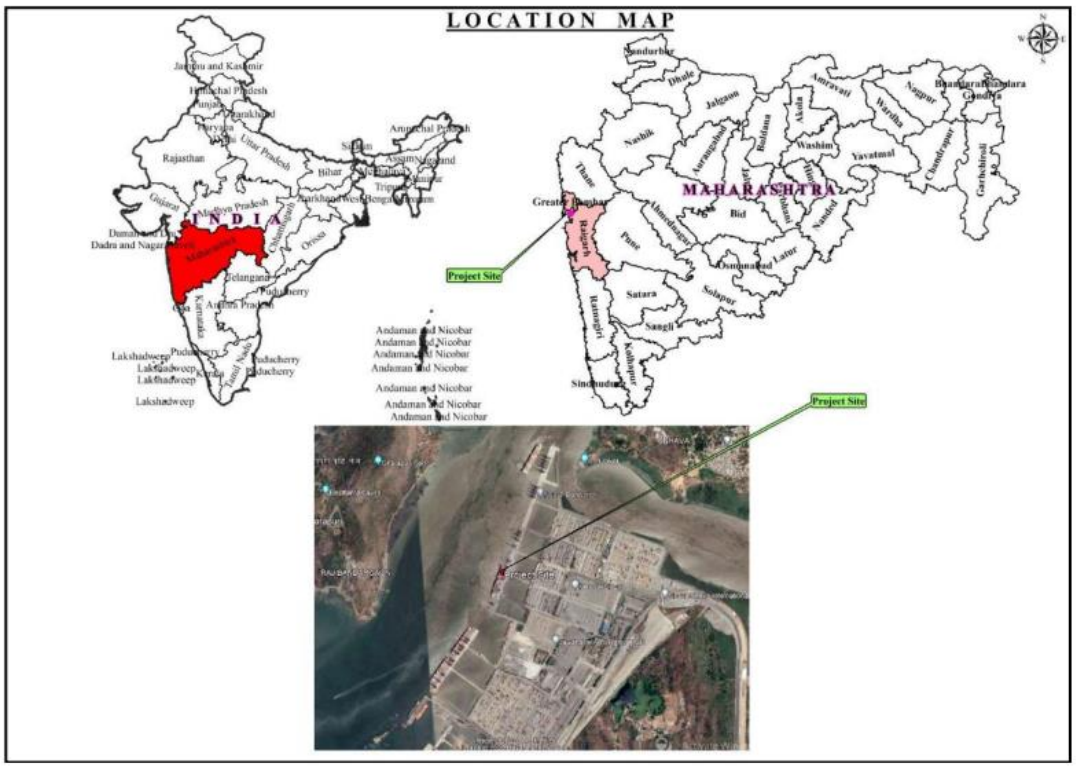

Figure 2.1: Location map

The proposed project involves:

a) Increasing the crane Rail span from 20 m to 30.50 m for 680 m berth length;

b) Increasing the deck width of the berth by 15 m on land side for smooth vehicle manoeuvring & for keeping vessels hatch covers;

c) Up-gradation and strengthening of existing 530 m berth and 150 m wharf to accommodate design vessels of size 12200 TEU for which the facility was originally designed & commissioned;

d) Up-gradation of Fenders and Bollards as may be necessary;

e) Repairs and strengthening of the existing damaged portion of the berth structures as may be necessary and

f) Underdeck repairs of the existing structure wherever necessary.

The existing container berth (680m length) of JNPA was initially designed in the year 1983 by the consultant M/S Howe (India) Pvt. Ltd. and was handling 6000 TEU capacity vessels and later was verified for 9000 capacity TEU vessels by the same consultant in the year 2003. The existing container berth was extended for 150m in the year 1997. Later in the year 2018, JNPA requested I.I.T. Madras to verify the existing container berth with a wharf structure for larger capacity vessels and the existing structure was verified based on 12200 TEU capacity vessels by IIT Madras.

This proposed widening part falls within the CRZ category such as CRZ IV- A (The water area and the sea bed area between the Low Tide Line up to twelve nautical miles on the seaward side shall constitute CRZ-IV A) Figure 2.2.

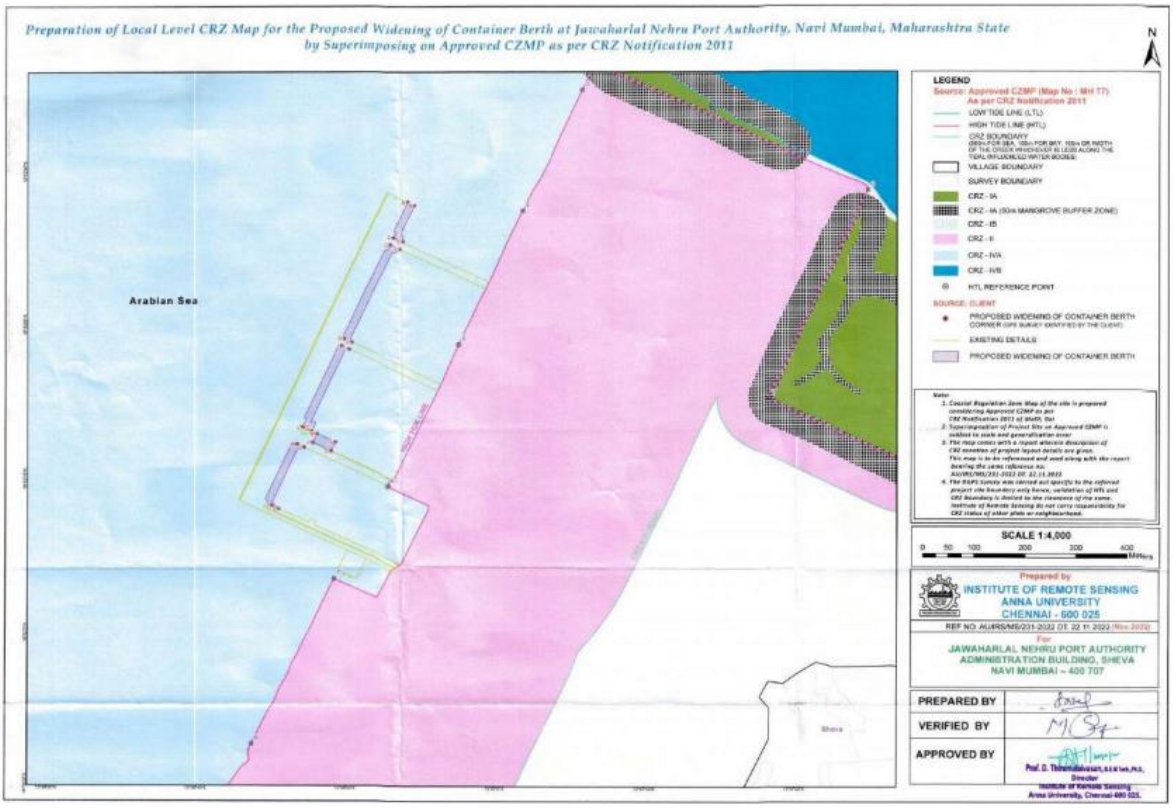

Figure 2.2: Coastal Regulation Zone Map on 1: 4000 scale

2.2 Requirements for The Project

2.2.1 Water Requirement

The total water requirement for the proposed widening project would be 50 KLD, sourced from M/s City and Industrial Development Corporation of Maharashtra Limited (CIDCO) / Maharashtra Jeevan Pradhikaran through JNPA.

2.2.2 Power Requirement

200 KVA/KW will be required for widening purpose. This power shall be provided from MSEDCL through JNPA.

2.2.3 Manpower Requirement

As this is an expansion project, there is a great employment opportunity during the Construction and Operation phases. The JNP area is very well developed with all kind of infrastructure, power, water, stormwater disposal management, sewage management facilities, educational & healthcare facilities, recreational facilities, housing & logistics required for existing JNP area.

2.2.4 Land Requirement

The project is located between NSICT existing container berth and existing Shallow Water Berth of JNPA.

2.2.5 Connectivity

JNPA has very good road and rail linkages with hinterland as well as important business centres like Thane, Pune, Nasik, Aurangabad and Ahmedabad, which facilitate excellent port -industry interface.

2.2.6 Raw Materials

The raw material required for the widening of the existing container berth is given below:

1. Concrete
2. Bricks
3. Sands
4. Cement
5. Aggregate
6. Pipes
7. Filler rod for welding pipe

2.3 Project Cost

The project cost for the widening of the proposed berth is estimated as Rs. 196.82 Crore.

3 STUDIES CONDUCTED

3.1 Period of Previous Monitoring Undertaken in the Study Area

CSIR-NIO is carrying out regular water quality and biota studies in the Thane creek over a period of time. The data presented as the baseline water and biota in this report include the observations of 2022 to 2023 in Thane creek.

3.2 Sampling Location

Subtidal sampling stations of the previous monitoring area based on the bathymetry as given in available National Hydrographic Office (NHO) Chart 255. These locations are shown in (Figure 3.1). Stations T1 and T2 fall in the upper Creek segment and stations T3, T4, T5 and T6 in the middle creek while station T7, T8 and T9 lies in the lower creek segment of the study area.

Figure 3.1: Sampling locations

The positions of sampling locations (Table 3.1) were as follows:

Table 3.1: Station co-ordinates of sampling locations

Zones	Station Code	Latitude	Longitude
Upper creek	T1	19°2’45.00”N	72°58’43.00”E
	T2	18°59'34.06"N	72°59'26.87"E
Middle creek	T3	18°58'55.84"N	72°57'9.17"E
	T4	18°57'12.21"N	72°56'21.15"E
	T5	18°55'52.83"N	72°55'42.12"E
	T6	18°56'28.60"N	72°54'23.42"E
Lower creek	T7	18°55'35.29"N	72°52'55.72"E
	T8	18°54'56.17"N	72°54'3.12"E
	T9	18°53'40.39"N	72°52'21.29"E

3.3 Frequency of Sampling

Water quality, sediment quality and biological characteristics were assessed from 9 locations in the Thane creek region during pre-monsoon, monsoon and post-monsoon of the year 2022 to 2023.

3.4 Water Quality

a) Sampling Methodology

Surface water samples were collected using a clean polyethylene bucket while an adequately weighed Niskin sampler (5L) with a closing mechanism was used for obtaining bottom water samples. Sampling at the surface and the bottom (1 m above the bed) was done when the station depths exceeded 3 m. For shallow regions, only surface samples were collected. The sampler (2.5 L) was used for obtaining samples at depths of 1 m below the surface, for the estimation of PHc.

b) Methods of Analyses

The majority of the water quality parameters were analysed within 24 h of collection in the field laboratory. Colorimetric measurements were made on a Shimadzu (Model 1201) spectrophotometer. Shimadzu (Model 5301, Japan) fluorescence spectrophotometer was used for estimating PHc. The analytical methods for the measurements were as follows:

i) pH:

pH meter (Model pH 510 UTECK-pH 700) was used for pH measurement. The instrument was calibrated with standard buffers just before use.

ii) Suspended Solids (SS):

A known volume of water was filtered through a pre-weighed 0.45 μm Millipore membrane filter paper, dried and weighed again.

iii) Salinity:

A suitable sample volume was titrated against silver nitrate (25 g/L) with potassium chromate as an indicator. The salinity was calculated by standardizing silver nitrate against standard seawater (Ocean Scientific International Ltd., UK).

iv) DO and BOD:

DO was determined by Winkler method. For the determination of BOD, direct unseeded method was employed. The sample was taken in a BOD bottle in the field and incubated at 27^0 C in the laboratory for 3 days after which DO was again determined. The difference in DO before and after incubation was considered as BOD.

v) Phosphate:

Acidified molybdate reagent was added to the sample to yield a phosphomolybdate complex that was then reduced with ascorbic acid to a highly coloured blue compound, which was measured at 882 nm.

vi) Nitrite:

Nitrite in the water sample was allowed to react with sulphanilamide in acid solution. The resulting diazo compound was reacted with N-1-Naphthyl-ethylenediamine dihydrochloride to form a highly coloured azo-dye. The light absorbance was measured at 543 nm.

vii) Nitrate:

Nitrate was determined as nitrite as above after its reduction by passing the sample through a column packed with amalgamated cadmium.

viii) Ammonia:

Ammonium compounds (NH^{3+} NH^{4+}) in water were reacted with phenol in presence of hypochlorite to give a blue colour of indophenol. The absorbance was measured at 630 nm.

ix) PHc:

Water sample (1 L) was extracted with hexane and the organic layer was separated, dried over anhydrous sodium sulphate and reduced to 10mL. Fluorescence of the extract was measured at 360 nm (excitation at 310 nm) with Saudi Arabian crude residue as a standard. The residue was obtained by evaporating lighter fractions of the crude oil at 100^{o}C

x) Phenols:

Phenols in water (500 mL) were converted to an orange coloured antipyrine complex by adding 4-aminoantipyrine. The complex was extracted in chloroform (25 mL) and the absorbance was measured at 460 nm using phenol as a standard.

3.5 Sediment Quality

a) Sampling Procedure

Subtidal surficial bed sediment from all locations was obtained by a van Veen grab of 0.04 m^2 area. The sample after retrieval was transferred to a polyethylene bag and preserved for further analysis. Intertidal sediment was sampled using a hand shovel.

b) Method of Analyses

i) Texture:

Dried sediment (25 g) mixed with deionised water and 10 mL sodium hexameta phosphate (6.2 g/L) was sieved through 63 µm sieve to retain sand and the passed material was dispersed in deionised water (1L). The fraction (20 mL) picked up at 20 and 10 cm depths immediately and after 2 h 30 min, respectively were considered as silt and clay after drying and weighing.

ii) Metals:

Sediment was brought into solution by treatment with conc. HF-$HClO_4$-HNO_3-HCl and the metals namely aluminium, chromium, manganese, iron, cobalt, nickel, copper and zinc were estimated by inductively coupled plasma optical emission spectrophotometer (ICP- OES, Perkin Elmer, USA) Optima 7300 DV (Perkin-Elmer, USA). The analytical results were authenticated by analyzing certified reference material (PACS-2, NRCC, Canada) with each set of analysis.

For estimation of mercury, the sample was digested with aqua regia followed by oxidation with potassium permanganate. Mercury was measured by cold vapour AAS technique. FIMS-400 (Perkin-Elmer) was used for the analysis of mercury.

iii) C_{org}:

Total organic carbon C_{org} in the dry sediment was determined by oxidizing organic matter in the sample by chromic acid and estimating excess chromic acid by titrating against ferrous ammonium sulphate.

iv) Phosphorous:

The sediment was brought into solution by treatment with a mixture of conc. HF-$HClO_4$-HNO_3-HCl acids and phosphorus (P) was estimated as described under Section 3.4 (v).

iv) PHc:

Sediment (~100 g) was refluxing with KOH-methanol mixture was extracted with hexane. After removal of excess hexane, the residue was subjected to clean-up procedure by silica gel column chromatography. The hydrocarbon content was then estimated by measuring the fluorescence.

3.6 Flora and fauna

a) Sampling procedure

For microbiological analysis, surface water was collected directly in a sterilised glass bottle. Sediment sample was obtained using Van-Veen grab and transferred directly into sterilised polyethylene bag. Polyethylene bucket and Niskin sampler respectively, were used for sampling surface and near bottom waters for the estimation of phytoplankton pigments and population. Samples for enumeration of phytoplankton cell count were fixed in Lugol's iodine and a few drops of 3% buffered formaldehyde.

Zooplankton samples were collected by oblique hauls using Heron Tranter net (mesh size 0.20 mm, mouth area 0.25 m^2) attached with a calibrated flow meter (Hydrobios make, USA). All collections were of 5 min duration. Samples were preserved in 5% buffered formaldehyde.

Sediment samples for subtidal macrobenthos were collected using a van Veen grab of 0.04 m^2 area. Intertidal collections between the HTL and the LTL were done using quadrates. Samples were preserved in 5% buffered formaldehyde- Rose Bengal. Fishes were collected from the study area by performing experimental trawling and gill netting.

i) Microbiology

Bacteriological parameters of water and sediments were analyzed by plating techniques for Total Viable Counts (TVC), Total Coliforms (TC), *Escherichia coli* like

organisms (ECLO), Faecal Coliform like organisms (FC), and *Streptococcus faecalis* like organisms (SFLO). Colonies of TC, ECLO, and SFLO were counted separately. The media employed for growth of colonies were as follows:

Nutrient agar (NA) for TVC, Mac Conkey agar (MC) for TC, MFC agar for ECLO, MFC agar for faecal coliforms, and *M. enterococcus* agar for SFLO. Spread plate technique with serial dilution was used for enumeration of all groups.

ii) Phytoplankton

A known volume of water (500 mL) was filtered through a 0.45 µm Millipore Glass filter paper and the pigments retained on the filter paper were extracted in 90% acetone. For the estimation of chlorophyll *a* and phaeophytin the fluorescence of the acetone extract was measured using Fluorometer (Turner Design, USA) before and after treatment with dilute acid (0.1N HCl).

Phytoplankton population: Water samples for phytoplankton cell counts were preserved in Lugol's solution with 2% formaldehyde. Enumeration and identification of phytoplankton were done under a compound microscope using a Sedgewick-Rafter slide.

iii) Zooplankton

Biomass was obtained by displacement volume method. Sub-sample (25-50%) was analysed under a Stereo Microscope (Leica, Germany) for faunal composition and population count.

iv) Benthos

The sediment samples were sieved through a 0.5 mm mesh sieve and animals retained were preserved in 5% buffered formaldehyde. The total population was estimated as number of animals in 1 m^2 area and biomass on wet weight basis.

v) Fishery

Fishes collected from Thane creek were sorted out into different groups, weighted and composition were determined. A part of the catch was preserved in 5% formaldehyde for identification at the species level. Fish landing data were obtained from the Department of Fisheries, Government of Maharashtra, for assessing the fishery status of the region.

4 PREVAILING MARINE ENVIRONMENT

4.1 Water Quality

The water quality was assessed from different stations (9 Nos) of the Thane creek during the period of March 2022 to January 2023. The average values of parameters from stations falling in each segment (upper, middle and lower creek) have been assessed to describe the segment wise marine environment and the ranges were quoted wherever required.

4.1.1 Temperature (ºC)

Water temperature generally regulates species distribution and their composition and activity of life associated with aquatic environment. Since most of the aquatic animals are cold blooded, water temperature regulates their metabolism, ability to survive and reproduce effectively. Hence artificially induced changes such as those by the return of warmer water may alter local communities of the ecosystems. For instance, elevated temperature may affect periphyton, benthic invertebrates and fish in addition to causing shifts in algal dominance. Unnatural short term fluctuation in temperature appears to cause reduced reproduction of fish and invertebrates. Size of harvestable stocks of commercially important fish and shellfish particularly near geographic limits of the fishery appear to be markedly influenced by slight changes in the long term temperature regime. In extreme conditions mass mortality of the biota may take place due to thermal shocks. Severe damage generally occurs to lower order biota while high order organisms may migrate from the affected area. Since generally toxicity of a material increases with increase in temperature, organisms subjected to stress from toxic material are less tolerant to temperature extremes.

An upper threshold limit of 35 ºC is considered for tropical aquatic species though many may be less tolerant. In the coastal waters of Maharashtra, the annual temperature range is expected to be 20 to 30 ºC. But in summer when stagnation condition prevails in the shallow segments, the water temperature may rise to 33 to 35 ºC in isolated water pools.

The water temperature recorded at each station during the study period are presented in Table 4.1.1.

Table 4.1.1: Water temperature at different stations of the study area during different seasons

Water Temperature (ºC)										
Month & Year	**L**	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
March, 2022	**S**	27.2	30.4	29.3	28.6	31.5	28.2	27.5	27.7	29.0
	B	27.6	29.9	29.0	28.0	30.5	27.9	27.5	27.7	28.0
October, 2022	**S**	30.2	29.8	31.0	29.1	29.4	30.2	29.0	28.6	29.3
	B	29.1	28.3	29.1	28.5	29.5	29.0	28.5	28.4	28.5
January, 2023	**S**	24.9	26.4	26.2	27.6	26.0	27.0	27.6	26.8	26.9
	B	24.5	26.1	25.7	26.8	25.7	26.4	25.8	25.9	25.9

The water temperature in the study region varied between 24.5 to 31.5 ºC (av. 28.0ºC) during different seasons. High average temperatures were observed in different segments of the study area during the pre-monsoon period (March, 2022). Low values were observed during post monsoon (January, 2023) and can be attributed to change of air temperature as a result of seasonal variability and time of sampling. These results indicated minor variations in water temperature during a particular set of observation and the resultant minor changes were related to the prevailing air temperature and wind that largely controls the temperature of water of shallow water bodies. The average water temperature in the study area during the current study period are graphically represented in Figure 4.1.1.

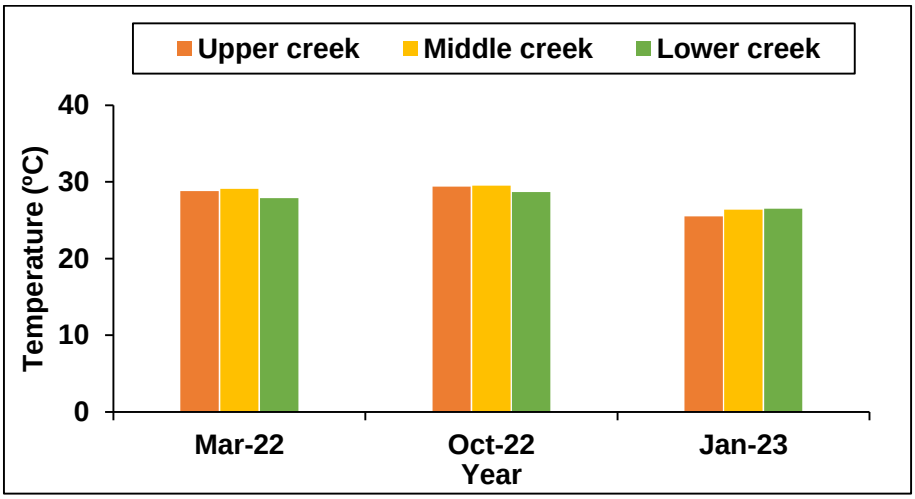

Figure 4.1.1: Average water temperature (ºC) in the study area during different seasons

The variation in water temperature will be depending on time and month of sampling. An upper threshold limit of 35^{o}C is generally considered for tropical aquatic species though some may be less tolerant. In this respect the temperature of the study area has not exceeded this threshold during present monitoring.

4.1.2 pH

The pH is the measure of hydrogen ion activity in water. It is known as master variable in water since many properties, processes and reactions are pH dependent. The principal system that regulates pH in seawater is the carbonate consisting of CO_2, H_2CO_3, HCO_3^- and CO_3^{2-}, salt content and alkalinity due to borates. Because of the buffering capacity of seawater, generally seawater pH has limited variability (7.8 - 8.3). In shallow, biologically active tropical waters, large diurnal pH changes from 7.3 to 9.5 may occur naturally because of photosynthesis. The nearshore influx of freshwater, particularly during monsoon, can affect the buffering effect and the pH often remains below 8. These areas are also vulnerable to pH changes due to release of anthropogenic discharges. For instance, domestic and metallurgical effluents can lower the pH, while effluents from textile processing industries may raise pH above 9 particularly in the vicinity of outfalls. These variations are often normalised by tidal mixing in estuaries.

The pH recorded at each station during the study period are presented in Table 4.1.2.

Table 4.1.2: pH at different stations of the study area during different seasons

pH									
Month & Year	**L**	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
March, 2022	**S**	7.7	7.6	7.4	7.7	8.0	7.7	7.6	7.6	7.9
	B	7.5	7.5	7.6	7.7	7.9	7.8	7.6	7.6	7.9
October, 2022	**S**	8.0	7.5	7.9	7.5	7.9	7.6	7.9	7.7	8.1
	B	7.5	7.6	7.6	7.6	7.9	7.6	7.5	7.7	7.8
January, 2023	**S**	7.7	7.7	7.8	7.8	7.9	7.8	7.9	8.0	8.0
	B	7.7	7.8	7.9	7.8	7.9	7.8	7.9	8.0	8.0

The pH values from the study area were ranged between 7.4 to 8.1 (av. 7.7). The inner creek shows marginal low pH and can be linked with the sewage input

received from the surrounding area. The temporal changes in pH are marginal as expected for marine waters.

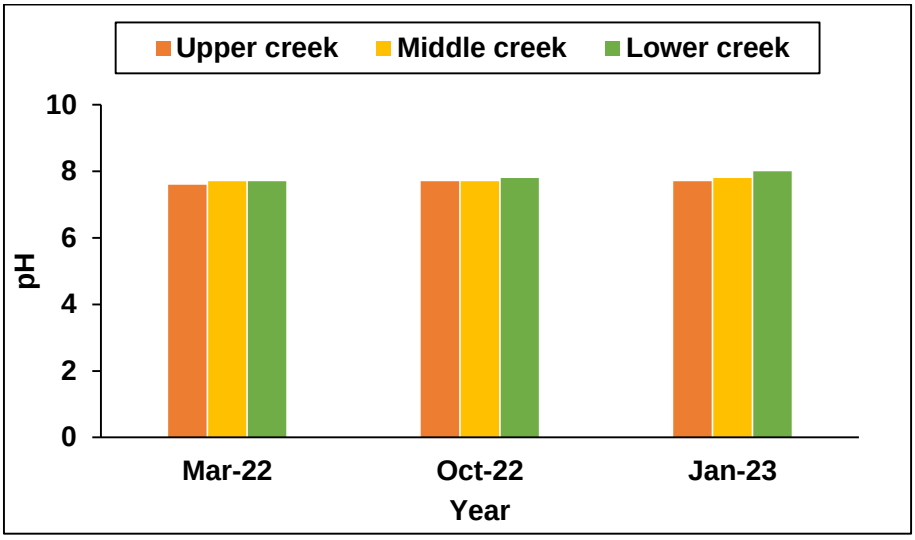

Figure 4.1.2: Average pH in the study area during different seasons

pH of the study area is found slightly alkaline due to the prevalence of high salinity during the present observations.

4.1.3 Salinity

Salinity influences several processes such as dissolution, dispersion, dilution etc. in seawater due to high dissolved salt content and higher density. For instance, DO is relatively low in seawater as compared to freshwater at equivalent water temperature. Biota is generally acclimatized for certain range of salinity where they thrive. Hence, wide changes in salinity can result in adaptation with modification and dominance of selected species in the lower order while higher order biota may migrate. Sudden changes in salinity may cause high mortality of biota including fish due to salinity shock.

The salinity recorded at each station during the study period are presented in Table 4.1.3.

Table 4.1.3: Salinity (PSU) at different stations of the study area during different seasons

Salinity (PSU)										
Month & Year	**L**	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
March, 2022	**S**	32.6	34.1	33.0	34.0	33.3	35.9	35.8	35.9	36.1
	B	35.4	35.4	35.8	36.0	34.1	36.6	36.2	36.1	36.4
October, 2022	**S**	18.8	22.0	18.9	28.3	27.3	28.9	29.1	29.5	31.7

	B	27.7	30.1	27.8	29.9	30.3	26.6	29.8	30.8	33.2
January, 2023	**S**	28.2	29.4	29.8	29.4	29.6	29.8	30.1	30.3	30.2
	B	28.2	29.4	29.7	29.8	29.0	30.0	30.2	30.4	30.4

The average salinity in the different segments of study area ranged between 18.8 and 36.6 PSU (av. 30.9 PSU). The average salinity (PSU) values in different segments of the study area during the study period are graphically represented in Figure 4.1.3.

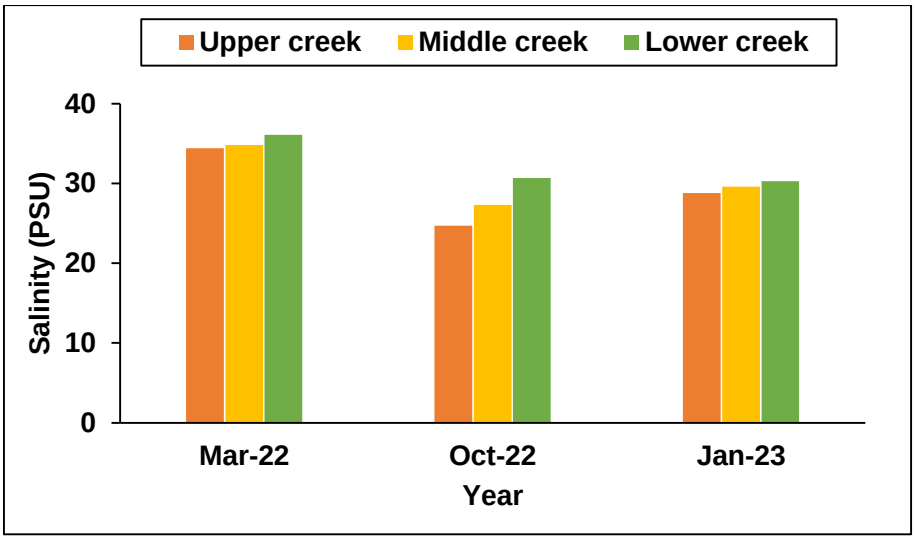

Figure 4.1.3: Average salinity (PSU) in the study area during different seasons

The above figure indicates seasonal variation of salinity in the region. Low salinity during the October 2022 indicated significant fresh water influx from the surrounding area due to precipitation. It is clear from the above result that the fresh water input from land during monsoon period plays a major role in the salinity of the creek environment.

4.1.4 Suspended Solids (SS)

SS is the descriptive term used for suspended/ settle able particulate matter in the water column. SS of natural origin mostly contains clay, silt, sand of bottom and shore sediment, and plankton for nearshore regions clay and vegetation matter form important component of SS. Anthropogenic discharges add a variety of SS depending upon the source. Since the major contribution comes from the disturbance of bed and shore sediments, energy of the region such as tidal currents are the vital influencing factor for SS and typically leads to high values in the bottom water. The major role played by SS is adsorption of constituents as well as contaminants from the water

column. They may get coagulated/ flocculated/ precipitated due to change of matrix. Pollutants such as toxic metals, PHc, pesticides etc. can be adsorbed onto SS and transferred to the bed sediment on settling.

The immediate effect of high SS results in increase in turbidity which reduces light intensity and the depth of photic zone leading to decrease in primary production and fish food. SS in the water column also adversely affects certain sensitive populations through mortality, reducing growth rate and resistance to diseases, preventing proper development of fish eggs and larvae, modifying natural movement, migration and reduction in abundance of available food. SS settling on the bed can damage the benthic invertebrate population, block spawning etc. Organic content in SS increases oxygen demand in the water column and its settlement on the bed can make the sediment anoxic.

The suspended solids recorded at each station during the study period are presented in Table 4.1.4.

Table 4.1.4: Suspended solids (mg/L) at different stations of the study area during different seasons

Suspended Solids (mg/L)										
Month &	**L**	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
March, 2022	**S**	18.7	21.6	23.9	20.5	70.7	52.0	21.6	30.3	22.9
	B	69.1	122.3	71.5	46.6	62.5	51.9	17.5	29.9	30.6
October, 2022	**S**	3.5	4.5	4.2	10.9	8.2	6.0	6.6	9.4	7.6
	B	9.9	54.9	32.6	54.7	11.0	12.2	9.6	27.3	6.7
January, 2023	**S**	40.0	34.2	58.0	50.7	78.4	64.9	32.9	47.4	25.9
	B	92.0	831.3	370.4	164.1	399.6	225.5	278.8	124.8	193.1

The concentration of SS (mg/L) in the study region varied over a wide range of 3.5 to 831.3 mg/L (av. 77.3 mg/L). High SS concentrations were observed during post-monsoon (January, 2023) in the upper creek segment from the study area. The SS concentrations were found multiple times higher in the bottom water than surface irrespective of seasons. The average concentration of suspended solids (mg/L) at various segments of the study area during the study period is represented graphically in Figure 4.1.4.

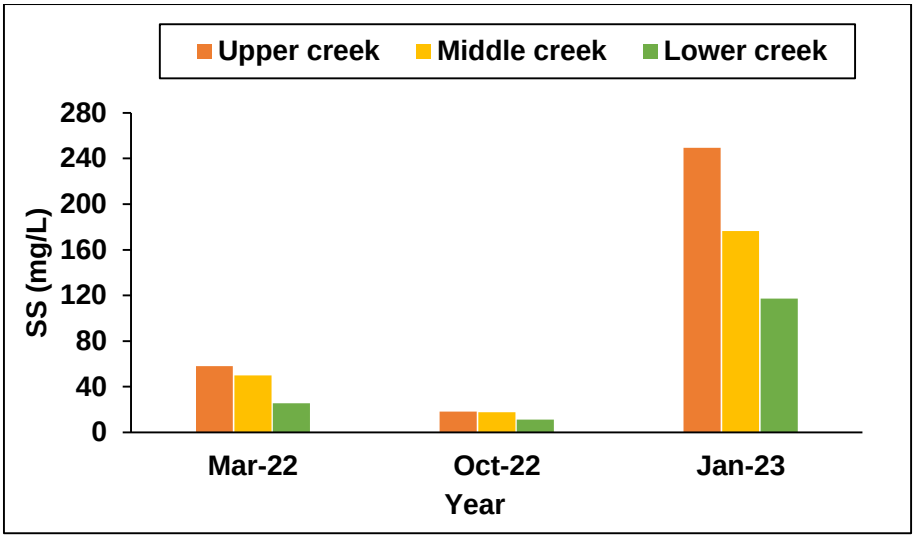

Figure 4.1.4: Average suspended solids (mg/L) in the study area during different seasons

The above graph indicated that the increase in suspended sediment in the upper creek and middle creek area might be due to the resuspension of SS and can be attributed to the dredging activities in the area for vessel navigation during January 2023.

4.1.5 Dissolved Oxygen (DO)

DO is an important constituent and plays a significant role in protection of aesthetic quality of water as well as maintenance of fish and other aquatic life. Hence it is of considerable interest in water quality investigations that its concentration in water is an indicator of prevailing water quality and ability of a water body to support a well-balanced aquatic life. Generally, DO is the characteristic of a water body under typical hydrologic, hydrographic, waste loading and environmental conditions. DO in water is replenished through photosynthesis, dissolution from atmosphere and addition of oxygen rich water. Simultaneously it is consumed during heterotrophic oxidation of oxidizable organic matter and respiration by aquatic flora and fauna as well as oxidation of naturally occurring constituents in water. Thus, equilibrium is maintained between consumption and replenishment of DO. In natural waters the rate of consumption of DO is lower than the rate of replenishment resulting in maintenance of adequate concentrations in water which are often at the saturation level.

DO vary in a certain range temporally as well as seasonally depending on the environmental conditions. Influx of anthropogenic discharges containing oxidizable organic matter and certain pollutants consume DO more than that the water body can replenish creating under-saturation which in extreme cases may lead to onset of septic

conditions with mal-odorous emissions thereby degrading the ecological quality. However, in a dynamic coastal environment the impact of such a condition is considerably low because of tidal action and turbulence. In water body of restricted tidal exchange, the DO may progressively decrease ultimately leading to anaerobic decomposition of organic matter resulting in the release of obnoxious gases such as H_2S, CO_2 and CH_4 in extreme conditions. High concentration of DO, on the contrary support abundant aquatic life. Under conducive conditions addition of excess vegetation growth can lead to eutrophication in enclosed/semi-enclosed water bodies, thereby adversely affecting the ecology. It is difficult to arrive at the threshold limit of DO for aquatic life, since environmental conditions, waste loading and natural levels of DO vary considerably and the existent composite aquatic life has variable demand for DO depending on their composition, age, activity, nutritional status etc. It has been observed that concentration of DO below 2 mg/L for prolonged time may affect aquatic life since feeding of many organisms is diminished or stopped and their growth is retarded at low DO levels.

The dissolved oxygen (mg/L) recorded at each station during the study period are presented in Table 4.1.5.

Table 4.1.5: Dissolved oxygen (mg/L) at different stations of the study area during different seasons

Dissolved Oxygen (mg/L)										
Month & Year	**L**	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
March, 2022	**S**	8.1	4.4	4.3	4.1	7.2	3.2	2.4	4.3	4.2
	B	2.6	2.7	2.9	3.1	6.9	3.1	3.1	4.4	4.7
October, 2022	**S**	4.8	4.7	5.6	4.0	7.3	4.6	4.0	4.5	5.8
	B	3.2	3.8	3.0	4.2	4.7	4.2	3.6	4.1	3.5
January, 2023	**S**	3.7	5.9	4.6	4.9	3.7	5.3	5.0	5.9	5.0
	B	3.4	4.6	3.6	4.3	2.8	4.9	4.8	4.7	4.5

The DO concentration ranged from 2.4 to 8.1 mg/L (Av. 4.4 mg/L) during different seasons in the study area. In a dynamic estuarine/creek environment, identifying the source of organic loading among the number of wastewater releases to the creek is difficult. However, domestic sewage and industrial wastewater from Thane creek entering in to Mumbai harbour can be a major source contributing to DO

depletion in the study area. The average DO (mg/L) recorded at different segments of the study area during study period are graphically represented in Figure 4.1.5.

It is evident from the above graph (Figure 4.1.5) that the inner creek indicated a depleted DO concentrations during monsoon (October, 2022) and post-monsoon (January, 2023) indicating the consumption of DO for oxidation of organic matter, discharged to the Thane Creek in the form of untreated sewage.

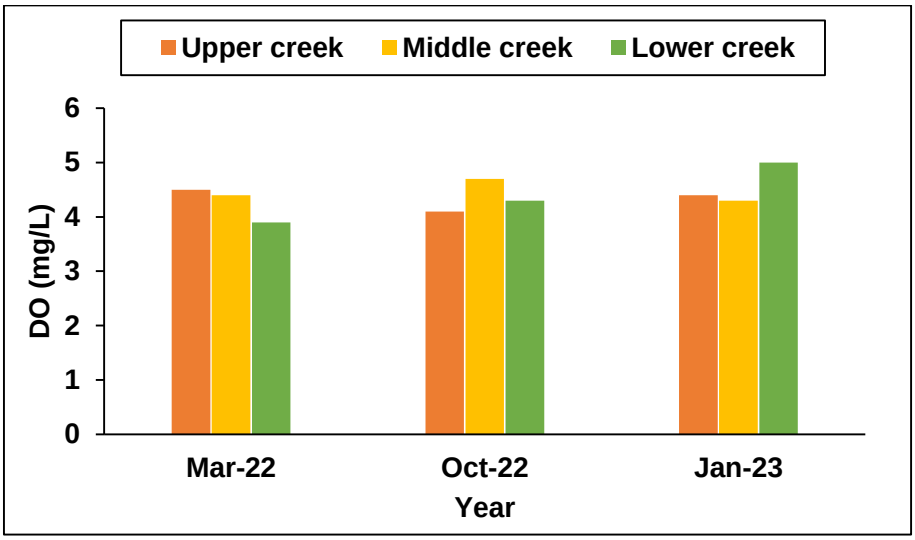

Figure 4.1.5: Average dissolved oxygen (mg/L) in the study area during different seasons.

4.1.6 Biochemical Oxygen Demand (BOD)

Consumption of DO during heterotrophic degradation of oxidizable organic matter creates oxygen demand popularly termed as the Biochemical Oxygen Demand (BOD). Presence of sufficient DO through replenishment keeps this demand low. However, input of oxidisable organic matter more than that a water body can assimilate, enhances BOD which is the indicator of unfavourable conditions for the aquatic life and aesthetics.

The biochemical oxygen demand (mg/L) recorded at each station during the study period are presented in Table 4.1.6.

Table 4.1.6: Biochemical oxygen demand (mg/L) at different stations of the study area during different seasons

Biochemical Oxygen Demand (mg/L)									
Month & Year	**L**	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
March, 2022	**S**	7.5	3.5	3.6	0.6	0.7	1.2	1.1	3.0	2.9
	B	2.3	1.5	2.3	0.9	0.1	0.9	2.0	3.2	3.2

October, 2022	**S**	8.5	3.0	7.5	1.1	3.5	1.3	2.0	1.3	4.6
	B	1.7	1.3	1.5	1.1	1.3	1.2	1.6	0.6	0.7
January, 2023	**S**	1.4	1.8	0.9	1.8	2.6	2.1	1.3	2.1	1.0
	B	1.1	3.8	2.1	1.2	0.2	1.1	1.1	0.8	0.8

The BOD concentration ranged from 0.2 to 8.5 mg/L (av. 2.06 mg/L) during different seasons in the study area. Low concentration of BOD was observed during postmonsoon (January, 2023). The average BOD (mg/L) concentration at different segments of the study area during different seasons is represented graphically in Figure 4.1.6.

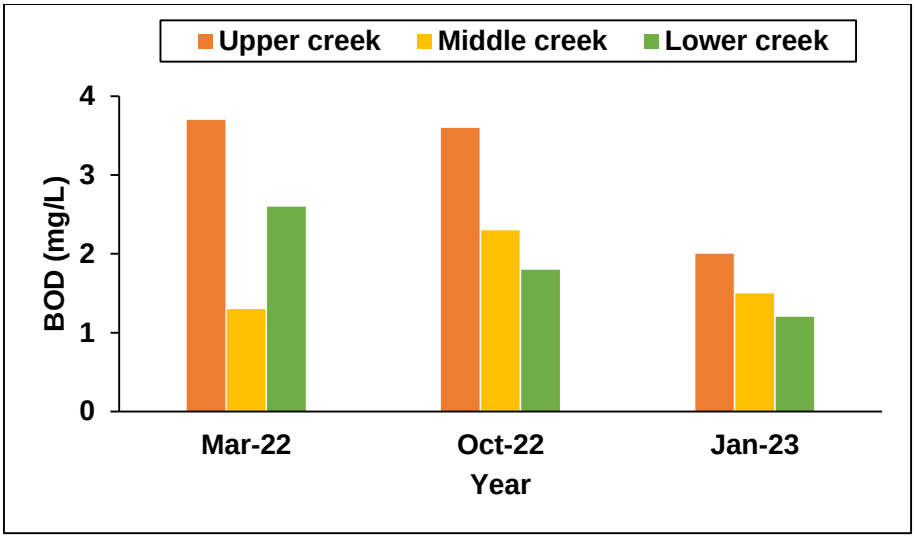

Figure 4.1.6: Average Biochemical Oxygen Demand (mg/L) in the study area during different seasons

The above data indicates that the oxidisable matter entering the creek and surrounding region was effectively consumed/degraded by the microorganisms and also the results were comparable with earlier observations from the study area.

4.1.7 Phosphate

Dissolved nutrients though in low concentrations are essential for production of organic matter by photosynthesis. They tend to be efficiently stripped from the surface water through incorporation into the cells, tissues and extracellular structures of living organisms. Among several inorganic constituents such as phosphate, nitrogen compounds, silicon, trace metals etc. the traditional nutrients namely phosphorus and nitrogen compounds have a major role to play in primary productivity. However, their occurrence in high levels in areas of restricted water exchange can lead to an

excessive growth of algae which in extreme conditions results in eutrophication. Among the several forms of phosphorus namely PO_4^{3-}-P, H_2PO_2, $H_2P_2O_7$, polyphosphoric acid, organic compounds such as phospholipids, phosphonucleotides and their derivatives occurring in seawater, reactive phosphate (PO_4^{3-}-P) accounts for only 10%. Sediment bound phosphate is generally associated with iron, calcium and magnesium which is released to the overlying water column during anoxic conditions. Phosphorus as phosphate is one of the major nutrients required for plant nutrition and essential for life though the elemental form is particularly toxic and is subject to accumulation. When in excess, it stimulates undesirable plant growth when other nutrients are also available. Sources of phosphate in coastal marine environment are mostly land based. These include domestic sewage, detergents, effluents from agro-based and fertilizer industries, agricultural runoff, organic detritus such as leaves, cattle waste etc. The sources within the marine environment are decomposition of algal plant cells, releases through sediment, bacterial action and recycling within the biotic communities. The concentration of phosphate (μmol/L) recorded at each station during the study period is presented in Table 4.1.7.

Table 4.1.7: Phosphate (μmol/L) at different stations of the study area during different seasons

PO_4^{3-}-P (μmol/L)									
Month & Year	**L**	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
March, 2022	**S**	5.1	4.1	5.6	4.6	2.7	2.6	4.8	2.2	2.0
	B	3.4	3.1	2.6	2.4	1.7	2.7	3.6	2.0	1.1
October, 2022	**S**	4.8	3.3	5.1	2.2	1.3	2.4	3.2	1.7	1.0
	B	2.7	2.0	2.5	1.9	1.3	3.9	3.2	1.7	1.5
January, 2023	**S**	4.6	2.6	2.4	2.4	2.4	2.5	2.0	1.8	1.9
	B	4.6	2.7	2.7	2.8	2.6	2.5	2.3	2.1	2.3

PO_4^{3-}-P varied in the range of 1.0 to 5.6 μmol/L (av. 2.8 μmol/L) during different seasons in the study area. The average phosphate concentrations recorded during the study period at various segments are presented in the graph below.

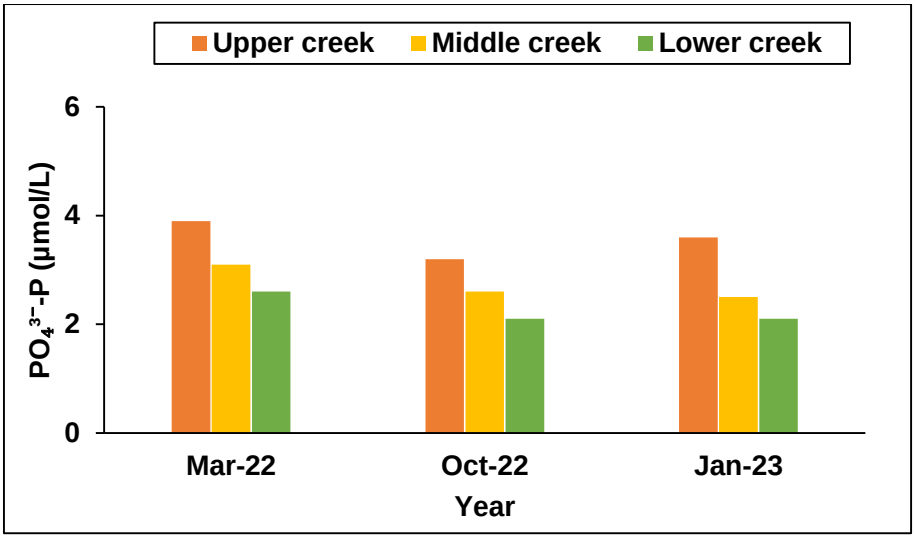

Figure 4.1.7: Average phosphate concentration (µmol/L) in the study area during different seasons

As it is evident from the above figure the average values of PO_4^{3-}-P gradually decreased from upper to lower creek region indicating that the PO_4^{3-}-P which is released in the inner creek is efficiently consumed and diluted while going towards the open shore region through tidal movements. The presence of comparatively high PO_4^{3-}-P in the upper segments can be attributed to the disposal of sewage from diverse non-point sources.

4.1.8 Dissolved Nitrogen

Nitrogen cycle involving elementary dissolved nitrogen; oxides: NO_3^-, NO_2^-; and reduced forms: NH_4^+, NH_3; plays a significant role in sustaining the aquatic life in marine environment.

a) Nitrate:

The concentration of nitrate (µmol/L) recorded at each station during the study period are presented in Table 4.1.8a.

Table 4.1.8a: Nitrate (µmol/L) concentration at different stations of the study area during different seasons

NO_3^--N (µmol/L)										
Month & Year	**L**	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
March, 2022	**S**	41.2	54.3	45.7	19.4	19.2	16.2	51.4	11.9	9.1
	B	64.1	56.5	62.1	13.7	19.1	15.2	67.1	9.2	6.8
October, 2022	**S**	13.7	29.3	13.6	7.4	11.9	7.6	22.3	6.5	9.9

	B	30.8	20.6	29.6	20.3	16.3	18.1	13.7	21.5	18.8
January, 2023	**S**	25.9	42.0	36.1	25.0	32.4	28.7	28.8	13.4	12.5
	B	30.9	33.9	44.9	39.6	40.2	29.2	11.9	12.5	16.2

The concentration of NO_3^--N varied over a wide range (6.5 -67.1 µmol/L) during the present study compared to lower creek segments, the high $NO3^-$-N concentrations were noticed in the upper and middle creek regions. The average NO_3^--N (µmol/L) at various segments in the study area is graphically represented in Figure 4.1.8a.

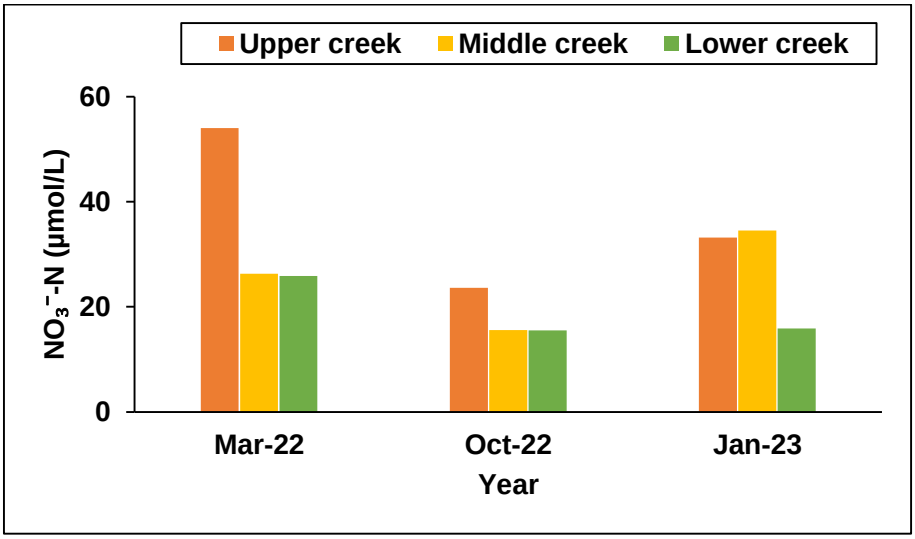

Figure 4.1.8a: Average nitrate concentration (µmol/L) in the study area during different seasons

It is evident from the above figure that the high NO_3^-- N values were observed in the upper and middle segments of the study region. This may be due to localised sewage releases in the inner parts of the Thane creek and the nitrification of NH_4^+.

b) Nitrite

The concentration of nitrite (µmol/L) recorded at each station during the study period are presented in Table 4.1.8b.

Table 4.1.8b: Nitrite (µmol/L) concentration at different stations of the study area during different seasons

NO_2^--N (µmol/L)										
Month & Year	**L**	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
March, 2022	**S**	51.5	27.8	51.8	8.2	44.0	6.8	19.1	11.3	2.2

	B	38.7	27.0	24.1	8.0	40.5	6.5	16.0	12.1	3.0
October, 2022	**S**	6.4	10.5	10.6	8.0	13.2	7.3	6.2	6.2	13.2
	B	10.1	8.2	11.6	6.5	7.8	5.8	7.3	4.8	3.2
January, 2023	**S**	31.5	10.4	17.0	12.7	20.1	7.0	5.5	1.3	0.4
	B	28.1	7.1	12.7	10.3	10.6	2.7	1.1	0.6	0.8

The concentration of NO_2^--N also varied over a broad range (0.4 to 51.8 µmol/L) during the present monitoring. Comparatively higher values were observed during premonsoon (March, 2022) and concentration were drastically reduced during monsoon (October, 2022). Upper and middle creek regions of the study area were showed higher values for nitrate concentration in all the seasons can be attributed to the increased loading of sewage in the upper creek segments. The average NO_2^--N (µmol/L) at various segments in the study area is graphically represented in Figure 4.1.8b.

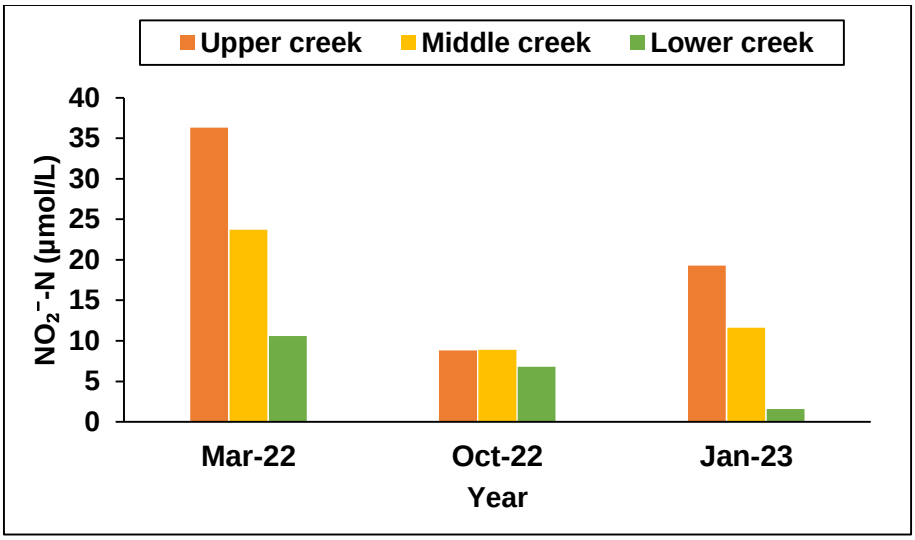

Figure 4.1.8b: Average nitrite concentration (µmol/L) in the study area during different seasons

c) Ammonia

The concentration of ammonium (µmol/L) recorded at each stations during the study period are presented in Table 4.1.8c.

Table 4.1.8c: Ammonium (μmol/L) concentration at different stations of the study area during different seasons

NH_4^+-N (μmol/L)										
Month & Year	**L**	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
March, 2022	**S**	2.8	0.7	3.2	3.3	7.4	3.8	9.7	6.1	9.0
	B	0.9	0.3	2.0	2.4	8.5	4.0	8.9	8.1	7.1
October, 2022	**S**	8.8	21.6	96.6	13.4	8.3	6.1	16.2	4.7	6.1
	B	11.7	5.8	12.3	12.6	5.2	16.8	10.8	7.3	4.9
January, 2023	**S**	0.7	1.0	1.0	0.1	1.4	0.5	0.4	0.2	0.4
	B	1.0	0.3	2.2	0.3	0.8	0.9	0.3	0.2	0.3

The range of NH_4^+-N observed from different segments in the study varied between 0.2 to 96.6 μmol/L (av. 6.8 μmol/L). It can be observed from the figure (Figure 4.1.8c) that comparatively high NH_4^+-N were present during October 2022 and there were no particular trends in ammoniacal nitrogen concentration. Such differences in ammoniacal nitrogen concentration may be attributed to the variations in the organic load that entering into the Thane Creek-Mumbai harbour system through different channels like Thane Creek, Patalganga Creek, Panvel Creek etc. and pushed to the nearshore coastal water with tidal changes. The average NH_4^+-N (μmol/L) at various segments in the study area is graphically represented in Figure 4.1.8c.

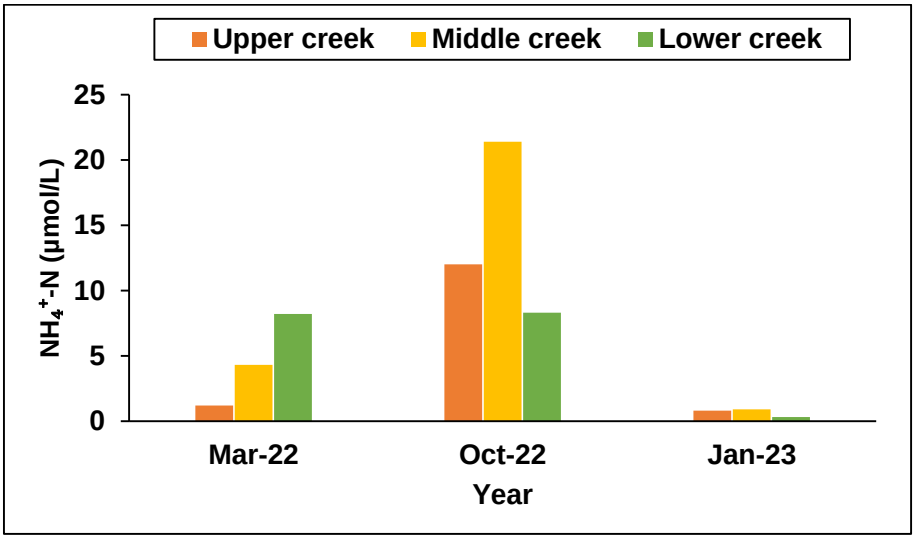

Figure 4.1.8c: Average ammonia concentration (μmol/L) in the study area during different seasons

4.1.9 Petroleum Hydrocarbons (PHc)

Naturally occurring hydrocarbons in marine environment are trace amounts of simple forms produced by microbes. PHc derived from crude oil and its products are added to marine environment by anthropogenic activities namely production of crude oil and its products, transport through pipelines, ship traffic, tankers etc. Prominent land based sources are domestic and industrial effluents, atmospheric fallout of fuel combustion products, condensed vapors etc. PHc consists of several hydrocarbons. They are saturated; unsaturated aliphatic; one ring, poly aromatic, fused aromatics; and alicyclic or naphthenic hydrocarbons having a wide range of boiling points. On entering the marine environment PHc is subjected to several weathering processes during which PHc gets distributed in the water column, evaporates, adsorbs on particulate matter and sinks, gets assimilated by biota, washes ashore etc. Consequently, its high boiling residue may remain in the marine environment till it is biodegraded and/or removed.

The concentration of PHc in water recorded at each station during the study period are presented in Table 4.1.9.

Table 4.1.9: PHc (µg/L) in water at different stations of the study area during different seasons

PHc (µg/L)										
Month & Year	**L**	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
March, 2022	**S**	69.8	12.0	20.1	16.5	5.4	12.6	22.4	18.1	6.6
October, 2022	**S**	10.5	6.6	6.2	5.8	3.4	12.1	6.4	3.6	4.5
January, 2023	**S**	0.9	11.7	7.1	10.5	8.5	7.7	5.0	5.9	6.3

The concentration of PHc varied in the range 0.9 to 69.8 µg/L during the present study. Comparatively high concentrations of PHc were observed in the upper creek area of the study region during premonsoon. The average concentrations of PHc (µg/L) in the study region during the study period are figured below.

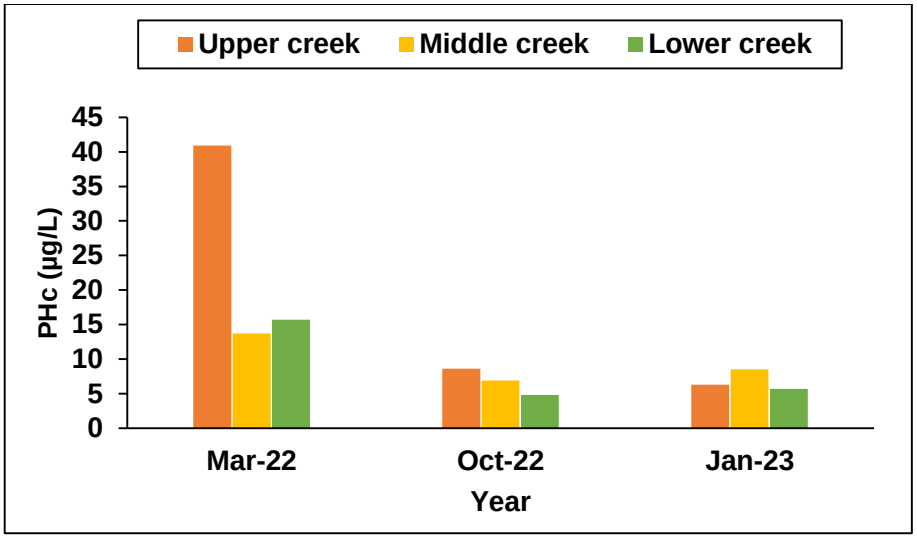

Figure 4.1.9: Average PHc concentration (µg/L) in the study area during different seasons

4.1.10 Phenols

Phenols include a wide variety of derivatives of phenol (C_6H_5OH) such as monohydric, dihydric, polyhydric, one ring, two ring, polyring and fused aromatic. Substitutions of $-CH_3$, -Cl, $-NH_2$ etc greatly influence reactivity of the molecule; phenol being highly reactive. Some of the commonly known phenols are chlorophenols, cresols and naphthols. Generally, naturally occurring phenols namely thymol, methyl salicylate, polyhydroxy phenols etc. which are lowly reactive compounds are not determined in the water quality parameter. Polyphenols related to catachols are produced by brown algae which on decomposition add phenols in intertidal regions. The High concentration of phenols in marine environment generally originates through onshore anthropogenic discharges. They are generated as by-products in manufacturing processes of coke, paper and pulp processing, coal gas liquification and produced from hydrocarbons in petrochemical industries. They are used on large scale in fungicides, antimicrobials, wood preservatives, pharmaceuticals, dyes, pesticides, resins etc. Hence, they become important constituent of domestic and industrial effluents.

The concentration of phenol in water recorded at each stations during the study period are presented in Table 4.1.10.

Table 4.1.10: Phenol (µg/L) in water at different stations of the study area during different seasons

Phenol (µg/L)										
Month & Year	**L**	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
March, 2022	**S**	13.2	70.2	83.7	110	66	89.8	126	81.7	71.8
October, 2022	**S**	118.5	104.3	120.4	70.2	115.5	83.3	95.2	94.0	111.5
January, 2023	**S**	53.2	64.9	57.2	42.9	59.2	69.7	83.0	77.4	73.0

The concentration of Phenol varied in the range 13.2 to 120.4 µg/L during the present study. There is an increasing trend of concentration of phenol from upper to lower creek region during pre-monsoon season and trend got directly reversed during monsoon. Such variations may be attributed to the anthropogenic sources in the creek regions. The average Phenol (µg/L) in the study area is graphically represented in Figure 4.1.10.

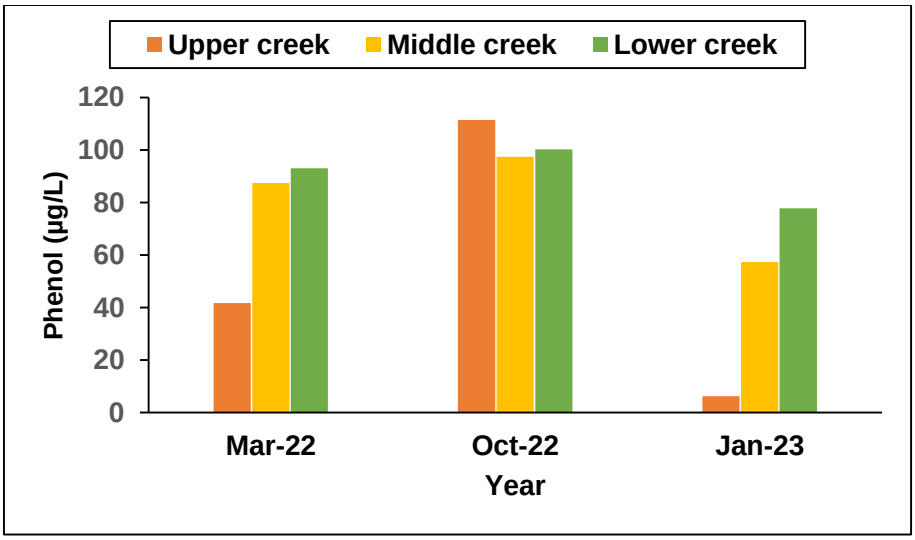

Figure 4.1.10: Average phenol concentration (µg/L) in the study area during different seasons

4.2 Sediment Quality

Determination of trace pollutants such as heavy metals and organic compounds in water often reveals fluctuations as the concentrations depend on the location and time of sampling, the nature of pollutant and chemical characteristics of water. Moreover, several pollutants get rapidly fixed to particulate suspended matter and/or hydrolysed and thus removed from the water column. In several instances, it is observed that even close to a location of effluent release, the metal content in receiving

water often decreases to a normal value making assessment of contamination through analysis of water, a difficult task. The pollutants adsorbed by the particulate matter are ultimately transferred to the bed sediment on settling. Evidently, concentrations of pollutants in sediment increase over a period of time in regions receiving their fluxes. Hence, sediment can serve as a useful indicator of certain trace pollutants such as heavy metals and PHc. Sediment samples were collected from different segments and seasons from the study area are given below.

4.2.1 Texture

The bed sediment of the study area was heterogeneous in nature with the texture varying over short distance. Overall, the study region is characterized with dominance of silt in the sediment. The sediment texture of selected segments during all the study periods was given below in Figures 4.2.1. The sand silt and clay (%) recorded at each station during the study period are presented in Table 4.2.1.

Table 4.2.1: Sediment texture at different stations of the study area during different seasons

Sediment Texture										
Month &	**Texture**	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
March, 2022	Sand (%)	0.3	0.2	0.4	1.5	0.1	18.2	3.3	0.3	0.9
	Silt (%)	92.4	92.7	93.9	91.9	93.5	77.1	90.1	94.6	92.9
	Clay (%)	7.3	7.1	5.8	6.6	6.4	4.7	6.7	5.1	6.2
October, 2022	Sand (%)	0.7	0.8	0.2	3.4	0.6	1.0	0.2	1.5	3.7
	Silt (%)	91.8	93.6	93.7	90.6	93.2	91.5	93.2	92.1	90.9
	Clay (%)	7.5	5.6	6.2	6.0	6.2	7.5	6.6	6.4	5.4
January, 2023	Sand (%)	2.0	0.2	1.7	1.1	1.7	0.3	1.8	70.0	0.9
	Silt (%)	92.0	93.4	91.3	93.0	90.9	93.7	91.2	29.2	93.3
	Clay (%)	6.0	7.8	7.0	6.0	7.4	6.0	7.0	0.8	5.8

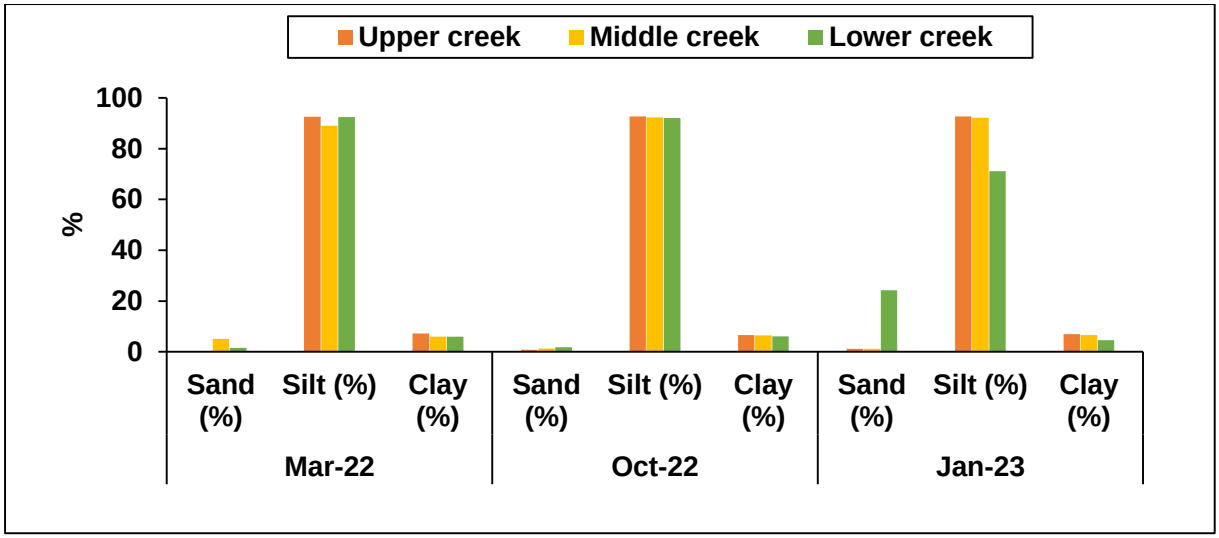

Figure 4.2.1: Sediment texture in the study area during different seasons

During the observation between 2022-23 the sediment texture in Thane creek was found dominated by silt content.

4.2.2 Metals

Natural sediments always contain heavy metals to a varying degree depending on the source rock from which they are derived as well as the environment of deposition and also on pH and redox potential at the sediment-water interface. This lithogenic fraction should be accurately known for assessment of sediment contamination of metals through anthropogenic sources. The heavy metal contents in sediment during the present study are given below in Figure 4.2.2. The concentration of metals in sediment recorded at each station during the study period are presented in Table 4.2.2.

Table 4.2.2: Concentration of metals at different stations of the study area during different seasons

Concentration										
	Metals	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
March, 2022	Al (%)	8.3	8.3	8.2	8.1	8.4	7.6	7.8	7.8	7.8
	Fe (%)	8.2	8.1	7.9	7.9	8.1	7.6	7.6	8.0	7.7
	Cr (µg/g)	178	165	163	155	155	150	166	147	152
	Mn (µg/g)	1098	957	904	878	954	924	1022	950	830
	Co (µg/g)	37.4	36.2	35.6	35.2	35.3	34.8	34.4	35.8	34.0
	Cu (µg/g)	149	126	140	116	113	116	125	113	110

	Ni (μg/g)	95.1	90.5	90.5	83.0	84.3	80.2	80.5	78.3	82.7
	Zn (μg/g)	186	145	138	121	118	128	143	111	107
	Hg (μg/g)	0.05	0.24	BDL	0.2	0.12	0.02	0.09	0.07	0.2
October, 2022	Al (%)	6.5	5.3	6.8	6.4	7.1	8.7	8.6	7.3	7.2
	Fe (%)	6.0	4.7	6.3	6.0	6.6	10.6	7.7	6.6	6.6
	Cr (μg/g)	184.2	174.8	183.3	169.8	158.5	167.5	171.5	159.1	157.0
	Mn (μg/g)	1098	1243	1163	1074	1142	1203	1199	1108	1024
	Co (μg/g)	38.0	38.5	38.8	36.9	35.9	37.8	36.6	36.0	34.9
	Cu (μg/g)	137.5	118.1	133.2	115.3	109.8	120.1	131.0	111.0	104.5
	Ni (μg/g)	95.1	95.1	97.5	90.8	87.2	92.0	91.9	86.8	85.0
	Zn (μg/g)	186	116.7	145.5	127.2	175.1	137.2	173.9	109.4	96.0
	Hg (μg/g)	0.05	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01
January, 2023	Al (%)	6.9	6.9	7.3	6.7	7.0	6.7	7.0	6.4	6.8
	Fe (%)	8.1	7.3	7.9	7.8	8.2	8.1	9.1	8.6	7.9
	Cr (μg/g)	167.2	159.6	159.6	156.1	150.1	143.1	149.9	154.9	150.9
	Mn (μg/g)	941.9	918.4	947.2	964.7	1090.7	978.3	1216.0	1498.2	947.1
	Co (μg/g)	34.4	33.4	35.9	33.0	32.0	30.9	38.2	38.1	32.4
	Cu (μg/g)	86.8	84.4	94.9	83.6	80.9	76.5	93.1	84.5	83.1
	Ni (μg/g)	118.5	113.6	116.0	103.9	100.8	97.8	165.1	100.3	102.7
	Zn (μg/g)	145.3	138.6	150.7	114.8	113.5	105.8	138.0	145.1	112.1
	Hg (μg/g)	0.05	0.05	0.04	0.06	0.03	0.03	0.06	0.04	0.03

Copper concentration varied in the range of 76.5 to 149.0 μg/g and showed a particular trend among seasons and sampling stations. There is a decreasing trend in concentration from upper to lower creek region of the study area. The higher values were observed during premonsoon season and gradually decreased during post monsoon. Concentration of Chromium varied in between 147.0 and 184.2 μg/g with higher values in the upper creek region. The concentration ranges of Mercury (0.01 – 0.2 μg/g) , Manganese (830 – 1498.2 μg/g), Zinc (96 – 186 μg/g), Cobalt (30.9 – 38.8 μg/g) and Nickel (78.3 – 118.5 μg/g) are varied widely without any trend along the stations of the study area during the study period.

It is clear from the above data that the metal content varied widely between and within segments. Accumulation of the metals was generally higher in creek which are highly influenced by the land run-off. The seasonal variation of metals was random and indicating no systematic trend. Concentration of metals also varies depending on the texture of the region.

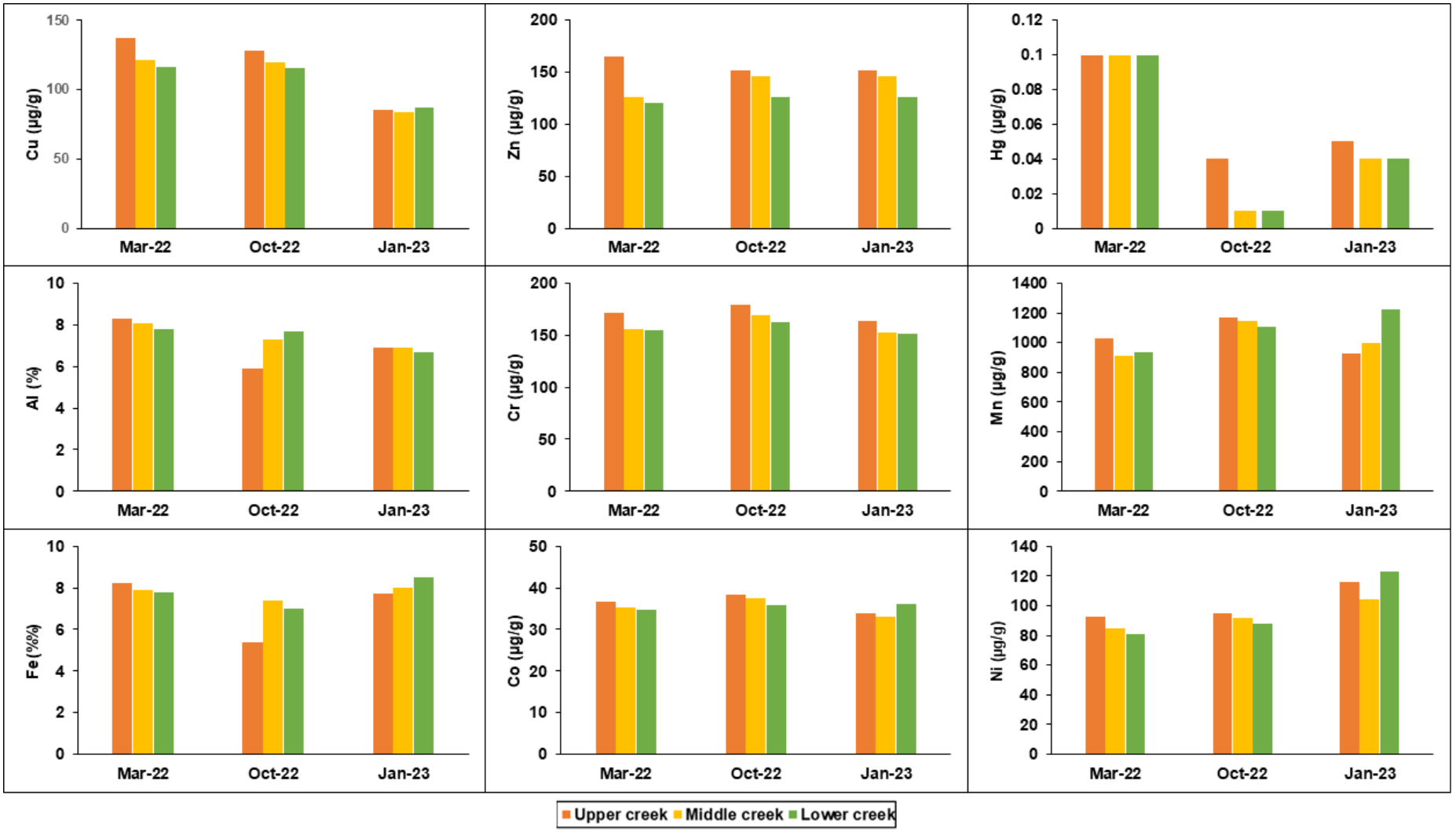

Figure 4.2.2: Average concentration of metals in the study area during different seasons

4.2.3 Total Phosphorus

Lithogenic phosphorus in sediment generally originates through geological sources. Sewage, runoff from agricultural areas, industrial effluents etc are the major anthropogenic sources of phosphorus to aquatic sediments. A portion of sediment phosphorus is released to the overlying water when the organic matter is biochemically decomposed.

Chemically bound phosphorus is also released under certain redox conditions in the sediment. The release from the interstitial water is accelerated due to disturbances caused by tidal scour, traffic, dredging etc. The segment wise average concentration of Phosphorous during the present study are given below.

The total phosphorus in sediment recorded at each station during the study period are presented in Table 4.2.3.

Table 4.2.3: Total phosphorus (µg/g) in sediment at different stations of the study area during different seasons

TP (µg/g)									
Month & Year	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
March, 2022	1203	963	995	931	975	984	1006	884	879
October, 2022	1313	1068	1257	1177	1114	1287	1351	1104	1048
January, 2023	1057	1103	1218	1036	1043	1036	1139	1340	1005

The total phosphorus in the study area varied in the range of 884 – 1351 (µg/g) during the study period. The higher values were observed during monsoon and post monsoon season compared with pre monsoon season.

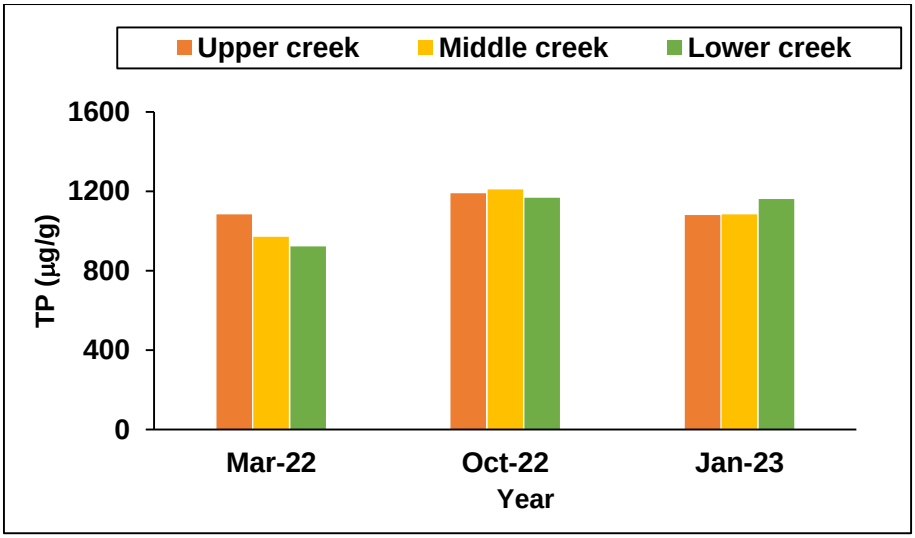

Figure 4.2.3: Average concentration of total phosphorus in the study area during different seasons

4.2.4 Total Organic Carbon

Generally, organic matter in natural coastal sediments originates from terrestrial run-off and remains of organisms inhabiting the region. Their decay is one of the important sources of nutrients in the water column. Anthropogenic organic inputs however can increase the content of organic matter to abnormal levels disturbing the equilibrium of the ecosystem. Organic matter settling on the bed is scavenged by benthic organisms to a large extent. The balance is decomposed by the heterotrophic microorganisms that require DO. Hence, DO in the sediment interstitial water is continuously consumed and anoxic conditions develop if the organic matter is more than that can be oxidised through oxygen as an oxidant. Such anoxic conditions are harmful to benthic fauna. The total organic carbon in sediment recorded at each stations during the study period are presented in Table 4.2.4.

Table 4.2.4: Total phosphorus (µg/g) in sediment at different stations of the study area during different seasons

TOC (%)									
Month & Year	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
March, 2022	2.8	2.1	2.2	2.0	1.8	3.3	2.3	1.8	2.0
October, 2022	2.5	2.0	2.4	2.0	1.9	2.2	2.6	1.9	2.0
January, 2023	2.3	2.0	2.2	2.0	2.1	1.9	1.6	1.7	2.0

The total organic carbon in the study area varied in the narrow range of 1.6 to 3.3% with higher values during pre-monsoon period. Upper creek recorded higher values for TOC in all the seasons.

The segment-wise average content of the organic carbon from the study area are given below in Figure 4.2.4.

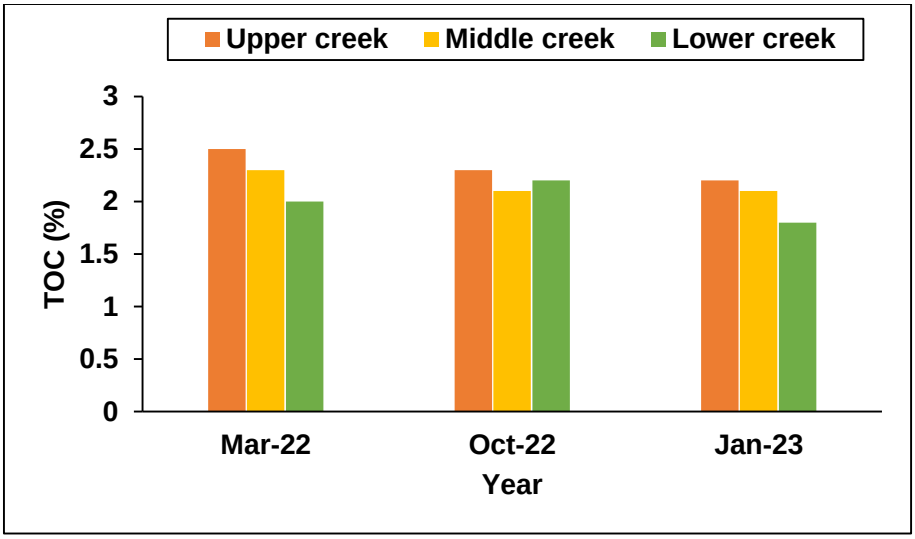

Figure 4.2.4: Average concentration of total organic carbon (%) in the study area during different seasons

4.2.5 PHc

Though large accidental releases of oil are easily sighted as slicks on the sea surface, minor chronic releases often go unnoticed. Being immiscible with water, distribution of petroleum is patchy and assessment of environmental quality through the analysis of water often provide ambiguous results with concentrations varying widely in the same area because of heterogeneous nature of PHc. Petroleum in the marine environment undergoes weathering leading to its partial removal from the sea surface thereby influencing the results of water quality. The residue left after petroleum weathers, is absorbed by SS and ultimately transferred to the sediment. Hence, sediment serves as an indicator of the cumulative effect of oil contamination.

The PHc in sediment recorded at each station during the study period are presented in Table 4.2.5.

Table 4.2.4: PHc in sediment at different stations of the study area during different seasons

PHc(µg/g)									
Month & Year	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
March, 2022	1.3	0.9	2.2	1.0	0.5	2.9	0.9	10.2	0.2
October, 2022	1.2	1.7	1.4	3.8	1.0	9.8	1.2	13.6	1.2
January, 2023	0.9	1.4	0.8	1.6	1.0	1.0	1.4	1.5	0.8

The PHc content in the study area varied between 0.2 to 13.6 µg/g. The average PHc content in sediment during the present study are given in Figure 4.2.5.

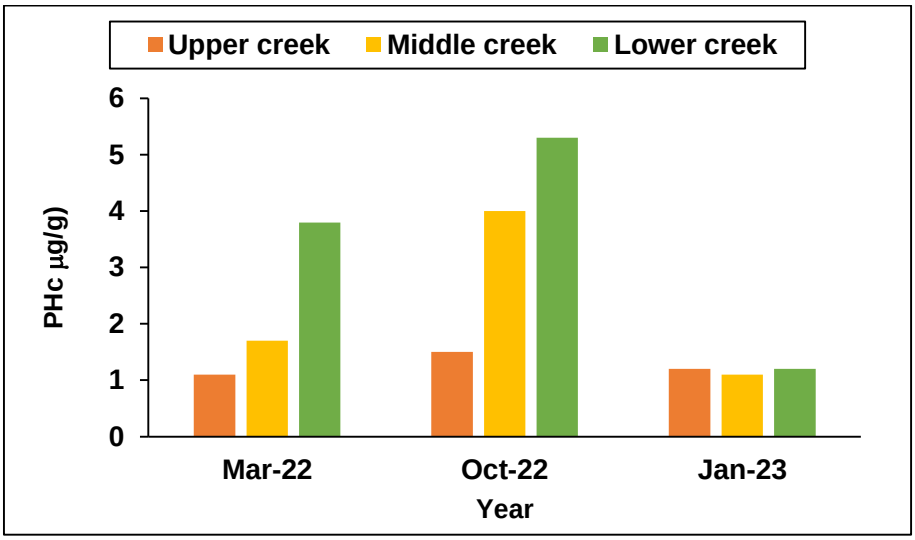

Figure 4.2.5: Average concentration of PHc in sediment of the study area during different seasons

4.3 Flora and Fauna

Study of the biological status of a marine ecosystem is an essential prerequisite to assess the existing status and predict the impact due to proposed developments in the coastal zone. Despite many changes in the physico-chemical properties of water body and sea bed sediment, the ultimate consequences of pollutants may be reflected on the biological system. Hence, the investigations of an ecosystem and particularly of its communities constitute an important part of any ecological assessment. This can be achieved by selecting a few reliable parameters from a complex community structure. In view of wide variations in biological production in an ecosystem, the biological parameters considered for the present study are

microbial parameters, phytoplankton production in terms of pigments, cell count and generic diversity, zooplankton standing stock in terms of biomass, population and total groups, macrobenthos standing stock in terms of biomass, population and faunal groups and fishery. The phytoplankton pigment, cell count and zooplankton standing stock reflect the primary productivity of water column at the primary and secondary levels. Benthic organisms being sedentary animals associated with the seabed, provide information regarding the integrated effects of stress, if any, and hence are good indicators of early warning of potential damage. Assessment of mangroves, corals and bacteria are considered as part of overall ecological evaluation. A collective evaluation of all the above components is a reliable approach to predict the state of equilibrium of marine life in coastal waters.

4.3.1 Microbiology

Microbial ecology is at the forefront of developing and applying a new generation of indicators of environmental stress and ecological change. The roles played by marine microorganisms are profound in the overall normal functioning, stability and continuance of marine ecological processes. Despite their small size marine microorganisms are far more important as they are linked to water column and sediment (benthic) processes. Marine microorganisms occupy the base of the food web, and form food for protozoa, invertebrate larvae and many large zooplankton and regenerate dissolved nutrients for marine photosynthesis and formation of newer organic biomass. Bacteria are major links to many biological and non-biological events in the oceans. As we learn about the diversity of microorganisms and their associated processes, our view of the marine ecosystem is being transformed, and the relevance of microbes to marine resiliency and marine resource management is becoming undeniable. The sheer number of micro-organisms act as sentinels for health status within marine ecosystem as well as their vast diversity and different functions has led to the realization of threats from emerging pathogens. In order to bring into focus the importance of marine bacteria at base of the food web, an assessment of their abundance and distribution are essential. The microbial diversity of coastal waters can be influenced by anthropogenic activities also besides oceanic processes.

The principal source of waterborne diseases such as cholera, typhoid and hepatitis are due to contamination of water by sewage and animal wastes. Apart from potable water, bacterial contamination occurs in surface waters such as those used for shell fishing areas, beaches, fisheries and recreational facilities. Though 90% of

the intestinal bacterial population dies off within 2 days in natural waters, the remaining 10% decline much more slowly. Coliform bacteria such as *Escherichia coli* and *Faecal streptococci* (Genus: Streptococcus) are the two most important groups of non-pathogenic bacteria found in sewage (Table 1a). Because of number of problems associated with the determination of populations of individual pathogens, non-pathogenic bacteria (such as coliforms) are used as indicators of water pollution.

a) Surface water

The TVC in water recorded at each station during the study period are presented in Table 4.3.1a.

Table 4.3.1a: TVC in water at different stations of the study area during different seasons

TVC x 10^2									
Month & Year	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
March, 2022	330	190	150	140	180	200	70	200	60
October, 2022	31	80	30	60	82	110	37	170	64
January, 2023	28	69	23	53	73	97	28	153	59

Average TVC of bacteria in different segments was in the range of 23 to 330 x 10^2 CFU/mL during the present study. Total viable count showed a decreasing trend from pre-monsoon to post-monsoon in the study area. Microbial counts were associated with sewage discharge and the highest count were observed in the upper creek region during pre-monsoon season.

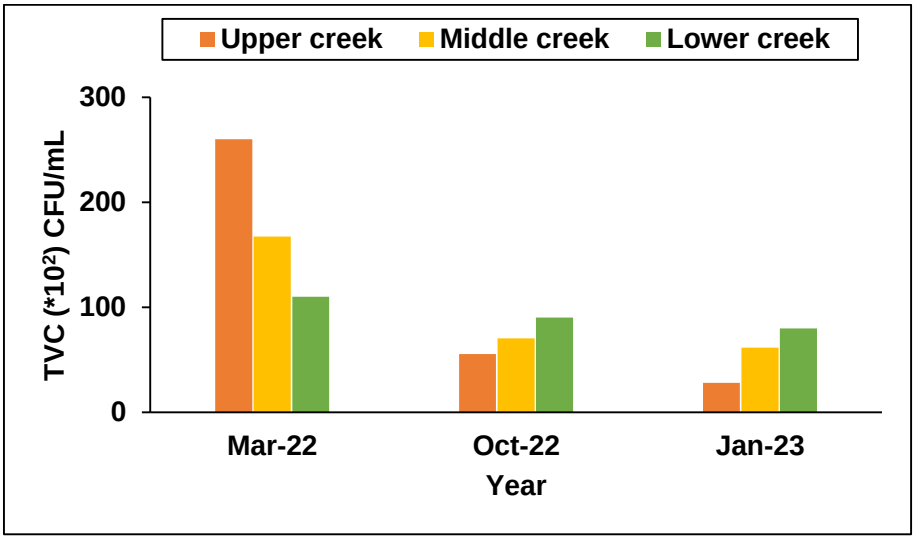

Figure 4.3.1: Average TVC of water in the study area during different seasons

b) Sediment

The TVC in sediment recorded at each station during the study period are presented in Table 4.3.1b.

Table 4.3.1b: TVC in sediment at different stations of the study area during different seasons

TVC x 10^4									
Month & Year	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
March, 2022	250	20	60	110	100	30	70	90	25
October, 2022	43	11	15	12	11	35	31	30	12
January, 2023	35	9	13	10	10	25	28	19	8

The bacterial population studied in sediment during pre-monsoon 2022 to post monsoon 2023. The results indicated that the bacterial population in sediments are not indicative of any significant contamination. The average TVC count ranged between 8 to 250 x 10^4 CFU/g with maximum at upper creek region during pre-monsoon period (March, 2022). The overall average values of microbial counts in sediment are found low (Table 1b).

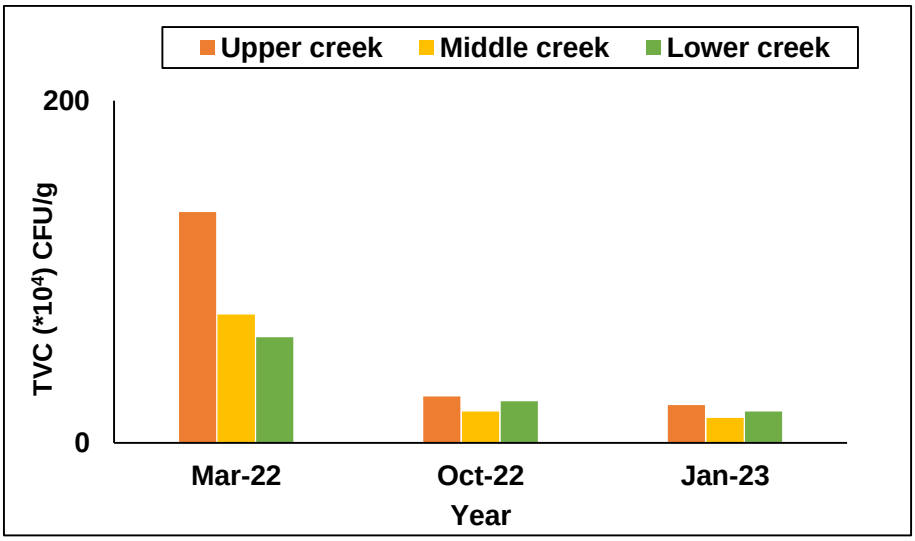

Figure 4.3.2: Average TVC of sediment in the study area during different seasons

Overall, the bacterial population observed in the area is found low especially in sediments; the variation in presence can be attributed to natural variability like flushing or high suspended sediment load.

4.3.2 Phytoplankton

Phytoplankton forms the vast array of minute and microscopic plants passively drifting in the sea and mostly confined to the photic zone. In an ecosystem these organisms constitute primary producers forming the first link in the food chain. Phytoplankton is broadly classified as diatoms, dinoflagellates, green algae and blue green algae. Arbitrary size wise classification is microphytoplankton (20 - 200 μm), nanoplankton (2 - 20 μm) and picoplankton (0.2 - 2 μm). Phytoplankton photosynthesize thereby assimilating carbon into plant cells and building up mainly carbohydrates and release of oxygen. Other substances such as aminoacids, proteins, lipids and a variety of other components are also incorporated into the living cells. Phytoplankton in polluted water condition develops noxious blooms, creating offensive tastes and odours or anoxic or toxic conditions resulting in animal death or human illness. Because of their short life cycles, plankton respond quickly to environmental changes, and hence their standing crop in terms of biomass, cell counts and species composition are more likely to indicate the quality of the water mass in which they are found. They strongly influence certain non-biological aspects of water quality such as pH and colour. However, because of their transient nature, and often patchy distribution, their utility as water quality indicators is limited. In the present study phytoplankton standing crop was studied in terms of biomass by estimating chlorophyll *a* and phaeophytin and in terms of population by counting total number of cells and their generic composition. The concentration of photosynthetic pigments is used extensively to estimate phytoplankton biomass. Chlorophyll *a* in phytoplankton constitutes approximately 1 to 2% of the dry weight of planktonic algae. The important chlorophyll degradation products found in the aquatic environments are the chlorophyllids, phaeophorbides and phaeophytins. Undoubtedly much of phaeophytin present in natural waters arises from the grazing activities of zooplankton with the subsequent decomposition of phytoplankton cells. It is widely suggested that chlorophyll is converted also to phaeophytin in nutrient deficient and when phytoplankton is kept in darkness. Marked differences exist between the phytoplankton biomass of different regions of the sea partly due to local climatic conditions and partly to a different grazing pressure/intensity. A real difference in phytoplankton apply not only to differences in density, but to distinction in floristic

composition. Phytoplankton composition also varies considerably (e.g., during bloom). Thus, a very few species may be overwhelmingly common during blooms, while a large number of species may occur without clear dominance under normal conditions.

4.3.2.1 Phytopigments

The concentration of phytopigments recorded at each stations during the study period are presented in Table 4.3.2a.

Table 4.3.2a: Concentration of phytopigments at different stations of the study area during different seasons

Month &	L	T1	T2	T3	T4	T5	T6	T7	T8	T9
Chlorophyll *a* (mg/m^3)										
March, 2022	**S**	15.81	8.01	9.98	6.00	10.14	1.28	0.65	1.50	1.21
	B	8.40	3.96	2.49	1.29	0.74	1.53	0.81	1.07	1.50
October, 2022	**S**	12.27	2.07	5.63	0.34	6.93	0.14	0.58	0.37	9.33
	B	0.71	0.41	0.91	0.38	3.99	0.30	0.37	1.11	0.73
January, 2023	**S**	1.94	1.64	0.97	0.61	0.41	0.65	1.49	0.68	0.41
	B	2.42	1.71	0.74	0.79	0.41	0.67	0.89	0.67	1.00
Phaeophytin (mg/m^3)										
March, 2022	**S**	0.06	0.00	0.06	0.10	0.66	0.37	0.03	0.07	0.03
	B	0.30	0.41	0.87	0.36	0.40	0.36	0.11	0.06	0.12
October, 2022	**S**	0.54	0.13	0.50	0.01	0.48	0.10	0.06	0.18	2.42
	B	0.39	0.89	0.46	0.94	0.47	0.02	0.11	0.01	0.23
January, 2023	**S**	1.52	1.18	0.82	0.49	0.55	0.18	0.56	0.63	0.92
	B	1.96	1.70	0.38	1.09	1.24	4.19	3.79	1.46	7.08

a) Chlorophyll *a*

The concentration of chlorophyll *a* during the study period varied in the range of 0.3 to 15.81 mg/m^3. Highest chlorophyll *a* concentration was observed in the upper creek region during pre-monsoon period. This can be due to the enrichment of nutrients in the creek system from the surrounding area. There is a decreasing trend were observed in the concentration of chlorophyll *a* from pre-monsoon to post monsoon.

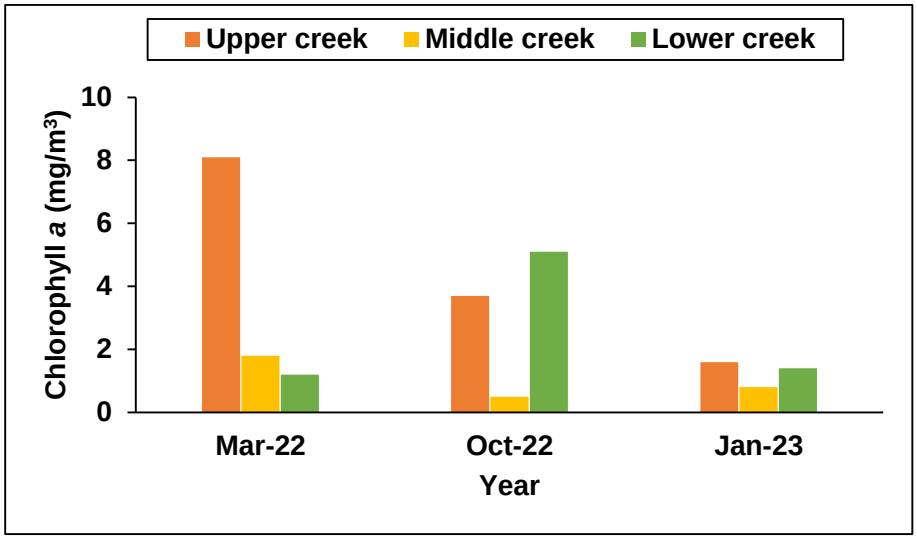

Figure 4.3.3: Average concentration of chlorophyll *a* in the study area during different seasons

b) Phaeophytin

The average concentration of phaeophytin at different segments from the study area also varied in the range 0.0 to 7.1 mg/m^3. Phaeophytin is a measure of dead cells and is an indirect indicator of stress conditions leading to deterioration of chlorophyll a. The ratios of chlorophyll *a* to phaeophytin generally exceed 1 indicating a healthy environment in the study area.

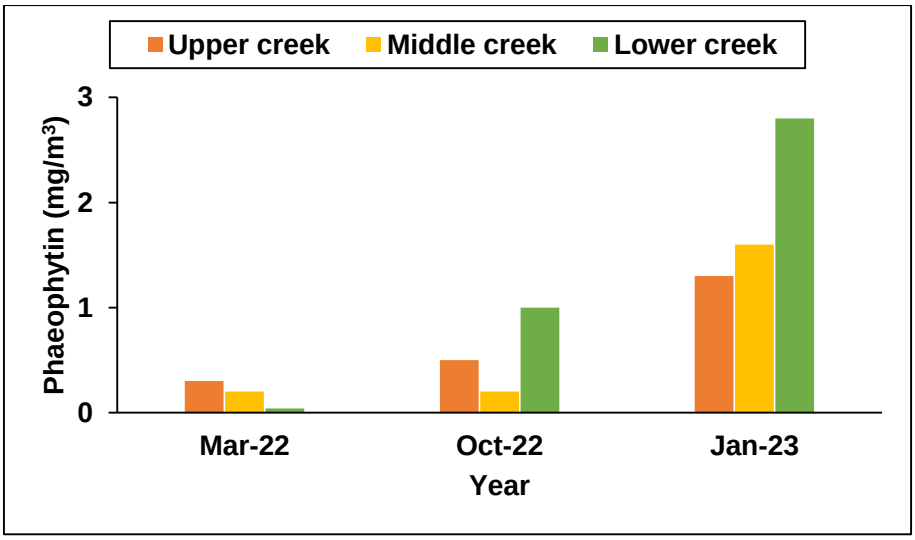

Figure 4.3.4: Average concentration of phaeophytin in the study area during different seasons

The above figure indicated a considerable variation in the concentration of phaeophytin in temporal and spatial scale in the study area. Post-monsoon period (January, 2023) showed the highest phaeophytin concentration in all the segments.

4.3.2.2 Population and diversity

The phytoplankton population and genera recorded at each station during the study period are presented in Table 4.3.2b

Table 4.3.2b: Phytoplankton population and genera at different stations of the study area during different seasons

Phytoplankton cell count (no x 10^3 Cells/L)										
Month & Year	**L**	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
March, 2022	**S**	1109.8	535.8	748.2	278.2	27686.8	89.0	59.6	84.4	71.4
	B	376.6	158.8	108.8	51.4	520.4	114.4	62.8	59.2	48.2
October, 2022	**S**	2730.0	1196.2	1996.0	512.0	13309.0	172.0	77.4	130.0	43495
	B	1277.4	440.8	1639.0	528.0	10647.6	104.0	155.8	86.0	249.2
January, 2023	**S**	978.8	955.4	490.2	396.0	112.4	293.4	693.0	254.8	6.4
	B	1562.8	12.5	497.8	4.4	0.9	5.8	4.1	320.0	10.0
Phytoplankton Genera (no)										
March, 2022	**S**	21	21	21	17	27	15	14	16	13
	B	22	19	18	16	11	16	12	11	11
October, 2022	**S**	25	23	23	17	26	14	19	14	24
	B	21	19	18	14	25	13	18	13	12
January, 2023	**S**	17	13	9	14	12	14	19	16	7
	B	17	11	14	11	5	9	11	16	5

The average phytoplankton population at various segments in the study area varied over a wide range 0.9 to 43495 x 10^3 cells/L revealing high and variable phytoplankton cell count which is in accordance with the trend in variation of chlorophyll *a*. High phytoplankton cell count was observed in the lower creek during post monsoon. On average, higher phytoplankton genera were observed in the upper creek region in all the seasons. There is a decreasing trend in phytoplankton genera

from upper to lower creek region. In general, the phytoplankton population was dominated by diatoms followed by dinoflagellates. During pre-monsoon and monsoon, the study area was dominated by *Thalassiosira* and *Skeletonema* (Table 2a,2b). The post-monsoon showed the dominance of *Pseudo-nitzschia* and *Skeletonema* during the sampling period (Table 2c).

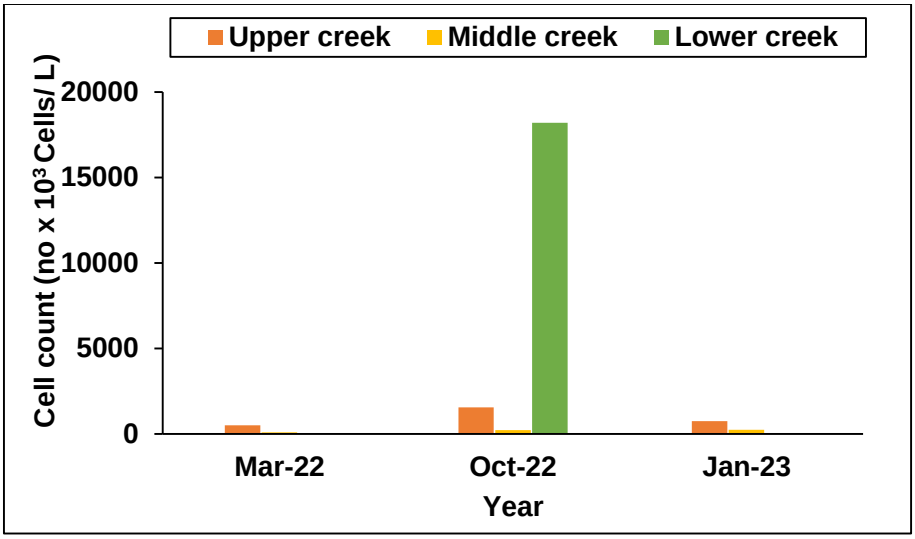

Figure 4.3.5: Average phytoplankton cell count in the study area during different seasons

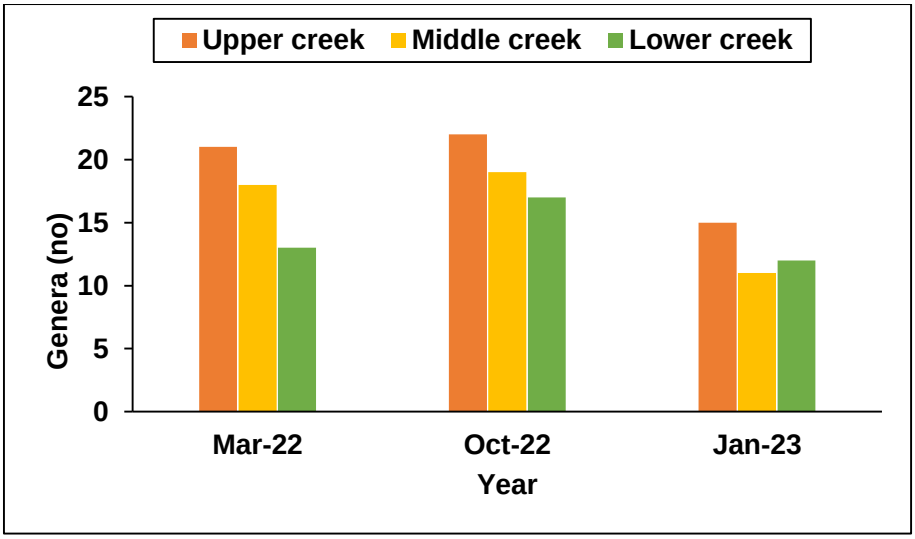

Figure 4.3.6: Average phytoplankton genera in the study area during different seasons

In general, the phytoplankton abundance and generic diversity depend on favourable environmental conditions in the coastal marine waters. Availability of essential nutrients in adequate quantities and optimum light are the most important factors regulating the phytoplankton abundance. The penetration of light in the

euphotic zone and nutrient concentrations in the coastal waters support the healthy growth of phytoplankton.

4.3.3 Zooplankton

Zooplankton is a myriads of animal organisms that drift with currents. B sheer abundance and intermediately role between phytoplankton and fish, they are considered s the chief index of utilization of aquatic biotope at the secondary tropic level. The herbivorous zooplankton is an efficient grazer of the phytoplankton and has been referred to as living machines transforming plant material into animal tissue. The zooplankton can be used as the indicator organisms for the physical, chemical and biological processes in the aquatic body. They occur at different depths and constitute a complicated ecological system. Zooplankton are characterized by their faunal diversity and include arrays of organisms, varying in size from the microscopic protozoan of a few microns to some jelly organisms with tentacles of several meters long. They have been classified into several groups of size like ultraplankton, nanoplankton, microplankton, macroplankton and megaplankton. The larger planktonic organisms are called micronekton. Besides size, the zooplanktons are classified by length of planktonic life (holoplankton - permanent plankton; meroplankton - temporary plankton), habitat (oceanic, neritic, estuarine, brackish and freshwater plankton), depth distribution (pleuston, neuston, epipelagic, mesopelagic, bathypelagic and epibenthic plankton) and feeding pattern (herbivores, omnivores and carnivores). Zooplankton employs various methods to capture food, but the most common is filter feeding. The herbivores filter the planktonic algae from the water currents generated by tides and waves or by animal itself. The different filters used by zooplanktonic organisms include mucus nets [salps, meshwork secretions (copelates)] and basket work of setae (crustacea). In contrast with the relative stability of the sea, the estuaries/creeks are dynamic environment, often showing sudden and extensive changes in salinity. The coastal zooplankton species have to be highly adoptive and are reported to show mechanism to detect changes in salinity and DO. They produce resting eggs to tide over unfavorable conditions. The reproduction rates counter mortality. Several zooplankton species show quick maturation, reproduce early, with shorter generation time and low species diversity. The physico-chemical boundaries play an important role in the distribution of zooplankton in the sea as there are usually strong gradients in terms of light, temperature and salinity from surface to bottom layers.

4.3.3.1 Biomass

The zooplankton biomass recorded at each station during the study period are presented in Table 4.3.3a.

Table 4.3.3a: Zooplankton biomass at different stations of the study area during different seasons

Month & Year	T1	T2	T3	T4	T5	T6	T7	T8	T9
Zooplankton biomass (mL/100m^3)									
March, 2022	3.4	8.2	5.8	0.6	4.8	7.1	1.2	6.0	0.7
October, 2022	4.7	9.5	4.0	3.4	8.3	3.9	12.5	6.2	13.0
January, 2023	17.0	19.9	9.7	6.8	12.3	1.9	2.8	9.9	5.8

The zooplankton biomass in the study area during the study period varied in the range of 0.7 to 19.9 mL/100m^3. On an average, higher biomass was observed in the upper creek region during post-monsoon period. There is a decreasing trend in the distribution of biomass was observed for all the seasons except monsoon period. From this data, it is apparent that considerable patchiness in the spatial and temporal distribution of zooplankton population occurs in the different segments of the region.

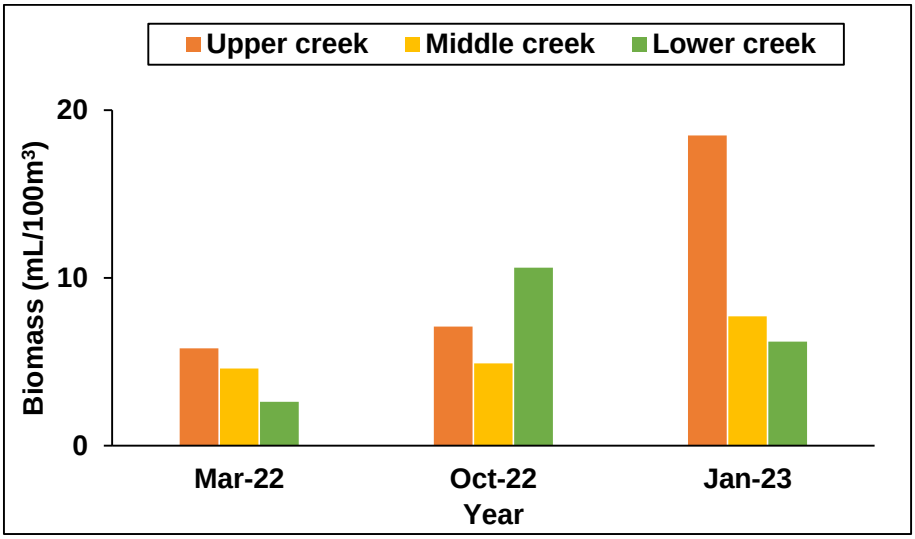

Figure 4.3.7: Average zooplankton biomass in the study area during different seasons

4.3.3.2 Population and diversity

The zooplankton population and genera recorded at each station during the study period are presented in Table 4.3.3b.

Table 4.3.3b: Zooplankton population and genera at different stations of the study area during different seasons

Month & Year	T1	T2	T3	T4	T5	T6	T7	T8	T9
Zooplankton Population (no x 10^3 /100m^3)									
March, 2022	11.3	15.6	11.0	78.1	12.3	13.2	20.1	24.7	5.4
October, 2022	99.1	152.5	75.7	29.4	16.1	61.7	80.3	49.4	51.5
January, 2023	160.6	79.1	75.7	11.3	32.8	5.5	11.3	27.8	18.7
Zooplankton Groups (no)									
March, 2022	12	10	9	15	14	9	14	10	10
October, 2022	16	17	17	17	15	18	19	17	14
January, 2023	11	17	16	14	17	11	13	14	13

The zooplankton population in the different segments of the study area were averaged and varied in between 5.4 and 160.6 x 10^3 ind/100m^3. The upper creek region of the study area showed the highest population for zooplankton. The population were increased from pre-monsoon to post-monsoon.

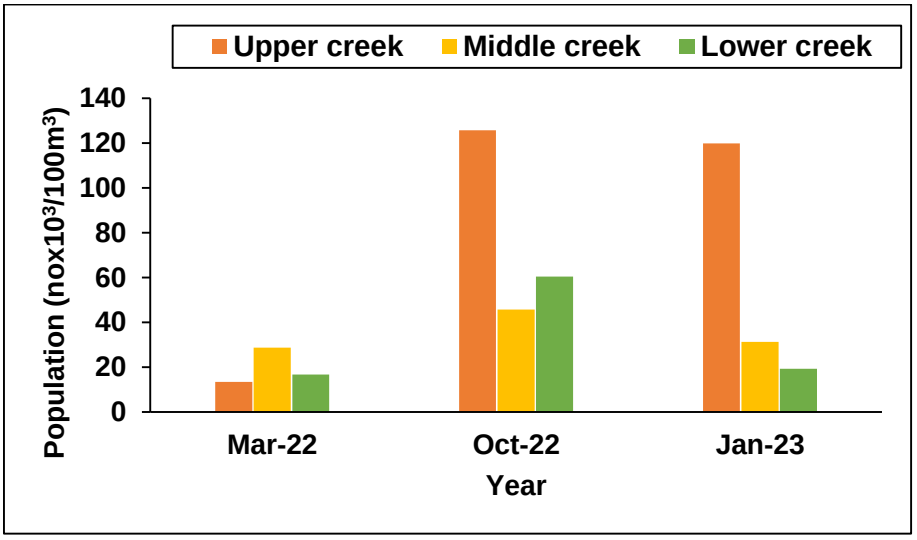

Figure 4.3.8: Average zooplankton population in the study area during different seasons

Number of zooplanktonic groups were identified from study area during the study period was in the range of 9 to 17 Nos (Plate 2). During monsoon season, study area possessed most diverse groups and least at pre- monsoon season. Copepoda was the dominant taxa in the study area during monsoon and post monsoon followed by decapod larvae (Table 3b, 3c). The pre-monsoon season showed the dominance of decapoda in all the segments of the study area (Table 3a).

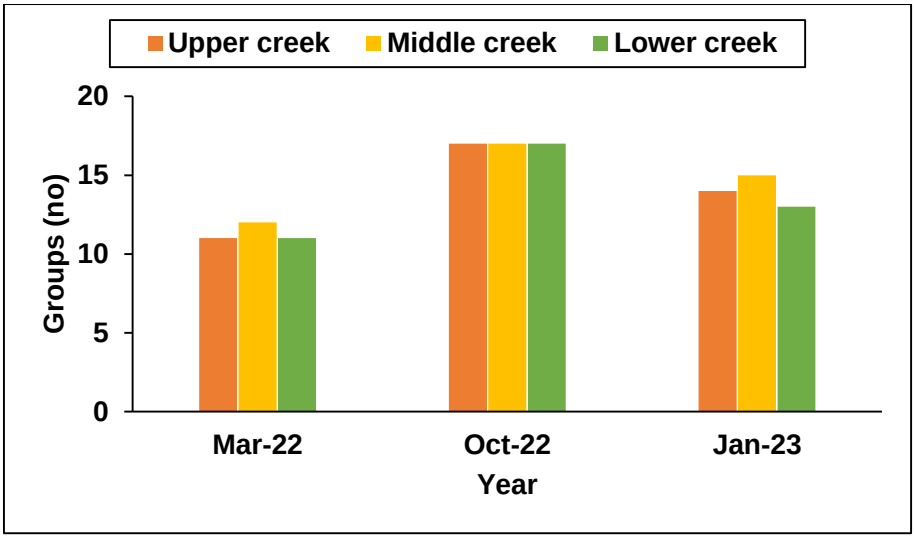

Figure 4.3.9: Average zooplankton groups in the study area during different seasons

It is evident from the above data that the zooplankton productivity in terms of biomass and population varied widely in the region.

4.3.4 Macrobenthos

Depending upon their size, benthic animals are divided into four categories; microfauna, meiofauna and macrofauna. Benthic community responses to environmental perturbations are useful in assessing the impact of anthropogenic perturbations on environmental quality. Macrobenthic organisms which are considered for the present study are animal species with body size larger than 0.5 mm. The presence of species in a given assemblage and its population depends on numerous factors, both biotic and abiotic.

4.3.4.1 Biomass

The macrobenthic biomass recorded at each station during the study period are presented in Table 4.3.4a.

Table 4.3.4a: Macrobenthic biomass at different stations of the study area during different seasons

Month & Year	T1	T2	T3	T4	T5	T6	T7	T8	T9
Subtidal Macrobenthos Biomass (g/m^2)									
March, 2022	10.4	0.3	1.2	2.3	1.3	1.6	0.1	0.2	1.7
October, 2022	0.3	0.1	0.7	0.2	0.04	0.2	0.1	0.1	0.4
January, 2023	0.2	1.6	0.2	0.4	0.2	0.0	0.0	0.1	2.2

Macrobenthic biomass was ranged in between 0.0 and 10.4 g/m^2 during pre-monsoon to post-monsoon of 2022-23. Higher macrobenthic biomass was observed in the upper creek region during March 2022 and there is a decreasing trend observed from upper to lower creek region.

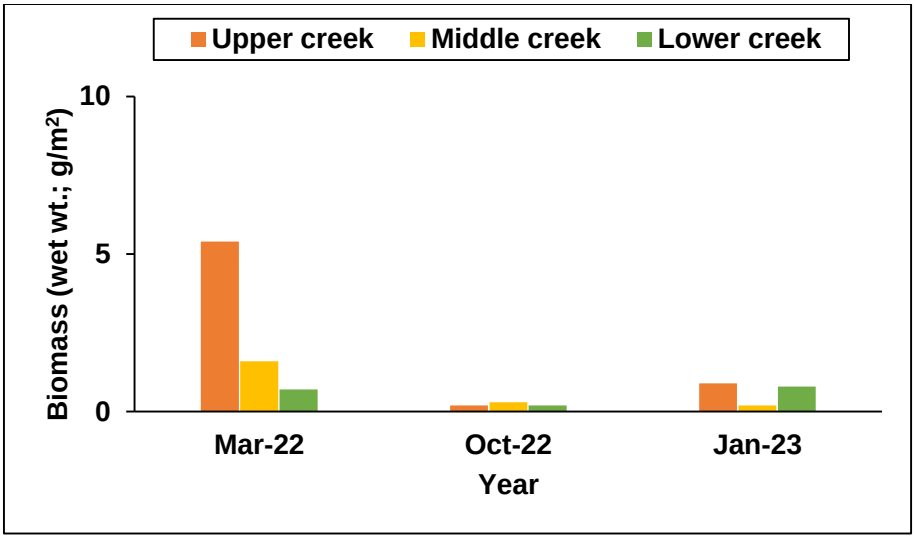

Figure 4.3.10: Average macrobenthic biomass in the study area during different seasons

4.3.4.2 Population and diversity

The macrobenthic population and genera recorded at each station during the study period are presented in Table 4.3.4b.

Table 4.3.4b: Macrobenthic population and genera at different stations of the study area during different seasons

Month & Year	T1	T2	T3	T4	T5	T6	T7	T8	T9
Subtidal Macrobenthos Population (no/m^2)									
March, 2022	612	112	256	219	58	37	31	19	168
October, 2022	506	88	394	400	50	94	181	250	256
January, 2023	219	767	113	125	88	0	0	38	925
Subtidal Macrobenthos Groups (no)									
March, 2022	1	1	1	2	1	1	1	1	2
October, 2022	3	2	3	3	2	2	2	2	2
January, 2023	2	4	2	2	2	0	0	1	5

The macrobenthic population observed in the study area during the period varied in the range of 0 to 925 no/m^2. There is no significant trend was observed for the distribution of the population of macrobenthos during the study period.

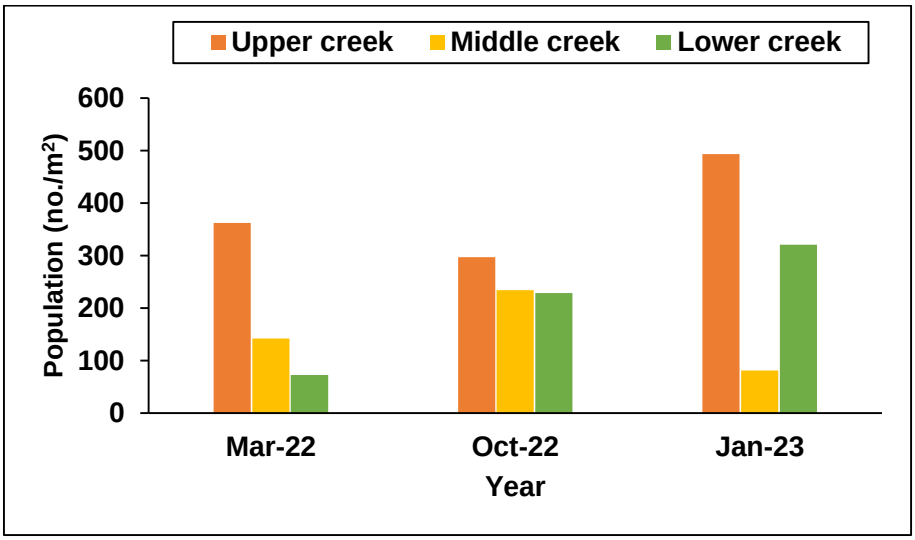

Figure 4.3.11: Average macrobenthic population in the study area during different seasons

The number of macrobenthic groups were identified from study area during the study period was in the range of 0 to 5 Nos (Plate 3). Polychaetes were found to be the dominant taxa in the study area throughout the study period (Table 4a, 4b, 4c).

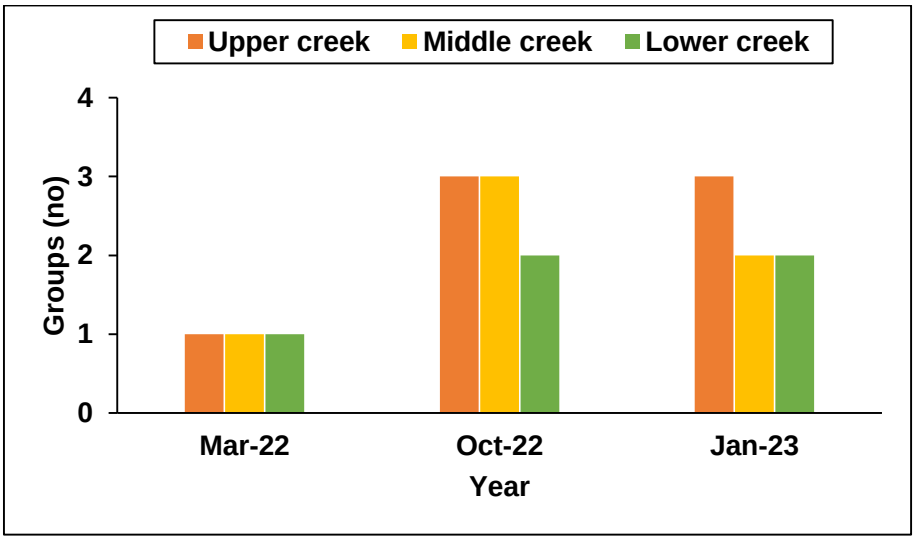

Figure 4.3.12: Average macrobenthic groups in the study area during different seasons

4.3.5 Fishery

a) Introduction

With a coastline of over 8,118 km, an exclusive economic zone (EEZ) of over 2 million sq km and a continental shelf area of 0.452 million sq. km, India has a

significant marine fisheries sector that has long been an important source of occupation and livelihood for the coastal communities of the country. Fisheries plays an important role in the regional and national economy and this sector has been recognized as one of the powerful income and employment generators as it stimulates growth of a number of subsidiary industries. Fishery is the only sector that offers cheap and good animal protein to the people. The potential of forward and backward linkages through boat building, construction of fishing harbours, fish processing etc., contribute further to diversification and strengthening of regional and national economy.

Continental shelf waters are generally considered to be the most productive regions (per unit area) of the world's oceans, which support many important fisheries. Adjoining shelf waters is the coastal fringe that is an area of industrial and urban growth. It has been widely demonstrated that harvestable fishery potential can seriously affected by various types of pollutants and environmental disturbances caused by man-made changes such as dredging and construction of jetties, movement of ships, destruction/alteration of habitats, discharge of effluents etc. Furthermore, these project activities could indirectly affect the spawning and breeding activities of the fishes. Therefore, increased attention has been focused in the recent times towards the protection and conservation of coastal marine environment against pollution both at national and international levels.

The biological processes of primary and secondary production are utilized at tertiary level of production (fisheries) indicating a strong inter-linkage of energy transfer at these levels. Therefore, any impacts on production at primary and secondary levels of trophic food chain ultimately affect the production at the next higher trophic level. It is widely accepted criterion that the location of marine outfalls and coastal development should be carefully selected in order to avoid potential fishing grounds as well as fish spawning and nursery areas.

The status of fisheries in the study domain has been assessed both based on information available with Department of Fisheries. Govt. of Maharashtra (landings, fishermen population, craft and gear etc.) and the data collected from field observations in the study area.

a) Marine Fisheries of Maharashtra State

The state of Maharashtra with 720 km long coastline (constituting about 8.9% of India's coastline) spread over the five maritime administrative districts viz. Thane, Mumbai and Suburban Mumbai, Raigad, Ratnagiri and Sindhudurg. The state has

continental shelf area of 1,12,512 sq. km and the continental shelf area up to 40 fathoms i.e. 55,529 sq. km (~50% of the total continental shelf) is being exploited for fishery resources. The state has marine fishery resource potential of 630,000 metric tonnes (MT) and is the one of the leading exporters of seafood. As per the latest statistics of the Department of Fisheries (Govt. of Maharashtra), there are 406 marine fishing villages and towns spread in six coastal administrative districts. Marine fishery resources of Maharashtra state are presented in Table 4.3.5a Marine fish production (MT) during the last 11 years (from 2011-2012 to 2021-22) is presented in Table 4.3.5b.

Table 4.3.5a: Marine fishery resources of Maharashtra state (Source: Dept. of Fisheries, Govt. of Maharashtra)

Coastline length	720 km
Costal Districts	6
Fishing Villages	526
Fish Landing Centres	173
Total Fishermen Population	364899
Active Fishermen (Full Time)	76928
Major Fish Harbours	3
Fish Landing Jetties	22
Mechanised Fishing Crafts	13,172
Motorized Fishing Crafts	2352
Traditional Fishing Crafts	7,073
Ice Plant & Cold Storage	112

Table 4.3.5b: Trends in marine fish production trends (in metric tonnes) in the state of Maharashtra during the years, 2011-2012 to 2021-22

Fishing Years	Marine Fish Production (MT)
2011-2012	433684
2012-2013	448913
2013-2014	467458
2014-2015	463585

2015-2016	434115
2016-2017	462747
2017-2018	474992
2018-2019	467232
2019-2020	443593
2020-2021	398511
2021-2022	432748

b) Fishery Status of Mumbai District

The project site falls in the Mumbai fishing zone. To study potential impacts associated with the upcoming project, it is necessary to assess the fishery resources of the study domain. The fishery resources of the study region were assessed in terms of the marine fish landings. Variety-wise marine fish landings in Mumbai fishing zone for the last 11 years (2011-12 to 2021-22) is presented in Table 4.3.5c. *Harpadon nehereus* dominate the marine fish landings accounting for ~17% of total finfish and shellfish species. Penaeid prawns (15.2%), Otolithoides (11.7%), Mackerels (9.4%), Non- Penaeid prawns (6.9%), cephalopods (4.9%), Anchovies (3.9%), Tunnies (3.8%) and Ribbon fishes (3.5%) are other major groups that constitute the marine fish landings. Majority of these fish varieties are in high demand in seafood industry with highest product value. Other species that contribute to the marine fish landings includes Pomfrets, Seerfishes etc. Marine fish production (in metric tonnes) from Mumbai fishing zone centre during years 2011-12 to 2021-22 is presented in Table 4.3.5.3.

Table 4.3.5c: Marine fish production from Mumbai fishing zone during the years, 2011-12 and 2021-22

Year	Marine fish Production (MT)
2011-2012	155799
2012-2013	168698
2013-2014	169574
2014-2015	181034
2015-2016	190813
2016-2017	202683

2017-2018	206333
2018-2019	216132
2019-2020	230685
2020-2021	210260
2021-2022	222481

(Source: Department of Fisheries, Govt. of Maharashtra)

c) Fishes in the Thane Creek

The data collected by CSIR-NIO from the study area and published literature shows the occurrence of total species composition of 117 in Thane creek. Species composition consists of 94 fin fish species and 23 shellfish species. Shellfish species were comprised of shrimps/prawns (11), stomatopods (1), crabs (6) and cephalopods (5).

Major species encountered in the study area are *Coilia dussumieri, Stolephorus commersonnii, Johnius belangerii, Johnius dussumieri, Thryssa mystax, Metapenaeus dobsoni, Metapenaeus brevicornis, Mierspenaeopsis sculptilis* and *Portunus pelagicus*. Local fishing populations (Sheva, Nhava, Panvel, Uran and Panje,) from the villages near the project site are using the creeks and mudflats and subtidal regions for fishing activities. They catch fishes with the help of barrier net, cast net, gill net and hooks also.

Table 4.3.5d: List of fishes in the Thane creek

Finfishes			
1	*Arius maculatus*	33	*Glossogobius giuris*
2	*Arius* sp.	34	*Gobius giuris*
3	*Arius thalassinus*	35	*Gobius ocelatus*
4	*Barbus pinnauratus*	36	*Gobius* sp.
5	*Batrachus grunniens*	37	*Harpadon nehereus*
6	*Belone strongilurus*	38	*Johnieops aneus*
7	*Boleophthalmus dussumieri*	39	*Johnius belangerii*
8	*Boleophthalmus boddarti*	40	*Johnius dussumieri*
9	*Carangoides malabaricus*	41	*Johnius sina*
10	*Caranx* sp.	42	*Kawala coval*

11	*Chaetosus chacunda*	43	*Lagocephalus spadiceus*
12	*Chaetosus nasus*	44	*Lates calcarifer*
13	*Chrysophrys* sp.	45	*Lepturacanthus savala*
14	*Chrysophryx datnia*	46	*Megalops cyprinoides*
15	*Clupea* sp.	47	*Mugil dussumieri*
16	*Coilia dussumieri*	48	*Mugil spigleri*
17	*Congromuraena anago*	49	*Mystus gulio*
18	*Cybium guttatum*	50	*Oreochromis mossambicus*
19	*Cynoglossus elongates*	51	*Osteogeniosus militaris*
20	*Cynoglossus lingua*	52	*Otolithoides brunneus*
21	*Cynoglossus arel*	53	*Pampus sinensis*
22	*Echeneis neurates*	54	*Pampus argenteus*
23	*Eleotris amboinensis*	55	*Pampus chinensis*
24	*Eleotris* sp.	56	*Pellona elongata*
25	*Eleutheronematetradactylum*	57	*Pellona feligera*
26	*Engraulis* sp.	58	*Pellona ditchela*
27	*Equula dussumieri*	59	*Planiliza parsia*
28	*Equula insidiatrx*	60	*Plotosus arab*
29	*Equula rueonius*	61	*Polynemus tetradactylus*
30	*Equula splendens*	62	*Rastrelliger kanagurta*
31	*Escualosa thoracata*	63	*Sardinella albella*
32	*Gerres filamentosus*	64	*Sardinella gibbosa*
65	*Saurida tumbil*	80	*Tetrodon oblongus*
66	*Scaena dussumieri*	81	*Tetrodon stellatus*
67	*Scaena glaucus*	82	*Teuthis cramin*
68	*Scatophagus argus*	*83*	*Therapon theraps*
69	*Sciaena* sp.	*84*	*Thryssa hamiltoni*
70	*Scomberomorus lineolatus*	*85*	*Thryssa malabarica*
71	*Sillago sihama*	*86*	*Thryssa mystax*
72	*Stolephorus commersonnii*	*87*	*Triacanthus brevirostris*

73	*Stromateus argenteus*	*88*	*Triacanthus strigilifer*
74	*stromateus sinensis*	*89*	*Trichiurus savala*
75	*Strongylurastrongylura*	*90*	*Trichiurus lepturus*
76	*Tenualosa toli*	*91*	*Trypauchen vagina*
77	*Terapon jarbua*	*92*	*Tylosurus strongylura*
78	*Tetrodon fulvitilis*	*93*	*Umbrina russellii*
79	*Tetrodon lunaris*	*94*	*Umbrina* sp.
Shrimps and Prawns			
1	*Acetes* sp.	7	*Nematopalaemon tenuipes*
2	*Alpheus* sp.	8	*Parapenaeopsis stylifera*
3	*Exopalaemon styliferus*	9	*Penaeus indicus*
4	*Metapenaeus brevicornis*	10	*Penaeus* sp.
5	*Metapenaeus dobsonii*	11	*Solenocera crassicornis*
6	*Mierspenaeopsis sculptilis*		
Crabs			
1	*Charybdis acutifrons*	4	*Portunus pelagicus*
2	*Charybdis callianassa*	5	*Portunus sanguinolentus*
3	*Charybdis lucifera*	6	*Scylla serrata*
Cephalopods			
1	*Loligo* sp.	4	*Sepia aculeate*
2	*Loliolus hardwickei*	5	*Sepiella inermis*
3	*Octopus* sp.		
Stomatopods			
1	*Oratosquilla nepa*		

4.3.6 Mangroves

Mangrove ecosystem, the most common natural marine wetland, consists of perennial plants of potentially high productivity and biomass, which have extensive root system that may be effective in trapping soil and nutrients. The plants are also specially adopted to the stressed environmental condition characterized by relatively high temperature, fluctuating salinities and shifting anaerobic/ aerobic substrata. In

Thane creek mangroves occur at Pir Pau, Elephanta, Butcher, Uran, Nhava, Sheva, Thane-Panvel, Panje-Mora-Karanja and Dharamtar covering an area of about 48 km^2. The region represents 23 species of mangroves and 3 species of associated mangroves species like *Avicennia marina*, *A. alba*, *A. officinalis* and *Sonneratia apetala* are dominant.

Mangroves from designated sites were assessed for population density (no/100m^2), height (m) and diameter at breast height (cm) (DBH) of plant, seedling density (SD) (no/m^2) and species diversity using quadrat method (5 x 5m). The studies were conducted at BMCT (M1), Panje (M2), Mora (M3), Nhava Sheva (M4), and Elephanta (M5).

Figure 4.3.13: Mangrove transect sampling locations

A) Mangroves at BMCT

The mangrove vegetation from the BMCT area was observed to be healthy and was dominated by the *Avicennia marina* species. Two locations (M1a and M1b) were selected for monitoring of mangroves. Monitoring was carried out during June 2022 and November 2022. Plant density of *A. marina* varied from 28 to 36 no/100m^2 with 100% frequency of occurrence in this location. The height of *A. marina* ranged in between 4.0 to 6.3 m indicating healthy plants. The mangroves in this region did not indicate any deterioration.

Figure 4.3.14: Mangroves at BMCT

Table 4.3.6a: Status of selected mangroves at BMCT

BMCT Transect	M1a	M1b
	A. marina	***A. marina***
Density (no/100m^2)		
June 2022	36	28
November 2022	32	36
Height (m)		
June 2022	4.0-6.2	4.4-5.5
November 2022	4.1-6.3	4.2-5.3
DBH (cm)		
June 2022	13-48	38-45
November 2022	13-47	32-42
SD (no/m^2)		
June 2022	17	29
November 2022	12	22

B) Mangroves at Panje

Mangroves at Panje were assessed from 2 locations (M2a and M2b) during June 2022 and November 2022. Panje area is dominated by *A. marina* and *Ceriops*

tagal. The plant density of *A. marina* varied from 48 to 52 no/100m^2 and *C. tagal* of 68-72 no/100m^2. *Acanthus ilicifolius, Aegiceras corniculatum* and *Brugiera cylindrica* were also recorded from this site.

Figure 4.3.15: Mangroves at Panje

Table 4.3.6b: Status of selected mangroves at Panje

Panje	**M2a**	**M2b**
	A. marina	*C. tagal*
Density (no/100m^2)		
June 2022	52	72
November 2022	48	68
Height (m)		
June 2022	1.3-1.9	1.1-1.7
November 2022	1.4-1.9	1.2-1.8
DBH (cm)		
June 2022	10-43	8-14
November 2022	11-44	9-15

SD (no/m^2)		
June 2022	4	3
November 2022	4	2

C) Mangroves at Mora

Figure 4.3.16: Mangroves at Mora

Mangroves of the species *A. marina* and *S. apetala* were identified from the intertidal regions of Mora. *A. marina* were found to be dominant with a 75% frequency of occurrence. Plant density of *A. marina* varied from 128 to 132 no/100m^2.

Table 4.3.16: Status of selected mangroves at Mora

Mora	**M3a**
	A. marina
Density (no/100m^2)	
June 2022	128
November 2022	132
Height (m)	
June 2022	2.5-3.5
November 2022	2.5-3.6

DBH (cm)	
June 2022	22-30
November 2022	22-30
SD (no/m^2)	
June 2022	3
November 2022	3

D) Mangroves at Nhava Sheva

The intertidal expanse along the Nava Sheva area was very small and rocky with sandy bottom. The mangrove vegetation from the upper intertidal region was observed to be healthy and mostly dominated by *A. marina*. Two locations (M4a and M4b) were selected for monitoring of mangroves during the present study. The plant density of *A. marina* varied from (64- 120 no/100 m^2) in June 2022 to November 2022 with *A. marina* recording 80 to 100% frequency of occurrence. The height of plants varied from 1.2 to 4.9 m with M4a location indicating better plant height than location M4b. The DBH varied from 8 to 28cm at the monitoring locations during the study periods. The seedling density ranged from 3 to 7 no/m^2 for the study area where location M4b sustained better seedling density than location M4a.

Figure 4.3.17: Mangroves at Nhava Sheva

Table 4.3.17: Status of selected mangroves at Nhava Sheva

Nhava Sheva	M4a	M4b
	A. marina	***A. marina***
Density (no/100m^2)		
June 2022	64	120
November 2022	68	116
Height (m)		
June 2022	1.2-4.8	1.9-2.4
November 2022	1.2-4.9	2.0-2.4
DBH (cm)		
June 2022	16-28	8-15
November 2022	16-28	8-15
SD (no/m^2)		
June 2022	3	4
November 2022	6	7

E) Mangroves at Elephanta

Figure 4.3.18: Mangrove at Elephanta

Around Elephanta Island, stray and adult plants prevail and the open mudflats around this potential for mangrove afforestation. Young plants of *A. marina, A. Alba, A. officinals* and *Sonneratia apetala* are dominant. The lower intertidal zone especially adjacent to the port area was rocky with muddy. The mid and upper intertidal zone sustained vast mangrove coverage.

Table 4.3.18: Status of selected mangroves at Elephanta

Elephanta	**M5a**	**M5b**
	A. marina	*A. marina*
Density (no/100m^2)		
September 2018	136	124
January 2019	140	120
Height (m)		
September 2018	1.9-2.4	2.8-3.2
January 2019	2.0-2.4	2.8-3.4
DBH (cm)		
September 2018	14-20	14-21
January 2019	15-27	16-27
SD (no/m^2)		
September 2018	4	10
January 2019	5	12

F) Important mangrove species found in the study area

- ***Avicennia marina***

Avicennia marina, also known as grey mangrove or white mangrove, is a shrub or tree belonging to the Acanthaceae family. They are generally 10–14 m long and have light gray or whitish bark with stiff, brittle, thin flakes. Their leaves are thick, glossy, and bright green on the upper side and gray or silvery white with small hairs on the lower side. Their pneumatophores can grow up to 20 cm. *Avicennia marina* is a widely distributed mangrove species that thrives in high-salinity habitats. It plays a significant role in supporting the coastal ecosystem and holds unique potential for studying molecular mechanisms underlying ecological adaptation. Because of its numerous merits, including medicinal value, this species is facing increasing pressure

of exploitation and deforestation. Illumina sequencing of an *A. marina* foliar cDNA library was performed to generate a transcriptome dataset for gene and marker discovery.

- ***Ceriops tagal***

Yellow mangrove is a glabrous shrub or small tree with a compact crown; it usually grows up to 6 meters tall, but some exceptional specimens in good growing conditions can reach up to 40 metres. The bole is usually short and slender, occasionally reaching 40 cm in diameter. The tree was formerly a commercial source of tannins and dyes. It is still an important local source of these products and is harvested from the wild for them as well as for medicines, timber and fuel. This species is widespread and common.

G) Mangroves in the study area recorded by other researchers

Table 4.3.19: Mangroves in the study area recorded by other researchers

Sl No	Mangrove Species	Shindikar 2009	Athalya 2013	Mugade and Sapkale 2014	Kantharajan 2018
1	*Avicennia marina*	*	*	*	*
2	*Avicennia officinalis*	*	*	*	
3	*Acanthus ilicifolius*	*		*	*
4	*Aegiceras corniculatum*	*	*	*	*
5	*Brugiera cylindrica*	*		*	*
6	*Bruguiera caryophylloides*		*		
7	*Ceriops tagal*	*	*		*
8	*Ceriops decandra*		*		
9	*Rhizophora mucronata*		*	*	*
10	*Rhizophora apiculata*		*	*	
11	*Excoecaria agallocha*	*	*	*	*
12	*Sonneratia apetala*	*	*	*	*
13	*Sonneratia alba*			*	*

H) Mangrove associates in the study area recorded by other researchers

Table 4.3.20: Mangroves associates in the study area recorded by other researchers (Athalya, 2013 and Kantharajan et al., 2018).

Sr.	Family	Scientific name	Type
1	Salvadoraceae	*Salvadora persica*	Mangrove Shrub
2	Verbenaceae	*Clerodendrum inerme*	Mangrove Shrub
4	Acanthaceae	*Hygrophila schulli*	Herb
5		*Hygrophila anriculata*	
6		*Hygrophila spinosa*	
7		*Hygrophila* sp.	
8	Aizoaceae	*Sesuvium portulacastrum*	Shrub
9	Amaranthaceae	*Alternanthera sessilis*	Shrub
10		*Celosia argentea*	Shrub
11	Asteraceae	*Pluchea odorata*	Herb
12	Caesalpiniaceae	*Cassia* sp.	Shrub
13	Chenopodeaceae	*Suaeda martime*	Herb
14		*Suaeda nudiflora*	*Herb*
15	Convolvulaceae	*Ipomoea* sp.	Herb
16	Cyperaceae	*Cyperus rotundus*	Herb
17		*Cyperus scariosus*	Herb
18		*Fimbristylis ferrugine*	*Herb*
19	Dioscoreaceae	*Dioscorea pentaphylla*	Climber
20	Euphorbiaceae	*Euphorbia hispida*	Herb
21		*Euphorbia hirta*	Herb
22	Fabaceae	*Derris trifoliata*	Climber
23		*Derris pentaphyla*	Climber
24		*Mucuna pruriens*	Climber
25	Malvaceae	*Abelmoschus manihot*	Shrub
26		*Abelmoschus sps*	Shrub
27		*Thespesia populnea*	Tree

28		*Sida acuta*	Shrub
29		*Acacia* sp.	Tree
30		*Pithecellobium dulce*	Tree
31		*Biophytum sensitivum*	Shrub
32		*Cynodon dactylon*	Herb
33		*Aeluropus lagopoides*	Grass
34		*Proteresia coarctata*	Herb
35		*Panicum sps.*	Herb
36		*Cressa critica*	Herb
37		*Tamarix troupii*	Herb

4.3.7 Seagrasses and seaweeds

Seagrasses are marine plants with the same basic structure as terrestrial (land) plants. They have tiny flowers and strap-like or oval leaves. They form meadows in estuaries and shallow coastal waters with sandy or muddy bottoms. Seaweeds traditionally include only macroscopic, multicellular marine red, green, and brown algae. However, each of these groups has microscopic, if not unicellular, representatives. During the present survey, no seaweed and seagrass were recorded from the project site and surrounding area.

4.3.8 Marine Molluscs

Molluscs are the largest marine phylum, comprising about 23% of all the named marine organisms. The molluscs include many animals like clams, snails, slugs, and squids. About 3270 species have been reported from India belonging to 220 families and 591 genera. Three classes of the phylum Mollusca are Gastropoda, Bivalvia and Cephalopoda. Among these, the bivalves are the most diverse with 1100 species, followed by cephalopods with 210 species, and gastropods with 190 species.

The study of Marine Molluscs in Thane creek was carried out by Athalye in 2013, and recorded the occurrence of 7 species of bivalves and 14 species of gastropods. In 2012, Pawar found a total of 55 species of molluscs representing 13 orders, 30 families and 39 genera were recorded in Thane Creek. 38 species of gastropods representing 18 families were recorded in which *Telescopium telescopium*, *Thais carinifera* and *Bursa tuberculate* dominantly found. 13 species of bivalves representing 8 families were recorded in which species like *Arca granosa,*

Placenta placenta, *Meretrix meretrix* were dominantly recorded and 4 species of cephalopods representing 4 families were recorded. Another study by Pawar in same site in 2017, recorded total 60 species of gastropods belonging to 25 families in which species belonging to Muricidae and Neritidae were dominant and 26 species of bivalves belonging 8 families in which species belonging to Veneridae is dominant.

For the present study, molluscan samples were collected from 4 locations of Thane creek viz, BMCT, Mora, Panje and Nhava Sheva (Figure 1.1) during the month of February 2023. A total of 14 species of gastropod representing 12 families were recorded from the study area. Species like *Telescopium telescopium, Pirenella cingulata* and *Nerita chamaeleon* were found dominant. In total 6 species of bivalves representing 5 families with the dominance of *Tegillarca aequilatera* and *Saccostrea cucullata*. 4 species of cephalopoda representing 3 families were also recorded from the study area.

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Plate 4A: Molluscan diversity sampling location around the berth terminal (A: BMCT; B:Mora; C: Panje; D: Nhava)

Figure 4.3.19: Nhava Sheva transect

Figure 4.3.20: *Modiolus* species from Mora transect

Figure 4.3.21: Occurrence of *Placuna placenta* in the intertidal region of BMCT transect

Table 4.3.21: Marine molluscs identified from the sampling locations

Sr no	Family	Scientific name	IUCN Conservation status	Location
Gastropods				
1	Melongenidae	*Volegalea cochlidium*	NE	D
2	Turbinidae	*Turbo* sp	NE	A, B, C
3	Littorinidae	*Littoraria pallescens*	NE	A, B, C, D
4	Nassariidae	*Nassarius* sp	NE	B, C
5	Muricidae	*Lataxiena* sp	NE	A, B ,C
6	Muricidae	*Indothais lacera*	NE	A, B, C, D
7	Cerithiidae	*Clypeomorus batillariaeformis*	NE	A, B, C, D
8	Potamididae	*Telescopium telescopium*	LC	A, B, C, D
9	Potamididae	*Cerithideopsilla cingulata*	NE	A, B, C, D

10	Cymatiidae	*Gyrineum natator*	NE	B, C
11	Neritidae	*Nerita chamaeleon*	NE	A, B, C, D
12	Haminoeidae	*Bakawan rotundata*	NE	A, B, C, D
13	Onchidiidae	*Onchidium daemelii*	NE	B, C, D
Bivalves				
14	Placunidae	*Placuna placenta******	NE	A, C
15	Ostreidae	*Saccostrea cucullata*	NE	B, C, D
16	Arcidae	*Tegillarca aequilatera*	NE	B, C, D
17	Arcidae	*Tegillarca granosa*	NE	B, C
18	Mytillidae	*Modiolus* sp	NE	B
19	Mesodesmatidae	*Atactodea* sp	NE	B, C
20	Tellinidae	*Tellina* sp	NE	B, C, D
Cephalopods				
21	Sepiidae	*Acanthosepion aculeatum*	DD	B, C
22	Sepiidae	*Sepiella inermis*	DD	B, C
23	Loliginidae	*Uroteuthis duvaucelii*	DD	B, C
24	Octopodidae	*Octopus vulgaris*	LC	B, C

*****Listed in Wild Life (Protection) Amendment Act, 2022: Schedule: II: Part (F) Mollusca

#Conservation Status : **NE** = Not Evaluated, **LC**= Least Concerned, **DD**= Data Deficient

$Location: **A**= BMCT, **B**=Mora, **C**=Panje, **D**=Nhava Sheva

Plate 4B: Gastropods identified from the study area

Volgalea cochlidium	*Turbo* sp	*Littoraria pallescens*
Nassarius sp	*Lataxieno* sp	*Indothais lacera*
Clypeomorus batillariaeformis	*Telescopium telescopium*	*Pirenella cingulata*
Gyrineum natator	*Nerita chamaeleon*	*Bakawan rotundata*

Onchidium damelii	*Placuna placenta*

Plate 4C: Bivalves identified from the study area

Saccostrea cucullata	*Tegillarca aequilatera*	*Teqillarca granosa*
Modiolus sp	*Atactodea* sp	*Tellina* sp

Plate 4D: Cephalopods found in the study area

Sepia aculeate

Sepiella inermis

Uroteuthis duvaucelli

Octopus vulgaris

4.3.9 Corals and associated flora and fauna

Thane creek subtidal and the intertidal area are largely silty and muddy with high turbidity and zero visibility. During the survey, no scleractinian corals were recorded from the study area. Coral growth in the subtidal region is unlikely in view of the high suspended load in the water column, and the conditions under which corals do not thrive.

4.3.10 Reptiles and mammals

Sea turtles play an important role as flagship species for diverse habitats such as coral reef ecosystems, seagrass meadows, open seas and sandy beaches. The threats that sea turtle populations face are representative of threats that impact other marine and coastal flora and fauna. Five species of sea turtles are known to inhabit Indian coastal waters and islands. These are the Olive Ridley (*Lepidochelys olivacea*), Green (*Chelonia mydas*), Hawksbill (*Eretmochelys imbricata*), Loggerhead (*Caretta caretta*) and Leatherback (*Dermochelys coriacea*) turtles. Except for the Loggerhead, the remaining four species nest along the Indian coast. Though many of the ecological interconnections influencing sea turtle behaviour and biology remain unclear, it is known that sea turtles occupy a unique position within the food web. They consume

an assortment of prey, including puffer fish, crustaceans, sponges, tunicates, seagrasses, and algae. The unusual life cycle of the animal plays a vital role in the transportation of nutrients from the highly productive marine habitats such as sea-grass beds to energy-poor habitats like sandy beaches. This helps reverse the usual flow of nutrients from land to sea.

Sea turtles have been used for local consumption since time immemorial providing food (oil and protein) as well as other commodities (bone, leather and shell). Their shells are widely used for the production of various curios. Threats to marine turtles in India are many and varied. Some of the major threats include unplanned beach development (including ports, lighting, tourism and plantations), by-catch mortality (in trawl nets and gill nets), weak enforcement of fisheries and protected area regulations and, to a limited extent, killing of turtles for meat and the poaching of eggs (WWF Report, 2013).

Marine turtles are common along the Mumbai coast and are mainly represented by Logger head (*Caretta caretta*) and olive Ridley (*Lepidochelys olivacea*). Other turtles like Hawksbill (*Eretomochelys imbricate*), Leather back (*Dermochelys coriacea*) and green (*Chelonia mydas*) are occasionally sighted.

The marine mammals are chiefly represented by Dolphin and porpoise in the coastal waters of Mumbai though whales are rare. Among marine mammals, Dolphins frequently enter the coastal waters mainly for feeding or breeding and often get entangled in fishing gear such as gill nets, trawl nets and purse seines.

Humpback dolphins (genus *Sousa*) are the most common nearshore cetaceans found along the Indian coast and are highly vulnerable to a number of anthropogenic pressures. Earlier surveys conducted by the NIO team recorded the presence of dolphins in the study area.

4.3.11 Birds

The mudflats of the mangrove ecosystems are reported to play a significant role in the conservation of resident birds, migratory and endangered birds (Pawar, 2011). Most of the birds that visit mudflats possess long legs and toes, long and sometimes curved bills and are called waders. These adaptations enable the waders to feed in shallow water habitats. Habitat destruction is considered one of the main reasons for such a decrease in bird species populations. Presently wetlands are reported as highly fragile ecosystems due to increasing anthropogenic stress.

The Thane creek and Mumbai coast offers different marine habitats like rocky/sandy/muddy intertidal and mangroves for a variety of resident and migratory birds. The birds use these habitats as their active feeding ground, especially during low tide. The birds recorded are Darters, Black crowned night herons, crows, cormorants, Drongos, Bee eaters, Egrets, Herons etc are most commonly seen in the study area. Paddy field Egrets, Babblers, Mynas, Crows, Jungle Crows and Kingfishers were more common than others.

Thane Creek located between Mumbai and Navi Mumbai, inhabits a large diversity of avifauna and is regarded as one of the Important Bird Areas (Islam & Rahmani, 2004), as over 205 species of birds are reported from Thane Creek alone (Nitsure, 2002). As per the secondary data Thane creek has been attracting flamingos in large numbers since 1994. Pachpande & Pejaver (2016) reported about 95 species of birds from the Thane creek area. November every year, over 30,000 of these birds, along with their chicks, descend here and occupy the mudflats and the bordering mangroves. They stay here till May, after which most of them migrate to Bhuj in Gujarat for breeding, leaving a small resident population. A large number of waders are also spotted along with them. Besides supporting a large congregation of flamingos, the area is a refuge for many resident and migratory birds. In all, nearly 200 species have been reported; including species such as Black-eared Kite (*Milvus migrans lineatus*), Western Marsh Harrier (*Circus aeruginosus*), Booted Eagle (*Hieraaetus pennatus*), Greater Spotted Eagle (*Clanga clanga*), Black-winged Kite (*Elanus caeruleus*), Black Kite (*Milvus migrans*), Brahminy Kite (*Haliastur indus*), Shikra (*Accipiter badius*), Western Osprey (*Pandion haliaetus*), Indian Spotted Eagle (*Clanga hastata*). Other Birds recorded included greater spotted eagle and others such as osprey, herons, black-headed ibis, common redshank, marsh sandpiper, common greenshank, curlew sandpiper, brown-headed gull, whiskered, gull-billed, little terns, white-bellied sea eagle, etc. been spotted. BirdLife International has declared the creek an important bird area. Upper Regions of Thane Creek has been recently declared as a Thane Creek Flamingo Wildlife Sanctuary by the Maharashtra Government.

Table 4.3.22: Checklist birds identified from the study area

Sl No	Bird species	Scientific Name	IUCN Status 2023
1	Coppersmith Barbet	*Megalaima haemacephala*	LC
2	Indian Golden Oriole	*Oriolus kundoo*	LC
3	Asian Paradise-flycatcher	*Terpsiphone paradisi*	LC
4	Asian Pied Starling	*Gracupica contra*	LC
5	Plain Prinia	*Prinia inornata*	LC
6	Ashy Prinia	*Prinia socialis*	LC
7	Black Eared Kite	*Milvus migrans lineatus*	LC
8	Peregrine Falcon	*Falco peregrinus*	LC
9	Western Osprey	*Pandion haliaetus*	LC
10	Terek Sandpiper	*Xenus cinereus*	LC
11	Curlew Sandpiper	*Calidris ferruginea*	NT
12	Pacific Golden Plover	*Pluvialis fulva*	LC
13	Curlew Sandpiper	*Calidris ferruginea*	NT
14	Sanderling	*Calidris alba*	LC
15	Lesser Sand Plover	*Charadrius mongolus*	LC
16	Common Redshank	*Tringa totanus*	LC
17	Eurasian Curlew	*Numenius arquata*	NT
18	Common Snipe	*Gallinago gallinago*	LC
19	Caspian Tern Flamingo	*Hydroprogne caspia*	LC
20	Common Teal	*Anas crecca*	LC
21	Lesser Flamingo	*Phoeniconaias minor*	NT
22	Black-headed Ibis	*Threskiornis melanocephalus*	NT
23	Grey Heron	*Ardea cinerea*	LC
24	Painted Stork	*Mycteria leucocephala*	NT
25	Indian Roller	*Coracias benghalensis*	LC
26	Flamingo	*Phoenicopterus roseus*	LC
27	Great Egret	*Ardea alba*	LC
28	Western Marsh Harrier	*Circus aeruginosus*	LC
29	Booted Eagle	*Hieraaetus pennatus*	LC
30	Greater Spotted Eagle	*Clanga clanga*	VU

31	Black-winged Kite	*Elanus caeruleus*	LC
32	Black Kite	*Milvus migrans*	LC
33	Brahminy Kite	*Haliastur indus*	LC
34	Shikra	*Accipiter badius*	LC
35	Indian Spotted Eagle	*Clanga hastata*	VU

LC: Least concerned; **VU:** Vulnerable; **NT:** Near Threatened

5 ANTICIPATED MARINE ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

5. 1 Environmental Impacts of Ports and Harbours

Article 1(4) of the 1982 United Nations Convention on the Law of the Seas (UNCLOS) defines pollution of the marine environment to mean the introduction by man, directly or indirectly, of substances or energy into the marine environment which is likely to result in negative effects on living resources, are hazardous to human health, a hindrance to marine activities including fishing and other legitimate uses of the sea, cause an impairment in quality for seawater uses and the reduction of amenities. As a part of the present study, anticipated environmental impacts associated with the widening of the existing container berth, repairing & strengthening of the existing damaged portion of the berth structures at Jawaharlal Nehru Port on the marine ecology of Thane Creek have been identified and listed below:

- Berth widening and repairing
- Impact of shipping operations on the marine environment
- Air pollution from port operations
- Noise and light pollution
- Impact of cargo handling
- Ship and boat generated wastes
- Introduction of non-native species into the marine environment
- Oil spill

5.1.1 Berth Widening and Repairing

Ports contribute significantly to the economy of any Nation; they also pose many adverse effects on the environment. The significant environmental effects caused by port activities, berthing ships, and emissions from intermodal transport serving the port hinterland include localized ambient air pollution, water pollution, noise and light pollution, traffic congestion, the introduction of invasive species, effects on marine ecosystems and impacts of marine accidents and spills. Piling is the main activity associated with the widening of the berth.

The potential impact of berth widening and repairing on marine water quality are the impacts originating from pile driving, permanent removal of benthic biota on the locations where the filling of excavation covers and piling has been carried out,

deposition of rubble and sediment compaction. There are chances that the piles can affect sediment deposition and erosion activities in the site. The disturbance created during the time of pile driving can temporarily displace fisheries and other moving marine organisms from the site. Suspended sediments generated due to the piling activity can reduce the light penetration and lead to primary productivity in the region. Water column contamination is expected during piling if the sediment is contaminated with toxic substances. Berth extension can create shading effects below the berth and can change the habitat structure. Underwater noise generated during the time of piling activity can affect the fishes and other marine mammals. Dust and other non-combustion particles generated from the construction activity and construction material storage can affect the water quality and nearby mangrove vegetation.

5.1.2 Impacts of Shipping Operations on the Marine Environment

Ship movements in the coastal region generate waves and propeller-induced turbidity in the water column. Propeller-induced turbidity is influenced by a number of variables like depth of water, levels of activity and sediment characteristics. The turbidity caused by these activities decreases the amount of light that penetrates the water column and therefore has a di. This reduction in primary productivity will affect the rest of the ecosystem. The re-suspension of sediments may cause disturbance to sensitive marine animals, particularly due to a smothering effect as the sediments settle. Depending on the quality of the sediments, organic matter, nutrients, and contaminants may be re-released, affecting water quality, by the removal of oxygen, for example, can adversely affect the marine animals and plants in the vicinity.

There is an inherent risk of marine accidents occurring where goods are transported by sea. Such accidents may occur if a ship is unsuccessful in its attempt to avoid another vessel or obstruction or by due to a natural calamity. Collision with Dolphins, in rare cases is an issue when these animals actively seek out moving vessels and swim close alongside in the bow wave, which may make them vulnerable to injury from collision.

5.1.3 Air Pollution from Port Operations

Ports contribute to various air pollutants that affect the health of people living in nearby communities and contribute to regional air pollution problems. The major air pollutants related to port activities that can affect human health include diesel exhaust, particulate matter (PM), volatile organic compounds (VOCs), nitrogen

oxides (NO_x), ozone, and sulfur oxides (SO_x). Particles directly emitted in the exhaust typically contain mineral ash, metals, black carbon (soot), condensable organics and sulphate. These particles, when leaving the ship stack, are very small (< 0.1 µm). During the ageing of these emissions in the atmosphere, secondary particulate matter is formed when the ship exhaust gases are oxidised and react with other pollutants like ammonia and volatile organics. Shipping also contributes to air pollution with emissions of carbon monoxide and polyaromatic hydrocarbons (PAH). Besides influencing particle formation, nitrogen oxides and VOC emitted by shipping affect tropospheric ozone formation.

5.1.4 Noise and Light Pollution

Noise associated with shipping and port operations is another major factor that has the potential to cause disturbance to marine animals, including marine mammals, fish and birds. Marine mammals are known to continue to use areas with very high levels of boat traffic and noise. However, there is concern over noise pollution in general which tends to centre on the possible behavioural effects and that in the worse cases marine mammals, fish or birds may be driven away from their home territories. Studies reported that noise and erratic boat movements can distract the feeding behaviour of dolphins and drive them away. Artificial night lighting affects the natural behaviour of many animal and bird species. It can disturb activity patterns and internal clock mechanisms in birds.

5.1.5 Impacts of Cargo Handling

During cargo handling operations in ports & harbours, discharges and emissions do occur. Sources of atmospheric pollution can stem from cargo vapour emissions. Release of cargo into the marine environment may have direct environmental effects, such as the loss of toxic substances, or indirect effects, such as the loss of non-toxic organic-rich substances which may result in oxygen depletion on their breakdown. Some dry bulk cargoes have high concentrations of organic material and/or nutrients, such as fertilizers and animal feed, with high biological oxygen demands, large spillages of these may cause localized nutrient enrichment and oxygen depletion. This may result in the suffocation of marine life in the vicinity.

5.1.6 Ship-borne Waste

Ship-source marine pollutants emanate from cargo carried or waste generated onboard, which usually contains oil or oily mixtures and noxious

substances. They accumulate from machinery operation or from the domestic activities of the crew living onboard. Mineral oil in the stern tube lubricating bearings supporting the propeller shaft, contained by shaft seals with certain operational leakage and solid wastes.

5.1.7 Introduction of Non-native Species into the Marine Environment

Rapid globalisation and increasing trends of trade, travel and transport in recent decades have accelerated marine biological invasions by increasing rates of new introductions of non-native organisms through various pathways, such as shipping, navigational canals, aquaculture, and the aquarium trade. Shipping plays a major role in the introduction of non-indigenous organisms through ships' ballast water and associated sediments and fouling on ships' hulls. Biological invasions severely challenge the conservation of biodiversity and natural resources. They are considered to be one of the most important direct drivers of biodiversity loss and major pressure on several types of ecosystems, with both ecological and economic impacts. In marine ecosystems introduction of alien marine species may become invasive and displace native species, cause the loss of native genotypes, modify habitats, change community structure, affect food web properties and ecosystem processes, impede the provision of ecosystem services, impact human health, and cause substantial economic losses.

5.1.8 Oil Spill

Oil pollution is considered as one of the major threats to the marine coastal environment, as it causes a variety of deleterious effects across a wide range of habitats and species. The oil possesses a multi-pronged lethality, being a complex mixture of many hydrocarbon compounds with varying physical and chemical properties such as water-solubility, toxicity, and environmental persistence. Most common accidental spills at port and harbour are caused during loading/unloading operations. The bursting of transfer hoses or pipes is another cause. Extreme cases of collision of vessels also are a reason for oil spills.

The extent of damage caused by an oil spill depends upon the quantity of oil spilled, the type of oil involved in the spillage and the oceanographic and meteorological conditions prevailing in the location where the spill has occurred. When the oil spills in large quantities, 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 is 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 benthic organisms such as clams and mussels. The other amenities that are affected include mangrove forests and several marine resources.

Oil spills can also have a serious economic impact on coastal activities and the resources of the sea. In most cases, such damage is temporary and is caused primarily by the physical properties of oil creating nuisance and hazardous conditions. The impact on marine life is compounded by toxicity and tainting effects resulting from the chemical composition of oil, as well as by the diversity and variability of biological systems and their sensitivity to oil pollution.

5.2 Construction Phase Impacts of Widening the Existing Container Berth on the Marine Environment (Marine Water, Sediment Quality and Biota)

Various activities during the project's widening, repairing, and operation phase are likely to impact various environmental components. Impacts related to the widening of the existing container berth, repairing & strengthening of the existing damaged portion of the berth structures at Jawaharlal Nehru Port on the intertidal and near-coastal environment during the construction and reclamation period can be generally classified into impacts on water quality, sediment quality and impacts on various flora and fauna present around the Thane creek region.

5.2.1 Water Quality

Piling in the subtidal area for expanding the berth has a high potential to disperse the bed sediment into the water column, thereby increasing the suspended sediments in the water and degrading the water quality locally. Due to the permanent damage caused to bottom biota, there is a potential risk to fishery resources which may lead to an increase in some undesirable species of biota. This can lead to water quality deterioration and adversely affect the marine and coastal ecology locally.

The texture of subtidal sediment at the proposed berth expansion site (Station T4) mainly consists of silt (Av. 91.8%) followed by clay (Av. 6.2%) and sand (Section 4.2.1). Hence, when the bed sediment is disturbed due to piling activities, the fine particles may remain in suspension, though locally, for some period. The SS generated due to piling activities could render the water muddy and turbid. The changes in salinity due to bed disturbance are not expected.

The discussion in sections 4.2.2 to 4.2.4 gives the results of heavy metals, organic carbon, phosphorus and PHc in sediments. The risk of release of pollutants

entrapped in the sediment to the water when the bed is disturbed thereby mixing interstitial water rich in contaminants with the overlying water is expected. The possibility of DO levels being suppressed and the increase in BOD because of the release of this polluted interstitial water which also includes oxidisable organic compounds, is also anticipated.

Different types of floating platforms such as barges, cranes etc. will be deployed in the area during construction. An accident involving such platforms may lead to the loss of onboard construction material and fuel. Without mitigation and containment measures, the materials may sink to the bed and the fuel spill would deteriorate the region's water quality. Thus, apart from local transient pulses of SS and deterioration due to accidental spillages, the water quality of the region will not be influenced adversely during the construction phase.

5.2.2 Sediment quality

The sediment dispersed in the water column during the piling time will be localised and temporary, consider if JNPA adopts advanced piling technologies. The discussion in Section 4.1 indicates that the water quality of the Thane creek, sustains moderately polluted sediment with respect to heavy metals. Hence, the possibility of releasing the pollutants bounded with the sediments, due to the disturbance of the seabed during piling activities in the creek water is expected. Misuse of the intertidal area by the workforce employed during the construction phase, can locally degrade the intertidal sediment by increasing BOD and populations of pathogens if proper sanitation is not made available to them.

5.2.3 Noise

The impact of anthropogenic underwater sound on marine biota is an important environmental aspect. Sound speed in water is about 4.5 times more than that in air and absorption is less compared to air. Consequently, many marine organisms are very well adapted to emit and receive sound and they use it for a variety of functions such as communication, mating, searching prey, predator, hazard avoidance, and for short- and long-range navigation (Janik 2009, Popper & Hastings 2009, Tyack & Clark 2000). In the marine environment, pile driving can produce some of the most intense anthropogenic noises.

There are several factors which affect the type and intensity of sound pressure waves during piling such as the size and material of the pile, the firmness of the substrate, and the type of pile-driving hammer that is used. Rotary drilling rigs

can generate substantial noise during operation, which can disrupt marine communities and wildlife habitats. Noise pollution can lead to stress for both humans and animals and even affect local ecosystems. Piling activity may contribute to the behavioural changes in marine organisms. Studies have shown clear behavioural reactions in fish due to a variety of sounds, sometimes at relatively low received sound pressure levels. Behavioral responses due to piling noise might happen anywhere within the zone of audibility and that the responses could potentially prevent fish from reaching breeding or spawning sites. This could result in long term effects on reproduction and population parameters.

The anthropogenic noise propagation, which is dependent on its frequency, characteristics and duration may have some impact on certain fishes, unless noise control measures are undertaken during construction activities. Fish may leave an area for more suitable spawning grounds or may avoid a natural migration path because of noise disturbances. However, the piling methodology to be adopted by JNPA is expected to consider this aspect and minimize the impact of noise and vibration considerably on marine organisms. Also piling is a short-term one-time activity, hence impacts if any, are minor and reversible in nature.

5.2.4 Impact on Flora and Fauna

a) Phytoplankton

In general, an increase in turbidity due to dispersion of fine-grained sediment in the water can lead to reduced light transmittance, which in turn may influence photosynthesis and consequently may affect primary productivity. The study area sustains high silt and clay content, and thus an enhancement of suspended sediments during the piling activities will cause an impact on phytoplankton production, resulting in a decrease in phytoplankton standing stock. The degradation of chlorophyll *a* to phaeophytin is also expected due to the enhancement of SS in the region. In general, the recovery of phytoplankton production will be fast after the completion of piling activities.

b) Zooplankton

The range of zooplankton standing stock of Thane creek during pre-monsoon, monsoon, and post monsoon season of 2022-23 in terms of biomass and abundance were ranged between 0.6 – 19.9 mL/100m^3 and 5.4 – 160.6 x10^3 no/100m^3 respectively (Table 4.3.6 and 4.3.7). A good number of decapod larvae, fish eggs, fish larvae and are also recorded from the study area. If the piling and

construction activity is prolonged, herbivorous zooplankton may deplete locally due to reduced phytoplankton crop, and it will impact on the standing stock of zooplankton in the region.

c) Macrobenthos

Macrobenthos is an important component of coastal ecosystems. The macrofauna is composed of Mollusca, Polychaeta, Echinodermata, Crustacea and other groups. The survival of these organisms depends on many factors like salinity, sediment texture, sediment organic matter, sediment biogeochemistry etc. Piling removes sediments from the pile footprint and modify the structure and dynamics of the soft bottom community. The construction and piling activities of the widening of existing berth can bring physical alterations, burying of benthic habitats, increased water column turbidity, enhancement of organic matter, nutrient and contaminant loads in sediments and their dissolution in the water column and thereby causing impacts to the macrobenthic organisms residing the vicinity of the project location.

Considering the relevant role of the benthic fauna in the secondary production of the creek, any impact created by the widening of the existing berth development on the macrobenthos may seriously harm the ecology and economy of the ecosystem, limiting its ability to function as a nursery area. However, the effects of piling and construction of the berth on the soft bottom organisms may be difficult to identify. Macrobenthic species are usually very resilient in recolonizing the substrate after a defaunation process, although records show that periods of fauna recovery may be highly variable, with intervals ranging from weeks to years.

Proposed constructions would have an adverse impact on the benthic habitats which would be destroyed in the areas directly disturbed (e.g. pile footprint). The total area identified under piling is about 317.5 m^2.

The average values of biomass (0.97 g/m^2, wet. wt.) and population (248.0 no/m^2) present at the subtidal segment (Station T4) are worked out to assess the permanent loss of macrobenthic standing stock in the proposed piling area. The total benthic biomass (g) and population (no) permanently loss due to the piling activity in the subtidal region is estimated as 307.9 gm and 787.4 no respectively (Table 5.1 A).

Table 5.1A: Estimation of Macrobenthos loss

Segment	No of piles	Affected Area (m^2)	Loss of Macrobenthos	
			Biomass (g)	Population ($nox10^2$)
Piles (Foot print)	281	317.5	307.9	787.4

d) Fishes

Turbidity increases in the water column due to dredging can reduce light transmission through the water and decrease photosynthesis by aquatic plants, consequently affecting dissolved oxygen levels. Suspended sediments absorb heat energy thereby raising water temperatures. Such effects of turbidity on water quality may result in biological effects on aquatic organisms such as disruptions in migrations and spawning, movement patterns, sublethal effects (e.g., disease susceptibility, growth, and development), reduced hatching success, and direct mortality in fishes. The effects of suspended sediments on fish depend upon several factors: species, the temperature at exposure time, the type of suspended sediment (eg. Silt or clay), and angularity.

In general, fish are more likely to undergo sublethal stress from suspended sediments rather than lethality because of their ability to move away from or out of an area of higher concentration to a lower concentration versus sessile or less mobile species. Depending on the foraging strategy of a species, direct exposure to high levels of suspended sediment can disrupt foraging activities or decrease foraging efficacy. The increased turbidity can cause changes in the feeding behaviour of the fish for the simple reason that the prey may be less visible. Turbidity, due to the scattering of light, can increase or decrease the contrast between prey and the water column. In the case of some fish larvae, their visual detection of prey increases due to less inference from light scattering. In addition, the protection of larvae from large predators increases from the decreased ability of large visual predators. Thus, in certain cases, turbid environments may offer some benefits for certain species and size groups of fish.

The deleterious effects of suspended sediments directly on fish physiology are well documented. While increases in sediment load (both suspended and

deposited) can have a negative effect across multiple scales of fish communities, from individual level (e.g., spawning success and fry emergence) to the system level (e.g., decreased species richness). Reproduction can be affected by stress in various ways, depending upon when it is experienced in the life cycle and the severity and duration. Increased suspended sediment loads can cause physiological, bioenergetic, and behavioural alterations (e.g., delays in spawning) which may, in turn affect egg quantity or quality and embryo development.

e) Turtles and mammals

Various activities during the widening of the existing container berth can have an impact on marine cetaceans (mainly dolphins) and their behaviour. The main impacts are physical injury or mortality from collisions with vessels, noise production due to piling activity, and increased turbidity in the water column. Collision with boats is a known cause of injury and mortality in marine mammals. Collision varies, depending on a number of factors, including vessel type, speed, location, species, and behaviour. Data from strandings are useful, but identifying the cause is often based on speculation from injuries, which may not be obvious or could be attributed to a number of sources. Active Vessels with stationary or moving at slow speeds of 1–3 kn are well managed and avoid critical habitats, times when animals may be distracted, or areas where calves are abundant, the risk of collision between marine mammals is minimal.

Marine mammals, particularly cetaceans, are acoustically reliant animals that utilize sound for detecting prey, navigating, and communicating. Reported effects include temporary threshold shift (TTS) or permanent threshold shift (PTS), the latter being considered as auditory injury. Other effects include acoustic masking, which could cause animals to alter the duration, frequency, or sound level of acoustic signals. Masking important sounds can theoretically impact the reproductive success of individual whales and affect populations.

Noise pollution created by the rotary drilling rigs can disrupt marine mammals. Vibrations produced during drilling operations can propagate through the ground and affect neighbouring structures and the benthic organisms residing in the sediments.

During operations like piling, an increase in suspended solids concentration is expected. This increase may potentially influence humpback dolphins' prey, and affect the dolphins indirectly by the loss of food supply due to disturbance of the seafloor and increased sedimentation.

f) Mangrove Vegetation

Mangroves are woody plants that inhabit the upper intertidal zones of saltwater areas, primarily in tropical and subtropical regions within 30° of the equator. The mangrove forests have been shown to sustain more than 70 direct human activities, ranging from fuel wood collection to fisheries. The Indian Forest Act, of 1927 and the Wildlife (Protection) Act, of 1972 provide protection to flora and fauna. The Environment (Protection) Act, of 1986 has an important part in the conservation and management of mangrove ecosystems. Mangroves provide critical habitat for diverse marine and terrestrial flora and fauna. Mangroves have a multi-faceted role in our environment, these are as follows:

- Economic benefits (Supports livelihoods of indigenous people)
- Ecological services (carbon sequestration, providing habitat for a wide range of fauna. etc.)
- Reducing the intensity of Cyclones, Tsunami and Flood
- Coastal protection
- Trapping the sediments

The project area falls in the mid-segment of Thane Creek. There is thick luxuriant growth of mangroves near the project site. Locations like Nhava, Sheva creek, Elephanta Island, Panje, Boripakhadi, Mora and upper Thane creek has good dense mangrove presence.

The activities proposed to be carried out at the berth are confined to the earmarked site and not falling any mangrove areas; therefore, a direct impact on the mangroves is not anticipated. There are dense mangroves present near the berth (Figure 5.1), so the possibility of indirect impact on the nearby mangrove ecosystem cannot be ruled out, and the major impact is dust deposition. Dust generated during the construction and operational phase of the berth could result in deposited on surrounding mangroves, which is adversely affected on mangrove photosynthesis process. The exhaust emissions from drilling rig engines can contribute to air pollution by releasing harmful particulate matter and pollutants which may affect the nearby mangrove patches.

Mangroves are also threatened by the disposal of wastes, oil spills, berth activities, erosion trends, cutting for firewood, grazing by livestock etc. The Forest Department and industries around Thane Creek, including JNPA can take up

mangrove afforestation programmes, which will result in the protection of the mangrove coverage in Thane creek. JNPA should further support the mangrove restoration programme near the project site, along the creeks and adjacent mud flats.

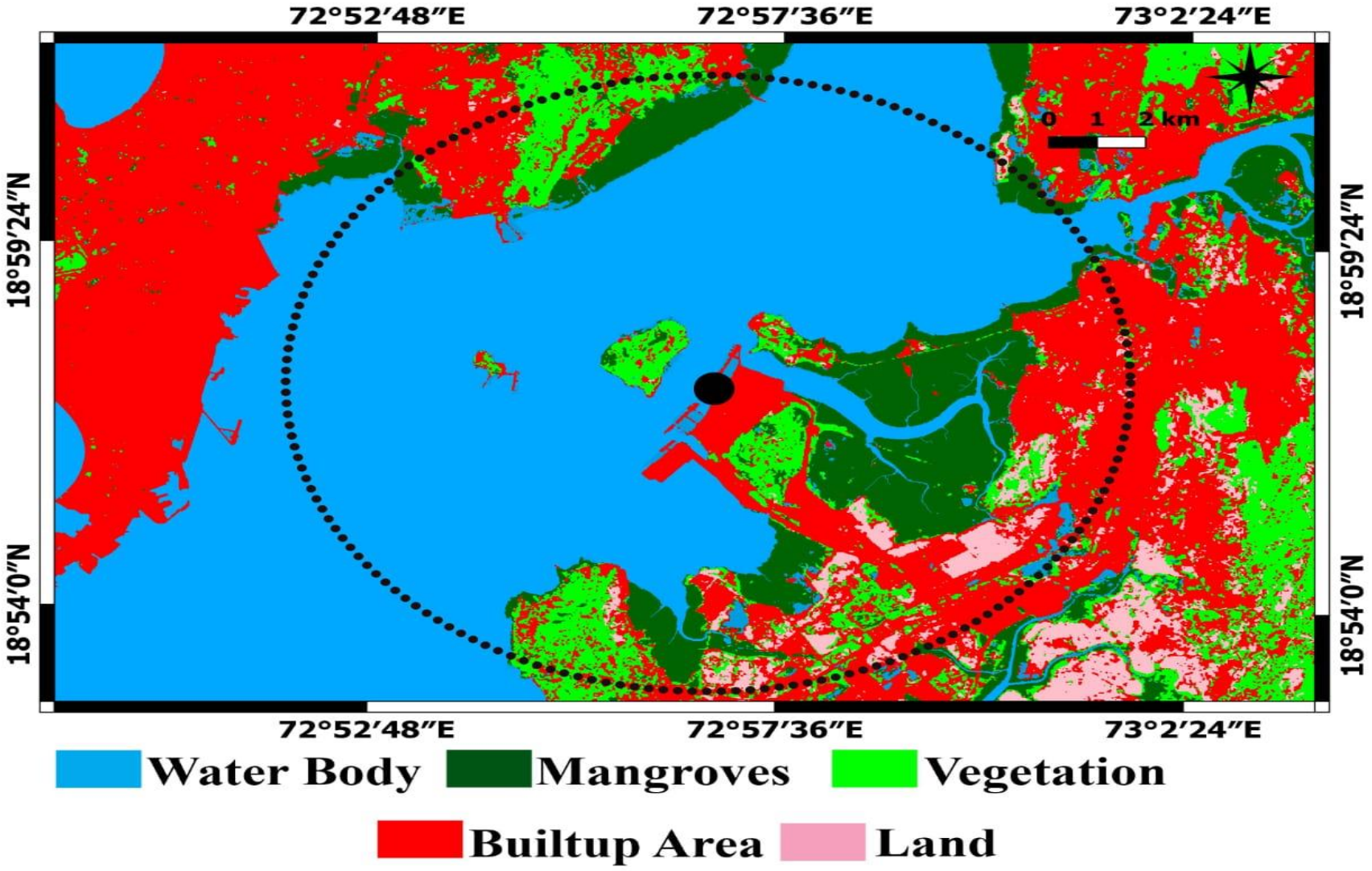


Figure 5.1: Landuse / landcover (10km) around the berth showing mangrove vegetation

5.2.5 Miscellaneous

A large number of machinery, construction materials and workforce would be brought to the site. The major part of the construction activities such as pre-cast of superstructures, fabrication etc. will be carried out on the land, out of CRZ areas, to minimise the impacts such as spillages, generation of the construction waste etc. at the berth area. Left-over solid waste generated during the piling and construction period would be a source of nuisance if not cleared from the site. The extent of the impact on marine ecology would also depend on the duration of piling and construction of the berth. If the construction is prolonged due to time overruns or improper planning, adverse influence would increase accordingly.

5.3 Operational phase

Possible marine environmental implications during the operational phase are mostly associated with ship accidents and grounding due to an increase in traffic at the berth, accidental oil spills and discharge of wastes from the berth and ships. Accidental spillages of these products can result in damage to the environment and assets, the severity of which would depend on the product and the quantity involved, the location of spillage, environmental conditions etc.

5.3.1 Petroleum products spill in the marine environment

Oil pollution is a major threat to the marine and creek environment, as it produces a variety of deleterious effects across a wide range of habitats and species. Oil possesses a multi-pronged lethality, being a complex mixture of many hydrocarbon compounds with varying physical and chemical properties such as water-solubility, toxicity, and environmental persistence. Most common accidental spills at jetty are caused during loading/unloading operation. Bursting of transfer hoses or pipes is another cause. Accidental spills can be prevented by taking proper care while handling such activities.

The extent of damage caused by an oil spill depends upon the quantity of oil spilled, type of oil involved in the spillage and the oceanographic and meteorological conditions prevailing in the location where the spill has occurred. 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 is 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

such as clams and mussels. The other amenities that are affected include mangrove forests and several marine resources.

Though very rare, bulk releases of petroleum product/fuel could result due to accidents such as ship collision, ship grounding, onboard fire etc. The majority of such accidents have occurred when the ships approach/leave the berth through the navigational channel. It has been well established that the human factor remains to be the cause of about 90% of accidents leading to petroleum spills.

If a spill occurs, it would negatively impact the local biota since petroleum products are toxic to marine organisms depending on their composition and volume spilled. Since 30% of the oil gets lost to the atmosphere, rest of the 70% would settle in the water column. This would be settled on the seabed over a period of time.

Spilled petroleum undergoes weathering through processes such as spreading, evaporation, dispersion, emulsification, dissolution, oxidation, sedimentation and biodegradation. A lighter product such as naphtha or Motor Spirit (MS) would soon evaporate under tropical conditions while heavy product such as FO would persist in the marine environment for a prolonged period. Thus the impact of a spill on marine biota of the Thane creek region would critically depend on the nature of the product, volume spilled and the area affected.

i. Mangroves:

Spilled oil if transported to the mangrove area may block the openings of air-breathing roots of plants or interfere with salt balance, harming them. The recovery of mangroves would be slow and may take a few months to years depending on the damage.

ii. Plankton:

An increase in concentrations of dissolved petroleum hydrocarbons (PHc) in water subsequent to a spill could lead to plankton mortality. The recovery of plankton would be however quick through the repopulation of the community by fresh recruits from adjacent areas not affected by oil. Eggs and larvae of fishes, crustaceans and molluscs in the spill area would be killed. However, it is unlikely that any localised losses of fish eggs and larvae caused by a spill would have a discernible effect on the size or health of future adult populations.

iii. Benthos:

If the weathered oily mass spreads on intertidal areas mortalities of organisms in the zones of physical contact are expected. Subtidal benthos of shallow

waters may also be affected if the sinking residue affects their habitats. The recovery would occur once the oil coating on the intertidal area is washed away by tidal action. Subtidal benthos is unlikely to be impacted significantly since the sinking oil residue would be dispersed widely by strong tidal displacements.

iv. Fishes:

A large oil spill can temporarily reduce the fish catch from the area as fish might migrate from the affected zone. Limited mortality may also occur particularly when the oil concentrations in the water go abnormally high. Often fishes get tainted and unpalatable but become normal when the ambient PHc level approaches the baseline.

v. Birds:

The birds are highly sensitive to oil spills and get particularly affected if their habitats are oiled. Oil pollution affects birds in several ways either indirectly by killing or contaminating their nutritional sources, such as plankton, invertebrates and fish, or directly via plumage oiling. The acute effect of oil pollution on birds is on their thermal balance. Oil adheres to the plumage and causes a reduction in the water repellent properties of the plumage, causing water to penetrate into the plumage to displace the insulating layer of air. In water, plumage oiling may cause the heat loss to exceed the bird's heat production capacity leads to hypothermia in birds.

vi. Turtles and mammals:

Marine turtles and mammals are highly sensitive to oil spills, and they tend to swim away from the spill site. But direct spillage or ingestion of oil will have a lethal impact on marine mammals. Contact with viscous oils can lead to long-term coating of the body surface, which may interfere with swimming ability and filtering capabilities in marine mammals.

5.3.2 Risk of ship accidents

Ship collision or grounding, onboard fire, explosion etc. could lead to bulk releases of oil and cargo to the marine environment. Of these, the first two were more common and often resulted from out of control ship movement. Accidents involving ships were rare, but if occurred it could be ruinous to the local environment if the cargo spilled was crude oil or petroleum product.

5.3.3 Jetty related wastes

The wastes generated at the jetty in normal operations include domestic effluent, garbage and solid wastes (debris, leftover plastic items etc). Liquid and solid

wastes if not properly collected and disposed, can potentially cause degradation of the terrestrial as well as marine environment. A site in the vicinity of the jetty will be cordoned and marked as a solid waste collection site. Solid wastes will be segregated at this site and stored separately.

5.3.4 Ship generated wastes

A number of sources of waste generated in the berth can degrade water quality and reduce dissolved oxygen concentrations, including sewage discharges from ships, tugs, recreational and commercial boats etc. The four basic categories of waste generated by ships, tugs etc. are as follows:

- Oily waste which usually consists of some oil mixed with larger quantities of seawater including fuel residues and sludges.
- Sewage generated by the crew in the ships.
- Garbage originating from the crew, the maintenance of the ship, cargo etc.

The International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78) prohibits all ships from discharging wastes at sea which could result in pollution of the marine environment. MARPOL 73/78 applies to oil tankers, cruise ships, general cargo and container vessels, tugs, ferries, yachts and small pleasure craft. MARPOL 73/78 requires that ships retain all the wastes on board until reaching port.

5.4 Mitigation Measures

It is essential that certain environment protection measures are conceptualized and strictly implemented at the planning and design stages of the project itself so that the negative impacts during construction and operational phases are reduced to a minimum to protect the project area’s biodiversity and avoid anthropogenic shocks.

5.4.1 Mitigating Measures for Reducing the Impact of Construction Activities

Several management techniques and mitigation measures have been developed to reduce the impact of construction activities on the marine environment. Methods like adoption of environmental piling techniques, physical barriers and so forth, which may be used to mitigate the effects of piling on sensitive organisms and on ecosystems. Noise Reduction Measures: Employ noise barriers, enclosures, or sound-absorbing materials to minimize noise propagation. Scheduling drilling

activities during less sensitive hours can also help mitigate noise impact on communities and wildlife.

Vibration Control: Monitor vibrations closely using advanced instruments. Adjust drilling parameters and techniques to minimize ground vibrations, ensuring neighboring structures and ecosystems are not compromised.

Emission Control: Utilize modern drilling rigs equipped with emission control technologies. Regularly service and maintain engines to ensure optimal combustion efficiency and reduced emissions.

Fluid Management: Implement proper containment and collection systems to prevent drilling fluids from escaping into the environment. Use eco-friendly drilling fluids that minimize the potential for sediment and water contamination.

Mitigating measures applied in other cases include confined land-disposal of rubbles, turbidity modelling (plume prediction), turbidity thresholds, minimizing the duration of piling, seasonal restrictions, the establishment of no-spud zones, use of silt screens, stopping piling when turbidity thresholds are exceeded. The use of a silt screen, however, lengthens the execution period, and increases the costs of the project.

Several local fishing populations are using the creeks, mudbanks and near subtidal regions for their daily fishing activities. Proper communication must be given to all the stakeholders near the project location to avoid any damage to their boats and fishing gear due to construction activities. Also piling should not carried out during the fish breeding and spawning season.

5.4.2 Construction Phase

i) Creek Environment

The possible impacts during the construction phase can be minimised or avoided by adopting the following measures:

- JNPA has to ensure that no creeks/drainages are blocked due to the widening of berth construction activity.
- The barges or vessels involved in the construction work and the equipment like cranes involved in the construction work will be in a proper condition with no leakages of oil, petrol, diesel, or grease which can lead to leakage of pollutants to the sea.

- The movement of the construction barges carrying construction materials and machineries should be well planned that the navigational channel should not be crowded with too many vessels so that the accidents and subsequent spillages of materials and fuel are avoided.
- During construction, the site will be well illuminated to compensate shading of natural sunlight penetration.
- The water quality may have depleted oxygen levels due to impact of construction; hence, aeration peddling systems can be released at various spots around the marine water area to provide aeration.
- The impacts of hammering during piling can be minimised using a bubble curtain extending from water surface to the bottom. The curtain is expected to reduce underwater noise levels by approximately 10dB on an average.
- Turbidity monitoring can be performed periodically to ensure compliance with water quality standards. If the turbidity levels are estimated to be approaching the turbidity exceeds criterion, the work can be temporarily suspended.
- If required, silt curtains should be implemented in minimising the dispersal of resuspended sediments.
- Temporary colonies of the work force etc. should be established sufficiently away from the CRZ areas and proper sanitation including toilets and bathrooms should be provided to the inhabitants to prevent abuse of the intertidal area.
- Sewage and other wastes generated in these settlements should be properly treated and disposed, to avoid any impact on the marine / land environment.
- No waste should be directly released into the creek.
- The workers should be provided with fuel to discourage them from cutting mangroves or any other vegetation.
- Several local fishing populations are using the creeks, mudbanks and near subtidal regions for their daily fishing activities. Proper communication has to be given to all the stakeholders near the project location to avert any damage to their boats and fishing gear due to the construction and operation activities.
- The developmental activities should not cause any disturbance to the fishing activity, or movements of fishing boats.
- Piling shall not be carried out during the fish breeding and spawning seasons.

- All activities pertaining to the widening of the existing berth shall be carried out according to the provision of CRZ notification 2011.
- Solid wastes and rubbles generated at the site is to be managed and disposed as per the norms of the Solid Waste Management Rules 2016.
- Periodic monitoring of construction works to notice and report any adverse events and mitigation measures to be implemented.

ii) Flora and Fauna

Except for the permanent burial of intertidal organisms present in the pile foot print and temporary destruction of macrobenthos along the surroundings of the piling area, the impact on the Thane creek ecology during the construction phase would be largely confined to the duration over which the activities are spread. Hence, the key factor in minimising the adverse impacts would be a reduction in the construction period at the site and avoidance of spillage of activities beyond the specified geographical area, which should be kept to a minimum.

Workforces employed during construction often misuse the intertidal and supratidal areas. This should be avoided by establishing temporary colonies of workers sufficiently away from the construction sites, and proper sanitation should be provided to them to prevent abuse of the intertidal region. The noise level during transport and construction of marine facilities should be kept to a minimum.

General clean-up along the corridor areas should be undertaken and discarded materials including excavated soil should be removed from the site and the aesthetic quality of the surroundings restored upon completion of the construction phase.

iii) Mitigation and Management of Mangroves

Mangrove conservation will only be successful when backed up by sound data and a broad knowledge, understanding and awareness of the need for mangrove conservation. Research and maintenance of accessible, long-term databases on mangrove coverage, management and protection, value and their response to pressures are essential for sound policy and management decision-making. Places near to the berth like Nava, Sheva, Elephanta Island, Panje, Boripakhadi and Mora have the presence of luxuriant growth of mangroves. Care should be taken during the time of construction to reduce the impact on these ecosystems.

a) Mangrove Conservation Plan for the Project Site

Mangroves grow along coastlines and estuaries, forming a complex coastal ecosystem. Therefore, effective management of this ecosystem should follow an integrated approach guided by key principles like connecting different sectors and agencies, participation and co-management, ecosystem-based management, zonation, and adaptive management.

Community Involvement: The fishing community near the project site are the main local stakeholders and uses these intertidal and subtidal regions for daily fishing activities. Involving these people in the mangrove protection and other environmental sustainability activities of JNPA's will directly and indirectly benefit the local community.

Environmental Awareness and Capacity Building: giving training to the local people on the importance of mangroves and the importance of mangrove conservation, ecosystem management, waste and litter management and involving students from local schools will spread the message of environmental awareness locally.

Research and Development: JNPA can support research through academic institutions and the Mangrove Cell of Maharashtra Forest Department to conserve the mangrove ecosystems around their berth. The National Forest Policy, 1988 also lists effective conservation and management of natural forest ecosystems as a priority area for forestry research. Some of the main activities that can be executed in the region are:

- **Mangrove monitoring**: Mangroves in the project area must be periodically evaluated during the project activity. Regular assessment to detect the mangrove health condition.
- **Sediment monitoring:** monitoring sediment within the mangrove community will provide an easy way to find potential impacts and also help in identifying the other flora and faunal communities associated with the mangrove ecosystem.
- **Reforestation:** It refers to planting trees in areas which were previously forested and where the site conditions have not been degraded since the removal of mangrove cover. It's part of the mangrove silviculture technique.

- **Rehabilitation:** It means converting a degraded system to a more stable condition. In sites where mangrove habitat loss or degradation has occurred to such an extent that natural processes can no longer self-correct or self-renew, appropriate, site-specific and affordable rehabilitation or restoration methods are needed.
- **Restoration:** It's a process that aims to return a system to a pre-existing condition whether or not this was pristine.
- **Mangrove planting:** Mangroves are well adapted to natural phenomena such as (erosion and accretion, storms and floods) and quickly recover from these disturbances without the need for planting. In contrast, human interventions will lead to permanent changes which may create conditions which are unsuitable for the natural regeneration of mangroves. In this kind of environment, planting is important to mangrove conservation. Planting is the most favourable method, it can be done using seeds, propagules or seedlings; the latter can be from nurseries or transplanted from other sites

IV) Mandatory Precautions during the time of Construction of the Berth

- Any discharge of wastes/wastewater to the mangrove patches near the berth during construction and operation would not be allowed.
- Metal chutes maybe provided to prevent the falling of debris and construction material into the creek environment
- Awareness will be given to workers about the importance of mangroves and the involvement of local communities in their conservation.
- Sanitation facilities should be provided to the workers as per Public Health Engineering Department, and any misuse of mangrove areas for these activities should be banned.
- The sensitive ecosystems such as mangroves and mudflats around the proposed site should be marked on maps and periodically monitored (At least once a year) to ascertain their health.
- Tidal water flow, channels and other inlets to the surrounding mangrove areas should not be blocked or diverted. Regular tidal water flow should be maintained. Any culverts or bridges along the construction site should be kept open and inspected thoroughly and maintained regularly for the flow of water.

- **Reduction of Dust**: Dust released from the construction site, movement of trucks may deposit on the existing mangrove foliage in the vicinity. These dust particles may affect the photosynthetic activity of the plant and may create problems both socially and environmentally. For the reduction of dust formation due to construction activity viz. sprinkling of water and covering of construction materials like sand, soil etc., placing dust screens around the construction site near to mangrove ecosystem for reducing the amount of dust generated etc.
- **Noise Control**: Noise generated by construction equipment will be controlled through the provision of mufflers in machines and the implementation of other noise control measures.
- The construction involves the use of heavy machinery and equipment which can generate pollution at various levels and* ultimately find its way into the mangrove area. This can cause a deterioration in the general health of the mangroves present nearby. Regular inspection of trucks, machinery and equipment used for the project should be done to ensure that they are in good working condition, thus avoiding excessive discharge of carbon monoxide.
- During the time of post-construction and clearing of debris, garbage proper care should be taken care that they should not end up in the close by mangrove ecosystems.

b) Mitigation Measures to Reduce the Impact on the Cetacean Community

- **Temporal and Geographic Closures:** The most obvious way to reduce or eliminate the impacts of various disturbing activities is to plan those activities to occur in places or at times when the animals of interest are not present. Even when the animals are present, temporal or geographic closures that restrict the activities to lower-density areas/times or less sensitive areas/periods may be useful. Geographic closures may be harder to implement; as most small cetaceans do not have ‘nursery areas’ in the sense that most fishes do.
- **Bubble Curtains and Jackets:** The impacts of hammering can be minimised using a bubble curtain extending from the water surface to the bottom. The curtain is expected to reduce underwater noise levels by approximately 10dB on average. Bubble curtains and various iterations (called ‘‘jackets’’ for small

curtains directly around noise-making equipment and ‘‘screens’’ for curtains enclosed in a foam-like mesh) have since been used in several industrial applications, especially to help direct fish and to reduce sounds of drilling activities. Such air-induced screening tends to be valuable in reducing noise towards seals, dolphins, and porpoises, especially when human-made sounds are loud and stationary in areas of important marine mammal habitats.

- **Acoustic Decoupling of Noisy Equipment:** Construction machinery, such as compressors and generators that are placed onto the steel hulls of barges, can cause trouble to marine mammals. By placing such equipment on rubber or foam mats or by using pneumatic rubber wheels under such machines, they can be ‘acoustically- decoupled’ to an extent.
- **Vessel Speed Limit and Restrictions:** All vessel captains working in the area should undergo training to educate them about local cetaceans and guidelines for safe vessel operations in the presence of dolphins and porpoises. Vessels traversing through the work areas should also be required to use predefined and regular routes to reduce disturbance to cetaceans due to vessel movements.
- **No-dumping Policies:** A no-dumping policy is simply prohibiting the dumping of wastes, chemicals, oil, trash, plastic or any other substance that would potentially harm dolphins and their habitat in the work area.

5.4.3 Impact During the Operational Period

Possible discharges from ships that could be a source of water pollution are bilge water, oily wastes, sewage, garbage and other residues in a ship. Spills of oils, lubricants, fuels and other oily liquids may be the other sources of water pollution. Discharges and spills of these wastes can cause problems of oil pollution, floating garbage, unsanitary conditions, odour and degradation of water quality. Biodegradation of oil generates polymerised oil particles and toxic aromatic fractions using dissolved oxygen in the water, and it indirectly causes damage to the bottom biota and habitat. Some oils contain carcinogenic contaminants and these are reported.

- Comprehensive and easy to implement Standard Operating Procedure (SOP) will be made for each category of cargo in order to avoid spillages.

- SOPs will address safe conditions of wind, tide, visibility etc, under which operations would be permissible.
- The operating staff at the berth will be trained in such operations and also to handle emergencies.
- For improved environmental safety and leak prevention, loading arms will be equipped with the following accessories:
    - Hydraulic Coupler, which allows rapid connection and disconnection of the arm to the tanker / pipeline flange.
    - PERC installed between two disco valves to allow quick disconnection from the tanker / pipeline without draining of the arm.
    - Limit switches that define 3D working envelope giving alarm at three stages.
    - Emergency Shut Down (ESD).
- In view of handling of increased volume of petroleum products when the berth is expanded the OSCP will be re-examined and modified if required in consultation with the Indian Coast Guard.
- SOPs will be developed for every facet of operational OSCP that will include notification; strategy for combating depending on oil / chemical type, quantity involved and area of spill impact; deployment of booms to contain and protect sensitive habitats, mainly mangroves; deployment of skimmers; on board and shore storage of recovered oil; strategy for shoreline cleaning and storage of oil-contaminated sediment; use of dispersants; final disposal of recovered oil and contaminated sediment; closure of operation; dissemination of information to public and media etc.
- The oil spill combating equipment will be stored in the vicinity of the oil berth and a suitable vessel will be always kept stand by for quick response during loading / unloading operations of petroleum and while providing bunker.
- Mock drills involving the deployment of critical oil spill containment and recovery equipment will be held at least once in 3 months.
- The oil spill combating equipment will be inspected regularly as recommended by the manufacturers and records of inspection will be maintained.

- Water drawl sources shall be identified and its impact shall be predicted. Similarly wash water discharge into the sea and impact prediction can be carried out.
- Adequacy of outfall in mitigating the adverse impacts shall be ensured by suitable study. Appropriate regulations on ship discharges and effluent from ships and provision of reception facilities are indispensable for proper control of emissions; detection of spills will be done for regulating ship discharges.
- To handle the spills recovery vessels, oil fences and treatment chemicals with a view to minimizing dispersal can be considered.
- Periodical clean-up of floating wastes is also necessary for preservation of port water quality.
- Emergency responders will be properly trained and equipped in accordance with OSHA's standards on emergency response and emergency fire protection.
- Reception facilities to be provided to receive residues and oily mixtures generated from ship operations according to International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL) as per 1978 Protocol (MARPOL, 1973/78).

5.4.4 Miscellaneous

The aesthetics of the area would deteriorate due to the presence of construction machinery and materials, make-shift huts for the labour force, cabins etc., Leftover solid waste generated during construction would be a source of nuisance if not cleared from the site.

The extent of the impact on the creek ecology would also depend on the duration of the construction phase. The adverse influence will increase if the construction is prolonged due to time overruns or improper planning.

6 MARINE BIODIVERSITY MANAGEMENT PLAN (MBMP)

6.1 Introduction

Indian sub-continent is assumed to be the fastest growing and emerging global economy of the 21st century. Within the coastal zone, there are a number of sensitive habitats, including estuaries, mangroves, coral reefs, sea-grass beds, and oceanic islands. These habitats support a wide spectrum of biota whose abundance and distribution vary both spatially and temporally. These habitats have been exploited for food and aesthetic purposes with no apparent ill effects until large-scale mechanization was introduced. The increasing human population coupled with the greater need for development has led to intensive exploitation of coastal areas and various fishery resources and has caused considerable impacts to many habitats. The coming decade will see unprecedented growth in port and shipping activities. Of the multiple modes of transport, India mainly depends on its ports and harbours for trade and navigation. In such a scenario, the proposed widening of the existing container berth will immensely support the growing transportation needs of the country.

Many places in the coastal waters of India have become danger-prone zones. Stress due to anthropogenic pollution is the principal cause of biodiversity degradation and ecosystem deterioration in coastal waters. Coastal waters are the beds or nursery grounds of many marine flora and fauna, including finfishes and shellfishes, the most influencing commodity for human population growth. Due to the over-exploitation and mismanagement of coastal ecosystems, these marine resources have been considerably declined. Managing a complex ecosystem to balance the delivery of all of its services is at the heart of ecosystem-based management. But, how can this balance be accomplished amidst the conflicting demands of stakeholders, managers, and policymakers? Several common ecological mechanisms link biodiversity to ecosystem functioning and a complex of essential services in marine ecosystems. As a result, preserving diversity can broadly benefit a wide spectrum of important ecosystem processes and services, including fisheries, water quality, recreation, and shoreline protection.

A management system conserving diversity will help accrue more ‘eco-service capital’ for human use and will hedge against unanticipated ecosystem changes from natural or anthropogenic causes. Although the maintenance of biodiversity cannot be the only goal for ecosystem-based management, it could provide a common currency for evaluating the impacts of different human activities on ecosystem functioning. It

can act as a critical indicator of ecosystem status. Significant advances in techniques and technologies have been made in recent years in to reduce environmental impacts, like the Environmental Management System (EMS) under ISO 14000. The following sections provide the management plans to be implemented for conserving the water quality, sediment and marine biodiversity of the Thane creek within and the vicinity of the container berth.

6.2 Objectives of MBMP:

- To identify the anticipated environmental issues which can affect marine water quality and marine biota during the construction and operational periods of the proposed project
- To provide guidelines and procedures for implementing mitigation measures
- Develop an institutional framework for the marine environment and biodiversity management
- Take immediate action when unpredictable impacts occur
- Monitor the effectiveness of mitigation measures
- Implementation of environmental sustainability in ports

6.3 Components of Marine Biodiversity and Environment Management Plan

The anticipated marine environmental impacts on the prevailing marine water quality and biodiversity at Thane Creek and mitigation measures for reducing the environmental impacts of the widening of the existing container berth project have been discussed in detail in Chapter 5.

The following specific marine biodiversity and environmental management aspects are discussed in this section:

- Summary of project activities, associated impacts and mitigation measures in the marine sector
- Site-specific Marine Biodiversity Management
- Community/stakeholder involvement in conservation activities
- Institutional arrangements for marine environmental management
- Mechanism for implementation of mitigative measures in the marine segment
- Approach towards voluntary compliance
- Management sections cover under MARPOL
- Legal framework
- Cost of Marine Environment Management Plan
- Marine Environment Monitoring During Construction and Operational Phase

- Disaster Management Plan (DMP)
- Environmental Sustainability in Ports

Table 6.1: Widening of the existing container berth developmental activities, associated impacts and mitigation measures in a nutshell

No.	Port activities	Marine compartment likely to affect	Impacts on the marine environment if no mitigation measures are implemented	Mitigation measures proposed	Responsible agency for implementation
Construction Phase					
	➢ Piling	• Marine water and sediment quality • Marine biota	➢ Decrease in primary productivity ➢ Decrease in zooplankton biomass ➢ Benthic biota loss ➢ Noise related issues	❖ Slop tanks on barges and boats for the collection of liquid, solid and hazardous waste ❖ Adoption of advanced piling technologies for piling activity ❖ Scheduling drilling activities during less sensitive hours ❖ Minimise the spill on the marine environment ❖ Application of temporal and geographic closures	JNPA/ assigned contractor

			➢ Impact on marine fishes and mammals ➢ Mangrove conservation	❖ Employing noise barriers, enclosures, or sound-absorbing materials to minimize noise propagation ❖ Bubble curtains and jackets around noise-making equipment ❖ Acoustic decoupling of equipment ❖ Adjusting drilling parameters and techniques to minimize ground vibrations ❖ Using modern drilling rigs equipped with emission control technologies ❖ Implementing proper containment and collection systems to prevent drilling fluids from escaping into the environment ❖ Using eco-friendly drilling fluids that minimize the impacts on sediments and water contamination ❖ Vessel speed limit and restrictions ❖ Installing silt curtains around sensitive areas ❖ Good mangroves patches were present near the project site	

				❖ Avoid any disturbance to this nearby mangrove vegetation ❖ Strict adherence to the marine environment and biodiversity monitoring plans under the environmental monitoring programme	
2	➢ Solid, liquid and hazardous waste handling	• Marine water and sediment quality Marine biota	➢ Impact on marine water, sediment and biota due to importer disposal ➢ Toxicity from hazardous chemicals	❖ Proper collection of waste generated at the worksite and its disposal as per MPCB and CPCB norms ❖ Adoption of safety measures as per OSHA Standards ❖ Hazardous materials such as oils, paints, compressed gases etc. will be stored as per the approved safety norms ❖ Medical facilities including first aid, will be made available for the workforce.	JNPA/ assigned contractor
Operation Phase					

1	Shipping operations	Marine water, sediment quality and biota	Releasing of ship waste Accidental spillages and leaks from cargo handling	❖ Vessels visiting the port shall meet emission standards as per MARPOL 73/78 ❖ Vessels are prohibited from discharging any form of wastewater, bilge, oil wastes, etc. into the near-shore as well as harbour waters ❖ Ships would comply with the MARPOL convention ❖ Facilities for waste reception from vessels Is to be established ❖ Comprehensive and easy to implement Standard Operating Procedure (SOP) will be made for each category of cargo to avoid spillages ❖ A separate de-ballasting pipeline should be provided to receive the washing from the ships.	JNPA/ assigned contractor
		Noise and light	Noise and light pollution on marine mammals and birds		
		Air quality	Regional air pollution (SO_x, NO_x, PAH, VOCs, PM etc.) from vessels		
2	➢ Oil Spills	Marine water, sediment and biota	Deterioration of marine water	❖ Implementation of Indian Coast Guard approved Oil Spill Contingency Plan (OSDCP)	JNPA

			quality and loss of biota	❖ Oil spill combating equipment will be stored in the vicinity of the berth and a suitable vessel will always be kept stand by for a quick response ❖ Conducting regular mock drills	

6.3.1 Site-specific Marine Biodiversity Management

The project area falls in the mid-segment of Thane creek. Thick luxuriant mangrove ecosystems and mudflats are present near the project site. Near to the berth areas like Nhava, Sheva creek, upper Thane and Elephanta Island and the south side of the berth, Panje, Boripakhadi, Mora are having good dense mangrove presence. It is observed that the local fisherman population is using these mudflats and shallow regions for fishing as part of their daily activities.

The windowpane oyster, *Placuna placenta*, also known as “Kapis,” is a bivalve marine mollusc in the family Placunidae. *P placenta* (Listed in Wild Life (Protection) Amendment Act, 2022: Schedule: II: Part (F) Mollusca) is found on muddy and sandy substrata from shallow water to depths of 100 m. *P placenta* is present near the berth (app. 2km) and setting up an exclusive protected area for the window pane oysters will ensure the conservation and survival of this scheduled species. Participation of the local fisher flocks who are dependent on window pane oysters for their livelihood fisheries and forest department officials, researchers and other government officials in the management and conservation activities is important to protect and conserve this species of high economic and ecological value.

Cumulative impacts due to the upgradation of the existing berth in the form of piling, shipping activities and sewage release can pose a considerable threat to the biodiversity present in these ecosystems. Destruction of marine biota is considered a loss to biodiversity and resource depletion. Due to the presence of these mangrove and mudflat ecosystems, the environmental cell of JNPA should continuously monitor these areas for biodiversity changes, eventually leading to the conservation of that area.

Threats to the biodiversity present in the priority areas can be minimised with the strict implementation of mitigatory measures proposed (Chapter 5) for each type and stage of activities related to the upgradation of the berth. Adopting a proper management plan for solid & liquid wastes and oil pollution will help to conserve these locations. For the long-term conservation of these eco-sensitive sites, JNPA and its environment cell can implement activities like regular monitoring of these sites, scientific research, eco-restoration and plan conservation activities with the help of Mangrove cell, Maharashtra Forest Department to improve the degraded mangrove sites and organise public awareness and education programmes.

6.3.2 Community/stakeholder Involvement in Conservation Activities

Scientific information and knowledge about the current status of biodiversity, values associated with it and necessary conservation methods will be communicated to the public/stakeholders. Important aspects to be covered under this are given below:

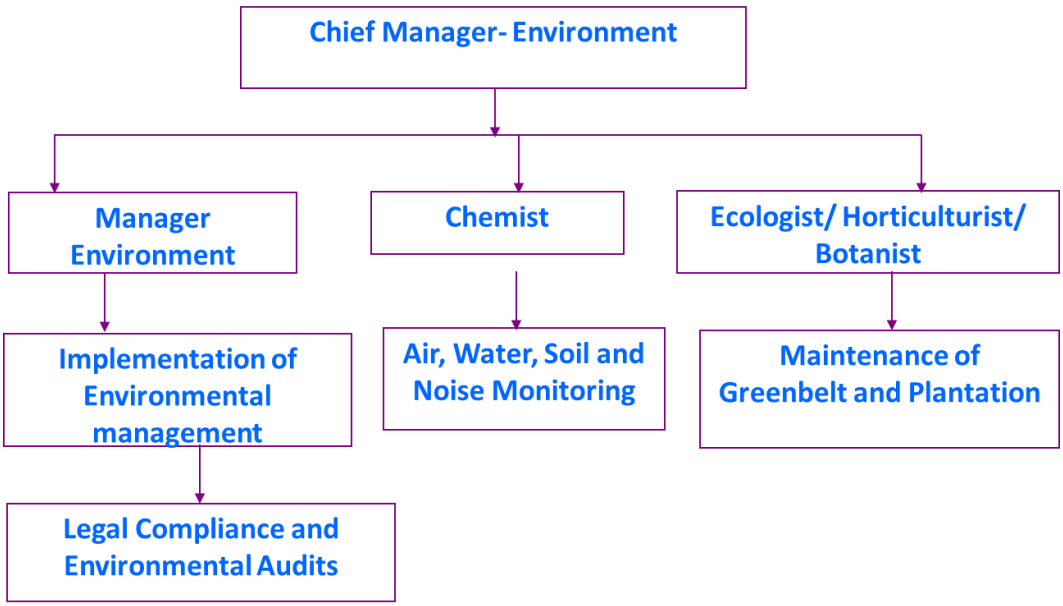
- Importance of natural biodiversity and ecosystem functions and linkages with human survival and well-being
- Biodiversity conservation should be the common aim for ecosystem-based management for all agencies involved in the marine environment
- Setting up objectives for local stakeholders to improve biodiversity by applying traditional conservation practices
- Maintaining a healthy relationship between port authorities and local stakeholders
- Supporting local communities with incentives for biodiversity conservation and management
- Practising good governance and sustainable ecosystem management practices involves local participation and transparency
- Conducting outreach programmes and workshops for stakeholder knowledge improvement and conservation of marine life
- Establishing local self-help groups to empower and educate women and local fisherman communities

Based on these concepts local village-level stakeholders' communities can be established for conservation and restoration of marine ecosystems near the proposed berth area. JNPA through its environmental team can provide financial support fully/partially as part of its CSR activities.

6.3.3 Institutional Arrangements for Marine Environmental Management

Institutional arrangements for marine management of the environment fall under the broad categories of project monitoring and post-project monitoring; inspections of machinery; solid, liquid and hazardous waste management; ballast water management; implementation of MARPOL 73/78; Identifying environmental aspects for normal, abnormal and emergency conditions; structures and pollution combating equipment; petroleum spill control and combating; ensure implementation of standard operating procedures; evaluate any non-conformity to the environmental standards and green belt development. For this purpose, JNPA's Environment Management Cell (EMC) is directly under the control of the Chief Manager and the

cell can control the environmental related issues in the marine segment. The model structure for the environment management cell is given below:



Apart from these routine monitoring and inspections, EMC should be responsible for arranging training programmes, refresher courses, mock rehearsals etc. The records of all these activities should be maintained as a part of the overall record system. The berth should have an operational Tier I Oil Spill Contingency Plan approved by the Indian Coast Guard, which is designed to deal with Tier-I oil spillage and to provide guidance for the initial response to Tier – II and Tier – III oil spills. The plan details the contingency arrangements for responding to actual or threatened oil pollution incidents at the berth.

6.3.4 Mechanism for Implementation of Mitigative Measures in the Marine Segment

For an efficient implementation and supervision of marine environmental and biodiversity management and to mitigate the environmental impacts, which are likely to arise due to the various phases of the widening of the existing berth and during the operational phases of the berth can be achieved through a well-organized institutional mechanism.

Implementation of appropriate marine environmental management plans and SOPs during different work stages is a requirement for the overall success of environment management. The persons assigned to this task should put up the various institutional arrangement needed for the implementation of effective environmental mitigative measures. Existing JNPA's in-house Pollution Control &

Environment Management Cell can take the lead in these aspects of environmental issues.

6.3.5 Approach Towards Voluntary Compliance

JNPA should successfully implement an Environment, Health & Safety Management System (EHS MS) based on recognized international standards for environmental and safety management systems like ISO 14001, OHSAS 18001, Social Accountability (SA) 8000 and International Maritime Organisation (IMO) and MARPOL 73/78 guidelines. The main objective behind this is to place a system to assess, monitor and manage various environmental performances in the field of marine, land, air, water, soil and noise which can lead to improved pollution prevention in these segments. Common procedures that can be adopted are given below:

- Identification of various environmental compartments and sensitive areas (classified under CRZ-I) and land, air and water which can be affected by the daily operation of the berth
- Find out the major operations that have significant environmental impacts
- Implementation of environmental legislation and policies
- Charting timelines for achieving environmental and biodiversity management goals
- Frame an Environmental Management System

Effective and proper implementation of these objectives is entrusted to JNPA and its environmental management team.

6.3.6 Management Sections Cover under MARPOL

At an international level, various legal instruments and controls have been provided to encourage regulation and enforcement by flag states, coastal states and port state control. For example, the International Maritime Organization (IMO) Convention on Marine Pollution MARPOL 73/78 outlines measures aimed at completely eliminating the willful and intentional discharge into the seas of oil and noxious or hazardous substances, chemicals, packaging, sewage and garbage. Specifically, Annexes I, II, III, IV, V and VI of MARPOL 73/78 identify these sources, and by their provision, port authorities are obligated to provide reception facilities for the handling of a range of waste including oil, chemical and garbage. Ports are also required to produce a Port Waste Management Plan (PWMP), including information on the type and location of facilities, notification requirements, details of providers and

costs. These plans are to be made available to port users, to ensure that vessels' needs are met promptly with no undue delay.

6.3.7 Legal Framework

Many acts and laws were established to regulate the activities and prevention of pollution in the coastal regions of India. The environment management cell of the proposed port must see the implications of these during the time of construction and operation of the berth. Some of the important ones are given below:

- Indian Ports Act, 1908
- Coast Guard Act, 1950
- Merchant Shipping Act, 1954
- Wildlife Protection Act, 1972
- Maritime Zone Act, 1974
- Water (Prevention and Control of Pollution) Act: 1974
- Forest Conservation Act, 1980
- The Environmental Protection Act, 1986
- Hazardous Waste Management Act, 1989
- Coastal Regulation Zone's (CRZ) Notification, 1991
- National Environmental Tribunal Act, 1995
- The National Environment Appellate Authority Act, 1997
- Biodiversity Act, 2002

Convention and policies to which India is a signatory

- United Nations Convention on the Law of Sea (UNCLOS)
- Ramsar Convention, 1971
- MARPOL 73/78
- Convention on Migratory Species, 1979
- Convention on Biological Diversity (CBD), 1992
- Basel Convention, 1992
- International Union for Conservation of Nature (IUCN)

6.3.8 Cost of Marine Environment Management Plan

The responsibility of MEMP action items lies with Jawaharlal Nehru Port Authority and their construction contractors. The cost could be a part of the construction contract rates and prices. The item-wise break-up of various activities of EMP is listed below. The list is not exhaustive; it gives a broad idea of the various

items for which funds need to be allocated in the cost estimate of an MEMP. The funds to be allocated for the various heads are given below:

Personnel ➢ Instrument/boat hiring ➢ Training	 Rs. 1.0 lakhs annually Rs. 2.0 lakhs annually
Marine Environmental Monitoring (Involvement of third-party monitoring) ➢ Water, sediment quality and marine biota ➢ Shoreline change monitoring ➢ Stakeholder's/community programmes for mangrove protection and biodiversity conservation	 Rs. 5.0 lakhs annually Rs. 10.0 lakhs annually Rs. 10.0 lakhs annually

6.3.9 Marine Environment Monitoring During Construction and Operational Phase

The monitoring plan during the construction and operational phases of the berth includes the parameters to be monitored, the number of sampling locations, sampling frequency, duration, implemental agency and guiding standards, as summarized in Table 6.2A.

6.3.9.1 Baseline studies

As a first important step towards the maintenance of the health of the marine ecology of the study area, critical locations are to be carefully selected around the project as monitoring sites for periodic health checks with respect to water quality, sediment quality and flora and fauna. The results presented in this report are adequate to identify the monitoring sites. The parameters to be monitored are listed below.

i) Water Quality:

Water samples near-surface and bottom for temperature, pH, SS, salinity, DO, BOD, dissolved phosphate, nitrate, nitrite, ammonia phenols and Petroleum hydrocarbons.

ii) Sediment Quality:

Sediment from sub-tidal and intertidal regions to be analysed for heavy metals, organic carbon, texture and petroleum hydrocarbons.

iii) Flora and Fauna:

Biological characteristics are to be assessed based on primary productivity, phytopigments, phytoplankton populations and their generic diversity, biomass, population and group diversity of zooplankton, biomass, population and group diversity of benthic organisms, fishery diversity and mangrove diversity & assessment.

iv) Survey along the coastline:

A survey is to be carried out to assess the shoreline changes around the project site to study the changes in shoreline geomorphology if any.

v) Assessment:

The results of each monitoring should be carefully evaluated to identify changes if any, beyond the natural variability identified through baseline studies. Gross deviation from the baseline may require a thorough review of operations at the berth to identify the causative factors leading to these deviations, and accordingly, corrective measures to reverse the trend will be necessary.

A comprehensive marine quality-monitoring program with periodic investigations at predetermined locations (8-10) by a competitive agency is a practical solution to ensure quality data acquisition. This can be a continuation of the study designed for baseline quality. The parameters listed in the baseline study are to be included in the post-project monitoring program. The results of each monitoring should be carefully evaluated to identify changes if any, beyond the natural variability identified through baseline studies.

Table 6.2A: Monitoring Framework

Sr No	Project activity/stage	Monitoring indicator	Frequency	Responsibility
1	Construction	Piling	Once - at time of detailed alignment survey and design	JNPA
		Noise during construction	Once – during construction machinery specification	JNPA and assigned contractor
		Oil spill containment and spill cleanup	Once – Built-in product specification	JNPA
		Sewage disposal system	Once – in tender specification	JNPA
		Fire prevention and fire protection equipment Monitoring	Once – in tender specification	JNPA
		Hazardous materials management plan	Once – in tender specification	JNPA
		Water quality monitoring	Seaonal	JNPA and assigned contractor
		Discharge from construction vessels	During the time of construction	JNPA
2	Operation and Maintenance	Effectiveness of Training programs and plan	Once in a year	JNPA

		Water, sediment and marine biota monitoring	Twice in a year	JNPA and assigned contractor
		Shoreline change monitoring	Once in a year	JNPA and assigned contractor

6.3.10 Disaster Management Plan (DMP)

Disaster is an unpleasant sudden event of such magnitude that may cause extensive damage to life or property due to natural calamities like an earthquake, floods, cyclones, landslides, lightning etc. The purpose of DMP is to give an approach to detailed organizational responsibilities, actions, reporting requirements and support resources available to ensure effective and timely management of emergencies.

6.3.10.1 Purpose of Disaster Management Plan

- Design contingency plan, taking into account the accident scenario and natural disasters.
- Safeguard personnel to prevent injuries or loss of life by protecting them from the hazard and evacuating from the site on short notice.
- Obtain early warning of emergency conditions so as to prevent impact on personnel, assets and environment.
- Ensure the safety of people, protect the environment and safeguard commercial considerations.
- Ensure immediate response to an emergency situation with an effective communication network and organized procedures.
- Provide guidance to help stakeholders to take appropriate action to prevent accidents and to mitigate adverse effects of accidents that do nevertheless occur.
- Minimize the overall impact of the event at the berth.

6.3.11 Disaster Management Cycle

The Disaster Management Cycle (DMC) has a significant role to play. The four stages of the disaster management cycle have their own importance in terms of their implementation during, after and before the occurrence of any disaster.

a) Mitigation

Mitigation activities actually eliminate or reduce the probability of disaster occurrence, or reduce the effects of unavoidable disasters. Mitigation measures include OSHA standards, SOPs, MARPOL regulations, building codes; vulnerability analyses updates; zoning and land use management; building use regulations and safety codes; preventive health care; and public education.

b) Preparedness

The goal of emergency preparedness programs is to achieve a satisfactory level of readiness to respond to any emergency situation through programs that strengthen the technical and managerial capacity of governments, organizations, and communities. These measures can be described as logistical readiness to deal with disasters and can be enhanced by having response mechanisms and procedures, rehearsals, developing long-term and short-term strategies, public education and building early warning systems. Preparedness can also take the form of ensuring that strategic reserves of food, equipment, water, medicines and other essentials are maintained in cases of national or local catastrophes.

c) Response

The aim of emergency response is to provide immediate assistance to maintain life, improve health and support the morale of the affected population. Such assistance may range from providing specific but limited aid, such as assisting refugees with transport, temporary shelter, and food, to establishing semi-permanent settlement in camps and other locations. It also may involve initial repairs to damaged infrastructure. The focus in the response phase is on meeting the basic needs of the people until more permanent and sustainable solutions can be found. Humanitarian organizations are often strongly present in this phase of the disaster management cycle.

d) Recovery

As the emergency is brought under control, the affected population is capable of undertaking a growing number of activities aimed at restoring their lives and the infrastructure that supports them. There is no distinct point at which immediate relief changes into recovery and then into long-term sustainable development. There will be many opportunities during the recovery period to enhance prevention and increase preparedness, thus reducing vulnerability. Ideally, there should be a smooth transition from recovery to on-going development.

6.3.12 Environmental Sustainability in ports

Due to the problems of climate change as well as the increasing requirements for the logistics and transportation industry, environmental sustainability has become one of the key cornerstones on the agenda of many maritime ports. The environmental impacts of ports are quite significant, especially due to the various sources and forms of port-related emissions, such as those from seagoing vessels, heavy-duty trucks, and cargo-handling equipment. Apart from that, the port community consists of various actors and stakeholders with different perspectives and interests in terms of environmental sustainability.

The term environmental sustainability describes a broad concept, it is important to first identify key areas in the context of maritime ports. There are six core areas that come in this category. First, environmental objectives, pursuing a green strategy, as well as performance indicators, measuring the success of management efforts, need to be defined. The green strategy takes stakeholder interests, public policies and regulations, and social responsibility into account. Given this foundation, various practices and instruments exist to achieve various environmental objectives. Continuous improvement can be obtained by auditing, measuring, and monitoring the progress as a feedback function on the one hand, and by facilitating an alignment between the strategy, projects, operations, and technology. Thereby, new technological developments and advancements in the port infrastructure, for instance, may create new opportunities for adapting port strategies, business models, and operations.

6.3.13 Environmental objectives

A clear definition of strategic objectives is required to determine a coherent green strategy in accordance with the overall port strategy, stakeholder interests, external regulations and policies, and social responsibility.

- **Landlord function**: This involves the management of port-related areas and activities in a way that negative environmental effects are mitigated. Environmental implications must be considered in port related decisions and actions, such as the selection and management of tenants, infrastructure and construction, master planning, dredging, and connectivity (e.g., hinterland transport).
- **Regulatory function:** This subsumes controlling, auditing, and policy functions to not only ensure safety and security within the port but also

environmental protection. The latter involves the regulation of environmental matters as well as implementation, monitoring, and sanctioning in case environmental requirements are not fulfilled.

- **Operator function:** This traditionally covers the provision of port services with respect to the physical transfer of goods and passengers between sea and land, the provision of technical-nautical services (pilotage, towage, and mooring) and a range of ancillary services. In this regard, the port needs to ensure that the environmental impact is minimized, such as by improving energy efficiency and conservation, as well as when selecting and managing subcontractors.
- **Community manager function:** A coordinating function for stakeholder management and for maintaining good relationships within the port community. Regarding this role, the port needs to facilitate environmental awareness, stimulate and ensure the adoption of green practices, coordinate environmental activities, and increase the visibility of the green efforts within the port and in public.

6.3.14 Environmental performance indicators

To measure, monitor, and report the performance and trends of environmental activities, resulting from the implementation of a green strategy, environmental performance indicators must be specified. Measuring and reporting those indicators serve as a feedback loop for port governance and management. A comprehensive set of indicators for maritime ports falls under the categories of environmental indicators specified in ISO 14031, the indicators are grouped as follows.

- **Management performance indicators (MPIs):** A set of indicators devoted to evaluating the efforts made by the port towards the implementation of an environmental management system (EMS) which is used to organize and manage environmental programs in the port. This involves, for example, indicators to assess the implementation of processes for auditing, monitoring, budgeting, training and awareness, communication, and emergency planning.
- **Operational performance indicators (OPIs):** Allow the assessment of port operations in terms of resource consumption, noise, waste management, and port development.
- **Environmental condition indicators (ECIs):** These indicators are used to measure and analyze the quality and state of environmental conditions, such

as with respect to the quality of air (e.g., regarding GHG emissions like CO_2, SO_x, NO_x), water, soil, and sediments. Indicators to show the status of specific flora and fauna species are also contained in this category.

6.3.15 Policies and Regulations

A port policy can be regarded as an essential governance instrument for implementing green objectives and regulating port activities of individual actors. As environmental policies and regulations may impose substantial costs, a balance between environmental quality and economic feasibility must be sought. The government is responsible for making public policies and regulations at the local, regional, national, and supranational level, whereas the national authorities are, in some cases, the local enforcement authority of international conventions, such as regarding IMO (International Maritime Organization) conventions. Group policy measures for establishing a “green transport corridor” according to related incentives.

- **Economic incentives:** To promote energy-efficient transport, better utilization of resources, and the use of advanced environmental technologies. Common examples include tax incentives, extended gate hours, pricing strategies such as port due discounts for eco-friendly ships, penalizing and restricting access to ports, and financial incentives for modal shifts.
- **Legal incentives:** Regulations that hinder unwanted intensive transport activities or reduce/ban polluting technologies in certain. areas (e.g., low-emission zones, emission control areas), e.g., to improve access for other port actors. Examples include the Clean Truck Program in US ports (e.g., Port of Los Angeles and Long Beach) and the application of specific access rules for trucks in the Port of Rotterdam (Netherlands), where only trucks with certain emission standards can enter.
- **Supporting incentives**: Involves investments and grants for promoting the adoption and development of eco-friendly infrastructure, procedures, and technologies. Examples are truck replacement programs to facilitate the use of clean energy engines. This may also include investments in infrastructure (e.g., equipment for cold ironing, clean bunkering, renewable energy) and information technology. An example is the Maritime Singapore Green Initiative (MSGI), which has provided huge grants within several programs for reducing the environmental impact of port-related activities.

- **Voluntary incentives**: By participating in voluntary programs, companies may benefit from better public perception and might get free access to technical innovations and best practices. Often, policy-makers use voluntary incentives to test potential policies, which may reduce the transition time for participants in case the policy is implemented.

6.3.16 General management practices

Ports have been early adopters of EMS as a systematic approach to manage and certify port operations. Considering well-defined standards and performance indicators, the overall goal is to enhance the environmental performance, fulfillment of compliance obligations, and achievement of environmental objectives (ISO 14001). Eco Ports has developed a basic EMS designed to facilitate the environmental certification and specifically adapted to the needs of maritime ports. It is built from elements of the ISO 14001 system, facilitates environmental certification, and can be implemented by applying the port environmental self-diagnosis method (SDM) and implementing the port environmental review system (PERS), allowing the port to apply for a certificate.

An environmental management information system (EMIS) further supports the management in obtaining, processing, and distributing relevant environmental information in response to internal and external requirements (e.g., regulations, policies, and stakeholder interests). Environmental risk analysis is another responsibility of ports to identify, assess, and prioritize risks associated with environmental duties and liabilities for environmental damage. As seen in Europe, a mutual collaboration between the port sector, research institutes, and specialist organizations fully supported by the ESPO, has paved the way for an improved concept of port environmental management. Moreover, an international working group, in collaboration with the International Association of Ports and Harbours (IAPH) and the World Association for Waterborne Transport Infrastructure (PIANC), is working on guidelines for sustainable reporting.

6.3.17 Infrastructure and Technologies

The improvement of port infrastructure and the use of innovative port technologies can lead to enormous energy savings and reduced emissions. This includes energy-efficient vehicle and handling technologies, such as battery-powered automated guided vehicles (AGVs) or electric rubber-tired gantries, as well as the development of an improved transport infrastructure using intelligent transportation

systems (ITSs) to mitigate traffic congestion and facilitate intermodal transportation. The environmental impacts of infrastructure projects, such as regarding dredging activities and techniques need to be considered.

6.3.18 Planning and Optimization

Besides adapting port governance and management practices and investing in innovative infrastructure and technologies, an enormous potential for making port operations more eco-efficient lies in the consideration of environmental aspects while planning and optimizing port operations and activities. This not only involves the internal activities of individual port actors, but also the coordination and collaboration among different actors along the logistics chains. Mitigating the environmental impact means explicitly considering ECIs in the planning and optimization phase. To reduce energy consumption and better utilize available resources, several concepts have been introduced in recent years regarding landside operations, for example, the implementation of gate/truck appointment systems. Moreover, slow steaming and the management of vessel arrivals for reducing the fuel consumption of seagoing vessels.

Decision-makers usually cannot only take environmental objectives into account; often, a good trade-off between economic and environmental goals needs to be found, leading to multi-criteria decision problems. Gaps in the theoretical deviation and implementation of multi objective decision support systems in maritime logistics, taking into account environmental sustainability, has to be identified for every ports for a greener and sustainable port operations.

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Table 1a: Microbial counts in surface water (CFU/mL) at Thane Creek during March 2022, October 2022 and January 2023

Month & Year	T1	T2	T3	T4	T5	T6	T7	T8	T9
TVC x 10^2									
March, 2022	330	190	150	140	180	200	70	200	60
October, 2022	31	80	30	60	82	110	37	170	64
January, 2023	28	69	23	53	73	97	28	153	59
TC									
March, 2022	100	80	120	120	60	80	NG	80	100
October, 2022	57	113	63	88	24	81	57	33	11
January, 2023	52	108	59	76	43	73	45	32	9
FC									
March, 2022	80	30	40	60	10	55	NG	47	60
October, 2022	40	53	30	40	13	67	40	28	7
January, 2023	38	47	25	33	12	56	38	19	3
ECLO									
March, 2022	60	30	20	20	06	27	NG	35	NG
October, 2022	25	67	18	37	8	25	30	16	5
January, 2023	22	50	16	27	6	19	24	14	3
SFLO									
March, 2022	NG	NG	NG	NG	NG	NG	NG	NG	NG
October, 2022	19	4	9	5	1	NG	16	3	1
January, 2023	17	9	6	3	NG	2	39	2	NG

TVC: Total Viable Counts, **TC**: Total Coliforms, **FC:** Faecal Coliforms, **ECLO:** *Escherichia coli* like organisms, **SFLO:** *Streptococcus faecalis* like organisms

Table 1b: Microbial counts in sediment (CFU/g) at Thane Creek during March 2022, October 2022 and January 2023

Month & Year	T1	T2	T3	T4	T5	T6	T7	T8	T9
TVC x 10^4									
March, 2022	250	20	60	110	100	30	70	90	25
October, 2022	43	11	15	12	11	35	31	30	12
January, 2023	35	9	13	10	10	25	28	19	8
TC									
March, 2022	210	30	10	NG	10	NG	NG	300	NG
October, 2022	103	40	92	68	32	72	57	81	30
January, 2023	90	39	81	59	28	68	50	72	18
FC									
March, 2022	100	08	NG	NG	08	NG	NG	80	NG
October, 2022	96	17	70	28	27	65	49	77	16
January, 2023	72	14	53	18	30	58	45	60	13
ECLO									
March, 2022	80	NG	NG	NG	NG	NG	NG	40	NG
October, 2022	10	16	12	3	23	5	28	24	7
January, 2023	7	14	11	2	19	2	25	20	5
SFLO									
March, 2022	NG	NG	NG	NG	NG	NG	NG	NG	NG
October, 2022	NG	NG	2	NG	NG	NG	88	1	NG
January, 2023	10	20	3	NG	NG	NG	5	2	NG

TVC: Total Viable Counts, **TC:** Total Coliforms, **FC:** Faecal Coliforms, **ECLO:** *Escherichia coli* like organisms, **SFLO:** *Streptococcus faecalis* like organisms

Table 2a: Phytoplankton diversity at Thane creek during March 2022

Genera name	T1	T2	T3	T4	T5	T6	T7	T8	T9
Diatoms									
Bacillaria	2.2	0.9				3.4			
Bellerochea					<0.1				
Biddulphia	1.9	6.3	7.0	13.2	<0.1	3.4	0.4	1.8	0.2
Cerataulina	58.5	26.2	17.1	8.6	0.5	0.3	0.2		
Chaetoceros	0.2	10.4	1.9	11.5	43.5	4.8	8.8	6.5	20.9
Corethron		<0.1							
Cylindrotheca	0.5		0.7		<0.1	1.4			
Dactyliosolen	0.3				<0.1				
Diploneis								0.9	
Ditylum		<0.1	1.2						
Eucampia								0.2	0.2
Guinardia	0.1	<0.1			0.1	1.6	0.2	1.0	1.7
Gyrosigma	0.3	0.3	0.5	1.0		9.6	1.3	0.4	0.2
Leptocylindrus	<0.1		0.5	<0.1	0.2				
Lithodesmium	<0.1		<0.1	<0.1		3.4		0.3	
Melosira		2.6							1.8
Navicula	0.7	1.8	1.9	0.4	<0.1	12.3	8.8	2.3	3.5
Nitzschia	1.9	6.9	5.1	3.3	<0.1	16.4	9.3	9.6	18.4
Oscillatoria	<0.1	<0.1		<0.1			0.3		
Pleurosigma	0.1	1.2	0.3	0.7	<0.1	2.7	1.3	1.1	0.2
Pseudo-nitzschia	0.7	0.3	1.6	0.7	<0.1	<0.1	4.6		
Rhizosolenia	1.5	0.4	2.3	4.0	0.3	1.6	4.8	2.5	5.4
Skeletonema	5.2	2.0	25.4	24.0	53.6	15.0	35.2	21.1	13.4
Surirella		<0.1							
Thalassionema			<0.1	0.1					
Thalassiosira	19.4	36.6	23.8	20.7	1.4	19.8	24.2	47.4	26.8
Trachyneis	<0.1	0.9	<0.1	0.3		3.4	0.3	2.5	0.7
Triceratium	<0.1					0.1		0.2	
Unknown 1	1.7	1.4	7.7	7.2					

Unknown 2	<0.1								
Dinoflagellates									
Alexandrium	0.5	<0.1	0.7	0.7	0.1		0.1	1.8	
Ceratium	2.7			<0.1	<0.1				
Gonyaulax					<0.1				
Gymnodinium	0.7	0.9	0.9	0.7	<0.1				
Gyrodinium	0.3	0.3	0.5	0.2	0.1	0.7		0.9	0.2
Katodinium					0.1				
Peridinium					<0.1				
Preperidinium		<0.1							
Prorocentrum	<0.1		0.3		<0.1				3.3
Protoperidinium	0.1		<0.1		<0.1				
Pyrodinium	0.1	0.3	0.2	2.0					3.3
Pyrophacus			0.3						
Torodinium					<0.1				
Cryptophytes									
Plagioselmis					<0.1				
Teleaulax					<0.1				
Chlorophytes									
Selenastrum				0.6					
Mougeotia	<0.1								

Table 2b: Phytoplankton diversity at Thane creek during October, 2022

Name of Genera	T1	T2	T3	T4	T5	T6	T7	T8	T9
Diatoms									
Actinoptychus					<0.1				
Amphiprora					<0.1				
Amphora		<0.1							
Asterionellopsis					<0.1		5.2		<0.1
Aulacoseira					<0.1		0.3		<0.1
Bacillaria	0.2								
Bacteriastrum								2.9	
Biddulphia				0.1		1.3			
Cerataulina	<0.1		<0.1		0.1		0.7		<0.1
Chaetoceros	0.9	<0.1	1.0	1.5	3.5		10.9	5.2	0.5
Coscinodiscus	<0.1		<0.1	0.2	<0.1				<0.1
Cyclotella	2.6	2.0	3.1	2.9	0.2	4.5	<0.1	5.2	0.4
Cylindrotheca	0.8	0.7	1.1	0.6	<0.1	1.8	2.6	1.2	<0.1
Dactyliosolen					<0.1				
Ditylum			<0.1						
Eucampia									
Hemiaulus					<0.1		5.2	2.3	
Lauderia		0.3	1.0		<0.1				
Leptocylindrus			0.3		<0.1		0.6		<0.1
Melosira	4.9		0.7						
Navicula	0.8	0.5	0.7	1.1	<0.1	6.7	5.2	8.7	<0.1
Nitzschia	2.4	1.1	2.1	1.8	0.7	5.8	14.8	17.9	0.3
Pinnularia	<0.1	<0.1	<0.1					0.6	
Planktoniella				0.2	<0.1				
Pleurosigma	0.2	0.2	0.1	0.2	<0.1	0.9	0.5		
Pseudo-nitzschia	0.1	1.1	0.1	2.1	0.1	0.9	3.9	8.1	<0.1
Pyrophacus	<0.1	<0.1	<0.1		<0.1			1.2	<0.1
Rhizosolenia	0.4	0.1	0.2	0.4	<0.1	2.7			<0.1
Skeletonema	56.2	46.0	71.7	76.9	82.9	22.8	21.2	11.0	92.2

Stephanodiscus	0.5		<0.1			0.9		1.7	
Surirella	<0.1								
Synedra				0.4	<0.1	0.9	0.2		<0.1
Thalassionema		0.4		0.1	<0.1	2.2	2.6	2.9	<0.1
Thalassiosira	16.3	39.9	12.1	8.8	11.9	16.1	21.9	19.1	6.3
Thalassiothrix		0.1	<0.1						
Tropidoneis					<0.1		0.9		
Dinoflagellates									
Akashiwo							0.1		
Alexandrium	0.5	1.3	0.7	1.6	<0.1	12.1	0.1	6.4	<0.1
Ceratium		0.6							
Cochlodinium									
Gonyaulax sp							<0.1		<0.1
Gymnodinium	0.1	1.4	0.5	0.6		6.3		3.5	<0.1
Gyrodinium						3.6	0.2		<0.1
Katodinium	0.1	0.4	0.2		<0.1			1.2	
Oxytoxum	0.1	0.1	<0.1	0.2	<0.1		1.9		<0.1
Prorocentrum		0.1					0.3		<0.1
Protoperidinium	<0.1								
Scrippsiella	0.2								
Chlorophytes									
Ankistrodesmus		0.3			<0.1				
Pyramimonas					<0.1				
Scenedesmus					<0.1				
Cryptophytes									
Plagioselmis	0.2	1.1	0.5	0.2	<0.1	10.7		1.2	<0.1
Cyanophytes									
Oscillatoria	8.8		1.6						
Sphaerocystis	1.6		1.3						
Spirullina		0.1							
Euglenoids									
Eutreptiella	<0.1	0.4							

Teleaulax	0.2	1.3	0.3		<0.1		0.6		
Silicoflagellates									
Dictyocha									
Chrysophytes									
Mallomonas					<0.1				<0.1
Unknown									
Unknown 1	0.6	<0.1							

Table 2c: Phytoplankton diversity at Thane creek during January, 2023

Name of Genera	T1	T2	T3	T4	T5	T6	T7	T8	T9
Diatoms									
Amphiprora				0.1	1.8		<0.1	<0.1	
Asterionellopsis	<0.1				3.5				
Asteromphalus				<0.1	0.5				
Aulacoseira	0.5	0.2	0.8	0.1					
Biddulphia		<0.1						0.3	
Cerataulina	1.0	<0.1	0.8			13.2	15.8	6.6	10.2
Chaetoceros	1.5	8.7	0.3	<0.1		11.5	10.4	4.1	0.2
Coscinodiscus		<0.1	<0.1		1.8		<0.1	<0.1	<0.1
Cyclotella	<0.1		0.4	0.5	3.6	<0.1		0.4	
Cylindrotheca	0.4	1.5	0.4	2.0		<0.1	0.6	0.7	
Ditylum	<0.1	<0.1					0.3	0.3	
Hemiaulus							<0.1		
Leptocylindrus							30.7	0.1	0.2
Navicula	0.6	0.4	0.6	2.5	1.8	2.0	1.7	1.7	1.2
Nitzschia	1.8	1.0	0.4	1.0	5.3	2.0	2.6	0.5	1.2
Pleurosigma	0.3	0.4	0.4	<0.1	1.8	<0.1	<0.1	<0.1	
Proboscia	<0.1								
Pseudo- nitzschia	65.5	76.5	64.0	62.2		33.7	6.7	45.2	26.2
Rhizosolenia		<0.1		<0.1		<0.1	0.3		
Skeletonema	25.9	9.9	28.7	27.6	69.4	23.0	13.8	31.3	60.0
Thalassionema						0.2		<0.1	
Thalassiosira	1.7	1.1	2.2	3.1	3.5	12.1	14.4	5.9	0.7
Thlassiothrix						<0.1			
Triceratium	<0.1	0.2	<0.1	<0.1			0.3	<0.1	
Dinoflagellates									
Alexandrium	<0.1				3.5	1.3	1.1	1.4	
Ceratium			0.4						
Chochlodinium	<0.1					<0.1		0.3	
Gonyaulax	<0.1		<0.1				<0.1		

Gymnodinium				<0.1	3.5		0.6	0.3	
Gyrodinium	0.3	0.1	0.4	0.5			0.6	0.3	
Protoperidinium							<0.1		
Scrippsiella	<0.1					0.7	<0.1	<0.1	
Cyanophyceae									
Oscillatoria	<0.1								

Table 3a: Zooplankton groups identified from Thane creek during March 2022

Faunal groups	T1	T2	T3	T4	T5	T6	T7	T8	T9
Foraminiferans	-	-	-	<0.1		-	-	-	-
Siphonophores	-	0.1	-	<0.1		-	0.3	-	-
Medusae	0.3	0	13.7	<0.1		11.7	<0.1	0.2	1.0
Ctenophores	-	0.9	<0.1	<0.1		-	<0.1	-	-
Chaetognaths	0.3	-	-	0.24		0.1	0.4	0.2	1.6
Polychaetes	-	<0.1	-	<0.1		<0.1	<0.1	-	0.7
Copepods	84.5	94.9	72.7	98.0		82.5	96.8	92.9	74.7
Amphipods	0.1	0.1	0.1	<0.1		-	<0.1	0.3	6.1
Mysids	-	-	-	-		-	-	-	2.6
Lucifer sp.	0.4	1.2	10.9	0.2	NC*	0.2	0.2	-	-
Decapod larvae	8.8	2.6	1.5	1.1		4.5	1.5	2.4	9.9
Stomatopods	0.2	-	0.1	-		0.1	0.2	-	-
Gastropods	0.2	0.2	0.4	0.2		0.3	0.5	0.3	-
Lamellibranchs	4.3	0.1	0.4	<0.1		0.5	<0.1	0.1	-
Fish Eggs	0.5	-	-	<0.1		0.2	0.1	3.5	1.9
Fish Larvae	-	-	-	<0.1		-	<0.1	0.1	1.2
Isopods	0.1	-	<0.1	<0.1		<0.1	<0.1	-	-
Marine Insects	-	-	-	<0.1		-	-	-	-
Pycnogonids	0.1	<0.1	0.1	<0.1		<0.1	<0.1	<0.1	0.2

***NC-No collection**

Table 3b: Zooplankton groups identified from Thane creek during October 2022

Faunal groups	T1	T2	T3	T4	T5	T6	T7	T8	T9
Foraminiferans	<0.1	-	-	-	-	<0.1	<0.1	<0.1	<0.1
Siphonophores	-	-	-	-	<0.1	-	<0.1	<0.1	-
Medusae	<0.1	0.2	0.1	0.6	0.1	0.2	0.4	0.3	<0.1
Ctenophores	<0.1	0.2	<0.1	0.6	0.9	<0.1	0.4	0.3	-
Chaetognaths	<0.1	0.2	0.4	0.2	2.3	<0.1	<0.1	0.2	0.7
Polychaetes	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	1.3	<0.1
Cladocerans	-	<0.1	<0.1	<0.1	<0.1	<0.1	0.6	1.6	<0.1
Ostracods	0.1	0.2	0.2	0.1	-	<0.1	-	0.2	-
Copepods	99.2	97.6	97.6	92.7	32.9	98.3	92.2	78.4	91.7
Amphipods	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Mysids	<0.1	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Lucifer sp.	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	0.2	<0.1
Decapod larvae	0.3	1.2	1.2	3.5	7.3	0.7	1.6	7.7	1.6
Stomatopods	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1
Gastropods	<0.1	0.1	0.2	1.01	0.2	0.2	0.4	2.2	<0.1
Lamellibranchs	<0.1	0.1	0.1	0.4	1.5	<0.1	1.3	6.7	0.7
Appendicularians	<0.1	<0.1	<0.1	-	0.1	<0.1	<0.1	<0.1	0.8
Doliolids	-	-	-	-	-	-	-	-	-
Fish Eggs	0.2	0.1	0.1	0.5	54.4	0.4	3.0	0.6	4.3
Fish Larvae	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	0.1	<0.1
Isopods	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-
Marine Insects	<0.1	-	-	<0.1	-	<0.1	<0.1	-	-
Others	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	-	-

Table 3c: Zooplankton groups identified from Thane creek during January 2023

Faunal groups	T1	T2	T3	T4	T5	T6	T7	T8	T9
Siphonophores	-	<0.1	<0.1	-	<0.1	-	-	-	-
Medusae	2.1	<0.1	0.5	0.1	0.2	<0.1	0.21	0.1	<0.1
Ctenophores	<0.1	0.1	0.7	0.6	1.4	0.1	0.2	0.5	0.1
Chaetognaths	0.7	6.02	0.7	18.9	1.3	6.3	2.9	7.4	5.2
Polychaetes	<0.1	<0.1	-	-	-	<0.1	<0.1	<0.1	<0.1
Cladocerans	-	-	-	-	-	-	-	-	-
Ostracods	-	<0.1	-	-	<0.1	-	-	-	-
Copepods	95.3	69.2	96.0	73.2	93.8	76.8	54.3	85.8	77.9
Cumaceans	-	-	-	-	-	-	-	-	-
Amphipods	-	<0.1	<0.1	<0.1	<0.1	-	-	<0.1	<0.1
Mysids	-	-	0.4	<0.1	<0.1	-	-	-	-
Lucifer sp.	<0.1	-	0.8	<0.1	0.5	-	-	<0.1	-
Decapod larvae	1.8	19.7	0.3	3.7	1.4	12.6	<0.1	3.2	5.9
Stomatopods	-	<0.1	<0.1	-	<0.1	-	13.05	<0.1	<0.1
Pteropods	-	<0.1	-	-	-	-	-	-	-
Cephalopods	-	-	<0.1	-	-	-	-	-	-
Gastropods	<0.1	2.01	<0.1	0.9	0.1	1.4	-	0.7	0.1
Lamellibranchs	<0.1	2.7	<0.1	1.03	0.1	1.4	8.4	0.9	10.1
Appendicularians	<0.1	0.1	-	<0.1	-	-	11.1	-	<0.1
Doliolids	-	-	-	-	-	-	0.2	-	-
Salpids	-	-	0.1	-	-	-	-	-	-
Fish Eggs	<0.1	<0.1	0.3	1.4	0.7	1.2	-	1.2	0.6
Fish Larvae	-	<0.1	0.1	<0.1	0.3	0.1	9.6	<0.1	<0.1
Isopods	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-
Acetes sp.	-	-	-	-	-	-	<0.1	-	-
Others	-	-	<0.1	-	<0.1	-	-	-	-

Table 4a: Composition (%) of Subtidal macrobenthos at Thane creek during March 2022

Faunal Groups	Station								
	T1	T2	T3	T4	T5	T6	T7	T8	T9
Phylum Cnidaria									
Anthozoans				2.7					
Hydrozoans								31.6	
Phylum Sipuncula									
Sipunculids									7.1
Phylum Mollusca									
Pelecypods				2.7					
Phylum Platyhelminthes									
Turbellarians	2.0								
Phylum Annelida									
Polychaetes	98.0	100	100	79.9	100	51.4	100	68.4	59.5
Phylum Arthropoda									
Amphipods				8.8					29.8
Brachyurans						16.2			
Penaeids						16.2			3.6
Phylum Echinodermata									
Ophiuroids				5.9		16.2			

Table 4b: Composition (%) of Subtidal macrobenthos at Thane creek during October 2022

Faunal Groups	Station								
	T1	T2	T3	T4	T5	T6	T7	T8	T9
Phylum Sipuncula									
Sipunculids	2.5			3.1					
Phylum Nemertea									
Nemerteans									2.4
Phylum Mollusca									
Pelecypods	14.8	7.1	19	39.1		6.7	6.9	12.5	7.3
Gastropods					12.5				
Phylum Annelida									
Polychaetes	76.5	85.7	30.2	54.7	75	60	89.7	82.5	87.8
Oligochaetes						26.7			
Phylum Arthropoda									
Amphipods	1.2			3.1				5	
Isopods	1.2								
Mysids							3.4		
Harpacticoids	3.7	7.1	50.8		12.5	6.7			2.4

Table 4c: Composition (%) of Subtidal macrobenthos at Thane creek during January 2023

Faunal Groups	Station								
	T1	T2	T3	T4	T5	T6*	T7*	T8	T9
Phylum Nematode									
Nematode									1.4
Phylum Phoronida									
Phoronida	2.9	2.2		20	28.6				
Phylum Mollusca									
Pelecypods		3.3							
Phylum Annelida									
Polychaetes	88.6	67.4	88.9	70	57.1			66.7	78.4
Oligochaetes		1.1			14.3				10.8
Phylum Sipuncula									
Sipuncula	8.6		11.1	10				33.3	6.8
Phylum Arthropoda									
Crustacean Larva		15.2							
Amphipoda		6.5							
Isopoda		3.3							1.4
Stomatopod		1.1							
Cumacea									1.4

***NIL**

JAWAHARLAL NEHRU PORT AUTHORITY

Administration Building, Nava-Sheva,
Sheva, Navi Mumbai 400707

TRAFFIC MANAGEMENT AND TRAFFIC DECONGESTION PLAN

FOR

WIDENING OF EXISTING CONTAINER BERTH AT JAWAHARLAL NEHRU PORT, NAVI MUMBAI, MAHARASHTRA (CARGO HANDLING CAPACITY= 22.1 MTPA

Traffic Study

October 2023

CONSULTANTS
M/S QMAX TECHNO CONSULTANT PVT. LTD.
Navi Mumbai 400614

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Chapter-1:- Traffic Management and Traffic Decongestion Plan

1.1 Introduction

Jawaharlal Nehru Port, formerly known as Nhava Sheva port, is the largest container port in India. East of Mumbai harbour, in the state of Maharashtra, JNPT handles the majority of India's containerized trade, and is the focal point of long-haul calls to and from the emerging developed market economy.

JN Port is the biggest container handling port in India, handling around 55% of the country's containerized cargo, crossing the historic landmark of 4 million TEUs (Twenty-foot equivalent units) in container throughput consecutively for the last five years. In its coveted role as the Hub Port on the West Coast of India, JNP is ranked 28th among the top 100 Container Ports in the world.

M/s Qmax Techno Consultant Pvt. Ltd., Navi Mumbai have been awarded the task for traffic assessment in and around JNPA Area for "**Traffic Management and Traffic Decongestion Plan for Widening of Existing Container Berth at Jawaharlal Nehru Port, Navi Mumbai, Maharashtra (CARGO HANDLING CAPACITY= 22.1 MTPA)"**.

Current chapter deals with the assessment of the cumulative impact of all development and increased inhabitation being carried out or proposed to be carried out by the project or other agencies in the core area, in a 05 kms radius from the site.

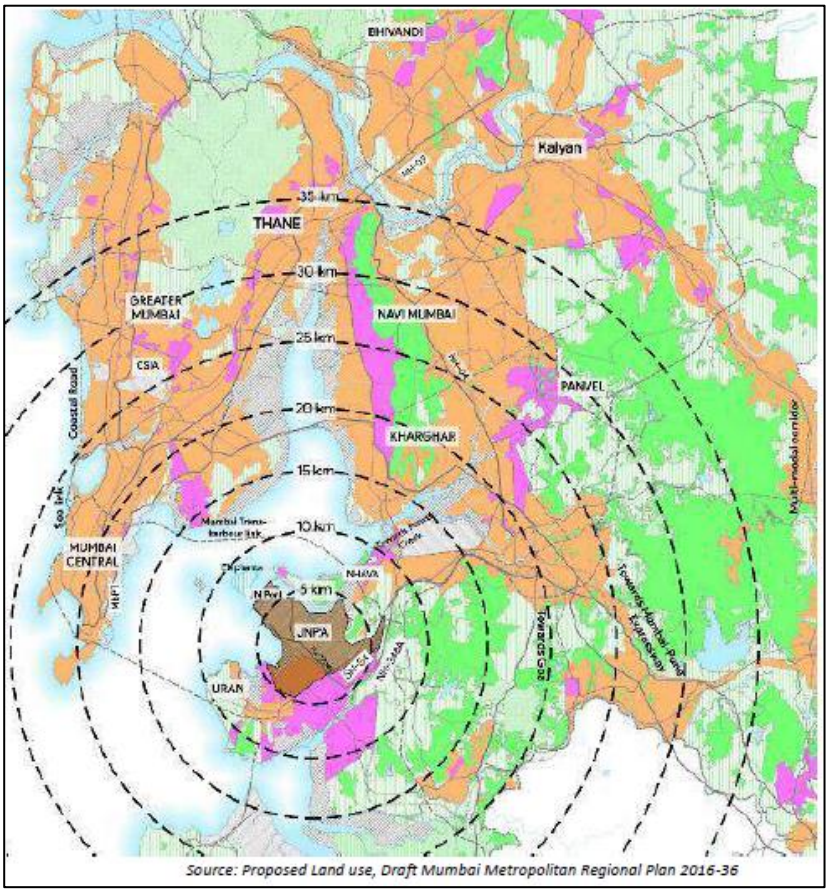


Fig. -1 -Map Showing Regional Connectivity with Respect to JNPA Area

05 Kms Study Area Map

Fig. -2 -Satellite Image of the Project site & 5km area

1.2 Purpose of the Traffic Impact Study

As the proposed project activity is mostly related with the transportation of containers by suitable vehicles up to the project site, it has been envisaged that a detail traffic impact study will be carried out for seeing and estimating the traffic volume by the proposed project traffic on surrounding adjacent roads and its intersections. To study the possible traffic impacts on it and to suggest and implement mitigative measures for reducing the estimated traffic impacts by the proposed project activity on surrounding adjacent roads and its intersections.

Today, JNPA is a fully mechanized port that uses the latest technology in handling cargo at the terminals. JNPA is one of the pioneers in running its day-to-day operations with the help of Information Technology (IT), including Electronic Data Interchange (EDI) and Vessel Traffic Management System (VTMS).

1.3 Scope of the Traffic Impact Study

We are intended to do "Traffic Analysis" for the said project explaining Traffic Management System for proposed development of JNPA Berth.

Traffic study covers the daily estimated traffic of port including commercial and passenger by considering the port activities.

The Traffic Impact Study is included the following:

a. The Entry and Exit points of the Proposed Development to the adjacent road network.

b. Topographic details of the roads and intersections with the actual geometry and number of lanes on the ground with dimensions.

c. Present Traffic Volume on all the external roads surrounding the proposed Development.

d. Present Capacities of the adjacent roads and intersections based on width of the road, number

of traffic lanes available etc.

e. Calculation of V/C (Volume Over Capacity Ratios) at present on adjacent roads and intersections and levels of services as per IRC.

f. Traffic Volume generated from the Proposed Development based on Residential/ Commercial/ Industrial/ Transport Terminals/ Other uses number of occupants, vehicles, parking and other factors etc. including any other assumptions made.

g. Growth rate assumed for Traffic Projections and basis for the same such as Govt. Documents etc.

h. Projections of Traffic Volumes for 5-10-15 year period on the adjacent roads and intersections.

i. Future Capacities of the adjacent roads and intersections based on proposed widening etc.

j. Calculation of V/C (Volume Over Capacity Ratios) for 5-10-15 years period and levels of services as per IRC norms.

k. Tabulation and diagrammatic representation of the above including Traffic Flow Diagrams and graphic representations.

l. Mitigation measures proposed for Traffic Management and containment of V/C Ratios below 1 and levels of service not below C in future after development.

m. Traffic Signs, Signals and Markings on the adjacent road network and intersections proposed.

n. Detailed Parking Layout Plan for trucks and container lorries including Driveway widths, turning radius etc. for easy manoeuvring.

o. Cross sections of the driveways at various locations with clearances on both sides for services etc.

p. Parking Layout Plan for all Floors in all internal developments showing slope and width of the ramps if any. Ramps for Heavy Vehicles to be designed with gentler slopes, extra width and increased radius for safety and easy manoeuvring.

q. Parking Area Statement showing the number of cars and other vehicles required as per DCR and actually provided. Area Per Car calculations as per MOEF to be submitted for all levels.

The term **'Traffic Management'** represents the process of adjusting or adapting the use of an existing road system to meet specified objectives without resorting to substantial new road construction.

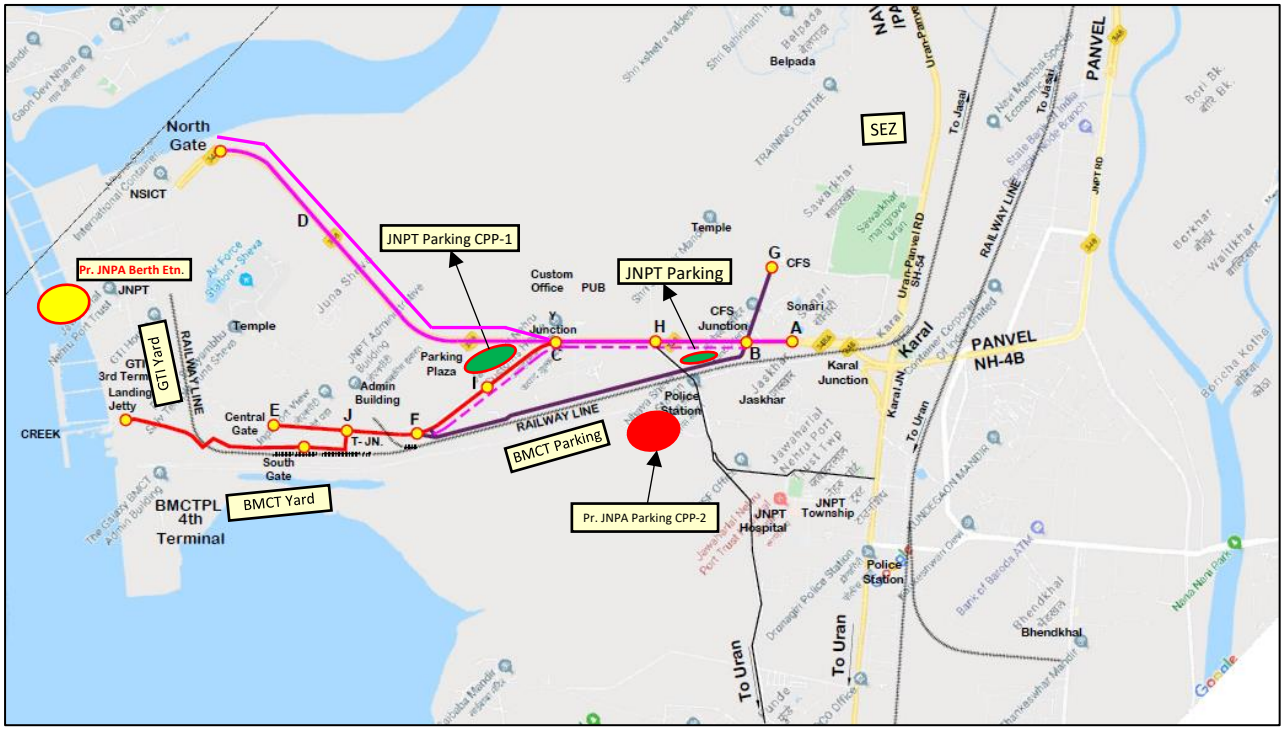


Fig.-3-Proposed Road Network around the Site

1.4 Traffic Study :-

The traffic data at JNPA of Container Traffic movement in TEU's for different Port users which are mentioned below:

- **NSICT** - Nhava Sheva International Container Terminal Pvt Ltd or NSICT, India's first private container terminal at a Central government-run port. It is one of the two container terminals run by the Dubai government-owned DP World Ltd at Jawaharlal Nehru Port Trust (JNPT), India's biggest container gateway. According to mutual understanding the terms of the NSICT contract, the royalty was set at 47 per twenty-foot equivalent unit (TEU) for the first year of operation and for the 30th year (last year) of operation in 2027, it is fixed at 5,610 per TEU. In 2022-23, NSICT handled 1.10 million TEUs.

- **GTIPL** - GTIPL being authorized dealer for supplying CNC Machining Services, Mechanical Engineering Services,. They are reckoned as one of the most coveted suppliers, trader, exporters and service providers of CNC Machining Services, Mechanical Engineering Services. It is a proprietorship company which is a leading supplier. Counted as one of the top suppliers, they are involved in offering a wide range of CNC Machining Services, Mechanical Engineering Services,. These CNC Machining Services, Mechanical Engineering Services, products are widely recommended by clients owing to its quality and consistent performance. Their CNC Machining Services, Mechanical Engineering Services, are widely appreciated in suppliers

market and offering CNC Machining Services, Mechanical Engineering Services, which is in great demand to the clients.

For handling above business GTIPL has to import products from offshore countries and also export their products via shipment at JNPT port. Expected growth in business is shown below in the statement.

- **NSIGT** - Global trade enabler DP World operated Nhava Sheva (India) Gateway Terminal (NSIGT) has once again reinforced its position as the leading container terminal in India, setting a new benchmark for the industry. NSIGT recently hosted the container vessel with the deepest draft to call at India's premier container gateway, Jawaharlal Nehru Port (JNPT), post the dredging project. "DP World has always aimed at being a pioneer in the industry, seeking to introduce new services and facilities as part of commitment to customers. It is with great pride that company bring newly opened Nhava Sheva (India) Gateway Terminal at JNPT, the largest vessel to ever call at the port. NSIGT is the only terminal at JN Port to have the requisite state-of-the-art facilities to receive such modern vessels." Future projection of traffic to be handled in next 5 years is given in statement shown below.

- **BMCTPL** - Bharat Mumbai Container Terminals Pvt. Ltd (BMCTPL—a subsidiary of PSA International of Singapore)—has been completed as per schedule and a provisional completion certificate has been issued to BMCTPL. BMCTPL was awarded the prestigious project of 'Development of Fourth Container Terminal' (FCT) on Design, Build, Fund, Operate and Transfer (DBFOT) basis in line with JNPT's initiative of modernization and capacity addition programme in May 2014.

  The facilities offered by BMCT include:

  - A 1,000-m long quay with 5 approach trestles
  - A huge storage facility comprising 9,336 ground slots with rail/road connectivity
  - State-of-the-art container handling equipment - 12 quay cranes, 4 RMGCs and 36 RTGCs
  - 324 reefer container ground slots that include 1,620 reefer plugs.
  - 4 railway lines. BMCT's rail facilities will be the largest terminal rail infrastructure in India. The on-dock Dedicated Freight Corridor (DFC)-compliant facility in JNPT-BMCT is capable of handling 1.5 km long, 360-TEU container trains on completion of the DFC.

Fig.-4-Map Showing JN Port Terminals

1.4.1 Following are the brief details of traffic handled by JNPA till August 2023.

Operating Performance Profile

Total Traffic

JN Port handled 83.86 million tonnes of total cargo during the financial year 2022-23, increase of 10.35% as compared to previous year. The containerized cargo was 76.19 million tonnes (90.86%), liquid cargo was 6.30 million tonnes (7.52%) & remaining 1.37 million tonnes (1.63%) was miscellaneous cargo of Dry Bulk (Cement) & Break Bulk.

The break-up of cargo handled at JN Port is as under:

Table 1- Cargo Handled at JN Port

Total Traffic	In million tonnes	
	2021-22	2022-23
Discharge	39.9	45.79
Loading	34.84	36.6
Transhipment	1.26	1.47

Total Traffic	In million tonnes	
	2021-22	2022-23
Total	76	83.86

Container Traffic

JN Port handled 6.05 million TEUs of container traffic during the financial year 2022-23, increase of 6.44 % from the previous annual container handling of 5.68 million TEUs during the year 2021-22. Of the total traffic of 6.05 million TEUs, the share of the Port operated JNPCT was 0.21 million TEUs (03.40%), the share of NSFT was 0.05 million TEUs (0.82%), the share of NSICT was 1.10 million TEUs (18.13%), 1.14 million TEUs (18.79%) were contributed by M/s. Nhava Sheva (India) Gateway Terminal Pvt. Ltd. (NSIGT) , 1.85 million TEUs (30.52%) were contributed by M/s. APM Terminals (APMT) and remaining 1.71 million TEUs (28.33%) were handled by PSA's Terminal Bharat Mumbai Container Terminal Pvt. Ltd. The container handled at JNPA constitute about 53.00% of total container traffic handled by all Major Ports (11.391 million TEUs).

The break-up of container traffic handled at JN Port is given below-

Table-2 – Container Traffic Handled at JN Port

Container Traffic	**In TEUs**										
	2021-22					**2022-23**					
	JNPCT	**NSICT**	**APMT**	**GTI**	**BMCT**	**JNPCT**	**NSFT**	**NSICT**	**APMT**	**GTI**	**BMCT**
Containers Unload	2,40,762	4,50,507	9,22,920	5,69,183	6,31,662	1,11,888	28,682	5,24,907	9,25,651	5,64,473	8,89,972
Container Load	1,95,225	4,59,535	9,10,806	6,05,619	6,01,412	89,251	19,545	5,32,823	8,86,522	5,63,449	7,86,514
Conatiners Transhipment	4,223	37,845	31,861	11,379	11,620	4,928	1,464	39,224	34,747	9,112	37,760
Total of Terminal	**440,210**	**947,887**	**1,865,587**	**1,186,181**	**1,244,694**	**2,06,067**	**49,691**	**18,46,920**	**10,96,954**	**11,37,034**	**17,14,246**
JN Port Total	**56,84,559**					**60,50,912**					

Bulk Traffic

The total Bulk cargo handled during the year 2022-23 was 7.67 million Tonnes as against 6.90 million tonnes handled in the previous year. The increase in Bulk Traffic is 11.07% over previous year. Commodity wise Bulk Cargo Traffic is given below:

The break-up of Import-Export of bulk cargo is given below:

Table-3 – Import-Export of bulk cargo at JN Port

Commodity	In tonnes		
	2021-22	2022-23	% Variation over previous year
Liquid Bulk	5,983,209	6,302,356	5.33
Cement and Other Dry Bulk Cargo	807,421	1,360,245	68.47
Break Bulk	112,868	5,211	-95.38
Total Bulk	**6,903,497**	**7,667,811**	**11.07**

Bulk Traffic	In Million Tonnes	
	2021-22	2022-23
Discharge	5.75	6.39
Loading	1.16	1.27
Transhipment	-	-
Total	**6.9**	**7.67**

Vessels Handled

During the year 2022-23, a total of 3,273 cargo handling vessels sailed from JN Port as against 2,837 vessels in the previous year. The year witnessed 15.40% increase in total sailed vessels. The break-up is given below:

Table-4 –Cargo Handled at JN Port

Types of Vessel*		In Nos.	
		2021-22	2022-23
Container	JNPCT	220	102
	NSFT	--	35
	NSICT	522	675
	APMT	575	536
	GTI	306	329
BMCT		480	758
DRY BULK (CEMENT)		52	78
BREAK BULK		66	31
LIQUID		616	728
Total		**2,837**	**3,273**

Container movement by Rail

This year witnessed rail share of 18.37% as compared to 19.06% in previous year. Even though the rail share has decreased in current year, the rail traffic has increased by 6.37% as compared to previous year.

ICD Traffic - JN PORT

A total of 1,022,951 TEUs were handled through 6,504 rakes during the year 2022-23 as against 1,008,079 TEUs handled through 6,278 rakes in the previous year, showing an increase in rail traffic by 1.48%. The break-up is as under:-

Table-5 – ICD Traffic Handled at JN Port

ICD Traffic (In TEUs)	2021-22	2022-23	% Variation over previous year
Import	502,764	519,164	3.26
Export	504,390	507,318	0.59
Total	1,007,154	1,026,482	1.92
NO. of Rakes	**6,278**	**6,504**	**3.6**

General

Cargo handled at JNPA's Anchorage

No traffic handled at JNPA Anchorage during FY 2022-23.

Average Parcel Size:

The average parcel size of container vessels reduced from 2,703 TEUs to 2,485 TEUs.

Table-6 –Average Parcel size at JN Port

Types of Vessel*		Average Parcel Size	
		2021-22	2022-23
Container	JNPCT-MCB	24,504 Tonnes 2,001 TEUs	24,610 Tonnes 2,019 TEUs
	NSFT	--	18,340 Tonnes 1,420 TEUs
	NSICT	22,616 Tonnes 1,816 TEUs	21,457 Tonnes 1,625 TEUs
	APMT	40,922 Tonnes 3,244 TEUs	42,728 Tonnes 3,446 TEUs
	NSIGT (GTI)	44,308 Tonnes 3,876 TEUs	42,600 Tonnes 3,456 TEUs
BMCT		30,849 Tonnes 2,593 TEUs	28,545 Tonnes 2,262 TEUs

Types of Vessel*		Average Parcel Size	
		2021-22	2022-23
DRY BULK (CEMENT)		15,527 Tonnes	17,439 Tonnes
BREAK BULK		1710 Tonnes	92 Tonnes
LIQUID	At Berth	9,713 Tonnes	8,645 Tonnes
Overall		**26,787 Tonnes**	**25,614 Tonnes**
		2,703 TEUs	**2,485 TEUs**

Output Per Ship Berth Day:

The average Output Per Ship Berth Day reduced from 28,938 tons to 27,643 tons.

Table-7 – Output /Ship Berth day at JN Port

Types of Vessel*		Output per ship berth day	
		2021-22	2022-23
Container	JNPCT-MCB	19,638 Tonnes	17,565 Tonnes
		1,597 TEUs	1,445 TEUs
	NSFT	--	15,445 Tonnes
			1100 TEUs
	NSICT	30,914 Tonnes	30,709 Tonnes
		2,482 TEUs	2,326 TEUs
	APMT	41,757 Tonnes	41,964 Tonnes
		3,311 TEUs	3,384 TEUs
	NSIGT(GTI)	45,433 Tonnes	47,822 Tonnes
		3,975 TEUs	3,880 TEUs
BMCT		39,727 Tonnes	32,400 Tonnes
		3,342 TEUs	2,865 TEUs
DRY BULK (CEMENT)		6,390 Tonnes	6,651 Tonnes
BREAK BULK		1082 Tonnes	215 Tonnes
LIQUID	At Berth	7,009 Tonnes	5,899 Tonnes
Overall		28,938 Tonnes	27,643 Tonnes
		3,033 TEUs	2,882 TEUs

1.4.2 JNPA - Traffic Dept. Performance Report for the month of Aug-2023 & FY 2023-24

The total traffic handled at JNPA during the month of Aug-2023 is 7.34 million tonnes, which is 14.75% higher as against 6.39 million tonnes in Aug-2022. This month's traffic includes 6.64 million tonnes of container traffic and 0.69 million tonnes of Bulk Cargo as against 5.81 million tonnes of container traffic and 0.59 million tonnes of bulk traffic in the corresponding month of last year respectively.

In terms of container traffic, 555,275 TEUs were handled at JNPA during the month of Aug-2023, which is 11.60% higher as against 497,568 TEUs handled in Aug-2022. Out of this, 192,298 TEUs at BMCT (+39.14%), 100,787 TEUs at NSICT (15.96%), 108,533 TEUs at APMT (-28.98%), 100,226 TEUs at NSIGT (+7.03%), 52,869 TEUs at NSFT and 562 TEUs at NSDT were handled. (%age shown in bracket above is variation over same month in previous year). Nhava Sheva Freeport Terminal (NSFT) and Nhava Sheva Distribution Terminal (NSDT) have started operations from 14th Feb-2023 & 26th May 2023 respectively.

The total traffic handled at JNPA during the period from April-2023 to Aug-2023, is 35.25 million tonnes, which is 4.58% higher as against 33.70 million tonnes during corresponding period in previous financial year. This includes 32.09 million tonnes of container traffic and 3.16 million tonnes of Bulk Cargo as against 30.58 million tonnes of container traffic and 3.13 million tonnes of bulk traffic in the corresponding period of last year respectively.

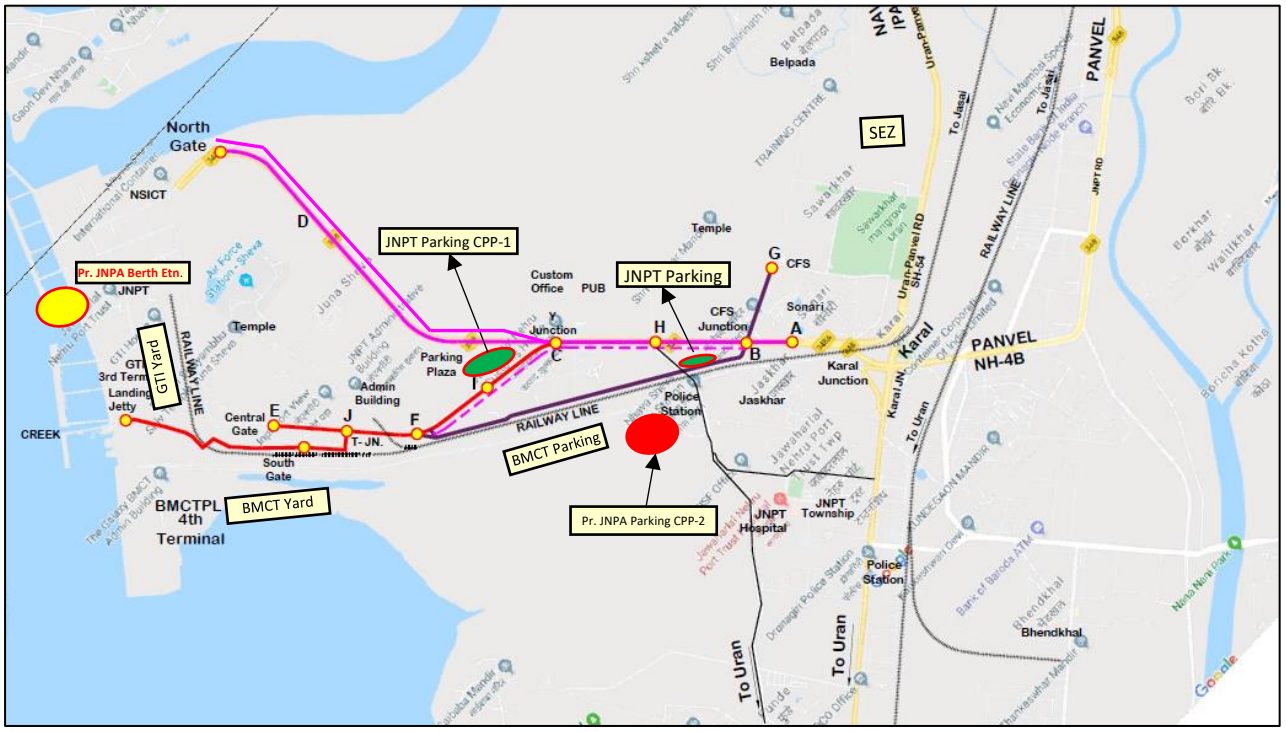


Fig.-5-Road Network around the Site

In terms of container traffic, 2,599,834 TEUs were handled at JNPA during the Apr-2023 to Aug-2023 which is 4.88% higher as against 2,478,898 TEUs handled during corresponding period in previous financial year. Out of this, 904,195 TEUs were handled at BMCT (+39.51%), 494,264 TEUs at NSICT (+19.58%), 521,367 TEUs at APMT (-34.01%), 456,825 TEUs at NSIGT (-7.45%), 225,621 TEUs at NSFT and 562 TEUs at NSDT. (%age shown in bracket above is variation over same period in previous year).

During Aug-2023, JNPA handled 550 container rakes and 89,284 TEUs as compared to 550 rakes and 84,316 TEUs in Aug-2022.

During April-2023 to Aug-2023, JNPA handled 2,591 container rakes and 414,173 TEUs as compared to 2,664 rakes and 429,216 TEUs during corresponding period in the previous financial year.

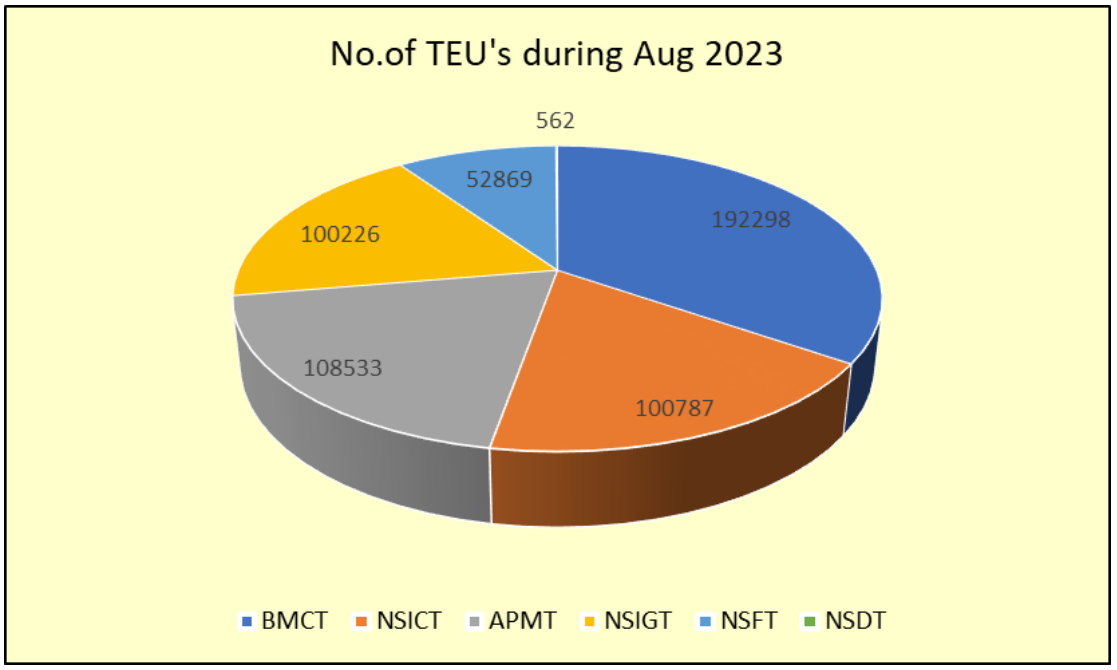


Figure-6 - TEU's Handled by different Departments during Aug 2023.

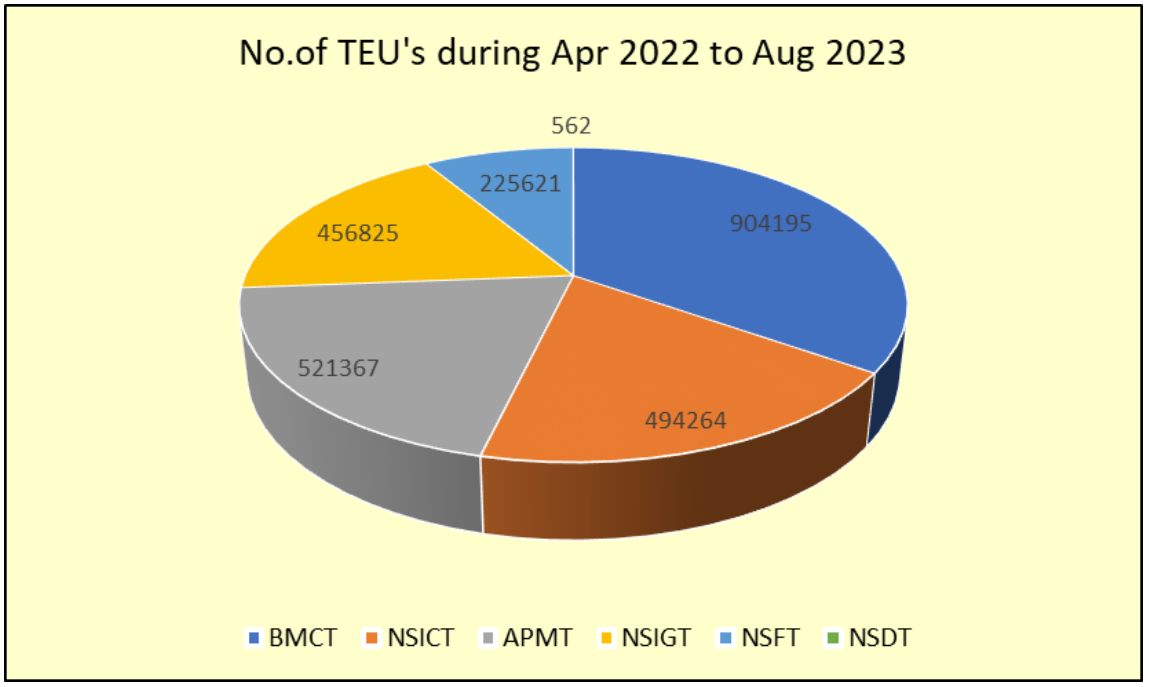


Figure -7-TEU's Handled by different Departments during Apr 2022 to Aug 2023

1.4.3 Highlights of Aug 2023:

1. JNPA handled 7.34 Million Tonnes of total cargo & 555,275 TEUs of containers in Aug-2023 which is higher by 14.75% & 11.60% respectively as compared to traffic in Aug-2022.

2. JNPA handled a total 555,275 TUEs in the month of Aug-2023 which is the highest in a month since inception.

3. BMCT handled 192,298 TUEs in the month of Aug-2023 which is the highest in a month by any terminal at JNPA since inception.

1.4.4 Highlights of FY 2023-2024:

1. JNPA handled 35.25 million Tonnes of total cargo & 2,599,834 TEUs of containers from Apr-2023 to Aug-2023 which is higher by 4.58% & 4.88% respectively as compared to corresponding period in previous financial year.

Considering the large amount of traffic moving to and fro from JNPA, proper planning of traffic movement along with sufficient parking space needs to be provided. Following Key plan shows route followed by container to reach their destinations.

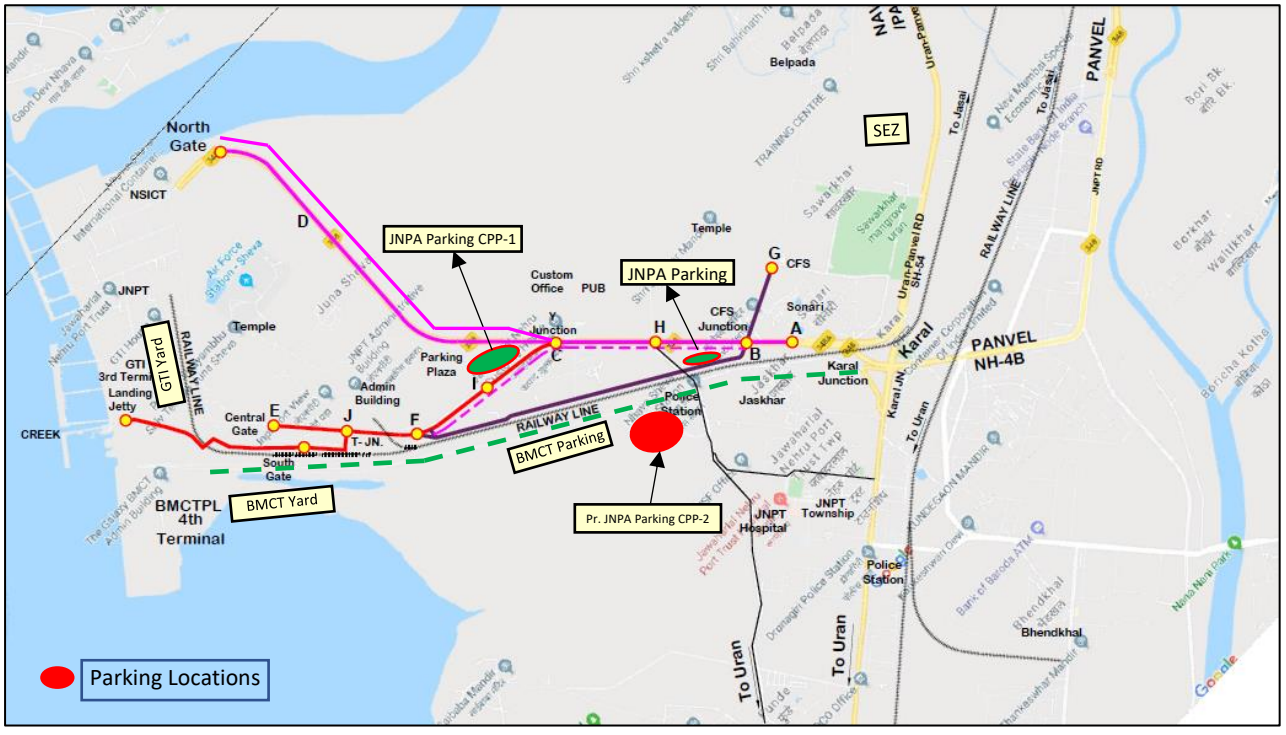


Figure -8-Key Plan showing Parking Locations within 5 Kms of radius from site

During the month of Aug 2023 out of total container traffic of 5,55,275 TEU's, 1,92,298 TEU's is handled by BMCT. To reach BMCT from Karal junction traffic follows the new route shown

in green dotted line instead of going through Y junction as before, thereby decreasing the traffic volume on road between point A to Y junction. Parking Plaza is provided for traffic going towards BMCT 4th Terminal.

Traffic density along Karal Junction to CFS junction is around 61600 PCU and traffic density along the route towards BMCT 4th Terminal is around 23100 PCU.

Internal roads in JNPA area are planned taking into considerations the present volume of traffic along with the future projection. Roads connecting different important locations in JNPA are widened to accommodate increasing traffic. Major roads like CFS to central gate and Y-junction to North Gate are widened to accommodate increasing traffic as tabulated below. Necessary parking space is provided at different locations to avoid congestion on road.

1.4.5 Traffic composition, Lane Requirement & Capacity of Existing road.

Traffic composition at Karel junction is as given below.

Table 8: Average Daily Traffic at Karel Junction going towards JNPT

Type of Vehicle	ADT	%	PCU	%
2 Wheeler	3385	13.89%	1694	2.19%
3 Wheeler	881	3.61%	662	0.86%
Car / Jeep / Van/Taxi	3583	14.70%	3583	4.63%
Bus (Govt.)	23	0.09%	69	0.09%
Bus (Pvt.)	262	1.07%	786	1.02%
LCV/ Tempo	592	2.43%	890	1.15%
Truck/Lorry (2 Axle)	444	1.82%	1332	1.72%
Truck/Lorry (3 Axle)	917	3.76%	4127	5.34%
Truck/Lorry (Multi-Axle)	14258	58.49%	64161	82.97%
Tractors without Trailier	1	0.004%	2	0.003%

Type of Vehicle	ADT	%	PCU	%
Tractor with trailier	0	0.00%	0	0.00%
Cycle	14	0.06%	8	0.01%
Cycle Rickshaw	0	0.00%	0	0.00%
Bullock cart	0	0.00%	0	0.00%
Horse Drawn	0	0.00%	0	0.00%
Others	18	0.07%	18	0.02%
Total	**24378**	**100.00%**	**77332**	**100.00%**

Assuming 30% of Traffic will be divert towards BMCTL after functioning of Karel Interchange & balance traffic of **around 53,900 PCU** will be using the internal roads going towards Terminals other than BMCTL (4th Terminal). Accordingly, the Level of Service for different roads during the coming period is summarized below in table form.

1.4.6 Vehicular Impact on Surrounding Roads, its adjacent & intersection roads

The Term Traffic Impact on Road is a ratio Volume of Traffic on it and its Capacity. The Volume will be existing Traffic Load and Future Traffic including Proposed Development & traffic growth as per the current vehicular traffic on surrounding roads of the proposed port & its adjacent and intersections roads.

The Ratio is also termed as V/C Ratio (Volume to Capacity) which will explain the Road condition or a impact on road. There is a standard stipulated by Indian Road Congress (IRC) of India which helps us to work out the Vehicular Impact. IRC 106-1990 pg. No. 7 & 8 and page no 11 helps us to define the Impact. Classification of Level of Service based on Volume to Capacity Ratio is tabulated in below **Table below**

Table -9 : Classification of Level of Service based on Volume to Capacity Ratio

Level of Service (LOS)	Volume to Capacity Ratio (V/C)	Level of Comfort	Nature of flow
A	<0.30	Highest	Free Flow
B	0.30–0.50		Reasonably free
C	0.50–0.70		Stable flow
D	0.70–0.90	Threshold	Approaching
E	1.00		Unstable flow

F	>1.00	Lowest	Forced flow

Existing vehicular traffic on surrounding roads and its adjacent and intersections for present period i.e.; Year 2018-19, after 5 years i.e.; Year 2023-24, after 10 years i.e.; 2028-29 and after 15 years i.e.; 2033-34 is estimated and given in respective Tables. Its graphical representation with traffic flow diagram is also presented below the respective Tables. Total 6 roads are considered for carrying out Traffic Impact Study for the proposed port as mentioned above. Combine traffic impact including estimated traffic on the respective road along with estimated traffic of the proposed port for the present period as well as for the period after 5, 10 and 15 years period. Its graphical representation with traffic flow diagram is also presented below the respective Tables. Based on the estimated traffic impact study, level of service with respect to Volume to Capacity ratio is calculated and presented in below Tables for the respective period.

Accordingly, the Level of Service for different roads during the coming period is summarized below in table form

Table – 10- Level of Service (LOS) with Current traffic and Lane configuration of different roads

Sr. No.	Particulars of Road	Pr. Type of Pavement	Present Carriage way	PCU on each Road	PCU on each Road in Peak Hours (Assuming 10%)	Capacities of Roads in PCUs Per Peak Hours as per Indo-HCM	V/C Ratio	LOS
1	Karal Jn. to CFS Jn.	Rigid	4L on RHS + (4 + 4 Flyover) + 4L on LHS	53900	5390	8+8 Lanes divided - 14400	0.374	B
2	CFS Jn. to CFS	Rigid	4+4L	5390	539	8 Lanes divided - 7200	0.075	A
3	CFS Jn. to Y junction	Rigid	4+4+4L	43120	4312	8 +4 Lanes divided - 9600	0.449	B
4	Y Junction to North Gate	Rigid	4+4L	20698	2070	8 Lanes divided - 7200	0.288	A
5	Y Junction to North Gate	Flexible	2+2 Lane	5174	517	4 Lanes divided - 5400	0.096	A
6	Y Junction to Central Gate (upto T-Jn.)	Rigid	4+4L	17248	1725	8 Lanes divided - 7200	0.240	A
7	T-Jn. to Central Gate	Rigid	2+2L	7762	776	4 Lanes divided - 5400	0.144	A
8	T-Jn. to South Gate	Rigid	2+2L	7762	776	4 Lanes divided - 5400	0.144	A
9	Tank farm road	Rigid	2+2Lane	5390	539	4 Lanes divided - 5400	0.100	A
10	T-Jn to Landing Jetty	Rigid	2 Lane	1725	173	2 Lanes divided - 2400	0.072	A

Table – 11- Level of Service (LOS) for traffic after 5 years and Lane configuration of different roads.

Sr. No.	Particulars of Road	Pr. Type of Pavement	Present Carriage way	PCU on each Road	PCU on each Road in Peak Hours	Capacities of Roads in PCUs Per Peak Hours as per Indo-HCM	V/C Ratio	LOS
1	Karal Jn. to CFS Jn.	Rigid	4L on RHS + (4 + 4 Flyover) + 4L on LHS	68792	6879	8+8 Lanes divided - 14400	0.478	B
2	CFS Jn. to CFS	Rigid	4+4L	6879	688	8 Lanes divided - 7200	0.096	A
3	CFS Jn. to Y junction	Rigid	4+4+4L	55034	5503	8 +4 Lanes divided - 9600	0.573	C
4	Y Junction to North Gate	Rigid	4+4L	26416	2642	8 Lanes divided - 7200	0.367	A
5	Y Junction to North Gate	Flexible	2+2 Lane	6604	660	4 Lanes divided - 5400	0.122	A
6	Y Junction to Central Gate (upto T-Jn.)	Rigid	4+4L	22014	2201	8 Lanes divided - 7200	0.306	A
7	T-Jn. to Central Gate	Rigid	2+2L	9906	991	4 Lanes divided - 5400	0.184	A
8	T-Jn. to South Gate	Rigid	2+2L	9906	991	4 Lanes divided - 5400	0.184	A
9	Tank farm road	Rigid	2+2Lane	6879	688	4 Lanes divided - 5400	0.127	A
10	T-Jn to Landing Jetty	Rigid	2 Lane	2201	220	2 Lanes divided - 2400	0.092	A

Table -12 -Level of Service (LOS) for traffic after 10 years traffic and Lane configuration of different roads

Sr. No.	Particulars of Road	Pr. Type of Pavement	Present Carriage way	PCU on each Road	PCU on each Road in Peak Hours	Capacities of Roads in PCUs Per Peak Hours as per Indo-HCM	V/C Ratio	LOS
1	Karal Jn. to CFS Jn.	Rigid	4L on RHS + (4 + 4 Flyover) + 4L on LHS	87798	8780	8+8 Lanes divided - 14400	0.610	C
2	CFS Jn. to CFS	Rigid	4+4L	8780	878	8 Lanes divided - 7200	0.122	A
3	CFS Jn. to Y junction	Rigid	4+4+4L	70238	7024	8 +4 Lanes divided - 9600	0.732	D
4	Y Junction to North Gate	Rigid	4+4L	33714	3371	8 Lanes divided - 7200	0.468	B
5	Y Junction to North Gate	Flexible	2+2 Lane	8429	843	4 Lanes divided - 5400	0.156	A
6	Y Junction to Central Gate (upto T-Jn.)	Rigid	4+4L	28095	2810	8 Lanes divided - 7200	0.390	B
7	T-Jn. to Central Gate	Rigid	2+2L	12643	1264	4 Lanes divided - 5400	0.234	A
8	T-Jn. to South Gate	Rigid	2+2L	12643	1264	4 Lanes divided - 5400	0.234	A
9	Tank farm road	Rigid	2+2Lane	8780	878	4 Lanes divided - 5400	0.163	A
10	T-Jn to Landing Jetty	Rigid	2 Lane	2810	281	2 Lanes divided - 2400	0.117	A

Table – 13- Level of Service (LOS) for traffic after 15 years traffic and Lane configuration of different roads

Sr. No.	Particulars of Road	Pr. Type of Pavement	Present Carriage way	PCU on each Road	PCU on each Road in Peak Hours	Capacities of Roads in PCUs Per Peak Hours as per Indo-HCM	V/C Ratio	LOS
1	Karal Jn. to CFS Jn.	Rigid	4L on RHS + (4 + 4 Flyover) + 4L on LHS	112054	11205	8+8 Lanes divided - 14400	0.778	D
2	CFS Jn. to CFS	Rigid	4+4L	11205	1121	8 Lanes divided - 7200	0.156	A
3	CFS Jn. to Y junction	Rigid	4+4+4L	89643	8964	8 +4 Lanes divided - 9600	0.934	E
4	Y Junction to North Gate	Rigid	4+4L	43029	4303	8 Lanes divided - 7200	0.598	C
5	Y Junction to North Gate	Flexible	2+2 Lane	10757	1076	4 Lanes divided - 5400	0.199	A
6	Y Junction to Central Gate (upto T-Jn.)	Rigid	4+4L	35857	3586	8 Lanes divided - 7200	0.498	B
7	T-Jn. to Central Gate	Rigid	2+2L	16136	1614	4 Lanes divided - 5400	0.299	A
8	T-Jn. to South Gate	Rigid	2+2L	16136	1614	4 Lanes divided - 5400	0.299	A
9	Tank farm road	Rigid	2+2Lane	11205	1121	4 Lanes divided - 5400	0.208	A
10	T-Jn to Landing Jetty	Rigid	2 Lane	3586	359	2 Lanes divided - 2400	0.150	A

1.4.7 - Road Cross Section & Widths in JNPA Area :-

Following are the typical cross sections of internal roads in JNPA

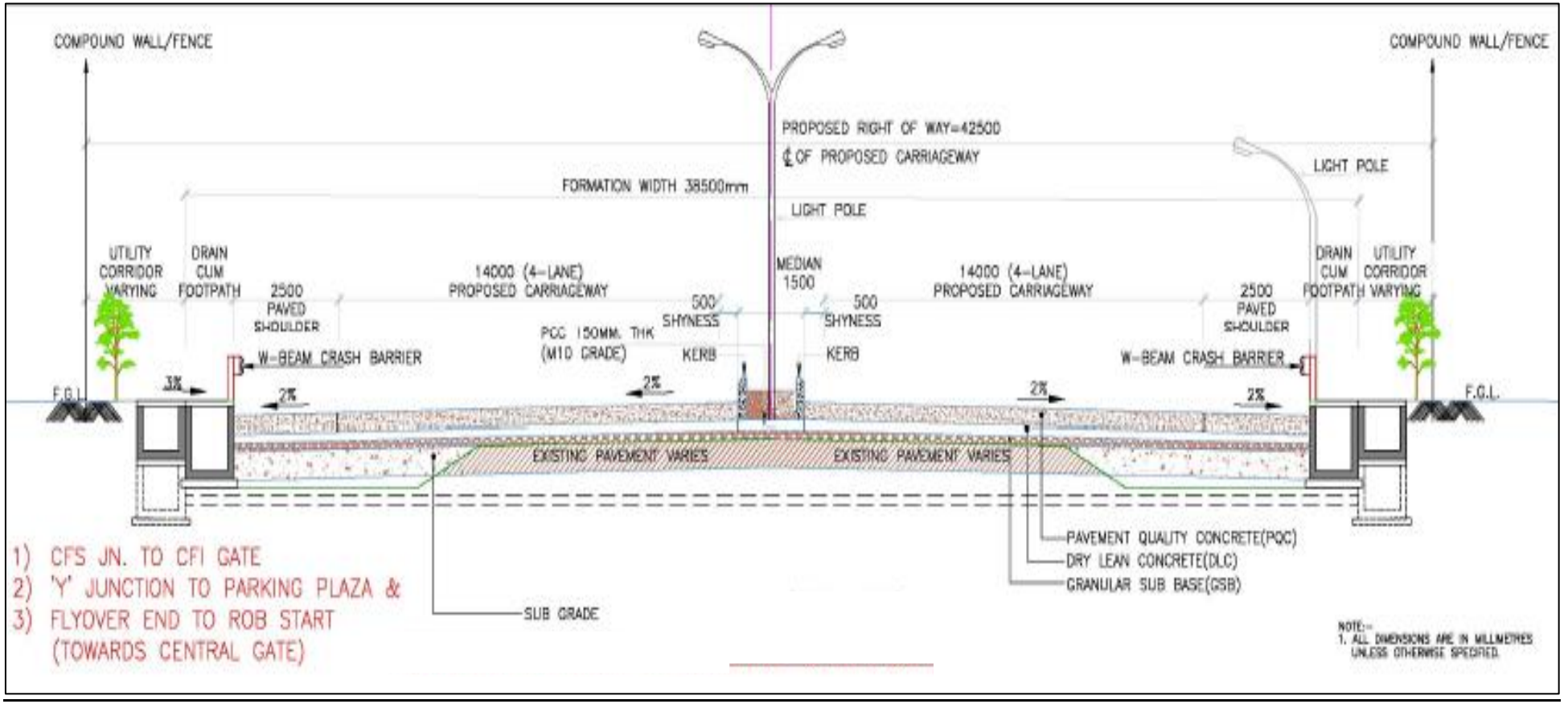


Figure -9 -showing Typical cross section of Road in around JNPA

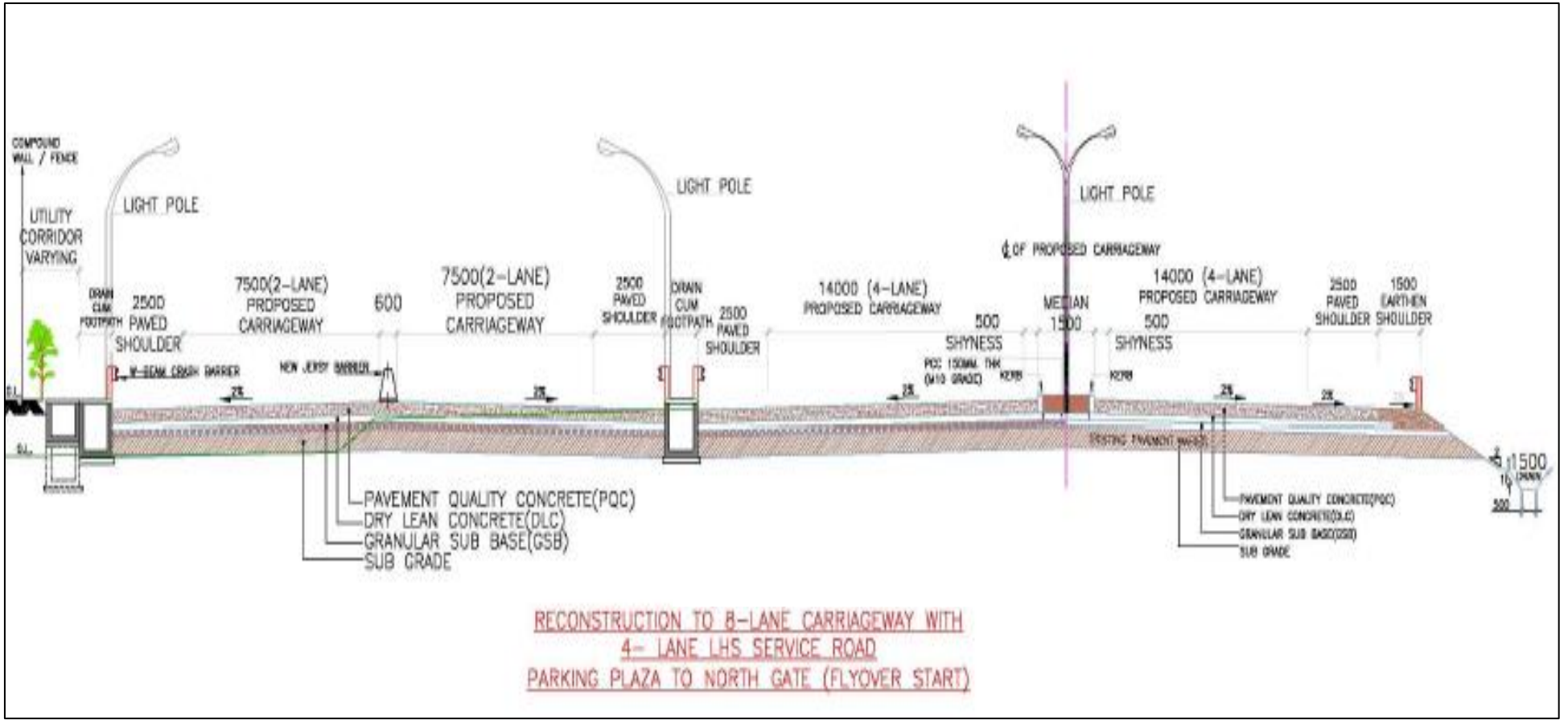


Figure-10- showing Typical cross section of Road in around JNPA

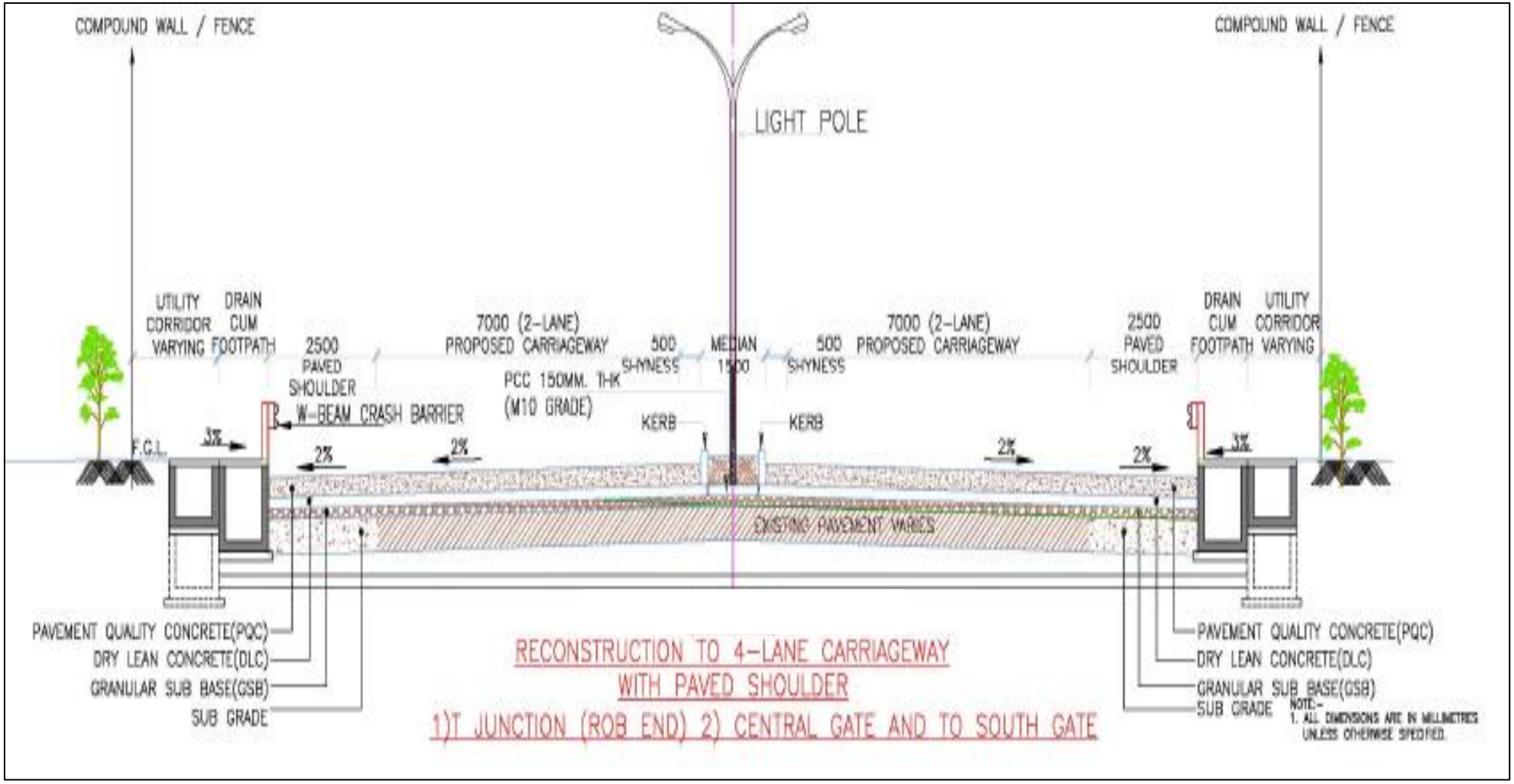


Figure-11- showing Typical cross section of Road in around JNPA

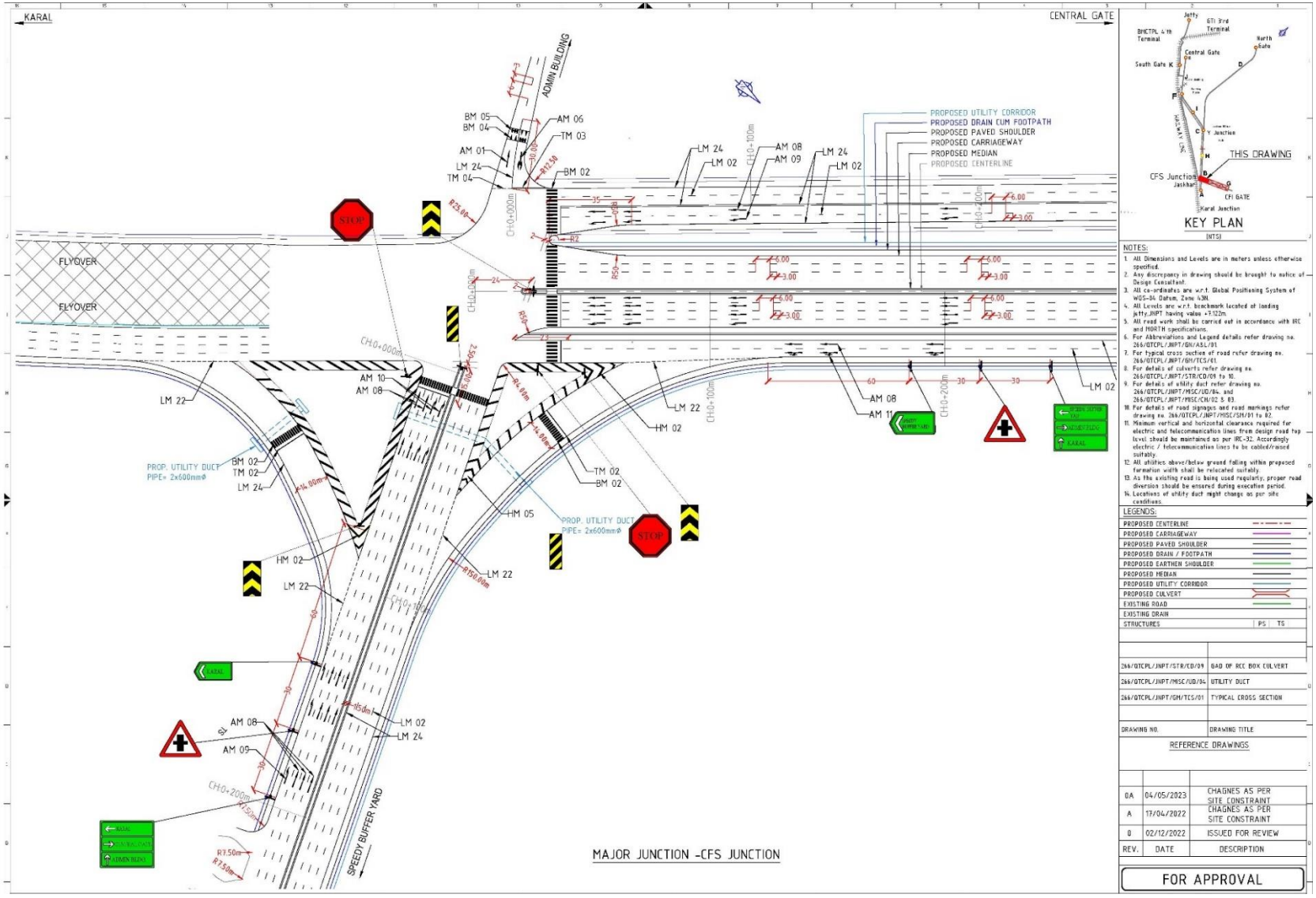


Fig-12 - CFS Junction

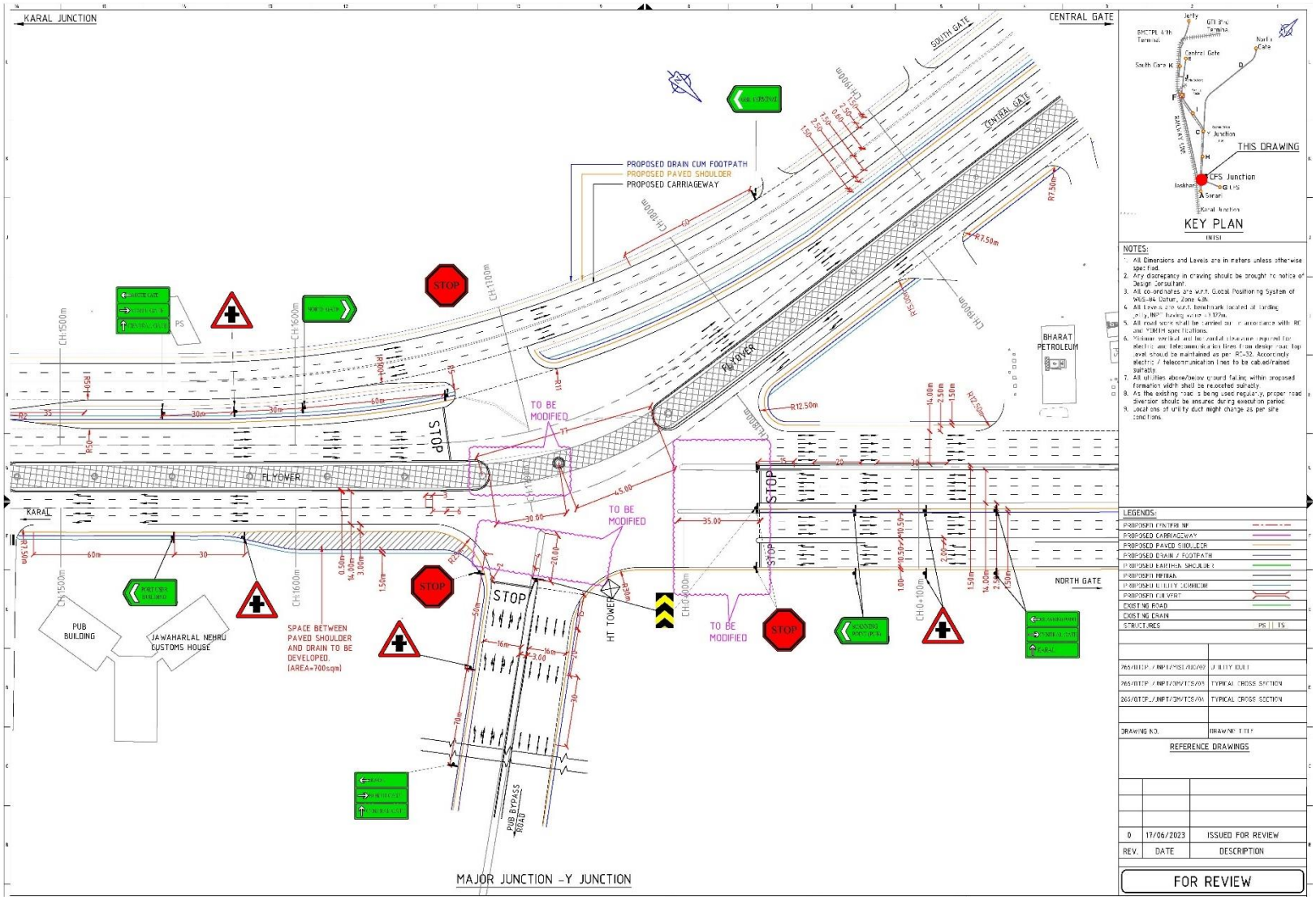


Fig-13- Y- Junction

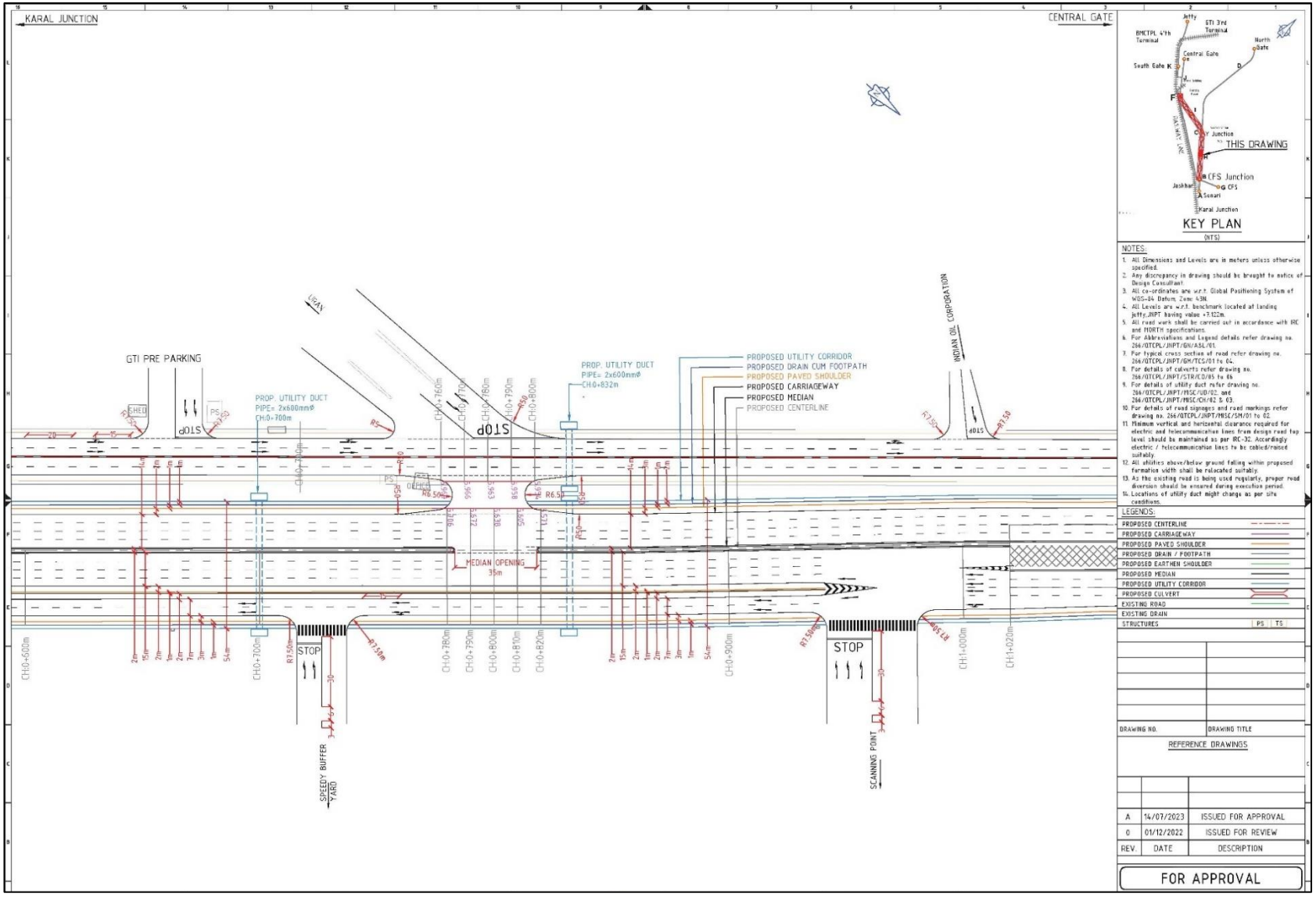


Fig-14-Junction at ROB

1.5 Proposed Road Network Development in surrounding areas of the Project Site:

Mumbai–Trans Harbour Link road (also known as MTHL) is an under construction, 22km, 8 lane Creek Bridge connecting the South Mumbai to Navi Mumbai.

Fig-15-Route of MTHL Link

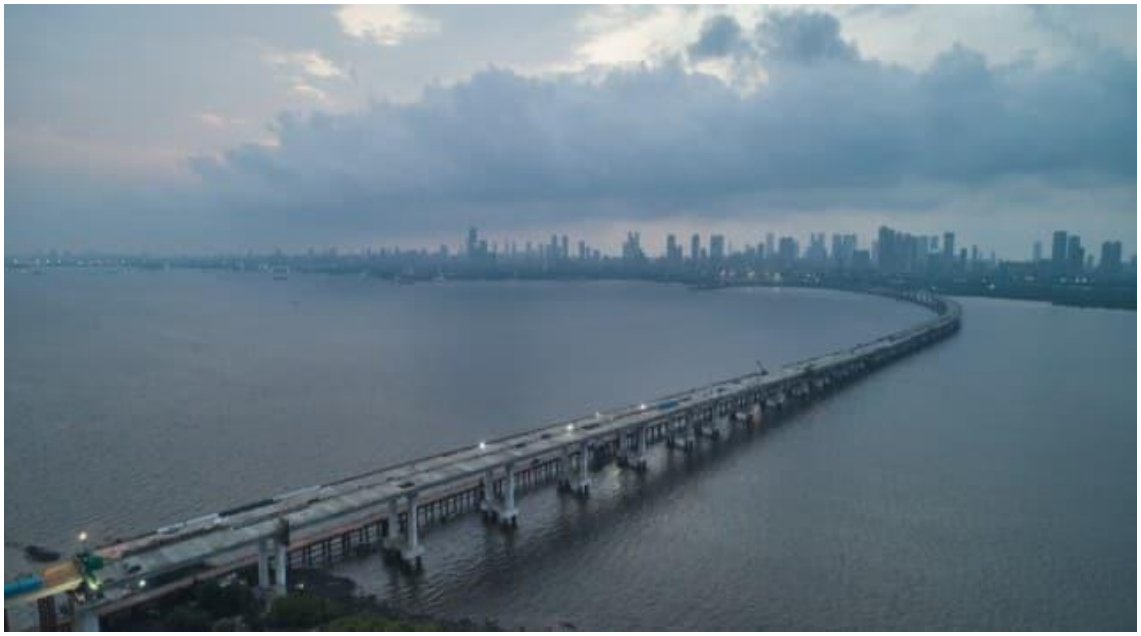


Fig-16-MTHL Link road Under Construction

1.6 Traffic Management Policy and Measures -

As mentioned above, the existing traffic congestion is caused by inadequate road usage due to a poor traffic management. An appropriate systematic traffic management system is essential for safety and smooth traffic flows on roads, making a maximum usage of road facilities to enlarge the current road capacities.

a) To achieve smooth traffic flow
b) To reduce traffic accidents, and
c) To create pedestrian –friendly facilities

Some measures should be implemented in short term period and the others are needed in medium and long term period. These countermeasures can be summarized as follows;

1) Short Term Measure

a) Improvement of bottleneck intersections
b) Improvement at U-turn and right-turn points
c) Improvement of traffic signals
d) Improvement of parking system
e) Improvement of traffic safety facilities
f) Traffic safety campaign and education
g) Improvement of traffic operation
h) Strengthening traffic enforcement
i) Coordination between agencies

2) Medium and Long Term Measures

a) Traffic information system
b) Vehicle location information system
c) Electronic demand management system
d) Traffic demand management system

1.7 Internal Mitigations & Traffic Management Plan

The improvements to maintain the required level of service can be implemented by adopting traffic management measures for efficient traffic operations. Traffic Management Plan (TMP) indicates traffic routes and the measures for traffic regulation.

It indicates the roads for use of certain classes of traffic, the location of traffic control i.e. signage, Zebra Crossings and markings and the directions in which traffic should move. These are necessary for safe and efficient movement of vehicles and pedestrians.

- The internal roads are undivided to maintain flexibility of traffic lanes. Minimum 20 m wide

Roadway width has been provided for the movement of vehicles. Recommended design Speed on the internal road is 15 kmph and on the turns is 10 kmph. Speed tables will be provided near the entrance/exit point to control traffic and regulate speed of vehicles, pedestrians crossing the road.

- Additionally, the following shall be required to maintain traffic flow at required level of service. Road Markings and Signages: Proper road markings (edge, median, arrows, turning, Kerb) and signages (direction, turning, speed, and pedestrian crossings) will be installed and maintained on all roads in the vicinity of project premises.
- Thermoplastic Paints for Lane Marking, Road Directions etc.
- On-street parking will be prohibited on all external and internal streets.
- Yellow Strip Marking on Internal Roads indicating **NO PARKING** on these roads. Preferably no U-Turn on roadway.
- Apart from internal signage – it will be requested to provide necessary signage and traffic control measures, on neighboring roads, such as Speed limit, Left hand curve, pedestrian crossing etc.
- Pedestrian Crossing Table will be provided and Marked along with Signages
- Convex Mirrors will be provided at Blind Turns, T Junctions.
- Traffic Wardens will be appointed at each Exit of Each Sector, to control on Entry Exit on Public Road
- Parking Tags will be provided for car parking, commercial vehicle parking separately and Staff Vehicles and visitors also.
- Security check for Vehicles will be inside the premises to avoid queuing on Public Roads.

Following mitigation measures will be followed at the proposed port for smooth movement of the vehicular traffic:

Table- 14-Mitigation Measures for Smooth Movement

Sr. N.	Problem will be arisen	Issues	Mitigation Measures
1	Traffic Congestion at Signalized Intersection	• Engineering improvement of traffic signal control system and intersection • Engineering improvement of intersection • Traffic enforcement	• Improvement of traffic signal control system ➢ Traffic response system on near/over saturated condition ➢ Synchronized system of traffic signal • Improvement at intersections ➢ Road marking and signs ➢ Geometric improvement of intersections • Traffic Enforcement for vehicles and crossing pedestrian
2	Traffic Conflict between Vehicles and	• Appropriate Pedestrian Safety Education Program	• Improvement of Traffic Safety Facilities ➢ Pedestrian crossing with traffic light ➢ Scramble pedestrian crossing

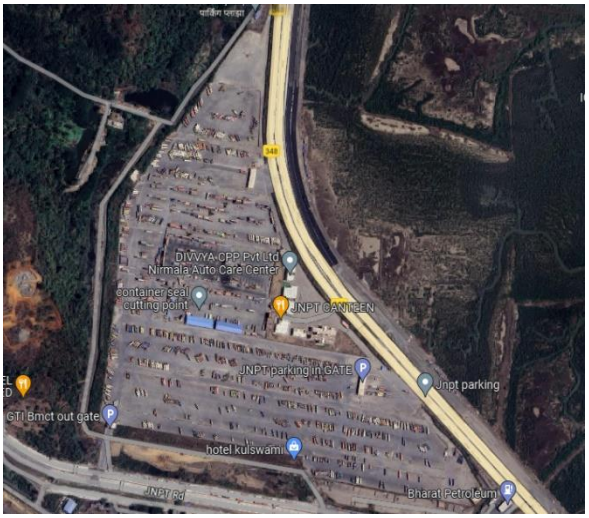
Sr. N.	Problem will be arisen	Issues	Mitigation Measures
	Crossing of Pedestrian	• Improvement of Pedestrian Facilities	• Improvement of Traffic Safety Education System ➢ Pedestrian safety education program • Strengthening traffic regulation enforcement
3	Traffic Congestion at non-signalized intersection or Roundabout	• Installation of traffic Signals	• Installation of Traffic Signal Control System ➢ Installation of traffic signal • Improvement of Intersection ➢ Geometric and channelization improvement at intersections ➢ Reconstruction of roundabouts
4	Poor Traffic Operation	• Improvement of traffic operation	• Installation of traffic signal • Improvement of Traffic Operation System • Reconstruction of roundabouts
5	Traffic Congestion by on-street parking	• Provision of Parking Spaces • Parking Policy	• Improvement of Parking System ➢ No parking area ➢ Construction of off-street parking • Establishment of Parking Policy and Regulations ➢ Establishment of parking improvement areas ➢ Revision of building code • Enforcement of Illegal Parking Vehicles ➢ Enforcement of illegal parking ➢ Removal of left vehicles
6	Traffic Conflict of Vehicles at U-turn and Right-turn Points	• Channelization Treatment	• Geometric improvement at U-turn Point ➢ Geometric improvement at U-Turn points ➢ Provision of U-turn lane • Traffic Enforcement ➢ No parking near U-turn points
7	Traffic Accidents	• Effective Traffic Safety Education Program • Improvement of Traffic Safety Facilities and Signs • Conduct of Traffic Campaign	• Improvement of Traffic Safety Education ➢ Traffic safety education to driver ➢ Traffic safety education to peoples • Improvement of Traffic Safety Facilities ➢ Traffic safety facilities • Conduct of Traffic Campaign ➢ Traffic campaign
8	Traffic Accident at Black Spots	• Improvement of Black Spot Points	• Improvement of Black Spot

1.8 Present Traffic Parking :-

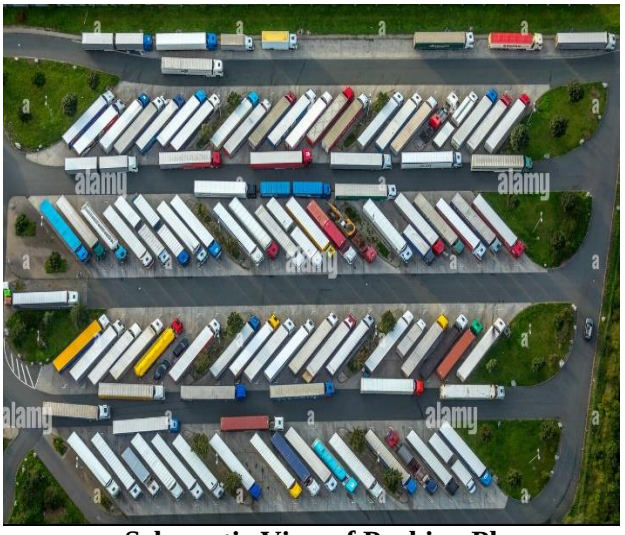
The container terminal handles about 0.5 million TEUs annually currently. With the expansion of the container terminal, the terminal is expected to handle 1.0 million TEUs annually.

a) **Initiative for ease of Traffic Congestion**: Total distance per TEU has reduced to 2.5 KM from earlier 5.0 KM. ITRHO Traffic has reduced to approx. 60% with green channel, reducing average from 45 TT to 15 TT performing the ITRHO operation on daily basis. The carbon footprint has drastically reduced to 50% with green channels.

b) **Centralized Parking Plaza (CPP-1) :** JN Port's Centralized Parking Plaza is equipped with huge parking capacity to help park 2,832 tractor trailers in one go, and is spread across **45 hectares**, hereby integrating document processing by Customs and streamlining traffic movement using Real Time Parking Management system. Reduce congestion on road.



Existing Centralized Parking Plaza (CPP-1)



Schematic View of Parking Plaza

Proposed JNPA Parking (CPP-2)

Existing Parking (JNPA Parking)

Fig – 17 – Existing Parking Places

Table – 15 - List of Parking Space in JN Port area

Sr. No.	Location	Remarks
1	Centralized Parking Plaza (CPP-1)	Existing (45 Ha)
2	Centralized Parking Plaza (CPP-2)	Proposed (DPR stage)
3	JNPA Parking	Existing
4	BMCT Parking	Existing

1.9 Parking in & around Port Area

1.9.1 Assumptions

- Passenger vehicle parking will be provided within the sector of port area
- Loading and unloading of raw material and finished product of port area will be carried out within the sectors
- Parking demand is categorized into three based on the parking duration as presented below in **Table**

Table 15 Parking Categories

Parking	Duration	% of vehicles required parking
Short term parking	Up to 4 hrs	30%
Medium term parking	4 - 12 hrs	35%
Long term parking	> 12 hrs	35%

- Based on the total truck traffic within Port area, parking requirement in area (Ha) is estimated both for loaded truck and empty truck
- Area required for parking of a single truck is 150 – 165 m^2 including circulation; however, 150 Sq. m area is considered to arrive the parking area requirement.

1.9.2 Demand Estimation

Based on the total truck traffic and the area required for parking of a single truck, the total parking area required for the Port area is estimated and presented in **Table**

Table no 17 - Sector wise Truck Parking Demand

Sr. No.	Terminals	No.of Trailer required for parking	Area required for parking (in Hec)
1	BMCT	1241	18.615
2	NSICT	650	9.75
3	APMT	700	10.5
4	NSIGT	647	9.705
5	NSFT	341	5.115
6	NSDT	4	0.06
	Total Area required in Hec		**53.745**

Currently Centralized Parking Plaza-1 consists of 45 hectares and JNPA Parking consists of 10 hectares.

Thus Total area required for parking **is 53.75 Hec** and currently available is **55 hectares**. In Future CPP-2 is under DPR stage about **75 Hec**.

1.9.3 Parking layout – Truck Parking

Two truck/container parking areas are proposed in the Port area. The assumptions and details are as follows. The size of the Parking lot and other amenity structures are estimated based on the

- Type of vehicles which use the parking facilities and its dimensions;
- Number of spaces required;
- Size of each space;
- Angle of parking;
- Driveway – Manoeuvring requirements.
- One parking area has been provided at the entrance. This facility is envisaged so that the customs clearance can be carried out for the incoming and outgoing vehicles without queuing up of the vehicles at the entrance.
- More vehicles could be parked per linear meter of driveway with 90^0 parking with the number decreasing as the parking angle decreases.

1.9.4-Detailed Parking Area requirement Statement for Commercial Vehicles

Table -18 Parking Area required after 5 years

Sr.No.	Terminals	No. of Trailer required for parking	Area required for parking (in Hec)
1	BMCT	1583	23.75
2	NSICT	830	12.45
3	APMT	894	13.41
4	NSIGT	825	12.38
5	NSFT	435	6.53
6	NSDT	5	0.08
	Total Area required in Hec		**68.60**

Table-19- Parking Area required after 10 years

Sr. No.	Terminals	No. of Trailer required for parking	Area required for parking (in Hec)
1	BMCT	2021	30.32
2	NSICT	1059	15.89
3	APMT	1141	17.12
4	NSIGT	1053	15.8
5	NSFT	555	8.33
6	NSDT	6	0.09
	Total Area required in Hec		**87.55**

Table-20 - Parking Area required after 15 years

Sr. No.	Terminals	No. of Trailer required for parking	Area required for parking (in Hec)
1	BMCT	2579	38.69
2	NSICT	1352	20.28
3	APMT	1456	21.84
4	NSIGT	1344	20.16
5	NSFT	709	10.64
6	NSDT	7	0.11
	Total Area required in Hec		**111.72**

Currently Centralized Parking Plaza-1 consists of 45 hectares and JNPA Parking consists of 10 hectares. In Future CPP-2 is under DPR stage about 75 Hec. Thus Total area required for parking **is 111.72 Hec.**

Total Area after proposed parking development will be 130 Hec which is more than calculated i.e **111.72** Hec after 15 years.

1.10 Conclusion:-

The Fourth Container Terminal is being developed in two phases of which Phase-I is operational and Phase-II is expected to be fully operational by April 2025 with a quay length of 2,000metres adding an annual capacity of 4.8 million TEU's.

JNPA handled 35.25 million Tonnes of total cargo & 2,599,834 TEUs of containers from Apr-2023 to Aug-2023 which is higher by 4.58% & 4.88% respectively as compared to corresponding period in previous financial year which works to around 7000 trailers per day. Considering a growth rate of 5% the traffic density will increase to around 14000 trailers per day. Considering 7000 trailers per day (50%) will be parked in JNPA area, sufficient parking space is provided which can fulfill the need for at least next 15 years as currently Centralized parking plaza-1 has a huge parking capacity of 2,832 trailers at one go along JNPA Parking area about 10 hectares near CFS junction and Centralized parking plaza-2 is proposed about 45 hectares considering future growth of traffic for 2500 trailers.

****

Annexure - XI

DISASTER MANAGEMENT PLAN (DMP)

a. Objectives

The emergency DMP for onsite and offsite location will be inter-related. The overall objectives are;

- To identify type of major disasters which may occur
- To localize the emergency and if possible eliminate
- To minimize the effect of accidents
- Elimination of hazard will require equipment like fire fighting equipments, water sprays,
- Emergency shutoff valves and purposeful construction.
- Minimizing the effect will be prompt action by operating and emergency staff, rescue, first aid, evacuation, rehabilitation and giving information promptly to people living / working nearby.

b. Types of Possible Emergencies:

- Fire on berth / approach trestle / storage / buildings
- Spillage while bunkering by vessel
- Spillage due to collision in channel
- Natural calamities like cyclone / rough weather / earthquake/ Tsunami
- War situation/ Air strike.

c. Functions of Disaster Management

Controlling spread of accidental effects with minimum damage to men, material, machine and structures.

- To inform relevant agencies and request for help.
- To rescue victims and provide succor.
- To protect other and safely evacuate.
- To inform nearby inhabitations.
- To identify the affected persons and inform their relatives.
- To provide authentic information to news media and other.
- To preserve relevant records and equipment needed as evidence in any subsequent inquiry.
- To rehabilitate the affected areas and alot specific assignment to available manpower.

d. Classification of Accident

- Level I : Operator Level
- Level II : Local / Community Level
- Level III : Regional level
- Level IV : International level

e. Critical Targets

Disaster Management Plan is prepared after identifying the objects likely to be affected in the event of emergency. The target of fire includes personnel if emergency occurs at service platform during discharging of vessel and tank farm on shore.

f. Control Room (CR)

A control room will be established at a location away from likely spots of accidents and shall be easily accessible. Better location will be near the room from where all unloading operation are conducted and controlled.

1.1 IDENTIFICATION OF MAJOR HAZARDS

The hazards occurring at Proposed Project can be broadly classified as natural and man-made hazards. Some of the hazards existing at site are as follows:

- Earthquakes
- Fire
- Tsunamis

1.1.1 Earth Quake

- An earthquake is a sudden, rapid shaking of the Earth caused by the breaking and shifting of rock beneath the Earth's surface.
- This shaking can cause buildings, bridges to collapse; disrupt gas, electric, and phone service; and sometimes trigger flash floods and fires; all these are possible scenarios at Proposed Project.
- The greatest danger for people in an earthquake exists directly outside buildings, at exits, and alongside exterior walls.
- Ground movement during an earthquake is seldom the direct cause of death or injury. Most earthquake-related casualties result from collapsing walls, flying glass, and falling objects.

1.1.2 Fire

- Fire is the most probable emergency scenario at proposed project.
- Fire can be caused in installations as electrical fire, chemical fire, etc.
- To handle this scenario an onsite emergency plan has been developed by the security team and is currently operational.

1.1.3 Tsunamis

- Tsunamis are generated by large and rapid displacements of water, mainly from sudden and large scale changes in the configuration of the sea floor associated with fault displaceme nt or gigantic underwater landslides, which could be mainly due to earthquakes.
- Earthquakes generate tsunamis by vertical movement of the sea floor as in normal faulting or thrust faulting. If the sea floor movement is horizontal, tsunamis are not generate d as in strike slip earthquake. Sometimes they are triggered by marine landslides into or under the water surface, also generated by volcanic activity and meteorite impacts, but such events are extremely rare.
- Tsunami hazard along a coastline is therefore a combination of all the potential sources of tsunamis that lie in the neighboring sea or ocean. Tsunami waves travel at a speed of

approximately 700 km/ hr in 4000 m of water. In 10 m of water the velocity drops to about 36 km/hr.

- The project area falls under seismic zone III and there has not been any Tsunami reported near emergency plan has been developed by the security team to handle such situation, if arised.

1.1.4 EMERGENCY RESPONSE MEASURES FOR NATURAL HAZARDS

Natural Hazards cannot be prevented. However with mitigation measures the effects/damages could be reduced.

1.1.4.1 Response in case of Earthquake

Response procedures for worker

If indoors:

- Take cover under a piece of heavy furniture or against an inside wall and hold on.
- Stop the process and move away from machinery, equipment, etc.
- Avoid moving around until the shaking stops.

If outdoors:

- Move into the open, away from process area, office building and utility wires.
- Gather at the Evacuation point mentioned during the safety drill and await instructions.

If in a moving vehicle:

- Stop quickly and stay in the vehicle.
- Once the shaking has stopped, proceed with caution.

After be prepared for aftershocks.

- Although smaller than the main shock, aftershocks cause additional damage and may bring weakened structures down. Aftershocks can occur in the first hours, days, weeks, or even months after the quake.

Help injured or trapped co-workers.

- Give first aid where appropriate. Do not move seriously injured persons unless they are in immediate danger of further injury. Call for help. Use Emergency numbers.
- Stay out of damaged buildings, machinery, equipments.
- Get your entire process area checked with Safety officers
- Use the telephone only for emergency calls.

Emergency Response Procedure

1. Initiate the Quick Response Team and First aid team for earthquake response
2. Give a long siren for earthquake warning
3. Inform the necessary authorities for aid
4. Ensure no personnel or residents are stuck beneath any debris
5. Ensure that all residents and personnel standing outside near the buildings are taken to open areas.
6. Close the entry gate to restrict any incoming traffic
7. Inform Electrical department to shut off the utilitie s.
8. Ensure that the first aid ambulance and fire tender vehicles are mobilized

9. Ensure that emergency telephone number is only used for this purpose
10. Check the utilities and storage tanks for any damage.
11. Inform structural engineers to check for any damage to the Dam structure

1.1.4.2 Response in case of Fire

- On sighting a fire the first person should immediately inform the control room.
- If the fire is small engage in extinguishing the fire using the nearest fire extinguisher or retrieve the property that may be damaged.
- The control room will immediately inform the first aid centre and the quick response team, which has trained fire-fighting personnel. Mobilize the fire tender.
- The Quick Response team will immediately move to the point of fire and take all nece ssary
- steps to stop the fire. If the fire is not controllable and spreads to the other area then immediately inform the security post who would in turn inform the district authorities and call for external help.
- First aid team will provide immediate relief to the injured personnel at the scene of incidence. The patients would then be evacuated on priority to the dispensary or hospital based on their condition.
- Instructions for an Individual in case of fire
- Get out of buildings as quickly and as safely as possible. If outdoors stop all processes and inform the control room using emergency alarm system and Emergency numbers.
- Evacuate the boat/barge with the help of life boat.
- If possible, cover mouth with a cloth to avoid inhaling smoke and gases.
- Call the security from the nearest phone
- Stay out of damaged boat/barge
- Check that all wiring and utilities are safe.

1.1.4.3 Response in case of Tsunamis/Storm Surges

a) Structural measures:

1. Construction of cyclone shelters
2. Plantation of mangroves and coastal forests along the coast line acting as Bioshields
3. Development of a network of local knowledge centers (rural/urban) along the coast lines to provide necessary training and emergency communication during crisis time
4. Construction of location specific sea walls and coral reefs in consultation with experts
5. Development of well designed break waters along the coast to provide necessary cushion against cyclone and tsunami hazards
6. Development of tsunami detection, forecasting and warning dissemination centres
7. Development of a “Bio-Shield” - a narrow strip of land along coastline. Permanent structures, if any in this zone with strict implementation of suggested norms. Bio -Shield can be developed as coastal zone disaster management sanctuary, which must have thick plantation and public spaces for public awareness, dissemination and demonstration.
8. Increasing the river dike height, increasing the height of the coast by filling up of coastal sand of the same place.

9. Identification of vulnerable structures and appropriate retrofitting for tsunami/cyclone resistance of all such buildings as well as appropriate planning, designing, construction of new facilities like

- Critical infrastructures e.g. power stations, warehouses, oil and other storage tanks etc. located along the coastline.
- All other infrastructure facilities located in the coastal areas.
- Public buildings and private houses.
- All marine structures.
- Construction and maintenance of national and state highways and other coastal roads.

b) Non-Structural Measures

1. Coastal regulations Zone Act – Strict implementation.
2. Aggressive capacity building requirements for the local people and the administration for facing the disasters in wake of tsunami and cyclone, 'based on cutting edge level'
3. Developing tools and techniques for risk transfer in highly vulnerable areas
4. Conserving and developing Natural Bioshields (Mangroves) and shelterbelt plantations (Casuarina).
5. Launching a series of public awareness campaign throughout the coastal area by various means.
6. Training of local administration in forecasting warning dissemination and evacuation techniques
7. Awareness generation and training among the coast guards, officials from fisheries department and port authorities and local district officials etc., in connection with evacuation and post tsunami storm surge management activities. Regular drills should be conducted to test the efficacy of the DM plans.

1.2 ORGANIZATION STRUCTURE

The Incident Controller tackling the emergency in real terms requires support from various other services e g. fire & safety, medical services, security, engineering, administration, technical services covering communication, transport and personnel functions, etc. A KEY PERSON for each one of these services, therefore, should be nominated.

The "SITE MAIN CONTROLLER" (SMC) will be the Unit In-charge the various controllers selected to carry out the work will co-ordinate with the SMC through the functional KEY PERSONS at the incident site. The KEY PERSONS will generally be at the site of incident and the CONTROLLERS will report at the EMERGENCY CONTROL CENTRE.

The duties and responsibilities of various KEY PERSONS AND CONTROLLERS will be written down ensuring no grey areas or overlapping responsibilities. Various Controllers will be drawn from the organisation and clear-cut responsibilities will be spelt out for the following controllers:

- Operation Controller
- Maintenance Controller

- Fire and Safety Controller
- Communication Controller
- Environment Controller

A Succession chart will be developed as above nominating second-line controller who would act as controller in the absence of any of the above officials. An emergency organization chart is shown in figure below;

1.2.1 Roles and Responsibilities of Emergency Team

1) Site Main Controller (In-charge):

- To access the extent and magnitude of the damage and by maintaining communication with the Site Incident Controller (SIC).
- To determine how far the emergency control plan can be extended
- Prepare action for monitoring and controlling the emergencies
- To decide whether any section I process I area to be shut down I isolated in the event of any accident
- To finalise the means of evaluation and explore the possibilities of taking help from offsite sources
- Review the fire fighting operations in consultation with Safety Coordinator
- Co-ordination with the safety officer regarding evacuation and shelter rehabilitation aspects
- Arrange for restoration and normalcy in consultation with Incident Controller
- Announcement of conclusion of emergency
- Issuance of authorised statements and ensures that all evidences of the incident are preserved.

(ii) Site Incident Controller (Shift in-charge)

- Establish Emergency Control Centre and inform SMC
- Ensure availability of Controllers/Team members
- Priority decisions for strategy for development of resources for incident control
- Periodic assessment of actual disaster zone and resource deployment (own I external)
- Periodic status report of SMC
- Seek help for
- Fire Fighting
- Medical Aid
- Rescue
- Transport
- Traffic Arrangement
- Law and Order

Inform the following authorities about the incident through zonal/sector authorities

- District Collector
- Superintendent of Police
- District Environmental Engineer
- District Health Officer
- Inspector of Factories

• Neighbouring Installations

Establish contacts with the following, through Controllers:

- Superintendents of nearby hospitals
- Chief Fire Officer of nearby fire services
- Insurance company
- Establish first aid centre through safety coordinator
- Establish information centres
- Emergency Co-ordinators

Logistics Coordinator: The duties and responsibilities in the event of any emergency include:

- Report at the affected area to the SMC & SIC
- Arrange to attend all maintenance jobs as instructed by SIC
- Ensure that all essential services like power, water etc. are maintained without interruption
- Ensure adequate manpower availability at the affected area
- Reporting all the incidents to SIC
- Arrange for all the tools, materials at the site of emergency

Communication Coordinator (Responsibilities include):

- Report to SMC & SIC
- Removal of non-essential personnel from the emergency area in consultation with SIC
- Contact with SIC and arrange for necessary facilities
- Control over entry and maintain law & order and arrange for police help in consultation with SMC
- Liaison with external agencies in consultation with SMC
- Coordination of transportation requirements for moving personnel for first aid, evacuation, rehabilitation etc.
- Maintenance of inventory systems in the Emergency Control Centre

Safety Coordinator (Responsibilities include):

- Immediate Reporting to SIC
- Co-ordination with Security officer and security personnel
- Ensure availability of all safety equipments at site
- Co-ordination of all rescue operations
- Co-ordination of availability of first aid to all injured personnel
- Advice to SIC on fire fighting operations
- Ensure availability of necessary antidotes/ medicines in case of toxic release

1.2.2 Communication

An essential component of any emergency preparedness programme is the communication links for gathering information needed for overall co-ordination. Emergency control centre with inhouse as well as outside emergency services. Too much reliance on the telephone system fixed lines/ mobile phones are risky as it can soon be overloaded in an emergency situation. A computer with internet and printer facility and photocopying machine, wireless networks, fax, intercom units are recommended for higher reliability. Help line numbers will be setup for emergency related queries.

Annexure - XII

OIL SPILL RESPONSE CONTINGENCY PLAN

MUMBAI & JNPT HARBOUR

Prepared by SADHAV SHIPPING LTD

RECORD OF AMANDMENTS

DATE	AMANDMENT NUMBER	SECTION/PARA/ SUBPARA	PAGE NO	INITIALS OF ISSUING OFFICER

NOTE

1. Amandment to Plan is to be carried out by replacing the text, information or data contained in the relevent section, para or sub para.

2. The old text is to be removed from ring binder file and replaced by amanded data, text or information.

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ACRONYMS

BPCL	Bharat Petroleum Corporation Ltd
DNV	Det Norske Veritas
COC	Communication and Operations Center
ESI	Environmental Sensitivity Index
HM	Harbor Master
HPCL	Hindustan Petroleum Corporation Ltd
IC	Incident Controller
IM	Incident Manager
IMO	International Maritime Organisation
IOCL	Indian Oil Corporation
IPIECA	International Petroleum Industry Environmental Conservation Association
ITOPF	International Tanker Owners Pollution Fund
JD	Jawahar Dweep
JNPT	Jawahar Lal Nehru Port
MARPOL 73/78	International Convention for the Prevention of Pollution from Ships 1973 as modified by the Protocol of 1978
MbPT	Mumbai Port Trust
NFPA	National Fire Protection Association
NOS-DCP	National Oil Spill Disaster Contingency Plan

ONGC	Oil and Natural Gas Corporation
OPRC Convention	International Convention on Oil Pollution Preparedness, Response and Co-operation 1990
OSC	On Scene Coordinator
OSD	Oil Spill Dispersant
OSR	Oil Spill Response
OSRO	Oil Spill Response Organisation
OSRO-M	Oil Spill Response Organisation - Manager
OSRO-S	Oil Spill Response Organisation – Specialist
PC	Port Control
POL	Petroleum, oil and lubricants
RIL	Reliance Industries Limited
SRV	Spill Response Vessel
UNCLOS	United Nations Convention on Laws of the Sea
TPC	Tata Power Corporation

1.0 CONTINGENCY PLANNING

In spite of best intentions to avoid oil spills through best and safe practices and rigid enforcement of good intentions in work place, the spills still occur and will keep on occurring. The next best post spill activity, then, is to address them in terms of containment and recovery within shortest possible time and through best available means that need to be planned and kept ready in advance and spelled through a Contingency Plan for the facility or area handling oil, oil products or other pollutants.

Increase in density of marine traffic, especially oil tankers and petroleum based installations along the Indian coast has increased the risks for occurrence of spills in harbour, coastal waters and during terminal operations apart from spills that could occur from collision, grounding of vessels and stranding. To address the fallout of incidents and accidents that could lead to pollution of marine environment, all countries handling polluting agents are required to have capabilities and create infrastructure and set up means that could handle the pollution response activity in case of any spill. The working parameters and strategy to address the response activities are spelled through a Contingency Plan.

1.1 PURPOSE AND OBJECTIVES OF CONTINGENCY PLAN

India being signatory to number of International agreements and conventions aimed at controlling marine pollution through measures and rules applicable to marine facilities or surface units, is under an obligation to honour and implement the same through municipal legislation and through adopting means, practices and rules in accordance with Article I of the Convention 73 and Protocol 78 i.e MARPOL 73/78.

The article has placed an obligation on the parties to the convention including India "to give effect to the provisions of the present convention and those Annexes

thereto by which they are bound, in order to prevent the pollution of the marine environment by the discharge of harmful substances or effluents containing such substances in contravention of the convention".

Apart from the specific obligations imposed by MARPOL, being a signatory to UN Convention on the Laws of the Sea (UNCLOS) , India has an obligation to protect and preserve the marine environment in addition to obligations under International Convention on Oil Pollution Preparedness, Response and Co-operation 1990 (OPRC Convention).

Accordingly, India too had to formulate rules or administrative directions giving effect to international procedures through structures to be developed by ports and facilities handling vessels and oil cargo.

While, regulatory procedures are expected to be put in place through rules-implementing the various provisions and annexure of MARPOL 73/78, the practical aspects of marine pollution to set up a mechanism on the ground are dealt by OPRC – National Oil Spill Disaster Contingency Plan being an instrument for the same.

NOS-DCP has its origin in IMO convention OPRC – 1990, ratified by India. As per the convention it is imperative upon each signatory state to have laws and mechanisms to respond to oil spills in its waters.

National Oil Spill Disaster Contingency Plan is aimed at coordination of resource agencies to combat an oil spill in Indian waters and also spells the actions required of oil handling facilities i.e to prepare contingency plans for respective facilities and to develop Tier I response capabilities and also to report oil spills. NOSDCP mandates a number of resource agencies comprising of 03 ministries and 15 departments apart from oil industry, off shore terminals etc. to an obligation to:

- Render resources for pollution response when called for,
- Report Oil Spills,
- Prepare contingency plans for respective spill scenario,
- Set up Tier I response facilities and
- Use of Oil Spill dispersants (OSD) in accordance with Plan.

Of the three tiers of response envisaged and planned to handle a spill situation in consonance with quantum of spill, Tier 1 is the primary and first step of responses, to be mounted by the facility where the spill takes place.

While, NOS-DCP outlines the response activities as per Tier system of addressal of spill, the facility plan is the instrument to address the spill scenario at local level. Tier 1 being the first and primary response level has to be executed and undertaken by the facility handling polluting cargo, for which purpose drafting of a CP is the primary requirement.

The National Oil Spill Disaster Contingency Plan was first drafted in India by Coast Guard during 1996 with an objective to put in place the machinery and mechanisms to combat oil spills in Maritime zones of India. The Plan has since been updated in 2002.

1.2 AIMS OF CONTINGENCY PLAN

The aims and objectives of the Oil Spill Response Contingency Plan (here after termed the Plan or CP) of a port or facility are to draw a methodology and strategy to indicate actions required to be taken by responders to:

- Ensure availability of timely, measured and effective response to incidents of oil spill in waters under jurisdiction of the port or facility,

- Take measures to control the spill within minimum area,
- Minimise volume of spill by securing the source in most appropriate way,
- Minimise extent of movement of released oil from the source by timely containment,
- Minimise environmental impact by timely containment and recovery response,
- Maximise effectiveness of recovery actions through selection of appropriate equipment and techniques,
- Maximize response effectiveness through trained and competent, operational and response teams,
- Guide response personnel through the process of managing a spill originating within their area of operation,
- Mitigate consequences of oil pollution incidents ,
- Allow those involved in rsponse to rapidly disseminate information to parties involved and to ensure optimum deployement of available equipment.

1.3 PLAN ELEMENTS

This Plan is a set of guidelines and instructions that outlines the steps that should be taken before, during and after an oil spill emergency. The Plan has to accordingly, pay attention to all the possibilities that could go wrong and "contingent" upon actual events, has the contacts, resource lists, and strategies to assist in response to the spill.

As incumbent by a reasonably workable plan, this Plan provides details of actions required to be initiated and taken to prepare for and respond to spills and address different situations that may arise during or after a spill. The Plan is structured on four major elements , viz:

1.3.1 Hazard Identification

While, it is impossible to know when an oil spill is going to happen and how much oil is likely to be spilled, however, it is possible to identify where oil is stored, the corridors through which it travels and the industries that use large quantities of oil.

Since, different situations can affect the ability of response personnel to contain and clean up an oil spill, such as weather and geographic conditions and spill size, this Plan has attempted to address actions and activities to be undertaken under different conditions.

The following information has been put into use as a part of hazard identification:

- Types of oils received, stored in or transported through the area of operation,
- Locations where oil is received in large quantities and mode of transportation used to receive the oil, such as vessels and pipelines etc,
- Weather conditions that would affect response operations in the area during different times of the year,
- Location of response equipment, trained personnel and other resources that could be called in for response to the spill.

1.3.2 Vulnerability / Sensitivity Analysis

The vulnerability analysis section of the Plan is an attempt to collate and provide information about resources and communities that could be harmed in the event of a spill. This information helps personnel involved in clean up operations to exercise identified reasonable, well-informed choices on protecting areas of high sensitivity - biological, economical and public utilities, that are vulnerable and of concern for public

health and environment. Vulnerability information taken into account for this Plan includes the following that have been indicated on concerned area maps -

- Shoreline types and ranking based on sensitivity to oil,
- Biological resources sensitive to oil or emergency response actions,
- Human use resources sensitive to oil or useful during response operations,

1.3.3 Risk Assessment

As required of a Contingency Plan, this Plan has tried to compare the hazard and vulnerability in a particular location to see the kind of risk that are posed and then to addresses those problems by determining how best to control the spill, how to prevent certain ecological elements or environments from exposure to oil, and how best to advise the local civil authority of the dangers that could be posed by the spill and how to address them and to repair the damage done by the spill.

1.3.4 Response Actions / Resources

As a part of this Plan, the port, facility or the identified OSRO is responsible to undertake spill mitigation operations apart from managing, acquiring and maintaining oil spill response equipment and resources appropriate for response. Equipment, resources and personnel will be stockpiled at one or more suitable location/s as necessary to meet response requirements within shortest period.

The team nominated by the executing authority (in this case the Chairman, Mumbai Port) or any OSRO nominated by the executing authority will give effect to all the response mechanisms and procedures identified by the Plan and maintain trained personnel to undertake the operations.

1.4 RESPONSE POLICIES - GIVING EFFECT TO PLAN

Objectives and aims of the Plan are achieved through formulation of oil spill response strategy for the area of operation and oil spill response plan to be addressed through Operations Manual. While, this Plan includes reference to wider concerns like Environmental Sensitivity etc, the Operations Manual will be the response activity guide along with other documents to ensure execution of each part of response and implementation .

The key deliverables to give effect to the Plan are:

(i) Action Planning - Tactical action strategies including initial containment and control procedures and locations for Tier 1 events are developed on geographic basis with resources located strategically within the area of operation at one or multiple sites.

(ii) Environmental Sensitivity Factors - Environmental sensitivity and risk factors having been taken into account through observations, secondary information sources and studies, the results are integrated into identification of high-risk areas / features and protection/cleanup priorities and selection of appropriate response procedures, resources and resource staging areas.

(iii) Response or Field Guide manuals - Describing procedures for containment and control actions, the manuals contain information on deployment of equipment etc as per the location of spill and safe practices that need to be adhered to by responders.

(iv) Availability of equipment, and employment and training – Response personal being the main key and element in any response, their expertise and knowledge of procedures and handling of spill is spelled through the CP.

1.5 LOCATION BASED RESPONSE

THE SCOPE OF THIS PLAN EXTENDS TO FOLLOWING LOCATIONS AND FACILITIES STRETCHED OVER A GEOGRAPHICAL AREA OF MORE THAN 400 SQ KMS WITH MULTIPLE OPS GOING ON AT THE SAME TIME

- PORTS OF MMB AND JNPT
- TRANSHIPMENT FACILITIES AT JAWAHAR DWEEP, PIR PAU, MUMBAI HARBOUR AND JNPT
- ONGC FACILITIES AT NHAVA AND LANDFALL POINT FOR URAN REFINERY

Protection of these areas requires rapid and well-planned tactical response actions. Considering the size and complexity of the area, the Plan has divided the area into manageable geographic segments. (Individual or multiple areas may be grouped into functional response zones, based on logistical issues including accessibility and driving times from resource bases). Geographical areas of concern in this Plan are :

(i) Anchorage/ Lighterage area
(ii) Alongside cargo berths at MbPT and JNPT
(iii) Jawahar Dweep
(iv) Pir Pau
(v) JNPT oil berths at Nhava and Sheva

1.6 INTEGERATION WITH WIDER AREA OPERATIONS (Spill classification and Tier Response)

This Plan is based on internationally accepted standards of Tier classification and response concept to describe different categories of oil spill events based on their severity and availability of response resources. Tier classifications are determined in

consideration of spill volume, sensitivity of threatened resources and other factors that can only be determined at the time of the incident.

This Plan, is first of the actions in the series to combat oil spill and is open to call for a bigger response activity at national level and is meant to address a spill of up to 7oo tonnes as per Tier 1. Accordingly, all calculations and illustrations in this Plan are as per a spill of 700 tonnes. Oil Spill Classification Standard (Tiers) definitions are:

Tier 1 (Minor Spills): The events include small operational spills, which can be dealt on site by local staff and contractors. Study of available spill data indicates that Tier 1 spills occur largely during operations such as bunker ops, refuelling, pig launching and receiving, valve and flange leaks, and routine operation and maintenance activities and are classified as spills up to 700 tonnes.

In most cases, containment and clean up is effected using the equipment held by facility operator or OSRO and also by use of Spill Response Kits maintained at the facility. All requirements of notification etc to Central authority are observed, though support from outside agencies is not required.

Tier 2 (Major Spills): Tier 2 incidents include larger spills that would require additional local (in-country) resources and manpower. Tier 2 spills usually result from large fuel losses, loading hose failure or small to medium pipe failures (hole size up to 50 mm).

Cleanup is effected by dedicated oil spill equipment from in country sources, equipment stockpiles, in-country oil spill response contractors and by sharing equipment held with other operators. In the event of Tier 2, support from the Central spill controller would be required to be called for.

Tier 3 (Crisis Event): Tier 3 incidents include very large, possibly ongoing spills, that would require additional resources from outside the country. Such spills are expected to be rare and may occur as a result of events such as full diameter pipe

rupture or an uncontrolled tank failure or a large tanker grounding. Response operation utilize all available in-country Tier 2 resources, augmented by additional assets from outside the country. Extensive support from the Central authority would be required in such an event.

1.7 PLAN FACTORS

The following factors are taken into account for the purpose of studying the risks and for preparation of the Contingency or response plan .

- Geographic location, coastline, area sensivity
- Type of oil/product, volume of traffic, quantities of cargo handled, frequency of handling
- Types of operation, terminal design, condition of facilities
- Quality of shipping/vessel types
- Weather, sea conditions, time of day, navigation hazards
- Response strategies, training programmes

1.8 REVIEW, REVISION AND UPDATES

Contingency Plan being a sequence and layout of dynamic operating procedures and parameters is subject to revision due changes in operational parameters of port, cargo, equipment innovations and changing response strategies. Exercises and real time drills being operational tasks might also necessitate a review of plan to be undertaken to incorporate the observations made, apart from the above mentioned.

Accordingly, a study in detail of observations made during every response operation would be undertaken by CMT with a view to incorporate the observations into the Plan for easy and flaw less implementation.

1.9 INTERFACE WITH OTHER PLANS

A spill situation may be, one of the emergencies arising out of an incident or a number of incidents. Such incidents could be natural or man-made leading to emergencies like fire, gas leak, threats or chemical spills. In the event of multiple emergencies, while the spill response will be undertaken as per this Plan, response to other emergencies will be as per the Disaster Management Plan of the particular facility, port, installation or terminal.

2.0 PLANNING AND ADMINISTRATION

In accordance with the National Oil Spill Disaster Contingency Plan (NOS-DCP) all Ports or facilities handling oil and oil products are required to maintain Tier-I Oil Spill Response (OSR) capabilities to undertake response activity within their area of operation.

Accordingly, the ports of Mumbai and Jawaharlal Nehru Port are required to set up and sustain Tier-I OSR facilities in Mumbai / JNPT Harbour in co-ordination with oil companies operating at these Ports. For this purpose, MbPT, JNPT and other Participating Oil Companies (POCs) viz. ONGC, BPCL, HPCL, IOCL, CTTL, TPC & RIL have executed a Memorandum of Understanding (MOU) for sustenance of Tier-1 OSR facilities for combating oil spills at and in surrounding area within Mumbai / JNPT Harbour.

Under the said MOU, it has been decided to put in place Tier-I Oil Spill Response Services in Mumbai and JNPT Harbour for conduct of oil spill operations and mitigation of pollution within the identified area of operation.

2.1 AREA LAYOUT

Since, the fall outs of any accident being addressed by any Contingency Plan cannot be confined and limited to geographical boundaries within the area of jurisdiction and are likely to have an impact on areas beyond the area of addressal, it is desirable to have a knowledge of the area. The area of operation of this Plan is a part of Mumbai Harbour an area encompassing Mumbai estuary.

Mumbai Harbour or Front Bay (Figure 2.1) is a natural deep-water harbour in the southern portion of Ulhas River estuary. The harbour is spread over 400 square kilometers (150 sq mi) and is protected by the mainland of Konkan to east and north

and the island city of Mumbai to west. The harbour opens to south to Arabian Sea. The narrower, northern part of the estuary is called Thane Creek .

Front Bay is the official name of the harbor, so named because the city started as a tiny settlement facing the harbor. The water body behind the original settlement, forming an arc between the former Colaba island and Bombay island, up to Malabar Hill promontory or peninsula, is called Back Bay.

Front Bay is home to Mumbai Port, which lies in the south section of the western edge of the harbor. Jawaharlal Nehru Port and Navi Mumbai lie to the east on the Konkan mainland, and the city of Mumbai lies to the west on Salsette Island.

There are six islands in Mumbai Harbor, a number of which are within the area of operation and are active in port activities.

(i) **Butcher Island**, also known as Jawahar Dweep , is used as an oil terminal by Mumbai Port. It has jetties for tankers and various other infrastructure for offloading crude oil and for loading refined petroleum products. The island is restricted to port employees, and not open to public. **C**rude oil is stored in tanks on the island and is piped to Wadala for refining . Most of the island is covered with dense vegetation with a hillock rising from the centre of the island. It is located 8.25 kilometres (5.13 mi) from Gateway of India.

(ii) The second island named, **Cross Island** is a small, uninhabited islet just off the coast of Dockyard Road.

(iii) **Gharapuri Island,** also known as Elephanta Island, is the best known of the islands in Mumbai Harbor and is a popular tourist destination because of the island's Elephanta Caves, that have been carved out of rock. The island has an area of 16 km^2 (6.2 sq mi) and is located at approximately 18.95°N 72.93°E. The area comes

under the jurisdiction of Raigad district and is thickly wooded with palm, mango, and tamarind trees.

The island is accessible by ferry from Mumbai, being about 10 kilometres (6.2 mi) from the south east coast of the island city. From the boat landing stage on the island, a walkway leads to steps that go up to the famous caves. There is also a narrow-gauge toy train from the boat area on the dock to the base of the steps leading up to the caves (about 600 meters).

(iv) Middle Ground is a small islet off Naval harbour. It features an antique coastal gun battery of the Indian navy. Gun salutes are exchanged with Indian Naval vessels as per ceremonials

(V) **Oyster Rock** is a small group of rock outcroppings in the harbor. The area has restricted access and is used for naval exercises.

(vi) **Salsette Island** is the largest island on which the cities of Mumbai and Thane are located. It is separated from the Konkan mainland by Vasai creek and the Ulhas river.

Creeks

The area is marked by a number of creeks that open into the harbour. The creek areas are ecologically sensitive and have thick mangrove vegetation and are navigable to some distances. The shallow mudflats stretch long distances all along the banks.

2.2. MUMBAI PORT

The Port of Mumbai is situated almost midway (Latitude 18° 54' N, Longitude 72° 49' E) on the West coast of India and is a natural deep water Harbour of about 400 square kilometres protected by the mainland of Konkan on its East and Island of Mumbai on its West.

The deep waters in the Harbour provide shelter for shipping throughout the year. The approaches to the Harbour are well lighted, with Prongs Lighthouse to the

North, visible 27 kilometres and Kennery Light House to the south visible 29 kms. The entrance to the Harbour which has approaches from the South-west is between Prongs Reef and Thall Reef lying off the mainland to the South-east, a distance of about 9 kilometres.

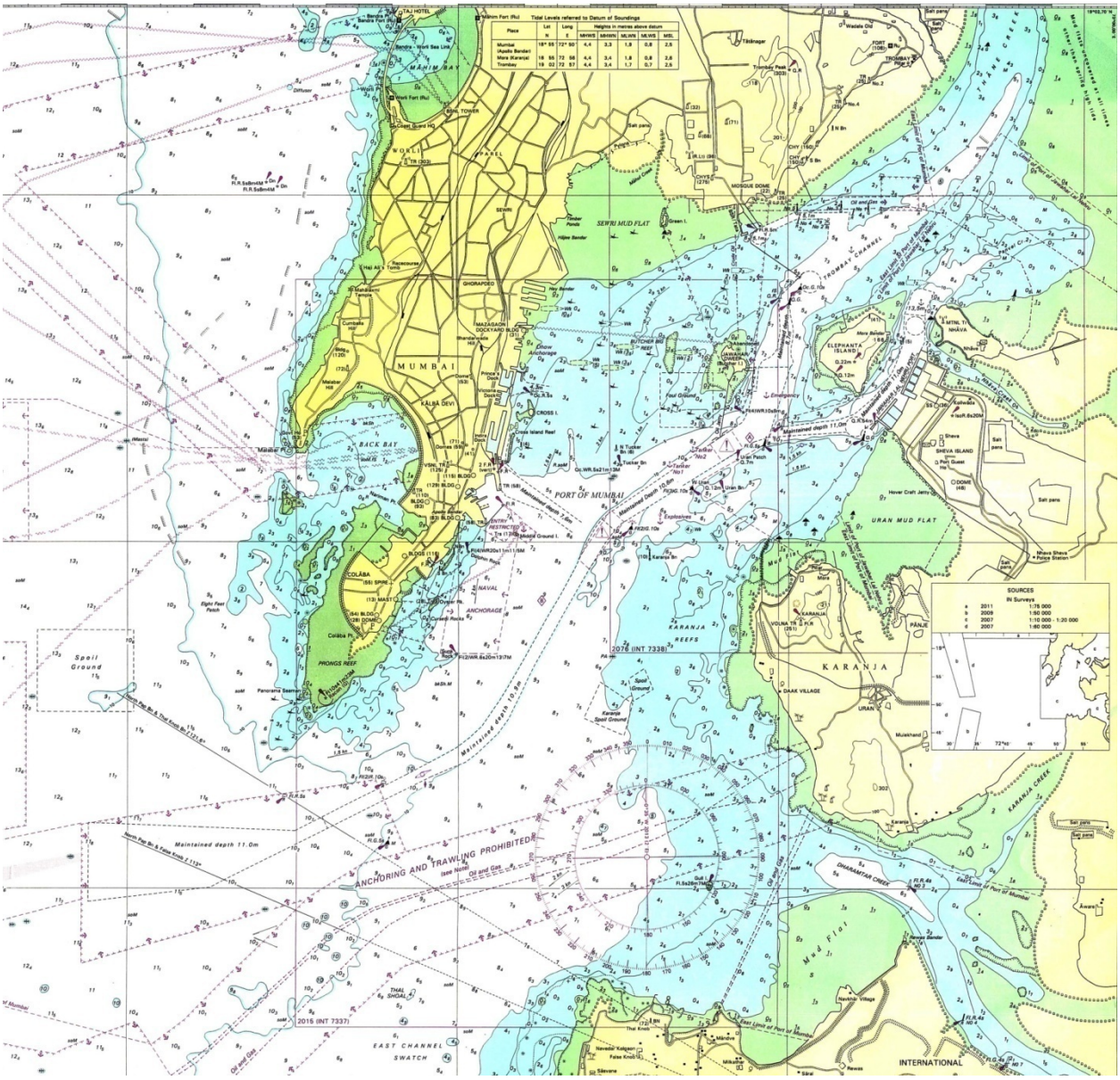


Fig 2.1 Mumbai Harbour

The main navigational Channel is, for the most part, a natural deep-water fairway. The channel has been deepened to 11 meters. With a mean high water neap tide of 3.3 meters, the channel is adequate to meet the requirement of a large number of cargo vessels, passenger ships and deep draft tankers. With good lighting arrangements navigation is allowed at the port round the clock.

The port is administered by Mumbai Port Trust (Mb PT), an autonomous corporation. The port is primarily used for bulk cargo, while most container traffic is directed to Jawaharlal Nehru Port (Nhava Sheva) across the harbour. The first of the present-day docks of Mumbai Port were built in the 1870s. Bombay Port Trust (BPT) was established as a corporation on June 26, 1873. The port and the corporation took their present names in the 1990s.

Over decades, the port has undergone tremendous expansion, with addition of berths and cargo handling capacities. Mumbai's expanding growth and population pressure has led to the establishment of Jawaharlal Nehru Port across Mumbai Harbour in Navi Mumbai on the Konkan mainland. This port began operations in 1989 and handles most of the container traffic.

Figure 2.2 - Mumbai PORT

2.2.1 Cargo Handling

The port handles both dry and liquid cargo at different jetties and locations apart from undertaking Lighterage operations through barges.

(i) Indira Dock

Indira Dock having a total water area of 24.04 hectares and a quay length of about 4000 meters is an enclosed wet dock . The Dock has an Entrance Lock 228.6 meters long and 30.5 meters wide though which vessels can enter or leave the docks at any state of tide. There are 21 berths inside the basin and 5 berths along the harbour wall with a designed depth of 9.14 meters and 7.5 meters respectively. Berthing depths inside the basin can be increased by 1.20 meters by pumping water.

The two berths on the Southward extension of East arm of Indira Dock are Ballard Pier Station and Ballard Pier Extension. Ballard Pier Extension berth is 244 meters long and has a modern passenger Terminal Building. It has a designed depth of 9.75 meters. Ballard Pier Station berth caters to container vessels and has a designed depth of 9.1 meters.

(ii) Liquid Cargo Terminal - Jawahar Dweep

There are four jetties at the island Jawahar Dweep for handling Crude oil and Petroleum products. One of the jetties at Jawahar Dweep, which was commissioned in 1984 can handle tankers with a maximum loaded draft of 12.5 meters corresponding to 125,000 Displacement tons. Two of the jetties (J-1 and J –3) can accommodate tankers up to 70,000 Displacement Tons and 228.6 m length, while, the third jetty can berth tankers of 213.4 m length and up to 48,000 Displacement Tons. The berthing dimensions and permissible parameters are as per table 2.1.

Dock	Dimension	Max. Normal Dimensions	Max oversize
JD marine Oil Terminal (3 Berths)	LOA	225.55	237.75
	Beam	39.62	
	Draft (designed)	10.97 to 11.58 (with tide)	
	Max. Disp	70,000 Tons (Berths1 &3)	
JD 4th Berth	LOA	300.00	
	Beam	39.62	
	Draft (designed)	12.25 to 14.30	
	Max	1,25,000 tons	

Table 2.1 - PERMISSABLE BERTHING PARAMETERS at JD

Jetty 1, 2 and 3 are provided with pipelines to handle both crude and products, namely, HSD, Naphtha, FO/LDO, SKO , ATF etc. The details are as per table 2.2.

Product	No of headers	Size (inches) & psi	No & dia of pipeline (inches)
Crude	8	10" / 150	2 / 24"
FO/ LDO	4	10" / 150	1 / 24"
Naphtha	2	8" / 150	1 / 16"
HSD	2	8" / 150	I / 16"
White oil	2	8" / 150	1 / 12"
Dirty ballast	2	8" / 150	1 / 16"

Table 2.2 - Product handling infrastructure

(iii) Liquid Cargo Terminal – Pir Pau

Chemical and POL products are handled at two jetties at Pir Pau. Old Pir Pau jetty can accommodate tankers of 170.69 m length, while, the new jetty commissioned in

December 1996 can handle tankers with a length of 197 m and a draft of 12.0 m. All the jetties are connected to Oil Refineries by a network of pipelines.

Dock	Dimensions	Max normal	Max. Oversize
Pir Pau (Old)	LOA (Day light)	170.69	178.30
	Beam	25.91	28.96
	Draft	6.40 to 7.5	
	Max Displacement	19,000 tons	
Pir Pau (New)	LOA (Day Time)	191.0	191.0
	Beam	28.0	28.0
	Draft	11.0	9.5 (Night)
	Max displacement	47,000 tons	

Table 2.3 - PERMISSABLE BERTHING PARAMETERS at Pir Pau

The cargo handled at Pir Pau and line sizes are as per table 2.4.

Product	Line size	Operated by
Lube Oil	8”	IOBL
LPG	8”	BPCL
LSHS	12”	BPCL
Chemicals	6”	AEGIS
	6”	CTTL
	8” and 4”	RCF

Table 2.4 – Cargo and line sizes at Pir Pau jetty

(iv) Bunders

Besides the wet docks, there are along the harbour front a number of bunders and open wharves where the traffic carried by barges/sailing vessels is handled.

(v) Storage

There are transit sheds at most of the berths and a number of warehouses in the Port area for storage of waiting cargo and pre-shipment storage of export cargo.

Figure 2.3 Jawahar Dweep

2.2.2 Cargo Statistics

The figures with respect to number of vessels and cargo handled for the years 2007-2014 at MbPT are as per table 2.5.

YEAR(Apr – March)	Vessels	POL vessels	POL cargo
2013-2014			35982
2012-2013	1949	1018	34785
2011-2012	2057	1102	33314
2010-2011	2156	1027	33229
2009-2010	1639	870	34496
2008-2009	1612	902	34371
2007-2008	1709	927	37074
2006-2007	2236	970	32171
2006- 2005	2153	834	

Table 2. 5 - Vessels and volumes of oil cargo handleded at MbPT

2.3 JAWAHALAL NEHRU PORT (JNPT)

The port lies along the eastern shore of Mumbai harbour off Elephanta Island on the Konkan mainland in location 18 56'43" North and 72 56'24" East .

The port shares a common 22.0 Km long main harbour channel with Mumbai Port up to No. 4 berth of Jawahar Dweep (J D) Terminal which is presently maintained to a depth of 10.7 to 11 mtrs. below Chart Datum.

The approach channel from J D to JNPT is 7.2 kms in length with maintained depths of 11 mtrs below Chart Datum with a width 350 meters at entry point i.e 460 meters off the berths. The available depth off the berths is 13.5 meters (Below Chart Datum)

Making use of tidal window, large size vessels having a draught up to 12.5 mtrs. are able to navigate through Mumbai harbour main channel and JNP channel. The Port is deepening and widening the existing channel to accommodate up to 14 mtrs.

2.3.1 Cargo handling

The cargo handling berths comprise of anchorage berth of 600 meters diameter and 2000 meter of quay length for Container Berth apart from 445 meters of quay length for Feeder Container / Cement / Project Cargo Ships.

Most of the container cargo is handled from this port only. Details of POL vessels and cargo handled at JNPT are as per table 2.6.

YEAR(Apr– March)	Vessels handled	POL vessels	POL cargo ('ooo
2013-2014			4566
2012-2013	2588	468	4125
2011-2012	2916	445	4926
2010-2011	3100	479	5135
2009-2010	3096	496	4916
2008-2009	2973	408	4552
2007-2008	3106	312	2189
2006-2007	2775	321	2625
2006- 2005	2395	356	

Table 2.6 - Vessel and volumes of oil cargo handled at JNPT

2.3.2 Liquid Cargo Berths

The port handles POL cargo for BPCL, IOC and ONGC through dedicated berths. Cargo for BPCL and IOC is handled at Sheva, while, ONGC handles its Mumbai High supplies and vessels from Nhava.

(i) Sheva

Liquid cargo is handled through the twin berth cargo jetty developed by M/s Bharat Petroleum Corporation Limited and Indian Oil Company Limited for handling liquid cargo including POL products. The jetty is 300 mtrs long with a width of 40.5 mtrs having capacity to accommodate twovessels of 85,000 DWT on seaside berth and 30,000 DWT on shore side berth.

Three dock lines are provided for white and black oil with a capacity of 5.5 million tonnes per annum. Jetty is provided wth six 12' marine loading and unloading arma (3each on sea and shore side) for working cargo. The deredged draught on seaside is 13.5 mtrs and 12 mtrs on shore side.

(ii) Nhava and Uran

Nhava is the main center for ONGC Mumbai High operations . The vessels operating in the High receive stores, fuel and lubricants from Nhava. The vessels calling Nhava are largely restricted to OSVs.

ONGC off shore facility – refinery and tank farm, is located at Uran and was established in 1974. The site is about 12 km east of Mumbai and is approachable by all-weather motor able roads.

The facility receives entire oil and part of natural gas produced in Mumbai offshore oil fields. Both the oil and gas received from offshore is processed at various units for producing value added products like LPG, C2-C3, LAN, apart from processing, storage and transportation of oil.

The unstabilized crude oil is received from offshore platforms through 3 oil trunk lines. 30" MUT oil pipeline from Mumbai High and 24" HUT oil pipeline from satellite off-

shore platform are the principal feed stock to plant. Processed product is shipped out through Jawahar Dweep.

Figure 2.4 JAWAHAR LAL NEHRU PORT

2.4 POL CARGO

Mumbai Port and JNPT are handling varied oil and oil product cargo including imported crude.

List of oil being handled at Mumbai within the area of ops of this Plan are placed at **Appendix 1.**

2.4.1 Chemical characteristics of different oils and their implications

Though, chemical characteristics of crude oil and gasoline remain confined within a small range of variations , yet different oils within the category of that ' oil' have a particular chemical signature defining the chemical properties of that class of oils. This signature is of great help to responders while planning response strategy. The processes that the oil would undergo post spill in terms of weathering processes depends on these base properties and weather conditions in the area at the time of spill.

The base properties of an oil will determine the physical and chemical changes that would occur when the oil is spilled onto water and will account for its persistence and toxicity. For this reason it is essential to have handy the list of properties of oils being handled in the area.

Many oils have a tendency to incorporate seawater and form a water-in-oil emulsion, which can increase the volume by a factor of three or four, and the viscosity by several orders of magnitude. Oils with asphaltene contents greater than 0.5 per cent tend to form stable emulsions, called 'chocolate mousse', which are particularly difficult to handle.

To study the probable behaviour on water and implications regarding effectiveness of different types of on-water recovery devices and chemical dispersants, all particulars of oil are required to be available to responders.

Broad classification of oils as per MARPOL 73/78 is placed at **Appendix 2**.(The list is not to be considered comprehensive).

Major characteristics of different classes of oil are placed at **Appendix 3.**

3.0 RISK AND SPILL ASSESSMENT

3.1 HAZARD RATING

National Fire Protection Association (NFPA) has accorded ratings with respect to degree of hazard posed by chemicals being handled in port. The rating is in numbers with respect to flammability (Nf), health hazard (Nh) and reactivity (Nr) . The rating of hydrocarbons (higher number being more hazardous) are as per table 3.1 -

Product	Nf	Nh	Nr
HIGH SPEED DIESEL	2	0	0
CRUDE OIL	3	1	0
GAS OIL	2	0	0
SKO	2	0	0
NAPHTHA	3	1	0
MOTOR SPIRIT	3	1	0

Table 3.1 - Hazard Ratings

Flammability (Nf) 3 – Liquids and solids that can be ignited under almost all ambient temperature conditions

2 – Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur

Health (Nh) 0 - Materials which on exposure under fire conditions would offer no hazard beyond that of ordinary combustible material

1 – materials which on exposure would cause irritation but only minor residual injury if no treatment is given

Reactivity (Nr) 0 – materials which in themselves are normally stable, even under fire exposure conditions and which are not reactive with water

It is apparent that risks to human life in terms of flammability, health and reactivity are not very significant and can be handled with some degree of expertise.

3.2 CAUSES OF OIL SPILL

The common causes of spill are

- Cargo operations- loading, discharge
- Ship collision, or grounding
- Bunker/ fuelling operations
- Ship distress / sinking
- Pipeline ruptures /accidental spills from sub-sea/over the sea/shore approach (in the tidal zone) pipelines

3.2.1 Location of spill within the scope of this Plan

Based on the location of vessel at the particular time of incident within the area of operation, the likely spill could occure at any of the following locations

(i) Sea or in channel due collission etc during passage

(ii) Close shore due grounding or

(iii) Alongside at jetty or at the terminal during cargo operations

Not withstanding the above locations, it is possible that an eventuality occuring at sea like a collission or mechanical failure could lead to a situation where the consequences would be felt in some other location at a coastal location.

3.3 OIL SPILLS - HISTORIC DATA

Historic data, oil properties, climate, local meteorology and environmental sensitivities are important factors in assessing the risk, behavior, fate and potential consequences of spilled oil.

Historic data being secondary data available in public domain is a good measure of causes, probabilities and averages of the happening of any scenario.

Historic data is of great help to responders and Contingency Planners since the study of this data helps in identifying trends and causes of spills which in turn help in identifying and implementing remedial approaches as per the gravity and frequency of incidents and plan appropriate response .

3.3.1 Analysis and figures

ITOPF has carried out extensive studies on all aspects of oil spill and compiled statistics over number of years. The causes have been annalyised under two heads viz. operations and accidents.

The data establishes that most spills from tankers result during routine operations such as loading, discharge of cargo, bunkering and normally occur in ports or at oil terminals and the majority of these operational spills are small, with some 92% involving quantities of less than 7 tonnes.

Accidents involving collisions and groundings generally give rise to much larger spills involving quantities in excess of 700 tonnes. Figures for the period 1974 to 2013 for spills of < 7 tonnes and 7 -700 tonnes are as per table 3.2 and 3.2A.

OPERATIONS	Loading /	Bunkering	Other	Unknown	TOTAL
Collisions	2	2	14	167	185
Groundings	2	0	14	224	240
Hull failures	324	10	47	195	576
Fires &	50	5	35	83	173
Eqpt failure	1125	104	251	202	1682
Others/unknown	1655	444	921	1971	4991
TOTAL	3158	565	1282	2842	7847

Table 3.2 – Incidences of spill , < 7 Tonnes (1974- 2013)

OPERATIONS	Loading /	Bunkering	Other	Unknown	TOTAL
Collisions	5	0	51	298	354
Groundings	0	0	25	246	271
Hull failures	36	4	14	46	100
Fires&	8	0	13	25	46
Equipment		6	17	38	203
Other/	200	22	49	106	377
TOTAL	391	32	169	759	1351

Table 3.2 A – Incidences of spill, 7 - 700 Tonnes (1974- 2013)

An analysis of available figures point out that major spills from exploration and production operations are far less common than those from oil tankers that usually take place in harbour or at terminals during routine operations.

Over 75% of marine oil spills that have occurred world wide have been within port or harbor area during routine ship operations such as loading, discharge of cargo and bunkering. Most of these are small in nature and less than seven tons.

3.4 RISK FACTORS FOR OIL SPILLS - TERMINAL / PIPELINE OPS

In spite of best intentions to conduct cargo work under best practices, a spill could still occur at a port or terminal during cargo work because of the failure of pipelines, loading arms, flanges or equipment. The potential accidents associated with a plant, port, terminal or pipeline can be divided into two categories in terms of Generic and Specific operating failures.

Generic failures are associated with mechanical component of the facility or terminal like vessels, pipelines, pumps or compressors. The failures under this category could be caused by factors as corrosion, vibration or external impact. A small event like a leak may escalate into a bigger event by itself causing a bigger failure.

The prime cause of **Specific operating failures** is human errors but they can also include accidents.

Every significant mechanical component that could fail with its operating conditions, contents and inventory, is a contributor to failure identification. The study of Generic failures requires consideration of each component under their normal operating conditions.

The possible range of failures being large in number are generally considered under the following heads and incidents

For vessel/ storage tanks

Rupture (Full bore)

Large leaks (20%mm equivalent leaks)

Medium and small leaks (due to corrosion, impact and other such cases)

For pipelines

Full bore ruptures

Large, medium and small leaks

3.4.1 Failure frequencies - Pipelines

The failure frequency of pipelines is subject to a number of factors like rate of corrosion, age of pipeline, duration of use, size of damage and length etc. Different value of any of these will give different figures for failure frequency.

The data as per table 3. 3 gives the failures frequencies in relation to type or size of leak and represents the chances of occurrence of mentioned type of leak per unit length of pipeline per unit diameter .

TYPE	% of cross sectional	Frequency per year
Small leak	< 1	$2.8x10^{-7}$ L/D
Big leak	5	$1.2x\ 10^{-7}$ L/D
Catastrophic leak	20	$5.0x10^{-7}$ L/D
Rupture(guillotine failure)	100	$2.2x10^{-7}$ L/D

Table 3. 3 - Pipe leak frequencies as per size of leak

With respect to causes of leak as per the failure of different systems , the frequencies are as per table 3. 4

SYSTEM	FREQUENCY
Flow line, Hoses, Arm failure	Partial rapture – 1.25×10^{-5} /year
Main oil line	Total rapture – 18-24" line 1.76×10^{-5} / yr
Hose Joints	3.94×10^{-5} / year
Block Valve	3 – 11" – 1.08×10^{-4} /year
Flange joints	3-11" – $5.56x\ 10^{-5}$/ year

Table 3.4 – Frequency of system failures

3.4.2 Cargo Ops or Transfer Spill Frequencies

Transfer spill is defined as an event where the oil is released to sea due to failure or error during loading/ unloading of cargo or fuel oil. This includes loading in port and ship-to-ship transfer also. Typical causes for this spill include overflow, hose failure, errors in setting valves etc.

As per figures compiled by DNV, during 2000-10, ten transfer spills on oil tankers with known quantities were reported. The oil tanker exposure during this period was 74,471 ship years. Based on an average of 80 port visits per ship year, a total of 5.6 million cargo transfers were undertaken. This figure gives a transfer spill frequency of 1.7×10^{-6} per cargo transferred.

3.4.3 Spill Volume Calculations – Pipelines

The quantity of oil spilled can be calculated in terms of total rapture and also for pin hole leaks using software taking into account the diameter of hole and flow rate . The formula for total rapture calculation is

Volume of Spill = 2 Pie X Radius of Pipeline X Length of Pipeline X Flow Volume

3.4.4 ONGC Pipeline Damage

As per risk assessment carried out for ONGC pipeline from Mumbai High to Uran plant, as carried out through " Oil Spill Contingency Plan- Western Offshore Unit", the rates of flow and pressures are continuously monitored at the platforms and Uran Terminal and in case of a rupture, the pumping will be stopped. At the instant of rupture, the oil being under pressure greater than the hydrostatic head due to seawater, will escape to sea. Once the pumps are stopped, the line back pressure would force out more oil that would join the escaping oil.

The expansion of gases entertained will also displace some oil from the pipelines to join the oil escaping to sea. Eventually, the hydrostatic head of sea water would be sufficient to hold in place the oil remaining in the pipeline, thus preventing any further escape of oil to sea. In case of a partial leakage, the oil release rate would be 23 - 34 m3/hour and in the case of a total rupture, the size of spill will be 1900 - 3600 m3/hour approx. In the case of sub-sea flow lines, the maximum capacity of the longest flow line is less than 250 m3/ hour. Assuming duration of one minute, before the line is shut down the estimated quantity of spill would be 20 m3 only.

3.4.4 ONGC Pipeline spill estimates

The main 30" diameter oil line from Mumbai High Field to Uran shore terminal if ruptured would cause a major oil spill. Any rupture in the oil line will be indicated by sudden loss of pipeline pressure from farthest pumping Platform Control Room and reduction in quantity of oil received at Uran terminal. The size of spill near the point of rupture would enlarge with passage of time in the manner as illustrated in Appendix 4 (as per Regional Contingency Plan, (W).

The quantity of oil to be recovered will depend on the loss due to evaporation. Studies in the Arabian Sea indicate that at the wind speed of 20 knots and sea temperatures of 23 to 30 deg C the loss due to evaporation is approximately 50% within first 2 hours of Oil Spill. After two hours of exposure evaporation does not increases significantly. The studies further establish that after a lapse of two hours the loss due to evaporation is not very significant.

In case of total rupture of the 36" bay line running from Uran to Trombay, the pump will be shut down automatically within few minutes and the volume of oil spill will be around 20 m3 only. The areas affected would be Trombay, Thane Creek, Elephanta and Butcher Island area.

3.5 SHIP ACCIDENTS AND FREQUENCY OF OIL SPILLS

Taking in account the total of world fleet and collision accidents during the period 2000-10 , DNV has carried out an in depth analysis of frequency of ship collision each ship type and oil spill there from, to calculate the probability of accident and oil spills. The figures arrived at with respect to eventualities are as per table 3.5

3.5.1 COLLISION

(i) Collision frequencies – vessel types

SHIP TYPE	NON SERIOUS INCIDENTS	SERIOUS INCIDENTS (total loss)	TOTAL LOSS
Oil tankers	1.3E – 03	3.0E – 03	9.4E – 05
Chemical tankers	1.4E – 03	3.4E – 03	1.6E – 04
Bulk carriers	1.6E – 03	4.3E – 03	2.0E – 04
General cargo ships	1.4E – 03	4.7E – 03	6.3E – 04
Container ships	2.1E – 03	7.1E – 03	5.1E – 05
Fishing vessels	1.4E – 03	3.7E – 03	1.0E – 04
Other ships	4.8E - 03	1.4E - 03	7.6E - 05
All ships	7.9E – 04	2.3E – 03	1.9E - 04

Table 3.5 - COLLISION FREQUENCIES (PER SHIP YEAR)

(ii) Oil spill probabilities - Collision

TABLE 3.6 shows oil spill probabilities due to collision for oil tankers during 2000 – 10. These figures are based on oil spills with known quantities and include ships that were loaded and in ballast. Hence, the figures include a 50% probability of the ship being fully loaded and a 50 % probability of it being in ballast with only bunker fuel onboard.

SEVERITY	OIL SPILLS	OIL SPILL PROBABILITY (per collision)	OIL SPILL FREQUENCY(per ship year)
Total losses	3	0.43	$4.0x\ 10^{-5}$
Serious casualties (total losses)	33	0.15	$4.4x10^{-4}$
Non serious incidents	3	0.03	$4.0x10^{-5}$
Total incidents	39	0.12	$5.2x10^{-4}$

Table 3. 6 - OIL TANKER SPILL FREQUENCIES DUE TO COLLISION, 2000-2010

(iii) Oil spill frequencies- Ship types

With respect to overall spill frequencies due to collision for each ship type, the probabilities are as per Table 3.7.

SHIP TYPE	IN PORT (per visit)	IN RESTRICTED WATER (per km)	AT SEA (per hour)	TOTAL (per year)
Oil tankers	8.8E-07	1.2E-08	3.1E-08	2.6E-04
Chemical tankers	1.0E-06	1.3E-08	3.5E-08	3.0E-04
Bulk carriers	1.2E-06	1.7E-08	4.3E-08	3.7E-04
General cargo ships	1.6E-06	2.2E-08	5.7E-08	4.8E-04
Container ships	1.9E-06	2.5E-08	6.4E-08	5.5E-04
Fishing vessels	1.7E-07	2.2E-09	5.8E-09	4.9E-05
Other ships	4.1E-07	5.5E-09	1.4E-08	1.2E-04

Table 3.7 - FREQUENCIES OF OIL SPILLS - SHIP TYPES, 2000- 10

3.5.2 VESSEL CONTACT

(i) Frequency

With respect to oil spill post contact with other objects than ship or the sea bottom, DNV has done further calculations with respect to tankers. The noted frequencies are as per Table.3.8

SEVERITY	CONTACTS	CONTACT FREQUENCY (per ship year)
Total losses	3	$4.0x10^{-5}$
Serious casualties (exctotal losses)	45	$6.0x10^{-4}$
Non serious incidents	26	$3.5x10^{-4}$
Total incidents	74	$9.9x10^{-4}$

Table 3.8 - Contact frequencies on Oil Tankers, 2000-10

(ii) Spill Probabilities

A total of 11 cases of oil spills from tankers having been reported due to contact during 2000-10, the average oil spill probability arrived at is 11/74 = 0.15. Oil spill frequency is 0.15x9.9x10 (raised to power -4) = 1.5x10 -4 per ship year.

OBSERVATIONS - HISTORIC DATA

Supported by statistics and frequencies, it remains a fact that the spills do occur from all types of vessels and at all locations but with varied frequency and need to be handled post occurrence.

3.6 MAX CREDIBLE SPILL VOLUMES

Calculation of volume of pollutants that could be spilled and the volume that will need to be responded to is undertaken taking in account the following :

(i) The rate of release - Taking into consideration of whether the release is instantaneous or occurs over a period of time,

(ii) The spill duration - The time period over which the release of pollution is likely to occur,

(iii) Oil weathering and behaviour – Slick volume losses through evaporation and volume increase through emulsification.

3.6.1 Volumes for maximum credible case scenario

Australian Maritime Safety Authority (AMSA) has issued figures and indicative maximum credible spill volumes to be used if actual volume cannot be or have not been calculated. These have been promulgated through AMSA Gguidelines and are as per table 3.9 below.

Scenario			Basis of Volume Calculation
Source	Incident		
Oil Tanker[1]	Collision	Major[2]	Volume of two largest outside tanks + one adjacent inner tank
		Non major[3]	100% of volume of largest wing tank (i.e. not double hull) 50% of tank protected by double hull
	Grounding	Major[4]	Volume of largest two consecutive potentially impacted tanks
		Non major[5]	100% of volume of largest wing tank (i.e. not double hull) 50% of tank protected by double hull
Other vessel[6]	Collision		Volume of largest tank
	Grounding	Major[7]	Total fuel volume + Cargo
		Non major[8]	Total fuel of one tank
MODU/ Production Platform	Blowout		Predicted flow rate per day x days estimated to get a relief rig on site + 20 days to cap well
	Refuelling (continuous supervision)		Transfer rate x 15 mts of flow[9]
	Refuelling (intermittent supervision)		Transfer rate x 2 hours [10]
Onshore pipeline	Rupture		100% of maximum flow for 1 hour + volume of affected pipeline section [11]
	Leak(above LoD)[12]		2% of maximum daily flow x 4 days or time taken to detect, reach and repair leak[13]
	Leak (below LoD)		2% of maximum daily flow x 90 days or time taken to detect, reach and repair leak
Offshore pipeline	Rupture		Maximum daily flow rate x 1 hour + volume of oil in the pipeline[14]
	Leak		2% of maximum daily flow x 1 day + time taken to clear flush the pipeline with seawater

Table - 3. 9 Determination of volumes for maximum credible case scenario

1. As per Table 3.10
2. Assumes penetration of external and internal hull at the water line and based on the loss of contents of largest potentially impacted cargo tank.
3. Based on the loss of contents of largest outside tank (including fuel tanks). In the case of tanks protected by double hull a maximum potential loss of 50% of the contents is assumed.
4. Based on the total loss of the vessel.

5. Based on vessel with bottom tanks. If no bottom tanks are present then there is no anticipated volume loss.
6. If a supply vessel carrying fuel as cargo, treat as a tanker.
7. Based on rupture to all impacted tanks and/or loss of vessel.
8. Based on damage to one impacted tank. Note: If tanks cannot be holed, this scenario will result in no loss.
9. Estimated days to get a relief rig onsite should be supported by a Blow-out Management Plan or other documentation. Alternative strategies for well control may be used but should be supported.
10. If spills can only be to deck then volume held by scuppers etc. may be deleted from the total provided that this volume will be recovered.
11. Based on presence of leak detection system, block valves and automatic shutdown systems. Note one hour shutdown time may be reduced if effectiveness of systems can be supported.
12. LOD = Level of Detection, as stipulated by pipeline automatic detection systems.
13. Times taken to reach and repair leak sites may be reduced if shorter times can be demonstrated.
14. Based on ability to detect major faults but absence of block valves.
15. Assumes daily over flights that will detect sheens.

3.6.2 Maximum Credible Spill Volumes – Vessel Spill

International measures implemented through regulation 13 of MARPOL 73/78, have prescribed strict measures in Annex 1 that are required by industry and administration to be followed to mitigate oil pollution through modifications to design, structural requirements, and inspections etc.

Irrespective of size and tonnage, all tankers are required to have a series of wing and centre tanks that run along the length of the vessel to carry either cargo or ballast.

Measures to have SBT, double bottom tanks and narrow wing tanks and a wider center tank have been brought into force so that , in the event of a collision, the oil spill is limited to a particular tank only. Regulation 13G (4) of Annex 1 of MARPOL 73/78 specifies the requirements applicable to existing crude oil tankers of 20,000 tons DW and above and product carriers of 30,000 DW and above to reduce the accidental outflow of oil in the event of a collision or stranding.

Taking into account the limitaions and requirements imposed by MARPOL, the Impact of tanker size on credible spill potential in tonnes on vessels of different (tonnage as per studies carried out by IPIECA) would be as per table 3.10

Typical tonnage(DWT)	Slight grounding or collision (one wing tank)	Grounding with rupture(two wing plus one centre tank)	Bunker fuel
30,000	700	3,000	450
50,000	1,100	5,000	750
70,000	3000	12,500	1,800
1,00,000	5,500	21,000	2,300
2,00,000	10,500	45,000	2,750
2,40,000	15,000	60,000	4,000

Table 3.10 – Tanker size and spill potential

3.7 WORST CASE SCENERIO - OIL RELEASE FROM GROUNDING OR COLLISSION

Giving effect to provisions of MARPOL requirements and guidelines laid down under Annex 1 for evaluation of an alternattive tanker design concept, Marine Environment Protection Committee (MEPC) of IMO has carried out intricate calculations for oil outflow probabilities from actual tanker damage statistics and

tanker casuality statistics. The studies carried out under stringent assumptions to arrive at comparative standards of tanker design based on oil pollution prevention index, have computed the quantity of oil flow after side and bottom damages to the vessel for different conditions of tide and taking into account different damage posibilities.

The calculations can be considered the worst case scenerio for the particular type of damage since they are computed by applying the damage density distribution functions to determine each unique grouping of damaged compartments and the probability of oil outflow associated with that damage condition.

The volume of oil lost from a cargo tank assuming hydro static balance can be calculated as follows

$Zs.ps.g = g.zc.pc + 100\Delta p$

Where :

Zc = height of remaining oil in the damaged tank (m)

pc = cargo oil density (0.9 t/m3)

g = gravitational acceleration (9.81 m/s2)

Δp = set pressure of cargo tank pressure/ vaccum valves (0.05 bar gauge)

Zs = external sea water head above inner bottom (m)

ps = sea water density (1.025t/m3)

Taking into account that double bottom spaces below the cargo tank also hold oil, oil outflow is calculated .

The summary of oil outflow parameters arrived at for a vessel with 38491 m3 cargo capacity but loaded to 98% i.e 37721 m3 is as per table 3. 11 and 3.12.

Bottom damage	(40 %) 0.0 m tide	(50 %) 2.0 m tide	(10 %) 4.5 m tide	Combined
Probabality of zero outflow (P0)	0.8431	0.8431	0.8431	0.8431
Mean outflow (m 3)	2133	2752	3528	2582
Extreme outflow (m 3)	14767	18976	3528	17820

Table 3.11 - Oil outflow with bottom damage

Combined side and bottom damage	(40 %) Side damage	(60%) Bottom damage	Combined
Probabality of zero outflow(P0)	0.8380	0.8431	0.8411
Mean outflow (m 3)	4272	2582	3258
Extreme outflow (m 3)	30824	17820	23021
Mean outflow parameter (Om)			0.0864
Extreme outflow parameter (Oe)			0.6103

Table 3.12 - Oil outflow with side and bottom damage

For side damage, 100% of the oil in a damaged cargo oil tank is assumed to outflow into the sea whereas, for bottom damage, oil water in 50 % composition each is supposed to be retained in bottom tanks and can be calculated .

3.8 SPILL IN Mumbai HARBOUR - MODEL STUDIES

A number of spill model studies have been carried out by National Institute of Oceanography (NIO) for various locations within the area of operation of this CP to study the movement and trajectory of oil post spill . These studies include

1. OIL SPILL RISK ANALYSIS AND CONTINGENCY PLAN FOR BPCL, Mumbai, AUGUST 2003

2. OIL SPILL RISK ANALYSIS AND CONTINGENCY PLAN FOR JNPT, NAVI Mumbai, OCTOBER 2008

The results of these studies have been used in this Contingency Plan (Section 3.9 to 3.11), wrt to movement of oil

3.9 MOVEMENT AND TRAJECTORY STUDIES - Jawahar Dweep and Pir Pau jetty

The results are obtained by running the data on computer model Hydrodyn – OILSOFT, taking into account the actual weather conditions. A number of model studies to test the validation of tides and currents had also been carried out. The results obtained for tidal elevation and tidal currents at various points at JD, Pir Pau Jetty and Vashi (though different at these locations), agree with the tides measured at these locations and validate all the data. The results of model study are as per table 3.13 and as mentioned below.

It is observed that Trombay and surrounding areas are vulnerable to spill oil reaching during SW monsoon, whereas Vashi and surrounding areas are vulnerable during NE monsoon, for quantum of spills studied during modeling. Post monsoon, the areas at Mora coast are vulnerable to spill reaching the coast

3.9.1 Location – Jawahar Dweep – Jetty 2 and 4

Channel location close to JD jetty 2

Pir Pau jetty

3.9.2 Spill Scenarios

Instantaneous spill – 700, 25000 tons each of crude and furnace oil

Continuous spill – 2200 m3/h of crude and furnace oil for 15 minutes at Pir Pau

3.9.3 Oil types

Crude

Sp Gr – 0.9

Viscosity – 6.5 at 37.8 C

Wax content 12-19%

Furnace oil

Sp Gr 0.95

Viscosity 6.5 at 37.8 C

Wax content 12 – 19 %

3.9.4 SW Monsoon Period (May – September)

The behaviour of oil spilled at JD2, JD4 or at Pir Pau will be the same. 60 % of spilled oil will reach the coast within 2 to 4 hours. The likely area of impact for spills of less than 700 tonnes is Trombay coastal areas.

3.9.5 NE Monsoon (December – February)

During this period, the most vulnerable areas, where oil will have an impact are Vashi and east coast of Thane creek. 60% of spilled oil will reach the coast within 2 to 6 hours. For spills of higher magnitude, the impact zone would extend to 10 kms at Vashi coastline.

3.9.6 Post Monsoon

During this period, the oil spilled at jetty 2 and 4 would not reach the coast and will move west towards open seas, but any spill at Pir Pau jetty and JD4 will reach the coastline at Mora on the east coast of Thane creek within 4 to 6 hours.

Spill location	Spill volume (t)	Losses (t)			Time to reach Coast (hours)			Coastal impact		
		SW	NE	Post Monsoon	SW	NE	Post monsoon	SW	NE	Post
Jetty 2	700 crude	100	120	100	3	3.5	3	Trombay	Vashi Thane creek	To sea
	25000 crude	8000	7500	7000	4	5	4	Trombay	Vashi Thane creek	To sea
	2200m^3/h for 15 mts, continuous, crude	650	630	600	14	13	10	Trombay	Vashi Thane creek	To sea
Jetty 4	700 crude	100	120	90	14	13		Trombay	Vashi Thane creek	To sea
	2200m^3/h for 15 mts, continuous,	600	630	500	12	13	5	Trombay	Vashi Thane creek	To sea
Pir Pau	700 furnace	100	120	140	3	4	8	Trombay	Vashi Thane creek	Mora coast
	10000 furnace	2500	2600	2700	4	5	8	Trombay	Vashi Thane creek	Mora coast
	2200m^3/h for 15 mts, continuous,	600	630	730	12	14	15	Trombay	Vashi Thane creek	Mora coast

Table - 3.13. Oil spill matrix and impact areas – Mumbai Harbour

NOTE. In case of spill being in the approach channel near Jawahar Dweep, the areas of Elephanta Island are also likely to get affected by spilled oil.

3.10 MOVEMENT AND TRAJECTORY MODEL - JNPT

To study the spill movements, a spill scenario of 400 tonnes oil was run on the model. Based on oil spill analysis occurring at the jetty and along the pipelines, it is observed through trajectory modeling that a FO spill of 400 t will spread over an area of around 300 mtrs. within 2 hours.

Post spill movement analysis and oil spill impact , volumes and areas are as per Table 3.14 and 3.15.

3.10.1 Spill location

Container terminal at JNPT

3.10.2 Oil type - Furnace oil

Sp Gr – 0.92

Surface tension – 3.0 e – 03

Molar volume – 0.002

Viscosity – 275 cst at 37.8 deg C

Wax content – 12-19 %

Pour point of untreated crude – 30 deg C

Pour point of treated crude – 18 deg C

3.10.3 Pre - monsoon (January)

It is observed that during the pre monsoon period, the spill will move to south west towards open seas and will reach the open seas. The area of spread oil will differ depending on the surface quantity.

3.10.4 Monsoon period (July)

During this period, the spill will move towards port boundaries and part of it will move towards Sheva island crossing reclamations and mangrove forest areas within 1 to 2 hours.

3.10.5 Post monsoon (October)

During the post monsoon period, most of the spill will reach Mora at Karanjia Island. Part of the spill will move to south west open boundaries to reach within 15 to 24 hours.

JNPT Container terminal	400 t FO	% reaching port / open seas	Pre monsoon	Monsoon	Post monsoon
			81	89	80
		Extent of oiling in port/ open sea boundaries (mtrs)	1050	600	1200

Table. 3.14. Post spill movement analysis

Facility	Spill quantity	Losses		Time to reach coast / open seas (hrs)	Amount of oil on surface	Area of impact / movement
JNPT container terminal	700 t FO	Pre monsoon	5	17	355	Crossing to SW
		Monsoon	6	5	364	JNPT
		Post monsoon	4	24	346	Manora

Table. 3.15. Oil spill impact , volumes and areas

3.11 MODEL PREDICTIONS – ICMAM and NIO

Apart from above studies, ICMAM , Chennai as well as NIO have carried out model studies of the spill assuming leakage rate of 3 t/hr over 3 days. ICMAM has used OILMAP to predict the movement and spreading of spilled oil and ADIOS to evaluate the weathering processes at spatial and temporal scales in the Mumbai Harbour – Thane Creek model domain, while, NIO has used Hydrodyn-Oilsoft software with the project domain extended to coastal area between Versova and Revdanda up to a distance of 25 km from the coast.

The results in both cases predicted that the spilled oil would hit the shores of Colaba, Uran, JNPT, Vashi, Trombay, Sewri etc. within the Mumbai Bay. The results of NIO study also predicted the pollution of coastal areas south of the Bay mouth namely Mandva, Kihim, Alibaug etc within 3 days of the spill. These predictions broadly match the feedback of field observations made during Environmental and pollution studies undertaken post collision of vessels in Mumbai Harbour in 2010.

4.0 FATE OF SPILLED OIL AND SPILL ANALYSIS

The physical and chemical characteristics of spilled oil change almost immediately when spilled in the marine environment due to evaporation, dispersion, emulsification, dissolution, oxidation, sedimentation and biodegradation. All of these processes that set in together are collectively referred to as oil weathering and decide the final fate of spilled oil and quantities that would need to be removed physically. An uncertainty in a trajectory fore-cast builds over time due to these processes that the spilled oil goes through.

If the oil is persistent and does not vaporizes immediately or disperses and comes ashore, than the costs in terms of cleanup, damages and economic loses can be considerable.

4.1 WEATHERING PROCESSES AND TIME SCALES

Some of the weathering processes that spilled oil goes though and the time duration of these processes which are important for emergency response and need to be taken into account by the responders are placed at **Appendix 5.** The details of the processes that the spilled oil goes through and which affect the response activity are as under -

(i) Evaporation

The amount of oil evaporated post spill depends on the oil properties, wind speed and water temperature. Generally light refined oils like gasoline or jet fuel, evaporate faster than heavier products such as heavy crude oil. While most of the gasoline would evaporate in few hours some crudes being more persistent in the environment much of the product would be expected to remain on the water surface even after long duration.

(ii) Dispersion

The action of breaking waves can drive small droplets of oil into the water column. If the droplets are small enough (diameters less than 50-70 microns) natural turbulence in the water prevents the oil from resurfacing. The smaller drop-lets that stay in the water column are considered dispersed.

Dispersion is an approved procedure for removing oil from the water surface and is undertaken by application of dispersants to oil. However, with some conditions can be put forth by local administration for application. The amount of oil dispersed depends on properties of oil (the viscosity and surface tension, in particular) and water conditions.

Oil products with low viscosity, like gasoline or kerosene, are more likely to disperse into the water with breaking waves than a high-viscosity oil, like an IFO 380 or a heavy crude. Therefore, the dispersed fractions of gasoline or kerosene can be relatively large in heavy seas.

A possible treatment of oil spills is to spray the slick with chemical dispersant. Chemical dispersants enhance natural dispersion by lowering surface tension.

(iii) Dissolution

Dissolution begins immediately and is likely to continue throughout the weathering process. The loss of petroleum product from dissolution is minor when compared to the other weathering processes.

Less than 0.1% (very heavy oil) to 2% (gasoline) of the spilled oil volume actually dissolves into the water column. However, the components of oil that dissolve into the water column are often more toxic to the environment.

(iv) Emulsification

For many crude oils and some refined products, weathered oil reaches a stage where water droplets get mixed into the oil - forming a water-in-oil emulsion or "mousse." The emulsion can contain as much as 70 to 90% water, so that the combined volume of oil and water mixture required to be handled by responders could be much higher than the volume of original spill.

The ability to form an emulsion depends on water conditions and the chemical properties of oil. Oils with high wax and asphaltene content emulsify easily in sea conditions with breaking waves and leads to an increase in viscosity of the spilled product.

Generally, oils weather a certain amount before forming an emulsion. Although the onset of emulsification may take several days, the emulsification itself can occur within a few hours and classified by their stability. In unstable emulsions, water and oil separates easily under calm conditions with warm temperatures. In stable emulsions, water remains in the oil for weeks to months.

(v) Sedimentation

Sedimentation is defined as the adhesion of oil to solid particles in the water column. In this process, the oil gets absorbed onto sediments in the water column to find its way eventually to bottom .

Turbulent waters with high sediment load (~500 g/m3), such as a fast-moving, muddy river, can move the oil through the water column within hours of the initial release, while, waters with low sediment load (< 5 g/m3), as in open seas, will allow oil to remain on the surface much longer (weeks), spreading the slick over a wider area.

(vi) Photo-oxidation

This process occurring due changes to chemical and physical properties of spilled oil and sets in because of exposure to sunlight and is limited to the surface of oil, resulting in a thin, crusty ”skin” on slicks and tar balls. The “skinning” of oil, limits evaporation because the lighter oil components can no longer diffuse through the surface of the slick. Photo-oxidation may increase the ease of emulsification and is considered a long-term weathering process taking weeks to months.

(vi) Biodegradation

The spill is finally removed when the oil biodegrades. The microbes that degrade oil occur naturally in the environment. The rate at which the organisms degrade the oil depends on the properties of water, oil and microbial activity. This process is thought to occur over time scales of weeks to years.

4.1.1 Calculation of Weathering losses

The spilled oil being subject to above mentioned factors is amiable to loss in terms of quantity and also an increase in volume due emulsification.

Considering a spill of 700 tonnes of Bombay High Crude at Mumbai harbour (the maximum quantity required to be addressed by this Plan) in the month of May and the climatic conditions prevalent during the time, the various parameters and details of losses calculated through ADIOS- the spill software and the volume remaining to be manually addressed of 700 tonnes would be as per **Appendix 6.**

4.2 OIL THICKNESS AND APPEARANCE OF SLICK

Oil slicks form very thin films on open water. Depending on the properties of the product, the thickness can range from a tenth of a micron to hundreds of microns. The colour of oil film post spreading is a good measure of quantity of oil that may be contained within the slick.

When direct light from the sun contacts a very thin oil film (<0.1 micron; µm), much of the light is reflected back to the observer as gray or silver sheen.

If the film is thicker (perhaps 0.1 to 3 µm), the light passes through the film and is reflected off the oil-water interface and back to the viewer . The observer will then see a film that can range from rainbow to darker-colored sheens.

For very thick films (> 3 µm), the light is absorbed and the slick appears dark-colored (i.e., black or brown) to the observer. However, the viewer can no longer determine film thickness based on color. If the slick is dark-colored, the observer cannot tell whether the film is 3 µm or 100 µm thick.

In order to quantify oil thickness, the following is used as guidelines

Appearance	Thickness
Silver Sheen	0.0001mm
Rainbow sheen	0.003 mm
Light brown/ Black slick	0.1 mm
Dark brown/ Black slick	more than 1 mm

To determine an approximate quantity of spilled oil, the following formula is used

$$L \text{ (Length of slick) meters } X \text{ W (Width) } X \frac{\text{Thickness (mm)}}{100} = \text{Cubic meters}$$

The extent of spread in terms of length and breadth along with % of area showing a particular colour as per thickness can be used for calculation of quantity of spill through spill calculation soft ware. An illustration is placed at **Appendix 7.**

4.3 MOVEMENT OF OIL

Spreading and advection are the two major processes that transport oil on water. For small spills (<100 barrels), the spreading process is complete within the first hour of the release, whereas for bigger spills the spreading process could continue for larger durations of time.

Winds, currents, and large-scale turbulence (mixing) are advection mechanisms that transport oil to large distances. For calculation purposes, the oil movement is estimated as the vector sum of the wind drift (using 3% of the wind speed) and 100% of the surface current.

Spreading

The spreading process occurs quickly and for most spills, mostly within the first hour. In open waters , winds, currents, and turbulence act on and move the oil.

Spreading occurs faster for lighter and for less viscous oils in warm water temperatures and for warm oils. The slick does not spread uniformly but will often have a thick part surrounded by a larger, but thinner sheen. About 90% of the oil is found in 10% of the slick area . A spill is likely to keep spreading until a thickness of about 0.1 mm is reached. At this stage breaking up of slick into windrows is an important source of further spreading.

5.0 CLIMATIC CONDITIONS

Forecasting the movement of an oil spill depends on availability of accurate and reliable input data, particularly location, volume lost, product type and environmental conditions like wind and current observations and forecasts.

Therefore, it is important to have all the climatic and weather information available for the area of operation. The climatic conditions and hydrographic features of area of operation of this CP that are of importance to responders are as mentioned here under.

5.1 TEMPERATURE AND RAINFALL

The temperature starts rising from March and May is generally the hottest month of the year with mean daily max temperature of 32.9 degree C. With the onset of monsoon by about first week of June there is an appreciable drop in temperature. The month of January is the coolest month of the year with mean daily maximum and minimum temperatures of 29.1 and 19.3 degree C.

The region is subject to a regular seasonal climatic variation determined by the occurrence of two annual monsoons. The South-West monsoon period extends from June to September. Most of the annual rainfall occurs during South-West monsoon, the average monthly rainfall being about 45 cm. Rain during the North-East monsoon is slight.

The average rainfall in the area is about 2422 mm and annual mean number of rainy days is about 77.8. The period between June to September receives nearly 95% of the seasonal rain. The monthly variation in temperature, humidity and rainfall is as per table 5.1

Month	Temp (Max) ^{0}C	Minimum ^{0}C	Rainfall(mm)	No of rainy days average
January	30.6	16.4	0.6	0.3
February	31.3	17.3	1,5	0.1
March	32.7	20.6	0.1	0.1
April	33.1	23.7	0.6	0.3
May	33.3	26.1	13.2	1.2
June	31.9	25.8	514.1	15.4
July	29.8	24.8	868.3	23.5
August	29.3	24.5	553.0	19.1
September	30.1	24.0	306.4	12.8
October	32.9	23.1	62.9	3.7
November	33.4	20.5	14.9	1.0
December	32.0	18.2	5.6	0.3

Table 5.1 – Temperatures and rainfall in Mumbai Harbour

5.2 WINDS

General direction of wind is from the North to the West quarter, with seasonal variations are as per table 5.2.

Months	Directions	Speeds
1. Feb-May	Mainly from N.W.	(Max. 8 to 10 Beaufort Substantial 4-6 Beaufort)
2. June-Sep	Mainly from W.N.W.	(Max. 8 to 10 Beaufort Substantial 6-8 Beaufort)
3. Oct-Jan	Mainly from N.N.W.	(Max. 6 to 8 Beaufort Substantial 2-6 Beaufort)

Table 5.2 – Wind directions

Winds are generally light to moderate with some increase in force in the summer and monsoon seasons. During January to May winds strengthen in the afternoon. In the southwest monsoon season winds are mainly from west or north east. During rest of the years, winds are north easterly to easterly in the mornings and blow from directions between south west and north west in the afternoons. Summary is as per table 5.3

Month	Wind speed (knots/hr)
January	9.1
February	9.3
March	10.4
April	10.5
May	10.0
June	12.8
July	14.8
August	13.4
September	10.0
October	8.5
November	8.2
December	8.5
Total/average	10.5

Table 5.3- Wind speeds in Mumbai Harbour

5.3 VISIBILITY

In general, on the West Coast, above latitude 16° N sometimes mist develops during sunrise but disperses thereafter. From November to March, this area is prone to occurrence of smog clouds over land thus obscuring visibility. This happens only for short periods most often shortly after sunrise but also occasionally in the evenings. Visibility is generally good for most part of the year.

5.4 Ph VALUE

The pH value within the harbour surface samples is 8.0 to 8.3 at surface and 8.0 to 8.2 at the bottom. The water quality is slightly alkaline.

5.5 TOTAL DISSOLVED SOLIDS (TDS)

The TDS levels in the surface waters vary from 20,920 mg/I to 24800 mg/I. In bottom samples TDS values vary from 20900 mg/I to 24800 mg/ I.

5.6 WAVES

The predominant waves are the swell waves generated by deep sea storms. These mainly arise just before and during the South West monsoon. The statistical analysis indicates that most wave periods fall between 6 seconds and 10 seconds.

During the continuance of the North-East monsoon, North-Easterly winds known as "Elephantas" blow for short durations during the months of October-November. As the fetch and duration of these winds are limited, the "Significant height" of the resulting waves is not likely to exceed 1 meter with period ranging from 3 to 5 seconds.

The predominant wave direction during monsoon is from south west to west. During this period, waves of 4 to 5 m height normally occur, however, waves of 8.0 m height and period of 14 seconds have also been reported. October and November are transition periods during which the predominant wave direction changes to north and north east. During December and January the waves mainly occur from north to north east and from February to May waves predominantly come from the north west quadrant. The summary of wave data is as per table 5.4.

Parameter	Value	
	1 Year	100 Years
Significant Wave Height	0.6	1.6
Significant Wave Period	10.0	10.0
Max. Wave Height	1.0	3.0

Table 5.4 – Summary of Wave Data

5.7 TIDES

The quality of water-spread area of the Bay is mainly influenced by tides which induce flushing and dispersion of pollutants entering the system. The tides in Mumbai harbor are characterized by occurrence of two high and two low waters with marked diurnal variation in the levels.

The monsoon freshwater flow, though important in flushing the inner zone, is not high enough to cause significant changes in the hydrography of the outer Bay. Tides (1.2 - 5 m) in the region are semi-diurnal type with an appreciable diurnal inequality. The flood tidal front advances in north-easterly direction and ebbs to south-west.

The dominant tide in the *Mumbai Harbour* is the semi-diurnal tide with a period of 12 hours and 40 minutes. Table 5.5 gives the particulars of tidal levels related to Chart Datum.

Tide	Above(+) or Below(-) Chart Datum
Highest High Water recorded	+ 5.39 m
Mean High Water Spring Tides	+ 4.42 m
Mean High Water Neap Tides	+ 3.30 m
Mean Sea Level	+ 2.50 m
Mean Low Water Neap Tides	+ 1.86 m
Mean Low Water Spring Tides	+ 0.76 m
Lowest Low Water recorded	- 0.46 m
Highest Low Water	+ 2.74 m

Table 5.5 – Tides in Mumbai Harbour

Statistical studies indicate that all high tides exceed + 2.70 m. and about 5% of all high tides would be less than + 3.20 m.

Variations in tides in Mumbai estuary are as per table 5.6 .

Location	Range (m)		Time lag from Apollo Bunder (min)
	Spring	Neap	
Apollo Bunder	5.0	1.6	-
Pir Pau	4.3	1.4	10 - 15
Vashi	4.2	1.2	10 - 30
Airoli	4.9	1.6	12 - 45
Thane	4.9	1.5	15 - 60

Table 5.6 – Tide variations in Mumbai Harbour

The tidal range decreases markedly up to Vashi as compared to that at the Apollo Bunder but increases in the inner creek, the range at Thane is only marginally

lower than that at Apollo Bunder. This increase appears to be due to the funnel shape geometry of the Bay that is conducive for accumulation of seawater with the advance of tidal front in the lower creek. The tide at Thane lags by 30 to 45 min with respect to the tide at Apollo Bunder with the lag more pronounced for neap tide.

Spring tides are important for spill response as oil beached during this time is likely to remain stranded on the upper portion of the shoreline until the next spring tide (about 14 days) or storm event. If there is a storm surge during a spring tide, the oil can remain stranded for a much longer period.

5.8 CURRENTS

The currents in Mumbai harbor and the near shore zone are tide induced with reversal at high and low waters. The current strength ranges from 1.5 to 3 knots.

Current speeds and directions within the Bay and associated tributaries are largely due to the tidal movements and show little variation from non monsoon to monsoon. The maximum current speed in the outer Bay exceeds 1 m/s and the variation in the water column at any given time is not significant.

Lateral variations in the speed however occur with current in the eastern area being somewhat stronger. The maximum current speeds decrease in the inner creek and are typically around 0.8 m/s, decreasing markedly during neap tide.

As characterized for a tide dominated system, the alongshore components are fairly strong with the dominance of seaward component while cross-shore components are relatively weak. Their relative magnitude and directions are indicative of net seaward movement over a tidal cycle though shoreward drift can be significant around the change of tide.

Excursion lengths and average current speeds observed for the Bay based on the available drogue trajectories are as per table 5.7.

Tide	Excursion length (km)		Av current speed (m/s)	
	Flood	Ebb	Flood	Ebb
Spring	11.5	11.5	0.5	0.55
Neap	5.5	6.0	0.25	0.3

Table 5.7 – Tide excursion at Mumbai Harbour

Excursion lengths during flood and ebb are more or less of a similar magnitude as expected for tidal creeks devoid of large volumes of external water inputs. The overall circulation pattern suggests that the pollutants entering the creek upstream of the bridge at Vashi tend to oscillate within the creek system and flushing to the sea is a delayed process. These pollutants would however be considerably diluted under the influence of tide induced turbulence and advection.

During monsoon however, the creek receives voluminous land run-off and the discharge of near freshwater through the Ulhas estuary, which flushes the inner creek to a large extent.

Current and tidal streams being of importance to study movement of spilled oils, the details thereof are mentioned here under.

5.8.1 Tidal stream (currents) on approaches to Mumbai Port

In approaches to Bombay' tidal streams are much influenced by winds and heavy rains. The rate of spring streams between Thal reef and Prongs Reef, 41/2 miles NNW is from 2 ½ to 3 knots and may attain 4 knots in rainy season.

Through the channel the tidal stream does not set fairly but is generally as under.

(i) In- going stream

The in-going stream, off the SW end of Prongs Reef, sets first in an ESE direction, but as the rate increases it changes to NE; there after E of the reef as far as Sunk Rock (18" 53''5 N, 72d 50'0E) it sets NNE.

Between Thal shoal and a position 4 miles WNW the in -going stream sets between ESE and ENE turning more N as the rate increases.

The in-going stream sweeps E over Thal Shoal. The in -going stream, in East Channel Swatch {18" 47'.5 N, 72d 49'5 E) sets NNE as it crosses the mouth of Dharmatar Creek 5 miles ENE.

(ii) Out going stream

The out going stream during the SW monsoon rains sets strongly W out of Dharmatar Creek. On the N side of the entrance to the harbour the stream sets S W from Sunk Rock until abreast Prongs Reef, from where it sets W changing to SSW as the rate increases.

The stream sets SW between Thal Shoal and a position 4 miles WNW. On the S side of the entrance to the harbour, the stream first sets WSW across Dharmatar Creek entrance altering towards SSW on nearing Thal Shoal then almost S as it goes further.

5.8.2 Tidal stream (currents) in Mumbai Harbour

Tidal stream within the port sets with rates of ¾ to 3 knots as follows

(i) East side of the harbour- In going stream

The stream sets North East abreast Karanja Island setting more ENE after passing Karanja beacon. Between Jawahar Dweep (JD) and Elephanta Island the stream sets N but towards Trombay island it becomes NE.

(ii) West side of harbour- In going stream

The stream sets NNE from Sunk rock to Cross island with a rate of 2 kn, north of Tucker beacon where the stream separates, a branch of it turns north until abreast Mazagaon Dockyard. Then the stream sets between NE and ENE to join the stream from the E side of the harbour N of Butcher Island.

(iii) East side of harbour- Out going stream

The stream starts later here than on the West side of the harbour.

The stream sets SW from the channel between Butcher Island and Elephanta Island along the NW coast of Karanja island. When abreast the entrance to Dharmatar Creek it sets WSW.

(iv) West side of harbour- Out going stream

The stream at ordinary tides starts 30 to 45 earlier than on the E side of the harbour. During strong spring tides the stream on the w side may start 40 minutes to 1 hour earlier. Inshore and near Indira dock wall during the SW monsoon, the stream starts about 45 minutes before Bombay high water.

The stream sets SW from Trombay Island to Mazgaon Dockyard and sets SSW from abreast Cross Island to W of Middle ground Islet. In the middle of the harbour, the set is S to SSW. The set is between S and SSW from Middle Ground Islet to Sunk rock but with the start of this stream the set off Sunk rock is more W going.

5.9 Model simulation and validation

A number of model studies to test the validation of tides and currents have been carried out. The results obtained for tidal elevation and tidal currents at various points at JD, Pirpau Jetty and Vashi , though different at these locations, agree with the data mentioned above.

6.0 ENVIRONMENTAL SENSIVITY

Spill movement predictions will determine which areas are under immediate threat from the slick after which the protection priorities will need to be determined, since it is unlikely that all the areas under threat can be successfully protected at the same time. The importance of the area both ecologically and socioeconomically is taken into account.

Areas such as coral reefs, mangroves, fish nursery areas, bird and turtle breeding areas are ecologically important. At times these areas are also socio-economically important. Other areas such as beaches and other facilities being recreational areas are also important and also provide revenue to the community.

Water intakes for industry or for inland aquaculture practices, shipyards and ports are commercially important but have limited biologically importance.

6.1 ENVIRONMENTAL SENSITIVITY MAPPING

Environmental Sensitivity Index (ESI) maps provide a summary of coastal resources that are at risk if an oil spill occurs in vicinity. Examples of at-risk resources include birds, shellfish beds, sensitive shorelines (such as coral reefs), and public beaches and parks.

Shorelines are color-coded to show their sensitivity to oil. Warm colors indicate the most sensitive shorelines, and cool colors indicate less sensitive shorelines. Large habitat areas (such as tidal flats and wetlands) are shown as polygons filled with a pattern of appropriate color. Symbols mark locations important to spill responders, such as areas where birds or sea mammals congregate or breed areas where different kinds of birds concentrate for feeding or nesting, and areas used by people.

Three kinds of information shown on the ESI maps are based on

(i) Shoreline ranking

Shorelines are ranked according to their sensitivity to oil, the natural persistence of oil, and the expected ease of cleanup after an oil spill. The ranking scale goes from 1 to 10.

Lower rankings represent shorelines that are less susceptible to damage by oiling; higher rankings become more likely to experience damage by oiling. A rank of 1 represents shorelines with the least susceptibility to damage by oiling. Examples include steep, exposed rocky cliffs and banks. The oil cannot penetrate into the rock and will be washed off quickly by the waves and tides.

A rank of 10 represents shorelines most likely to be damaged by oiling. Examples include protected, vegetated wetlands, such as mangrove swamps and saltwater marshes. Oil in these areas will remain for a long period of time, penetrate deeply into the substrate, and inflict damage to many kinds of plants and animals.

Shorelines on Environmental Sensitivity Index (ESI) maps are color-coded based on sensitivity to oil. Shorelines that are least susceptible to oil are ranked as 1 and are color-coded dark purple on ESI maps. Shorelines that are most likely to be damaged by oil are ranked as 10 and appear in red.

ESI shoreline rankings are defined using factors that influence sensitivity to oil including:

- Relative exposure to waves and tidal energy
- Biological productivity and sensitivity
- Substrate type (grain size, permeability, trafficability, and mobility)
- Shoreline slope

- Ease of cleanup
- Ease of restoration

A list of shoreline classifications for Environmental Sensitivity Index (ESI) maps for three types of environmental settings mentioned below along with colour coding is placed at **Appendix 08.**

(ii) Biological Resources

Categorizes and displays oil-sensitive animals and their habitats that are themselves sensitive to spilled oil (such as coral reefs). Each kind of animal has a designated color. Accordingly, the locations where each species is found is indicated using point symbols and/or polygons marked with appropriate colour.

Species that are especially vulnerable to the effects of oil spills are classified into seven general categories, such as Bird, Fish, and Marine Mammal. The categories are then further divided by grouping species together by similar taxonomy, morphology, life history, and/or sensitivity to spilled oil.

When a biological resource exists in a small area (such as a bird nesting site), it is indicated by a symbol. When a biological resource encompasses a larger area, it is represented by a polygon with a specific pattern and colour.

The table for all categories for biological resources and how the information is displayed on ESI maps are placed at **Appendix 09 and 9A.**

(iii) Human Use Resources

Human-use resources that may be either negatively impacted by an oil spills or used as access points for oil spill cleanup are typically marked with a symbol. Most human-use features (such as public beaches and aquaculture facilities) exist in a small

area and are represented by human –use point symbols. Larger areas such as parks, preserves, protected areas, and wildlife refuges are shown as polygons.

All categories of human-use resources displayed on ESI maps are placed at **Appendix** 10.

6.2 GEOGRAPHICAL & TOPOGRAPHICAL SENSITIVITY

The area of operation of this Plan i.e Mumbai harbour is enclosed by three districts of Maharashtra namely, Thane, Raigad and Mumbai. The shoreline shows variation with respect to sediment type, form and gradient and accordingly shows difference in shoreline energy and wetland use and distribution. The shoreline is a mix of exposed tidal flats, mudflats, sheltered rocky shores and thick mangrove vegetations.

The coastal stretches of Mumbai and the region around are variable with a number of creeks and bays. The creeks stretch deep inland and are a shelter to varied fauna and diverse commercial activity along the shoreline. The creek shores are thickly populated in stretches.

Historic data available with respect to pollution of shoreline in Mumbai estuary shows that differences in physical environment such as degree of exposure to waves and currents and geomorphic features like the terrain, greatly influence the distribution and persistence of pollutants. The pollutants are not able to flow out to sea but remain confined within the stretches of estuary.

In areas where the shoreline consists of sandy type of sediment, the movement of sand due to tidal action results in mixing of pollutants to deeper levels at impacted areas, thus increasing the persistence of pollutants being retained in the terrain for longer times increasing the risk of Environmental and biological hazards.

The major shoreline features are as per figure 6.1

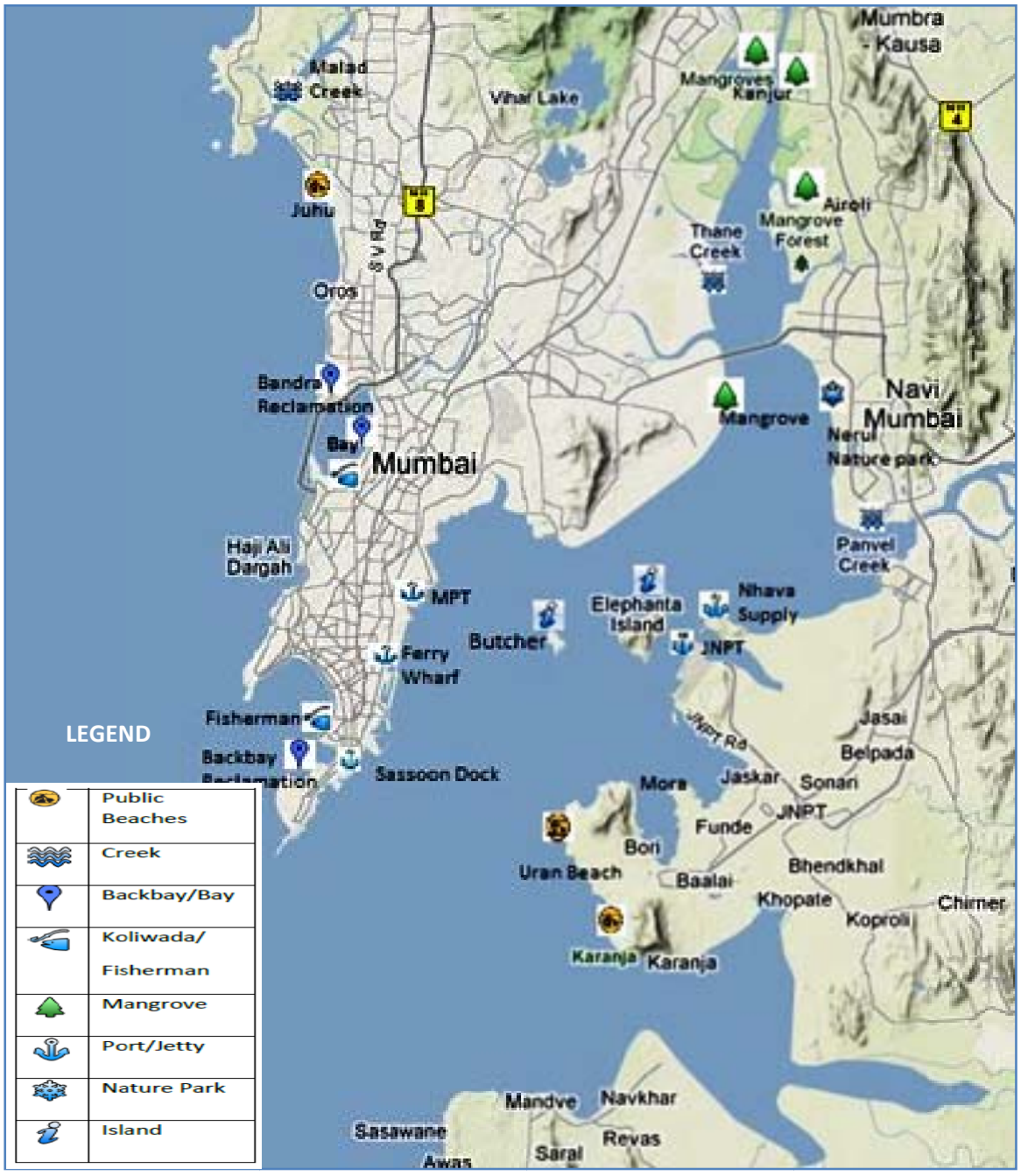


FIGURE 6.1 – Mumbai Sensitive areas - Overview

6.3 Shoreline sensitivity

Mumbai Area presents a high concentration of different kinds of sensitive zones to be protected or accorded priority. These zones under different classifications are –

(i) Ecological

Sewri – Mudflats
Thane Creek – Mudflats, marshes and mangroves
Nhava Sheva – Mudflats, marshes and mangroves
Mora – Marshes
Karnja – Mudflats and vegetation
Butcher Island North point - Mudflats and vegetation
Kolaba point - Prong Reef

(ii) Agricultural

Karanja – Crops
Mora – Rice Field

(iii) Fishing

Mumbai Inner Bay
West Coast of Mumbai
Panvel Creek (Oysters)

(iv) Industrial

Trombay Shore line (Water intakes to Refineries & nuclear plant)
Mumbai Harbour Installation
Mora (State Marshes)

(v) Tourist and Recreational

West Coast of Mumbai Beaches (Juhu – Mahim)

The area being large with varied coastline features and different commercial activities, is divided into sections for the purpose of Environmental Sensitivity. Maps indicating location of sensitive areas are placed at **Appendix 11.**

(i) Thaal knob - Navapada

Thaal knob - Ranjankhar Davali (West bank - Mouth of Dharmatar creek)

The extreme western part of the stretch (Mandva) is a sandy and rocky beach at geographical location 18°47′57.61″N, 72°55′56.42″E with a coastline length of approximately 8-10 km .

The jetty at Mandva is in use with boats plying regularly to Mumbai. The area has a sandy beach with minor rocky stretches. There are sand beaches on the side of the jetty with thick mangrove growths. The Geographical position of the jetty is 18°49′15.21″N, 72°56′47.58″E. The sediment in the area is mud and sand. Large swathes of mangrove stand along both sides of the Revas jetty and also in the creek- lets.

Ranjankhar Davali (Dharmatar creek) to Navapada

The area is a small bay with three creeks originating to east, south and south east. The creek stretching south to a distance of appro 8 kms up to Mothe Bal on the eastern bank is Dharmatar creek and has thick mangrove vegetation and mud flats. The second creek originating from within this bay and running inland south west is Patalganga river. The third creek running east is Karanja creek. All the creeks have thick stretches of mangrove vegetation.

The complete stretch from RK Davali to Navapada - situated on the southern end of Uran island, has thick growths of mangroves and mudflats and is not assessable from sea or shore. The mouth opening between RK and Navapada jetty is 1.8 km approx. (Appendix 11)

(ii) Navapada - Mora jetty – Juna Sheva Road (BPCL jetty)

(a) Navapada - Mora jetty

This stretch is a part of Uran Taluka. The geographic position of Uran is 18°52´42.45" N, 72°56´26.83"E. The stretch from Navapada to Mora consists of 3 fine sand beaches at Uran Pirwad, Uran Nagav and Kegav. The beaches are visited by large number of people and are popular spots. The stretch from Kegav to Karanja is hilly with rocky coastline and stretches of vegetation. ONGC Mumbai High pipeline land fall and other facilities are situated off Uran Pirwad beach.

The stretch has 3 jetties one each at Navapada, Karanja and Mora. The jetty at Navapada, situated at north entrance to Dharmatar creek has regular traffic with Mandava. The two jetties situated on north coast of Uran i.e. south extent of Mumbai Harbour have regular ferry service to Mumbai.

Mora jetty is in public use while the other at Karanja is under naval control. The sediment type of the area around Mora jetty is flat sandy and rocky (bed rock), while Karanja Land end to the east has thick growth of mangroves. There is thick mangrove vegetation along Mora jetty and Uran beach. One of the biggest extents of wetland tracts and mangroves in this part of India lies in this area. The area has developed into a special economy zone and has a large number of industries, namely JNPT, P&O, GTI and other shipping companies.

The stretch is accessible by road with certain stretches well connected with road running along the shoreline. The area is home to birds such as the Egrates, Carmorants, Seagulls and Crows. Crustaceans like crabs are also found over rocks and sediments. (Appendix 11A)

(b) Mora jetty - Juna Sheva road , JNPT

This stretch comprises of a small estuary and inlet running south from Mora Jetty or land head to Funde village and then north up to Panje Land Head and is named Boripkhadi, the stretch continues from Panje Koliwada further East up to starting of Juna Sheva road. The area consists of mud flats prone to flooding during high tide and is not accessible. The area has some of the thickest vegetation of mangroves in India and varied bird life. The Uran mangroves, about 60 km from Mumbai, are a vast stretch beginning from the northern end of Palm Beach Road in Navi Mumbai, up to Funde village in Boripkhadi. The mangrove area is considerably large, dominated by two species i.e. *Avicennia marina* and *Sonneratia alba*.

The small bay from Panje Koliwada to beginning of JNPT road leading to BPCL jetty, has thick mangrove vegetations. Reliance tank farm is situated on the western portion of this bay along the road. (Appendix 11B)

(iii) JNPT - Nhava - South entrance to Panvel creek (Sector 51)

The stretch from Juna Sheva to JNPT Nhava consists of the port and large number of associated manmade structures with metal approach roads and connections. The geographic position of the port is 18°56´56.00”N, 72°56´57.32”E. The port comprises of alongside berths and Sheva POL terminal being operated by BPCL and IOC. The port is the 6th largest port and largest container port in India.

The geographical position of Nhava island is 18°57□28.5□N and 72°59□11.45□E and Sheva is 18°56□05.34□N and 72°57□39.98□E .

The stretch extending from Nhava - where the facilities for ONGC vessel berthing and store supplies for Bombay high are created a tank farm is situated, is approximately 8 kms in length with mudflats and mangroves. The small water stream running south between JNPT and Nhava forms extensive JNPT backwaters that are thick in vegetation and mudflats. The internal areas of this small back water are not accessible either from Nhava or JNPT.

The complete stretch has thick mangrove vegetation and sea life. The stretch from Shivaji Nagar to Sector 3 on the south entrance to Panvel creek though well developed in terms of public utilities and manmade structures, the shoreline is muddy and has thick mangrove vegetation. Sector 51 forms the north entry point to Panvel creek. The shoreline is low lying mudflats with thick mangrove forests. Mangroves stretch inland along the Panvel creek on both banks to a considerable distance. (Appendix 11C)

(iv) Sector 51 to Vashi village

Sector 51 land head forms the north entrance of Panvel creek . The creek extending east is heavily polluted. The north entrance i.e. sector 56 to Vashi village is a strait stretch comprising Palm Beach road. Though, the road runs parallel to the coast, the areas west of the road are mudflats and thick with mangrove vegetations. The stretch has a few small sandy beaches.

The complete stretch is well developed in terms of man made structures.(Appendix 11D)

(v) Vashi village (E bank of Thane creek) to Vikhroli (W bank of Thane creek)

Thane Creek is part of the estuary of Ulhas River opening into Mumbai Harbour. It comprises the area stretching from Mumbra Retibunder to Mankhurd- Vashi Bridge. The creek (Lat 19 d 00 to 19d 15'N and Long 72d55' to 73d e) is connected to Ulahs river estuary (Lat 18d45' to 19d00 N and long 72d 45'N and 73d 20'E) in the north through a narrow shallow channel and is amongst the largest marine bodies in an enclosed area in India.

The Creek is one of the 500 significant bird conservation sites in India. With its rich natural resources and mangroves, the creek is home to over 205 species of birds. Rare birds such as whistling teals, golden plover, grey plover, hoopoe and avocet can be sighted here. Among the major waterfowls spotted here include lesser flamingo, greater flamingo, Asian open bill stork, white stork, pied avocet, eastern golden plover, ruddy turnstone and dunlin. The creek is recognized as an Important Bird Area by the Bombay Natural History Society being home to flamingoes and several other migratory and wading birds.

Water quality analysis of the creek and Ulhas estuary show increasing evidence of pollution due to anthropogenic discharges from surrounding areas. Areas between Balkum, in the north end of channel connecting the two water bodies and Vitawa has become a dead zone as per a 2006 report from the Municipal Council. However, the complete stretch has thick growth of mangrove vegetation.

Both sides of Thane creek have thick population and comprises of the areas of Bhandup, Kanjur, Vikroli and Airoli . The sediment is muddy in this area. The creek-lets have abundance of birds like Cranes and Egrets.

The area has thick mangroves along the eastern banks of the creek and Palm Beach road banks. Vashi- Thane creek cover a stretch of dense canopy of mangroves strands with a dominance of Aveccinia marina species in the fore-front of eastern banks.

As per NEERI report 2002, the creek has very low assimilating capacity. The waste water dispersed through the polluting units along the creek is not getting fully flushed. At the confluence of Thane creek and Ulhas river in the north, the basin of Thane creek is constricted and the geometry is such that water from Thane Creek is not getting discharged efficiently into Ulhas River during low tide.

The area is well developed and an industrial stretch. **(Appendix 11E)**

(vi) Vikhroli to BPCL refinery to Haji Bandar

Vikhroli stretch is a hook area of Thane creek comprising of regions of Vikhroli apart from Trombay and Mahul. The seabed sediment is largely muddy with some salt panes close to north extremity at Vikhroli. The stretch from Vikhroli (close to old Thane Creek bridge) to BPCL refinery comprises of mud flats and thick mangrove vegetation.

Pir Pau jetty - working chemical cargo is an extension stretching South into the Mumbai harbour from the land head adjacent to BPCL refinery. This stretch from BPCL refinery to Haji Bandar comprises of Mahul, Trombay, Sewri and Wadala. While, the inland area is well developed, the coastline is highly polluted and has large mangrove vegetation. BPCL tank farm is situated at Wadala and atomic power plant at Trombay.

A stretch of about 15 acres of mangroves exists between Sewri and Trombay. **Appendix 11F and G.**

(vii) Haji Bandar to Navy Nagar

The area includes shoreline of Mumbai port, Naval harbour, Colaba and INS Kunjali with geographical position 18°53□42.39□N and 72°48□35.07□E . The area is the hub of economic activity with thick population and embankments. Sasson dock is used by local fishing fleet for their activities and is the landing point for most of the fish for Mumbai.

The shoreline from INS Kunjali up to prongs reef light is mainly covered with bedrock, boulders and pebbles with few area covered with sandy sediment.

6.4 OBSERVATIONS

Overall, the area from Thal knob to Panvel creek is varied and marked by number of creeks, thick mangrove vegetation, mudflats, salt pans, JNPT installations and number of landing points. Public utility and marinas etc are not there.

The coastline from Panvel creak stretching north into Thane creek is highly developed in terms of manmade structures and has large extents of mudflats and thick mangrove vegetations. Thane creek is home to a number of species of birds and is ecologically sensitive.

The area from Vikhroli to BPCL complex though well developed in terms of man made structures has large stretches of shallow mudflats with mangrove vegetations. The further stretch up to Prongs reef is the hub of commercial activity and includes Mumbai Port and installations and number embankments like Gateway of India and Naval Harbour. The area from INS Kunjali to Prongs is rocky also comprising boulder shoreline.

6.5 PROTECTION PRIORITIES

While, it may not be possible to protect all the resources at the same time, the areas that need to be provided priority are

(i) Areas with presence of Mangroves
(ii) Elephanta island landing point
(iii) Entrance to Thane creek
(iv) Entrance to Naval and Mumbai port
(iv) Salt pans

PART II

RESPONSE OPERATIONS AND ORGANISATION

7. OPERATIONS AND RESPONSE STRATEGIES

Area of operation of this Plan being confined to Mumbai and JNPT Harbour all responses and actions would get limited to coastal zone and within the estuary.

Recommended action of NO RESPONSE as practised for off shore zones where the spill originates at a considerable distance from the shore and where movement is subject to a number of factors is not an option.

Taking into account the fact that the area of concern of this Plan is located within Mumbai Harbour where the spill would most likely originate alongside, at anchore or in the channel, taking of immediate action is a certanity.

7.1 RESPONSE ACTIONS

Response actions are required to be initiated by responders at the first notice or information about the spill. While, availability of all data and study of different parameters that affect a spill as compiled into this Plan are of benefit further acquisition of data can take place concurrently to launching of response operations.

Major actions that would be required to be taken when a spill occurs are mentioned below. While, some actions like containment are required to be initiated immediately following a spill, some actions like shore line clean up etc will get initiated in due time. The purpose of fast response is to minimize hazards to human health and environment. The following response are accordingly addressed through the Contingency Plan and Operations Manual :

- Stoppage of discharge and containing spill within a limited area,
- Defining size, position and content of spill, direction and speed of movement and likelihood of affecting sensitive habitats,

- Notification to private companies or government agencies responsible for cleanup actions ,
- Movement of trained personnel and equipment to site,
- Initiation of Response activity,
- Ensuring safety of response personnel and public,
- Oil removal and disposal.

7.2 OPERATIONAL PRIORITIES

Early hours of a spill being crucial and important for operations, all personnel involved with response, cargo operations, port or terminal have to be aware of the priorities to be followed. While, some of these actions are to be initiated and undertaken by responders, some actions would need to be initiated by personnel involved in cargo operations or persons ashore in case of clean up operations. The OPERATIONAL PRIORITES ARE

1. Stoppage of discharge. This action of primary responsibility can be achieved by terminating cargo operations, removal of vessel to a less vulnerable area, lightering of cargo, stopping the spill by patching , transferring the cargo to other undamaged tanks if possible and booming the ship with spill containment booms to retain the oil from spreading.
2. Prevent released oil from moving to shore. This would involve the use of mechanical means to contain the oil and remove it. It could also involve application of dispersants to floating oil keeping in view the area sensitivity.
3. Initiating action to protect sensitive environmental systems such as estuaries, mangroves, marshes or areas of high economic value. The containment activity could involve booming of the area or using deflection techniques to cause the oil to bypass sensitive areas to lesser sensitive areas. The activity could involve

closing the entrance to harbour or estuary , covering exposed walls with plastic sheets until the danger of contamination is over.

4. Removal of pooled oil from coastline. The coastline can be used as a natural boom to collect and pool the oil. In case of stranding of oil on shore, different processes would be required to be undertaken remove it. Where ever the use of mechanical means can be resorted to provide higher rates of recovery, priority to removal from the beach is to be accorded.
5. Removal of contaminated materials such as vegetation, trash, collected sorbents etc. after loose or liquid oil is removed.

7.3 OPERATIONS MANUAL / FIELD GUIDE

The strategy for handling a particular spill at terminal or at sea will be dictated by the OPERATIONS MANUAL. The Manual aims to provide information on the response measures to be taken in a particular spill situation and is a guide to deployment of equipment (and their limitations) and spells the philosophy of containment, recovery, spill cleanup and disposal with respect to different locations and origin of spill. Sections relevant to response operations covered in detail in Manuals (though not in mentioned sequence) are

- Containment – laying of booms and configurations
- Recovery – skimmers and their technical capacities
- Coastline cleaning – methods required to be used for different type of topography
- Disposal – of collected oil and debris

Ops manual would be used as an aid in contingency actions and would be available to all responders.

7.4 LIMITING AND ADVERSE CONDITIONS

(i) Weather

Weather, sea conditions and time factor play an important role in oil spill response operations. While, operations could continue at terminal or at the jetty most of the time, operations at sea would be largely restricted during night hours and sea conditions.

The area of operations of this CP is subject to rough and severe weather conditions during SW monsoon i.e June to September end. An appreciable weather change in the area is subject to heavy rains, high winds and waves. The sea conditions being rough, it is not possible to mount sustained operations or deploy equipment at the harbour mouth or in the channel. However, it is possible to continue operations at MbPT, JNPT, PP and JD, though at a restricted scale.

Best use of good weather windows would be required to be made to mount operations.

(ii) Terrain

A large portion of the area being mudflats is not accessible from sea and is constrained by availability of depths for vessels to approach.

(iii) Site approach

Certain areas specially mudflats and mangrove vegetations stretching long distances are not approachable by road or tracks from the shore.

(iv) Other limitations that might need consideration while planning response activity could include the following:

- Safety factors including vessel limits, night movements, risk of fire and explosion, toxicity (oil contact/inhalation/ingestion) and hazardous environments such as fast flowing rivers and steep terrain.
- Environmental conditions that can influence logistics including inclement weather, hazardous terrain and accessibility including condition of roads.

7.4 RESPONSE STRATEGY

Within the scope of this Plan, a response action required to be mounted could be at any of these locations

(i) Sea or channel, incident due collission etc during passage,
(ii) Close shore due grounding or stranding,
(iii) Alongside at jetty or at the terminal during cargo operations.

It is feasible that a casualty occuring at sea like a collission or mechanical failure could lead to a situation where the consequences would be felt in some other location or at a coastal location due movement of pollutants from the site of incdent.

The factors that would dictate immediate and long term strategies to deal with the spill are

(i) Location of discharge,
(ii) Spill movement and likely fate of spilled oil,
(iii) Time window available for response before hitting the coastline,
(iv) Nature of shoreline and priority for protection.

Keeping in account the location of spill, the response will required to be initiated either at the jetty / terminal or at sea and guided by OPERATIONS MANUAL. The actions required to be initiated would be immediate and long term depending on a study and analysis of spill movement.

7.4.1 Jetty/ Terminal /Vessel response interface – Jawahar Dweep, JNPT, Pir Pau

The reason for the spill would most likely be a failure of loading arm, flange or any failure on board. The operations being subject to facility operating procedures and as per facility manual, termination of operations is expect to be addressed at first notice. Port ship interface emergency checklist for use in case of oil pollution emergency is placed at Appendix 12. The check off list can be used for terminal operational procedures and guidelines also.

The spilled oil contained on the terminal/ jetty will be handled manually. While, use of vacuum pumps could be made, the absorbents will be required to be used to collect the spilled oil. In respect of oil released or introduced into water, response as per water body procedures are to be initiated.

7.4.2 On water response

The spill at sea could occur at anchorage or in channel due any eventuality or accident. An oil spill occurring due damage to vessel is a point source spill which would need to be addressed earliest. Taking into account the fact that a multiple response may be required, the vessel and responders will have to mount a rapid reaction.

(i) Vessel response

While, the first action is expected of the vessel operator in containing the spill by way of plugging of leak as far as possible, the first action of the response team is to be to contain the spill by placing booms attached to ships hull to isolate the damaged area. Recovery of spilled oil would also be required to be undertaken simultaneously.

(ii) OSRO response

The response team being stationed afloat with equipment placed on response vessel, would deploy the equipment to contain the spill. In the event of the spill originating from the ship side, the containment will be handled by placing booms along the ship side.

In case of a large spill, the actions to lighter the ship or transfer the cargo will be initiated by the port authority or ship owners.

While, Containment and recovery would be the preferred option, the other alternatives like dispersion could also be put to use subject to local restrictions.

7.4.3 Use of dispersants

Though, use of dispersants is not a much recommended option, there may be situations where the application may be required to be under taken. In a situation of priority response, where the spill is likely to hit a sensitive area, limited use of dispersants would be undertaken in accordance with the Guidelines issued by Coast Guard.

Application is to be dictated as per the procedures, calculations and methodologies recommended by Operations Manual. List of dispersants approved by Coast Guard for application is placed at **Appendix 13.**

7.4.4 Coastal and shoreline cleanup

The coastal stretches off Mumbai harbour are varied in terms of ecological sensitivity; with large stretches of mangroves inter spread with sandy beaches and rocky shores. Mumbai estuary shows differences in physical environment, the degree of exposure to waves and energy levels and currents. Geomorphic features like the terrain greatly influence the distribution and persistence of oil.

While, the first priority would be to stop the ingress of oil onto the coast, still the requirement of coastal or beach cleaning operations cannot be ruled out. The local administration being responsible for shore cleaning activity is to be notified in time about the movement of spill and advised about the strategy to be adopted.

Tactical beach cleaning ops are to be conducted as per the physical properties of the terrain with respect to retention of oil. Operations are to be guided as per OPERATIONAL MANUAL parameter.

Some stretches might require booming like at naval port and at Elephanta Island.

8.0 EQUIPMENT, SUPPLIES AND SERVICES

The typical response equipment required for mounting an operation consists of equipment for water response and shoreline operations and could include :

Off shore	**Shoreline**
Booms	Shovels
Skimmers	Diggers/loaders
Absorbents	Drums / skips
Sprayers & dispersants	Trucks/tankers
Radio communication	Plastic sheeting
Boats / tugs / response vessel	Protective clothing
Pumps / hoses	Communications
Tanks/ barges/storage	Control room
Aircraft	Transportation

8.1 LOCATION

(i) Off shore operations

The equipment required for response in terms of containment, recovery and disposal will be maintained at Jawahar Dweep and onboard the Oil Spill vessel. The equipment maintained on the vessel will be the first to be deployed for containment and would be augmented by movement of additional equipment as required by the situation. Details of total equipment held at these two locations is as per **Appendix 14.**

(ii) Shoreline operations

Shoreline operations will be undertaken by local civil administrative as per their contingency Plan. Taking into account the spill movement and area sensivity, the

equipment will be mobilized along with manpower to the site by the local administrative authority. The procedures laid down in Operations Manual will be available for reference to clean up teams along with expertise held with responders.

8.2 ADDITIONAL EQUIPMENT AND RESPONSE

While, the equipment held with response team will be available for initial and first response, the additional requirements would be met from equipment held by participating companies being addressed by this Plan.

In the event of a decision being taken by the team managing the spill, the equipment held with the participating units will be made available to response teams. The details of equipment held at different locations are placed at **Appendix 15.**

In the event of an ongoing spill or a spill that requires declaring of Tier 2 or 3 response, the additional equipment and manpower held with any other OSRO or facility will be sourced in an accelerating manner including resourcing from the international spill handling companies. Contact details of companies holding equipment in India and International OSROs are placed at **Appendix 16**.

8.3 INSPECTION, MAINTAINANCE AND TRAINING

As a matter of policy and prudence all equipment required for spill response is to be maintained at highest degree of readiness. For this reason, it is desirable that the equipment be periodically tried and tested through dry runs apart from actual deployment for training purposes.

Identified member/s of the response team will be responsible for maintenance and operational status of the equipment. In the event of an OSRO being appointed, the equipment will be maintained by the person appointed by OSRO as per laid down

schedule for each equipment, with records maintained as per preventive maintenance cards.

8.3.1 Exercises and drills

The purpose of exercises and drills is to test the knowledge of persons and members associated with response activity and maintain them in the highest state of readiness and professional competence. The exercises would aim to assess acquaintance of response teams with operationability and initiation of Plan and also the knowledge of operational parameters.

For this purpose it is required to conduct both in house training and evaluation exercises and also multi agency co-ordination exercises.

In addition to classroom training, the responders would need to go through regular internal and external exercises that would include deployment of equipment to demonstrate level of proficiency. With respect to management of operations in consonance with the plan, it is desirable to conduct real time CP exercises with all industrial stack holders involved. Such an exercise conducted at a large magnitude would need to incorporate the staff from MbPT, JNPT, Participating Oil Companies and the Indian Coast Guard and scheduled as mutually agreed.

The purpose of exercises and drill would be to check the following :

1. Organizational and Planning
a. Knowledge of Contingency Plan and Procedures
b. Personnel Notifications and Staff Mobilization
c. Ability to operate as per CP and Operations Manual
2. Operational Response
a. Oil spill assessment

b. Response equipment selection

c. Containment strategies

d. Spilled oil recovery techniques

e. Disposal of recovered oily water and contaminated material

3. Response Support

a. Communications

b. Logistics

c. Personnel support

d. Documentation

9.0 ORGANISATION

While, any response activity is envisaged to be undertaken by qualified team members on the ground, the larger issues of management of operations are to be handled by a core team of senior persons related to port operations.

The core operational team discharging the functions of incident control, administration and management is designated as Crisis Management Team/s (CMT) operating from the identified control center located in the Port Administrative building.

Apart, from the designated CMT, another senior level team designated as Core Management (CMG), headed by the respective head of MbPT, JNPT and ONGC will get activated in times of major spill crisis that may require liaison with senior level state, center authorities or other agencies. Apart from the respective head of organization, the other team members will be the heads of departments mentioned in 9.2.1. The functions of CMG will be the same as CMT (as mentioned in 9.1.1) with a view to provide support to operations in terms of administrative requirements. CMG will assemble on the recommendation of Chief Incident Controller.

This Plan formulates the policies and strategies to be followed in case of a response and to be executed on the ground by CMT along with response team or Oil Spill Response Organisation (OSRO).

The operational spill prevention provisions of this CP will be discharged by three CMTs - headed by Chief Incident Controller, one each for the area of jurisdiction of MbPT, JNPT and ONGC. Duties and responsibilities of all the three teams would largely remain the same- as spelled in this CP, with additions and amendments undertaken by each team as per operational situation and requirements particular to their area of

operation. Each team would be responsible for operations in their respective area of jurisdiction.

9.1 MANAGEMENT AND MANPOWER

Management, execution and delegation of teams to undertake duties with respect to discharge of this Plan and any other function that may come to notice is the responsibility of the respective Chairman, of Mumbai Port, JNPT and Head of ONGC establishment for their area of jurisdiction or any other person, persons or organization specifically appointed in writing or by identification through a notification or administrative order. Such delegation and notification will form an inherent part of this Plan-post issue.

While, the three respective heads will be the functional authority with respect to execution of this Plan, Chairman MbPT will be the custodian and administrative head of the Plan with respect to revisions and amendments as per recommendations of other members.

9.1.1 **Major functions of Crisis Management Team**

The major functions that would need to be carried out by CMT to discharge the Plan are as per table 9.1

Field ops	Initiation, Control of Operations and response activity Emergency Control room functions Implementing tired response and disposal Shoreline cleaning (when initiated through this CP) Planning and strategy
Admin and logistics	Victuals Transport Additional manpower and equipment Security
Technical matters	Cargo ops, availability of response items, repairs
Liaison	Communication- operational and with other Government / non govt. authorities , Media
Legal	Documentation of damages, claims and compensation, notifications
Health and safety	Medical assistance

TABLE 9.1 Major functions of Crisis Management Team

9.1.2 **Functional Designations**

Following functional designations stand identified and notified through the Plan, to give effect to this Plan:

(i) Crisis Management Team
(ii) Chief Incident Controller
(iii) Incident Controller (On Scene Commander)
(iii) Incident Manager / OSRO Manager
(iv) On Scene Co-ordinator / Response Specialist
(v) Responders

9.2 EXECUTION OF PLAN

Post activation, the execution of the Plan is to be carried out by following teams by giving effect to mentioned functions

9.2.1 Crisis Management Team and assembly

The team is the primary unit for incident management and is composed of senior managers from various departments for providing advice and resources and take 'on the spot decisions' to meet any immediate requirements arising during the response.

The composition of the team with respect to required functions would be to meet the requirements mentioned in 9.1.1 above and as per table 9.2

A typical organizational chart that usually gets followed in the event of a large spill response is placed at **Appendix 17**.

Details, composition and contact details of three CMTs (as detailed vide section 9) for operations in respective area of MbPT, JNPT and ONGC are placed at **Appendix 18, 18 A,B and C**.

	DESIGNATION	FUNCTIONS
	Chief Incident Controller(C IC)	Head, CMT (presently identified to be HM) Initiation, conduct and control of operations Emergency control room and response Implementing tired response and disposal Planning and strategy
	Incident Controller(IC)	On Scene Commander
	Member Admin & Finance	Admin and logistics Victuals / Financial reports and closing Transport Additional manpower Communication
	Member HSE & Media	Security, Medical advice and attention, Security and liaison
	Member legal	Legal advice, Damage compensations
	Member Tech	Technical matters
	Incident Manager / Manager OSRO	Incident administration
	OSRO/ Response Specialist	OS Co-ordinator

TABLE 9.2 Crisis Management Team Composition

NOTES

(i) Multiple duties and responsibilities as mentioned above can be assigned by IC to one or more persons as required,

(ii) In the event of multiple response operations, any response team member may be assigned the duties of OSRO specialist / OSCo-ordinator (OSCo) for that part of the operation,

(iii) Assembling of Crisis Management Team will depend on the severity or extent of incident, while, a major incident may require the whole team to assemble, a comparatively small spill may require part of team only to be assembled or may require action only of incident management team or operations team,

(iv) Assessing the gravity of spill, the Chief Incident Controller may call the whole team or part of team to assemble at Crisis Management Center,

(v) CIC may assign the responsibility or duty to administer or manage a small spill or part of spill to an Incident Controller (also termed On Scene Commander) - the person responsible for operational control of that part of the port or terminal. Accordingly, the appointed IC (OSC) will carry out the duties of CMT/CIC as mentioned in 9.3.1. However, CIC is to be kept informed of all actions taken and being planned by IC.

(v) Crisis Management Team being a permanent standing team of the Port authority remains identified and nominated at all times. The team members can be assigned a fixed tenure or duration, to be replaced in due time with other members competent to carry out the CMT duties.

(vi) **All CMT members are expected to keep themselves fully aware of all the contents and requirements of this Plan and to be aware of demands likely to be made on them in discharge of CMT functions.**

9.2.2 Operations and Response Team/ Teams

Incident operations and response team comprises of CMT or part thereof, as decided by CIC as per the magnitude of spill (Reference 9.2.1 Note iii). While, the CMT would be activated to meet in the event of a major accident, a comparatively small incident may need only limited action of CMT to be performed by a part of team.

i. **Chief Incident Controller (CIC)** - Harbour Master (H M) is nominated permanent Chief Incident Controller irrespective of the magnitude of spill. While, in the event of a large spill, major decisions and duties are expected of him to be discharged along with CMT, in the event where the spill can be handled by response team alone, the incident will be handled by Incident Controller (IC)(Reference 9.2.1, Note iv). **The appointed IC will carry out the functions of On Scene Commander for the operation.** However, the CIC is to keep account of the operation and ensure to be kept informed.

ii. **Incident Manager (IM)** – is a member appointed by HM or respective CMT leader to undertake the responsibilities associated with administration of operations and giving effect to decisions arrived at by CMT. He is to ensure timely execution of demands and decisions with a view to provide continuity to operations. To facilitate ease of operations and administration, a permanent IM is to stand nominated at all times by HM or CMT leader.

In the event, the response activity is assigned by the port to an OSRO, the OSRO will appoint a manager in addition to Incident Manager to undertake the responsibility of meeting the demands of response teams.

iii. **Operations Response Team (OSRO specialist/ Responder / OSCo)** - The response team is to have a permanent status and is to be nominated by CIC on behalf of CMT. The team would comprise of persons specifically nominated on account of their experience of response operations, their qualification or expertise in the matter. The nominated members could be employee of the port or any department in addition to nomination to response team. Being of permanent status, the details of identified members are to be available at Communication and Operations Center at all times and

are to be inserted as a temporary enclosure to this plan. All responders are to be qualified in term of having undergone IMO Level I course.

The functions of response team can be assigned to an identified and qualified OSRO also. In such an event of nomination, all functions with respect to response team and On Scene Co-ordinator will be carried out by the OSRO or OSRO representative, while, CMT and CIC will continue to function hitherto.

Response resources like equipment to be deployed having been identified in terms of quantity and location, additional resources like spill response vessel (SRV) and work boat etc along with responders would be as per identification and notification by CMT leader. In the event of an OSRO being assigned the responsibility to provide resources, OSRO will have to mobilize the different units.

The response team is to comprise of a Manager, Specialists, responders, response workers apart from the crew of the vessel or work boat assigned to response duties. The team and additional resource composition is

(i) Incident Manager / OSRO Manager
(ii) OSC- Incident Controller/On Scene Co-ordinator
(iii) SR Vessel and Captain
(iv) Responders
(v) Vessel crew
(vi) Work boat, master and crew

Additional responders or additional teams could be assembled during response ops as the requirement demands.

9.2.3 Shoreline clean up team

Shoreline clean up is usually the last of the response activity undertaken either at completion of response actions or at times in consonance with afloat actions as the situation demands.

While, the response is expected to be taken by the local administrative authority, there may be reasons and requirements that the same may be required to be undertaken by the port or facility. In such an event, the team or teams as required is /are to be nominated by CIC on behalf of CMT under the supervision of shoreline clean up advisor. The team response will be in accordance with the beach type response as dictated by Operations Manual.

The members of CMT will be responsible for providing support, equipment, advise and resources in the same manner as being provided to afloat operations team.

9.3 DUTIES OF CMT AND OTHER STAFF

CMT is constituted to provide support to operations, whether being carried out by nominated responders or by an OSRO. The primary duty of CMT is to provide logistics, equipment and resources to the operations.

All decisions taken by the CMT are to be logged with all details by the person appointed by CMT for providing administrative support.

9.3.1 CRISIS MANAGEMENT TEAM/ CHIEF INCIDENT CONTROLLER (CIC)/ IC

ANY ACTION/S UNDERTAKEN BY ANY TEAM OR MEMBER TO ACHIEVE THE OBJECTIVES OF THIS PLAN WOULD DEEMED TO HAVE BEEN TAKEN BY THE TEAM HAVING BEEN FULLY AUTHORIZED BY THIS PLAN.

In the event of a spill requiring response , Chief Incident Controller (CIC) as head of the CMT, supported by CMT is required to discharge the below mentioned responsibilities or part thereof as the situation may demand. The responsibilities are not exhaustive or all inclusive and could be amended or added to as the situation may demand.

Any of these responsibilities or part can be assigned by CIC to any other team member or members as the situation may require. Taking into account the operational demands, the CIC may nominate any members to be part of a team to carry out any of the CTM functions mentioned below. All actions undertaken by the members of the CMT are authorized by this Plan.

The responsibilities required to be discharged by CMT/CIC include

- Ensuring availability of mechanism in terms of manpower, equipment and infrastructure at all times to man Crisis Control room and receive reports of spill
- Receive details of incident from Port control/ OSRO control room, Incident Controller(On Scene Commander)/On Scene Coordinator
- Assess magnitude of incident and assemble CMT or part thereof as required
- Confer with IC/OSRO - S or and determine the most effective method of dealing with the spill
- Provide assistance to response team, IC/OSRO - S for surveillance of slick
- Ensure detailed recording of events
- Decide on safety & security of men and incident site in consultation with IM/OSC
- Liaise with OSC and team leaders for availability of resources and progress of response operations
- Mobilise additional response team members and equipment as may be required by OSC
- Coordinate response efforts between OSC and CMT

- Provide support to operations in terms of manpower, equipment, vehicles, watercrafts and other resources etc. (Sourcing of items not available is to be discussed with CMT for procurement and supply with demands justified.)
- Make weather forecast reports available to COC for further dissemination to response teams for both afloat and ashore operations
- Decide on requirement of medical cover
- Decide on mobilization of shore cleanup operations in consultation with OSC and advise state administration, if required
- Ensure availability of arrangements and facilities at ashore work site/s if operations are undertaken by CMT
- Consider use of external technical assistance in case of major emergency including decisions on lighterage, transfer of cargo, shifting of vessel etc
- Decide on requirement to suspend complete or part of port / cargo operations, traffic movement etc as the situation demands
- Initiate Mutual Aid Assistance Scheme, if such pact exists between different organizations (i.e ports, oil companies, etc.) beyond the MOU for this CP
- DECIDE on activation of tiered response and confer with Coast Guard to take over operations as per NOSDCP. In the event of tier response being initiated, confer with Coast Guard OSC or CIC to call for assistance from any OSRO – national or International
- Report spill details to National spill Reporting Centre i.e Indian Coast Guard
- In case of large spill, assess the risk to life and installation , size and consequences of spill , ability of the organization to handle the operations
- Instruct and direct additional teams and resources to act in consultation with OSC
- Advise state, private agencies of actions required to be taken by them in the event of threat by movement of spill

A common duty required to be performed by all members of CMT, Control Room, IC(OSC),OSCo, IM, Vessel Master, responders and any other person associated with the operations is to

- **Maintain personal detailed log of demands made on them and action taken or demands made or communication forwarded by them to any department or team member . Format is as per Appendix 19.**

NOTE

IN THE EVENT OF TIER RESPONSE BEING RESOTRED TO, WHILE THE OSC DUTIES MAY BE ASSUMED BY COAST GUARD MEMBER, THE CMT WILL CONTINUE TO FUNCTION AS EARLIER IN SUPPORT OF OPERATIONS.

HM WILL CONTINUE TO DISCHARGE THE DUTIES OF HEAD OF CMT, WHILE UTIES OF CIC MAY PASS TO OSC OR ANY OTHER CG PERSON SPECIFICALLY NOMINATED.

9.3.2 ADDITIONAL RESPONSIBILITIES OF TEAM MEMBERS

Apart from specific responsibilities mentioned above at 9.3.1 with respect to response activities, the appointed team members may be required to undertake the following tasks also in support of operations :

- Assessment of losses in terms of damages, cessation of operations etc
- Receive reports of damages to public utilities, loss to economic activity for compilation of compensation and demands
- Initiate compensation proceedings
- Authorization of expenses for spill response as per requirements raised by CMT
- Assist / Advise CMT in matters requiring financial approval

- Computation of expenses incurred by port on OSR activities(for compensation demands)
- Advise OSC/OSCo of dangers posed to port equipment and machinery from oil spill and advise on deciding priorities for response
- Brief breakdown/maintenance teams to be available to OSC in support of operations and making available mobile units, cranes, forklifts, tankers etc
- Advise OSC/OSCo on fire and safety matters which are likely to be encountered due to spill
- Making available equipment required for shore cleanup (to be discussed with shore clean up team leader/s)
- Order termination of all cargo operations or part thereof, if required
- Order removal of cargo from a location or locations
- Assist IC in addressing media and press
- Providing first aid in the event of injuries and evacuation of injured to medical center
- Advise on termination of Operations

9.3.3 ON SCENE COMMANDER and ON SCENE CO-ORDINATOR (OSCO)

As per requirement of this Plan, the Incident Controller appointed for response by CIC is designated as the On Scene Commander (OSC). He will report to Harbour Master, who is designated as CIC and Head of Crisis Management Team (CMT) for all operations, of whatever magnitude. OSC will be responsible for discharge of all response activity when the activity is being undertaken by the CMT or the Port. The appointed OSC can also be assigned the duties of Incident Manager required to be appointed.

In the event of an OSRO being appointed to undertake response actions within the jurisdiction of this Plan, the person appointed by the OSRO as OSRO specialist / OSRO responder will assume the duties of OSCo-ordinator and will be responsible for all response activity. However, the OSC will still remain nominated providing support to operations on behalf of the organisation.

Multiple operations

In the event of multiple response activities being undertaken at the same time, response team leaders appointed for each team would assume the duties of OS Co-ordinator for that part of response, while OSRO specialist will assume the duty of Chief OSCo. The IC will continue to discharge his duties of On Scene Commander hitherto. All OSCos thus designated will report to Chief OSCo who in turn will report to CIC.

The duties with respect to conduct of operation assigned and mentioned here under will accordingly be required to be discharged by each OSC (in the event of multiple ops).

On Scene Co-ordinator (OSCo)/ Chief OSCo is responsible for undertaking all possible and feasible actions to respond to spill and direct the response team / teams at site. He is to decide the best response action required to be adopted as per situation and guide the response team/ teams accordingly.

Every OSCo appointed for any part of the operation and OSCo would be responsible for the following duties or part thereof as per their activity, in the operation and area of operation :

- Determine whether the incident can be handled with resources available at site, on vessel or will require activation of CMT
- Advise CIC about activation and assembling of CMT

- Decide on most effective means to combat spill in most feasible manner within the limitations imposed by area
- Decide deployment of equipment and configuration to be adopted for containment of spill, recovery and disposal
- Use available resources, vessels and equipment to the best of capability and in the best manner for containment & collection of oil
- Safe and Effective deployment of OSRO team and equipment
- Deployment of response team/ teams and their turn around
- Co-ordinate multiple operations and vessel deployments
- Requisition additional manpower from CMT as required for land or water borne operations
- Initiate equipment deployment and undertake periodical review
- Ensure availability of operational non disruptive means of communication to all teams and establishing communication network between OSC, CIC , COC and team /s (in case more than one team is deployed)
- Assess spill scenario and advise CIC on declaration of spill as Minor or Major Spill of Tier-I, Tier-II or Tier-III magnitude
- Assess requirement and availability of consumables and response items and render timely advise to OSRO - M and CIC for further procurement
- Taking necessary preventive measure against Oil Fire arising or likely to arise out of any situation / action
- To monitor weather forecasts and carryout necessary changes to deployment of men and machinery, if required
- In case of large spill, assess risk to life and installation, size and consequences of spill and ability of the organization to handle the spill
- Advise CIC to decide on demanding support from external resource

- Take decision with regard to adequacy and effectiveness of response strategy and status of slick in terms of threats posed
- Availability of First Aid kit to all the teams at site of response
- Assist CIC in rendering report to National spill Reporting Centre i.e CG
- Ensure maintenance of equipment and undertaking of routines
- Conduct of training, drills and exercises for responders
- Prepare daily response activity log

9.3.4 Responsibilities of Incident Manager (IM) / O S R O - Manager

I M or OSRO- M will be in charge of all administrative activities required to be taken with regard to management of response team and running an actual incident response. IM or OSRO - M will be appointed by the CIC or OSRO as applicable.

Apart from additional responsibilities that an operation may demand of IM or OSRO M, some of his responsibilities are to

- Keep track of stock levels of consumables held by OSC and response team/ teams
- Initiate procurement action for stores as per demands and requirements from OSC as the case may be
- Ensure availability of victuals for teams at work site
- Availability of essential safety and personal protective gear to all team members
- Prepare duty roster of OSR personnel
- Turnaround of duty watch at ECR, responders and team members
- Coordinate movement of OSRO staff, personnel, equipment to incident spot
- Arrange for transport, stay, victuals etc for additional teams/ persons as required

- Arrange for boarding/lodging etc for any party/personnel arriving for undertaking OSRO activities
- Providing short notice back up support in terms of manpower for operations and activation of shore cleanup (as directed , if required
- Obtain necessary clearances for OSR personnel and equipment arriving from any national or international agency
- Execute requirements raised by CMT / OSRO S
- Provide support to vessel in terms of berthing, victuals and other requirements
- Arrange for and provide logistic support to operations
- Ensure maintenance of equipment as per laid down frequency and schedule
- Make available spares, tools and expendables to maintenance team
- Make available adequate number of first aid kits to all teams, vessels etc
- Carry out the duties of HSE Manager and ensure safety of personnel as per Safety Manual

9.3.5 Responsibilities and functions of Response Team

Composition of response team/s being identified in advance, the team/s would be available at all hours at the identified site for response activity.

In case of any spill, the first response is expected to be launched by the vessel master and responders - assigned the duty for spill response .

In the event where response activity is assigned to an OSRO, the OSRO responder and vessel will undertake the activity on first receipt of spill report. The functions of initial responder and vessel master would be to

- Render / receive preliminary spill report including extent, cause and quantity of spill

- Collect samples of spilled oil and assess the extent of spill and adequacy of equipment to address the spill
- Advise OSC, ECR and CIC on the situation and additional requirement of equipment
- Ensure non disruptive communication with ECR and rendering of reports as decided
- Advise the team to rig up containment recovery equipment in the best effective configuration
- Cooperate on rigging of equipment and maneuverability
- Co-ordinate with other teams operating in close vicinity
- Discuss equipment deployment strategy with the skipper / master of the vessel, so as to avoid last minute operational / navigational failures

9.3.6 Common duties - Responders/ OSC/ COSC / SR Vessel Master / Control room are as mentioned:

1. To maintain detailed daily log of activities undertaken by them and their team including deployment of equipment, advise rendered or demands raised. The log is to mention action taken daily (in narrative form) and observations made. **Appendix 20.**
2. The final report is to highlight achievements, failures, lessons learnt and specifically mention operational constraints and difficulties faced, changes to be made to operational doctrines, personal policies and training .
3. To be aware of deployment pattern of equipment and operational parameters
4. To be aware of the area layout including sensitive areas
5. Have in possession drawings and sketches of the area #
6. Be aware of the position of OSR equipment at each site along with all latest weather reports

7. To keep tide conditions in view and keep stores, vessel and other equipment safe from dangers imposed by tidal conditions
8. Knowledge of procedures and precautions for collection of spilled oil
9. To be conversant with the CP and responsibilities assigned to each through this section

Sensitive area sketches are to be available with OSC / COSC and Vessel Master at all times, Control room is to have adequate stocks available

(Members of a team undertaking operations under the supervision and orders of a responder, master of SR vessel or any other member of the team are exempted from maintaining the log. The log under these conditions will be maintained by the person supervising the part of operation.)

10. OPERATIONS CONTROL AND COMMUNICATION

Uninterrupted, clear and precise communication of information, situation, operational and demands is the basis for the success of any operation.

All functions related to any response operation will be planned and undertaken by CMT from the Communication and Operations Center (COC). While, activation of plan may be initiated by information to Port Control, the long term response decisions taken for protracted operations at any location away from COC, are to be passed to COC at the earliest . A working channel will be promulgated for the operations.

10.1 Communication and Operations Center

A permanent location is to be designated as Communication and Ops Center (COC) by the authority responsible for execution of this plan. Both functions are to be manned by different persons unless the magnitude of operations dictates manning of any particular operation by one operator only. (As far as practicable, both functions should be located at same site.)

The center has to be separate than the Port control and easily assessable to all the members of CMT and manned at all hours by persons qualified for such duties. In case the location has to be at the Port Control, the persons manning C O C are to be in addition to those manning the Port Control. Any information received in respect of an oil spill by any member associated with this CP is to be passed to the COC at the earliest.

In case the response activities have been assigned to an OSRO, the COC will be manned by OSRO rep and may be designated as Operations room also.

The person/ persons manning the center are to be fully acquainted with the contents and demands of CP.

10.2 Equipment and Publications

The communication center is to be provided the following equipment and publications

- VHF – 2 numbers
- Walkie talkies – as per the number of response teams and functional team leaders
- Telephone (landline or wireless) – 1
- Computer and printer with internet and projector facility
- Copy of CP and appendixes
- Details of CMT, OSRO organization and their contact details
- Charts of Mumbai harbour , Tide Table
- Large scale charts showing layout of POL and cargo berths
- GA plan of a typical oil tanker
- Location map of jetties, berthing and landing facilities available in Mumbai estuary along with facilities available
- Telephone contact directory of all emergency aid and medical services, port offices and local administration authority
- Disaster Management Plans of MbPT, JNPT, ONGC and BPCL

10.3 Actions required of COC

The actions required to be undertaken by COC at all times include:

- Continuous watch on working frequencies used by ships, port and terminal for POL cargo ops
- Watch on Ch 16 at all times

- Log all information in respect of an oil spill (with maximum details) received through keeping watch or from any other source
- In case of first receipt of information, pass all the details regarding spill to CMT leader to facilitate complete or partial activation of team or response actions by OSRO
- Pass all information regarding spill to OSRO and duty vessel or tug assigned response duties.
- Remain in constant touch with designated response team leader and response / support vessels as per working channel decided for operations
- Receive and pass information during operations to the authority identified through the message
- Collect latest information from MET dept on weather conditions in the area including wind direction & speed, tide condition and other weather parameters (all received information is to be logged)
- Provide weather data to operational teams as demanded
- Check the operational status of communication equipment periodically and bring the defects to attention of IM or OSRO M as applicable
- Details of vessels working cargo at different locations with quantity of cargo
- ETA, ETD of all vessels arriving/ leaving harbour
- Details of equipment location and stock pile

10.4 INFORMATION DISPLAY

The following latest information is to remain displayed at all times on wall boards in the Control and Operations Center :

- Vessels working cargo in port – quantity of cargo , location and expected times of completion
- Prevailing weather conditions and future forecast
- Vessels expected to arrive and depart port in next 24 hrs , cargo and quantity
- Important contact numbers of CMT, OSRO and other CP aid agencies

11. SPILL REPORTING AND PLAN ACTIVATION

Any person whether an employee of the port, vessel operator, appointed responder or not, can pass any information of any oil spill or a situation that could lead to an oil spill , held or observed by him or her, to any one of the identified centers to facilitate activation of this plan and initiation of response activity in accordance with the procedures laid down.

11.1 ACTIVATION

Any person who observes a spill or gets an information of a spill or observes a situation that could lead to a potential spill, may pass the available information with maximum possible details to any one of - Port Control, Control and Operations Room or Harbour Master, by fastest means available (All incidents of spill of whatever magnitude are to be reported to HM by Port Control Room or COC).

Contact details are as per table 11.1

Port Control	Landline - MbPT JNPT	
	VHF - MbPT JNPT	Marine channel 12 Marine Channel 13
COC	Landline number	
	Mobile	
	VHF	Marine Channel 12 and 13
Harbour Master /C IC	Landline- MbPT JNPT	
	Mobile	

Table 11.1 Contact details

11.1.1 Actions by Port Control / COC or HM

The following actions are to be initiated on receipt of information:

(i) Log information as per format at **Appendix 21(Incident Log)** with maximum information and details possible like position, source and reason of spill, likely quantity, action initiated by spill unit,

(ii) Pass all received information to other two incident receiving authorities,

(iii) Post receipt of information, the HM or CIC is to assess the magnitude of spill along with OSRO - M or S and decided whether CMT has to be assembled,

(iv) HM or CIC is to pass all available information to Chairman Port and other stack holders along with details of spill and decision to assemble CMT or not,

(v) Post confirmation of spill by any of the three mentioned sources, this Plan will stand activated in totality or a part thereof,

(vi) In the event, response action is initiated on first observation by OSRO, the information may be passed to Port Control Room and HM subsequently but at the earliest opportunity.

(vii) ALL RECEIVED INFORMATION IS TO BE REDUCED TO FORMAT AS PER POLREP REQUIRED TO BE PASSED TO SPILL INFORMATION CENTER i.e CG. POLREP FORMAT and contact details of center are placed at **Appendix 22 and Appendix 22A.**

11.1.2 Numbering of Incident Log

Any information received in respect of a spill is treated to be an independent incident and is to be docketed as under:

(i) Title identification – By name of vessel

(ii) Numbering - Report sequence for the day / date, month and year

In the event of a spill from an unidentified source only the numbering is to be mentioned along with place of observation and date, month and year.

11.2 COMMON DUTIES OF PORT CONTROL/ COC and HM

- Receive all details from person reporting the spill and start log of events
- Assess situation & take appropriate steps to establish source of leak/spill and render advise (if possible) on reducing / preventing further leak / spill

11.3 TEAM ACTIVATION

The following centers and teams associated with the discharge of this Plan will stand activated irrespective of the magnitude of spill or decision to assemble CMT.

i. Operations and communication center
ii. Response team and responder
iii. On Scene Commander(IC / IM) and On Scene Co-ordinator (OSCo)
iv. Vessel master and crew
v. Incident Controller / HM

In the event of a large spill and decision to assemble CMT being taken by CIC (HM), the CMT will join the above teams to take decisions with respect to conduct of operations. Composition of CMT and actions required to be initiated by different members and teams post activation of the plan are as per Section 9 of this Plan. Incident and information flow chart is placed at Figure 11.1

11.4 SPILL DETAILS

Any INFORMATION RECEIVED WITH RESPECT TO A SPILL, BEING OF IMPORTANCE TO ARRIVE AT A DECISION WITH RESPECT TO ACTIVATION OF CMT and RESPONSE REQUIRED TO BE TAKEN, HAS TO BE RECORDED WITH CARE AND WITH ALL POSSIBLE DETAILS.

Correct knowledge of the quantity of spill is a factor that would facilitate the CMT and other responders to decide on the scale of response action and also the requirements to decide on Tier responsibility. The information has to contain the following details

- Authority reporting spill (with all details)
- Time and position of spill
- Type of oil
- Assessed quantum of spill

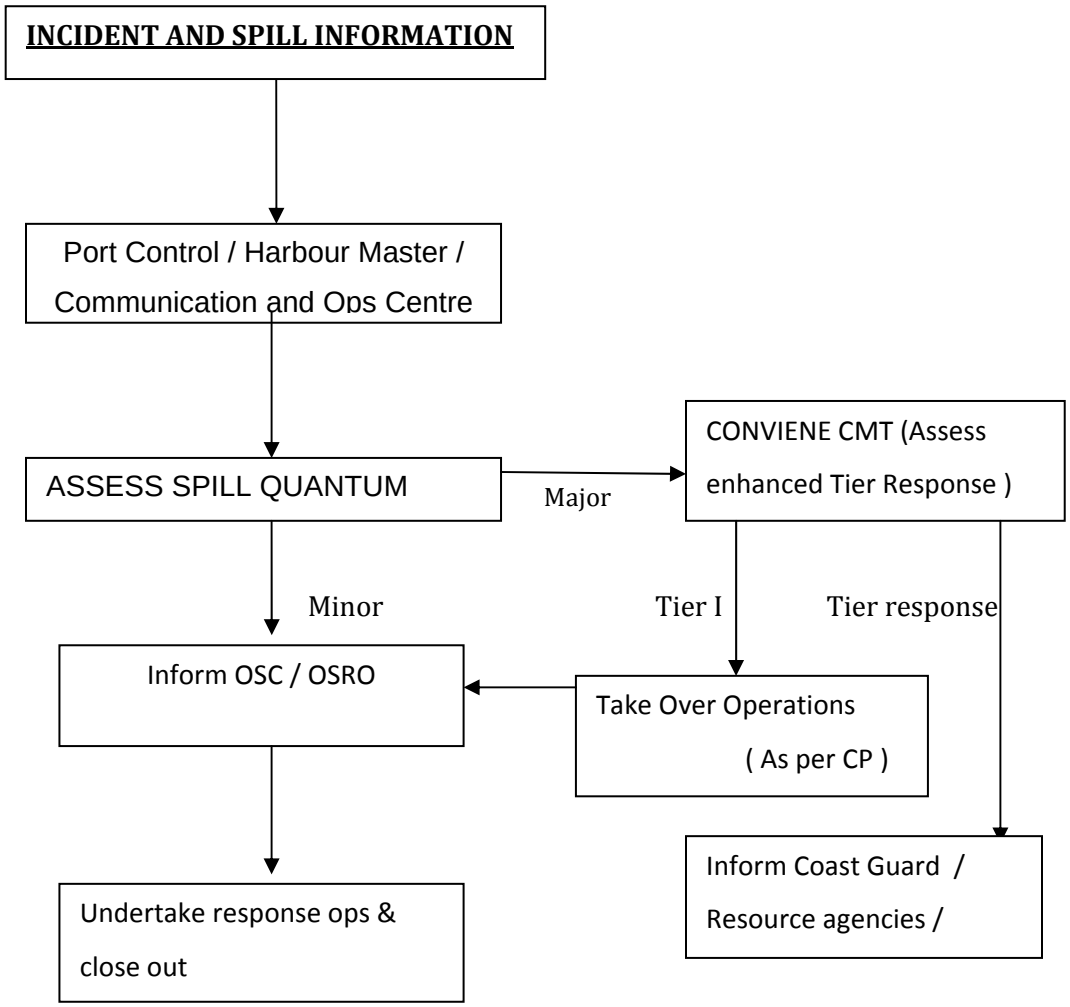


Figure 11.1 - INCIDENT AND INFORMATION FLOW CHART

11.4.1 Additional Information

In addition to the above information, following info is also to be recorded and provided to the responder or OSRO,

- Detailed weather conditions – wind, direction and speed
- Sea conditions

11.5 INFORMATION TO PUBLIC AUTHORITY

Based on information held with respect to parameters affecting the spill, like weather conditions and amount of spill, the CMT supported by OSC or IM has to arrive at the conclusion with respect to resources which are at risk at shore and need to be protected.

Information in regard to risks is to be passed immediately to the concerned resource management authority apart from information to respective district authority and CG.

The actions required to be initiated by the shore authority could be to prepare for beach operations, shut down a particular public utility plant, move economic resources like captive fisheries to other locations or prepare for any emergency action.

The contact details of civil authority are placed at **Appendix 23.**

11.6 INFORMATION TO MEDIA

Release of Information to media is to be as per 'Media policy' of the respective organisation heading the CMT for particular operation.

Information to media is to released by the person identified through respective Media policy of the organisation. In the event of non authorisation of any one person, the

media release will be made by CIC or by a person nominated by him after authorisation by head of the Organisation. The daily report of actions taken on a particular day as prepared by COC and OSC, is to be shared with the person nominated to brief the media. Each press brief is to cleared by CIC prior being provided to media.

While, providing factual details and information to media assists in passing the situational report to public likely to be effected by a spill, it is advisable not to sensalize the information with unwanted figures or actions that could shock or distress the public.

Most of the factual information like precautions required by public to be taken with respect to fishing activity, closure of beaches, demand for beach cleaning volunteers could be disiminated through media. A write up on good media practises is placed at Appendix 24.

12. TERMINATION AND COMPLETION OF OPERATIONS

TERMINATION AND COMPLETION OF OPERATIONS will be declared by CMT. The two phases of operations envisaged by this Plan are

(I) Spill response activity at terminal/sea and

(ii) Shoreline cleanup activity

Termination of operations is to be declared by Chief Incident Controller post discussions with CMT and OSC and is to be undertaken in steps as per the satisfactory completion of each phase .

In the event of multiple operations being undertaken, each operation is to be declared completed after satisfactory completion and post discussion with CMT.

In the event where both the activities are undertaken by the CIC, actions under each activity can be declared completed in phases post discussions with OSC and CMT. However, advise on termination is also to be sought from National Oil spill center ie. CG.

In the event of shoreline activity being conducted under the authority of local administration,that part of the activity will be declared terminated by the controlling authority.

12.1 Completion and Standing down

For declaring termination, the provisions outlined in Operations Manual with regard to assess different parameters espicially the Net Environmental Benefits (NEB) are to be taken into account.

While, all phases and activities (as dictated by para 11.1) of operation may be declared terminated on completion, the operations per say are to be declared completed after following activities have been completed

- Machinery and equipment accounting,
- Ensuring serviciability of equipment,
- Receipt of final report from OSC,
- Disussions about amendments, revisions, plans and procedures by CMT,
- Completion of actions arising out of final report on conduct of operations,
- Compilation of details with respect to compensations and damages.

12.2 Review of Plan and Procedures

Amandements as required to be undertaken to CP or Operations Manual are to be put up to CMT for review and approval for induction into the CP. Any member associated with response operations in any manner or otherwise may suggest amendements to COC / IM /OSRO-S or CIC. The amendmants will be undertaken by IM or OSRO-S as required for inclusion into the plan with authorization from CIC .

Amendments are to be inserted in the Plan by replacing the relevent page/s or section in the ring binder folder.

13. Disposal

Disposal of recovered oily waste is an integeral part of the Operation Manual and is explained in detail in "WASTE DISPOSAL PLAN". The purpose of disposal is not only to direct the recovered oil and waste to a final processing facility but also to bring to attention of responders, the methods to mininmize the amount of waste generated during operations.

All disposal is to be undertaken keeping in view the provisions of different statutes and legal parameters like 'The Environmental Protection Act 1986' and the Hazardous Waste (Management & Handling and Transboundary Movement) Rules 2008. Disposal of certain waste like solids and debris etc that can not be processed by participating oil companies will be required to be undertaken in close consultation with local adinistrative authority.

In the event, where, spill originates from any unit of the participating oil companies, the custody of waste and recovered oil is to be handed over to the company for trasportation, storage and disposal.

The participating companies will make available adequate resources to take over the waste from the responers, so as to make free the resources being used for recovery and collection earliest.

Any dispute arising on this account will be settled by respective CMT, whose decision will be final and binding.

APPENDIX 1

(Refers to Para 2.4)

OILS HANDLED AT Mumbai HARBOUR

1. Bombay High Crude
2. Persian Gulf Crude
3. Motor Spirit
4. High Speed Diesel Oil
5. Naphtha
6. Furnace Oil
7. Light Diesel Oil
8. Industrial Furnace Oil
9. Reformate / Benzene

APPENDIX 2

(Refers to Para 2.4.1)

BROAD CLASSIFICATION OF OILS AS PER MARPOL 73/78

Asphalt solutions
Blending stocks
Roofers flux
Straight run residue
Oils
Clarified
Crude oil
Mixtures containing crude oil
Diesel oil
Fuel no. 4,5 and 6
Residual fuel oil
Road oil
Transformer oil
Aromatic oil (excluding vegetable oil)
Lubricating oils and blending stocks
Mineral oil
Motor oil
Penetrating oil
Spindle oil
Turbine oil
Distillate
Straight run
Flashed feed stocks
Gas oil
Cracked

Gasoline blending stocks
Alkylates- fuel
Reformates
Polymer - fuel
Gasolines
Casing head (natural)
Automotive
Aviation
straight run
Fuel oil no.1 (Kerosene)
Fuel oil no. 1-D
Fuel oil no. 2
Fuel oil no. 2-D
Jet fuels
JP-1 (Kerosene)
JP- 3, 4
JP–5 (Kerosene, heavy)
Mineral spirit
Naphtha
Solvent
Petroleum
Heart cut distillate oil

APPENDIX 3

(Refers to Para 2.4.1)

CHARASTRISTICS OF DIFFERENT CLASS OF OILS

OIL TYPE	DENSITY (kg/l) At 15C	Viscosity mPas at 20C	Pour point C	Flash point C
Crude oil	0.8- 0.95	1-100	+10 to – 35	Variable
Gasoline	0.70 – 0.78	0.5	Na	Less than 0
Kerosene	0.8	2	Less than – 40	38-60
Jet fuel	0.8	1.5-2	Less than – 40	38-60
Diesel oil	0.85	5	-5 to -30	More than 55
Light FO IFO60	0.9	60 at 50 C	+ 50 to -20	More than 60
Medium FO IFO 180	0.9	180 at 50 C	+ 30 to – 20	More than 60
Heavy FO IFO 380	0.99	380 at 50 C	+ 30 to – 20	More than 60

APPENDIX 4

(Refers to Para 3.4.4)

ONGC PIPELINE SPILL VOLUMES (m3)

Time in hours after rupture	Spill SIZE
1	1900
3	3400
6	5300
12	9000
24	13500
36	14100

NOTE - Figures are for 30" Mumbai High Crude pipeline to Uran

APPENDIX 5

(Refers to Para 4.1)

WEATHERING PROCESSES AND TIME SCALES

Process		Importance	Time frame
Evaporation	Conversion of liquid to gaseous state. Lighter factions are lost first	Major process accounting for loss of oil. At 15 C gasoline will evaporate completely over a 2 day period, 80% of diesel fuel and 40% of light crude , 20% of heavy crude and about 5- 10% of Bunker C fuel.	< 5 days
Emulsification or mousse formation	Small water droplets get mixed into liquid oil. Water content will reach 50-80%	Will increase the amount of pollutant to be recovered by a factor of 2-4.	Onset may be delayed but emulsification process will start rapidly.
Natural dispersion	Breakup of an oil sleek into small droplets	Removes oil from water surface	< 5 days
Dissolution	Mixing of soluble oil components into water	Water soluble components are most toxic	< 5 days
Biodegradation	Breaking of oil by microbes into smaller compounds and finally to water and carbon dioxide	Rate depends on oil type, temperature, nutrients, oxygen and amount of oil	Weeks to months
Formation of tarballs	Breakup of heavy crudes and refined oils into small patches with long persistence	Hard to detect	Days to weeks

APPENDIX 6

(Refers to Para 4.1.1)

CALCULATION OF WEATHERING LOSSES – ADIOS SPILL CALCULATOR

OIL type

BOMBAY HIGH Crude
Location – INDIA
API 39.4
Pour Point – 30 deg C
Density – 0.825 g/ cc at 30 deg C
Viscosity – 5.0 cSt at 30 deg C

Emulsification

Mousse begins to form when 19% of the oil has evaporated

Wind and wave conditions

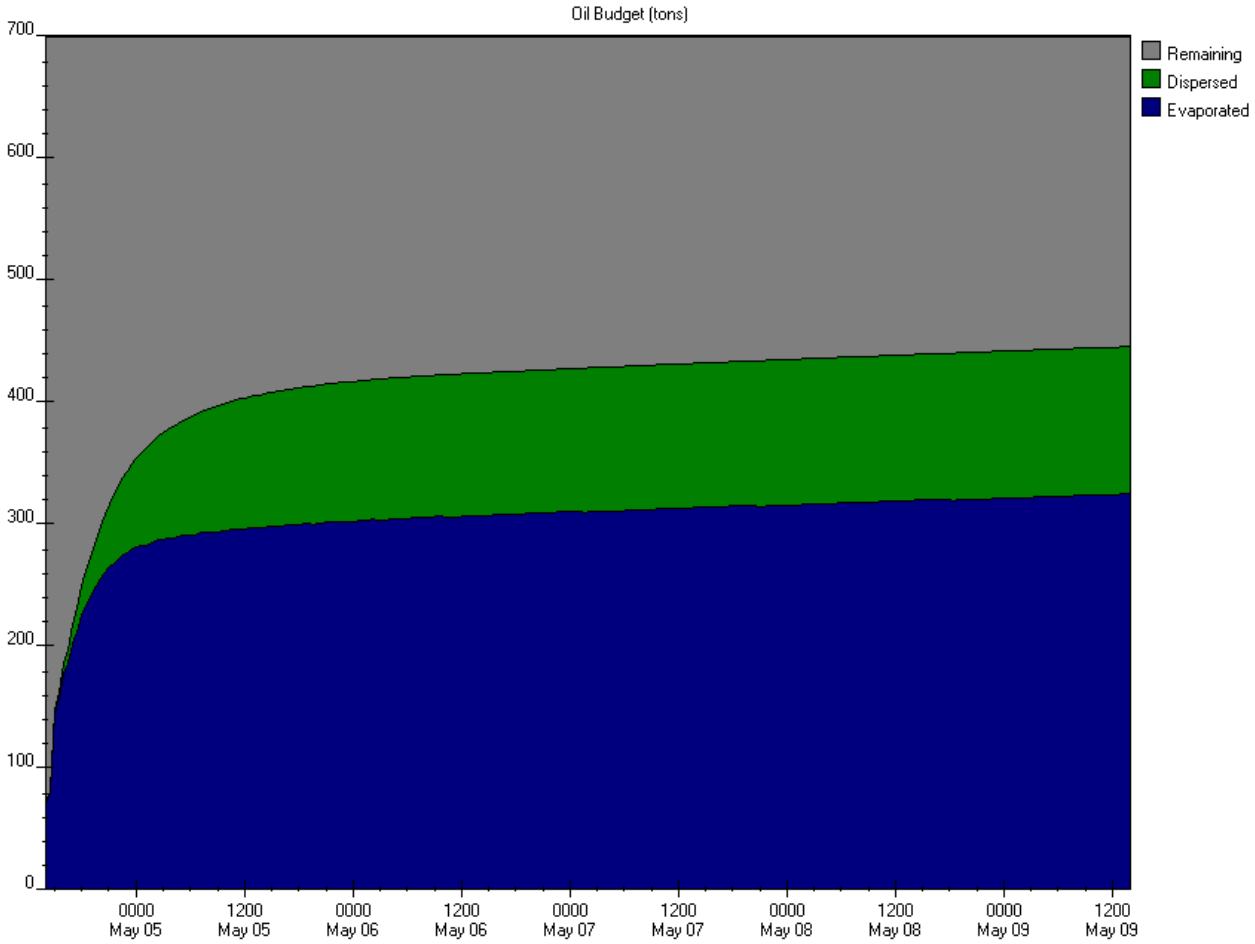
Wind speed – 10 knots from 245 degrees
Wave height – computed from wind speed, unlimited fetch (default)

Water properties

Temperature – 30 degree C
Salinity – 32 ppt
Sediment load – 500g/ m3 (muddy river)
Current – 3.0 knots towards 80 degree

Instantaneous release

Time - May 04, 2014
Quantity of spill – 700 tonnes



Loss at 0000 hrs / 05 May		**Loss at 1200 hrs / 05 May**
Evaporation	270 tonnes	280 tonnes
Dispersion	110 tonnes	190 tonnes
Remaining	320 tonnes	330 tonnes

APPENDIX 7

(Refers to Para 4.2)

CALCULATION OF SPILL QUANTITY AS PER SLICK CHARACTERISTICS

SPILL AREA AND OIL VOLUME

Average Slick Length	2.5	Km	TOTAL SPILL AREA	1,500,000 m^2
Average Slick Width	0.6	Km		1.50 Km^2

OIL TYPE	APPEARANCE	THICKNESS (mm)	LOADING m^3 / Km^2	COVER %	AREA Km^2	VOLUME m^3
Sheen	Silvery	0.0001	0.1	40%	0.60	0.060
Sheen	Rainbow	0.0003	0.3	30%	0.45	0.135
Slick	Yellow/Brown	0.01	10	20%	0.30	3.000
Crude/Fuel Oil	Black/Brown	0.1	100	10%	0.15	15.000
Mousse	Brown Orange	1.0	1000	0%	0.00	0.000
				100%	1.50	

TOTAL OIL VOLUME	18,195	L
	18.20	m^3

APPENDIX 8

(Refers to Para 6.1)

SHORELINE TYPES, RANKING AND COLOUR CODE

Vulnerability index of shores in order of increasing vulnerability to oil spill damage as per Gundlach and Hayes 1978

1. Exposed rocky headlands	Wave reflection keeps most of the oil offshore. No clean-up necessary.
2. Eroding wave- cut platforms Wave swept	Most oil removed by natural processes within weeks.
3.Fine-grained sand beaches	Oil does not usually penetrate into the sediment, facilitating mechanical removal if necessary. Otherwise oil may persist several months. (some evidence suggests that penetration can occur, depending on water table movements in sediments.)
4. Coarse-grained beaches	Oil may sink and/or be buried rapidly, making clean-up difficult. Under moderate to high-energy conditions, oil will be removed naturally from most of the beach face.
5. Exposed compacted tidal flats	Most oil will not adhere to, nor penetrate into, the compacted tidal flat. Clean-up is usually unnecessary.

6. Mixed sand and gravel beaches	Oil may penetrate the beach rapidly and become buried. Under moderate to low energy conditions, oil may persist for years.
7. Gravel beaches Same as above.	Clean-up should concentrate on high-tide/swash area. A solid asphalt pavement may form under heavy oil accumulations.
8. Sheltered rocky coasts	Areas of reduced wave action. Oil may persist for many years. Clean-up is not recommended unless oil concentration is very heavy.
9. Sheltered tidal flats	Areas of great biological activity and low wave energy. A number of interpretations of the 'biological activity' are possible. In this case, it is taken to mean a combination of high productivity, biomass and possibly bioturbation. Oil may persist for years. Cleanup is not recommended unless oil accumulation is very heavy. These areas should receive priority protection by using booms or oil-absorbing materials.
10. Salt marshes/mangroves	Most productive of aquatic environments. Oil may persist for years. Cleaning of salt marshes by burning or cutting should be undertaken only if heavily soiled. Protection of these environments by booms or absorbing material should receive first priority.

INTERTIDAL HABITAT RANKING

1A	Exposed Rocky Shores
1B	Exposed, solid man made structure
1C	Exposed rocky cliffs with boulder talus base
2A	Exposed wave cut Platforms
2B	Exposed scarps and steep slopes in clay
3A	Not Present in Study Area
3B	Scarps and steep slopes in sand
4	Sand Beaches
5	Mixed Sand and Gravel Beaches
6A	Gravel Beaches (Granules to Cobbles)
6B	Gravel Beaches (Cobbles to Boulders)
7	Exposed tidal flats
8A	Sheltered scarps in bedrock, mud or clay, sheltered rocky shore
8B	Sheltered, solid man made structures
8C	Sheltered riprap
8D	Sheltered rocky rubble shores
8E	Peat Shoreline
9A	Sheltered tidal flats
9B	Vegetated low banks
9C	Hypersaline tidal flats
10	Salt and brackish water marshes
10B	Fresh water marshes
10C	Swamps
10D	Mangroves

APPENDIX 9

(Refers to Para 6.1)

BIOLOGICAL RESOURCES ESI SYMBOLS

ELEMENT	COLOR	HATCH PATTERN ANGLE	SYMBOL
Birds	Green	45	
Habitats	Violet	90	
Fish	Cyan	135	
Invertebrates	Light orange	45	
Marine mammals	Light brown	0	
Reptiles and amphibians	Red	135	
Terrestrial mammals	Light brown	90	

APPENDIX 9 A

(Refers to Para 6.1)

POINT SYMBOLS FOR BIOLOGICAL RESOURCES

When a biological resource exists in a small area (such as a bird nesting site), it is indicated on an ESI map by a symbol. When a biological resource encompasses a larger area, it is represented on ESI maps by a polygon with a specific pattern and colour.

APPENDIX 10

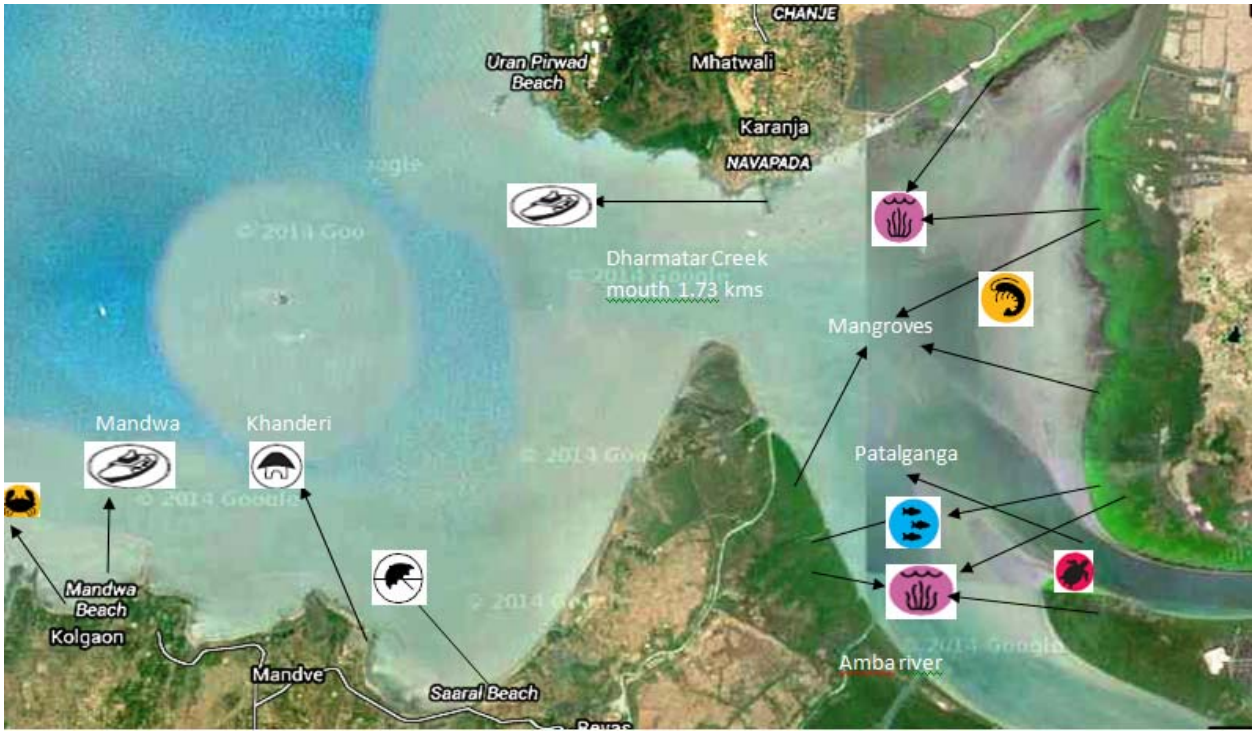
(Refers to Para 6.1)

ESI HUMAN USE RESOURCE SYMBOLS

APPENDIX 11

(Refers to Para 6.3)

ESI MAP – THAAL KNOB TO NAVAPADA



Shrimp, Nursery areas; high concentrations

Crab, Nursery areas; high concentrations

Areas of submerged aquatic vegetation; sea grass beds, kelp, algae

Turtle, Nesting beaches; concentration areas

Spawning, nursery, and other concentration areas

Village

Beach

Ferry

APPENDIX 11A

(Refers to Para 6.3)

ESI MAP – NAVAPADA TO MORA JETTY

LEGEND

	Exposed rocky shore
	Mangroves
	Gravel beaches

- Diving bird, rookeries, roosting
- Alcid , Pelagic bird, roosting
- Passerine bird, threatened, endangered
- Areas of submerged aquatic vegetation; sea grass beds, kelp, algae
- Harvest areas; high concentrations, threatened, endangered, or rare species

APPENDIX 11B

(Refers to Para 6.3)

ESI MAP – MORA TO JUNA SHEVA ROAD, JNPT

	1A &B Exposed rocky shore and man made structures
	10 D Mangroves

Crab, high concentration

APPENDIX 11C

(Refers to Para 6.3)

ESI MAP- JNPT(NHAVA) TO SOUTH ENTRANCE TO PANVEL CREEK

Exposed rocky shore

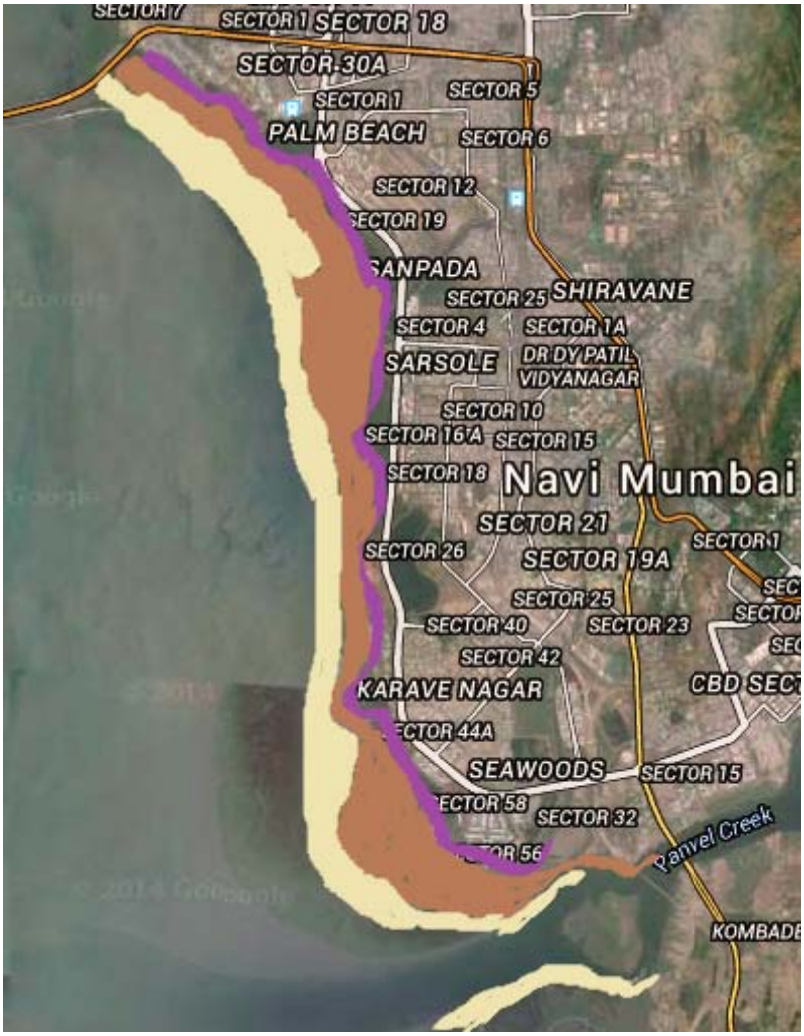
Mangroves

Port, Marina

APPENDIX 11D

(Refers to Para 6.3)

ESI MAP - SECTOR 51 TO VASHI VILLAGE



	1B Exposed solid man made structures
	10D Mangroves
	8B Sheltered solid , man made

APPENDIX 11E

(Refers to Para 6.3)

Vashi village (E bank of Thane creek) to Vikhroli (W bank of Thane creek)

- Diving bird, rookeries, roosting
- Alcid, Pelagic bird, roosting
- Passerine bird<threatened, endangered
- Wintering and migration concentration areas; nesting sites
- Harvest areas; high concentrations, threatened, endangered, or rare species
- Areas of submerged aquatic vegetation; sea grass beds, kelp, algae

APPENDIX 11F

(Refers to Para 6.3)

ESI MAP - VIKHROLI TO BPCL REFINERY TO HAJI BANDAR

Industrial cooling water Intake

Village

APPENDIX 11G

(Refers to Para 6.3)

ESI MAP - VIKHROLI TO BPCL REFINERY TO HAJI BANDAR

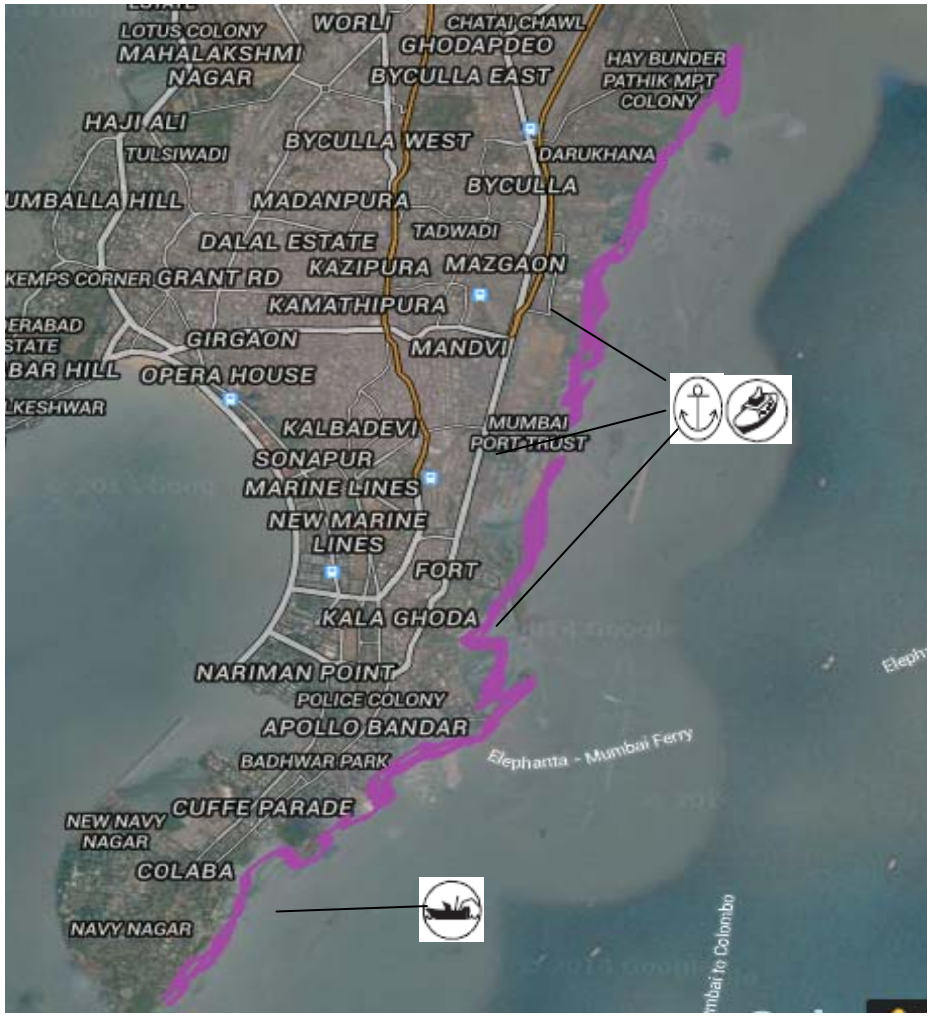
Industrial cooling water Intake

Harbour , Marina

APPENDIX 11H

(Refers to Para 6.3)

ESI MAP- HAJI BUNDER TO COLABA, NAVY NAGAR



Exposed solid man made structures

Harbour , Marina

Ferry

Commercial fishing

APPENDIX 12

(Refers to Para 7.4.1)

PORT- VESSEL POLLUTION EMERGENCY INTERPHASE

ACTION	RESPONSIBILITY
IMMEDIATE ACTION	
Sounding Emergency Alarm	Person noticing spill
Initiating Vessel Pollution Response Plan	Duty officer
INITIAL RESPONSE	
Suspend cargo ops	Ch. Eng./ Duty officer
Information to Terminal/Port Control / Master	Master / Duty officer/Ch Eng
Call crew to Pollution Response Positions	Master/ Duty officer
SECONDARY RESPONSE	
Location of source of spill	Chief officer
Assess & consider -	
Fire risk & manning of fire positions	Master
Stopping of air intake	Chief Engineer
Transfer of bunker to empty or slack tank, shore /barge	Master/ Ch Engineer
Prepare detailed report of spill and actions	Master/ Ch Officer
Inform agent, owners and PI club	Master/ Ch officer
FURTHER RESPONSE	
Call in external assistance to locate spill (if below waterline)	Master – Port
Consider stability of vessel	Master/ Ch officer
Follow directions of response authority	Master

APPENDIX 13

(Refers to Para 7.4.3)

LIST OF DISPERSANTS APPROVED FOR APPLICATION BY COAST GUARD

The NIO and Coast Guard approved list of oil spill dispersants (OSD) are enumerated below.

Type II - Water dilutable (1 part of dispersant: 10 parts of sea water is to be used in the ratio 1 part of diluted dispersant: 2-3 parts of oil)

COREXIT-9500 - (JAN 2003)
BG Exploration & Production India Ltd.,
1st Floor, Midas Sahar Palza
Kondivita, MV Road, Andheri (E), Mumbai - 400 059
Phone : 022-28395841 Fax : 022-28395201

Gold Crew - (Feb 2003)
MS Centerprise
Mayurpankh, 5th Floor
Agiany Lan, Jambli Naka, Thana (W) - 400 601
Phone : 022-25401010/25971880 Fax: 022-25373542

FireChem - (Feb 2003)
M/s Fire Chem Private Ltd
B-4, Rana Commercial Complex
Sector-20 B, Near Ajronda, Faridabad - 121 007
Phone : 0129-25288196/25288197 Fax : 0129-25288700

Spilcare-O - (Dec 2004)
Spilcare - O Metaclean Pvt. Ltd
AB-146, 3rd Main Road, Anna Nagar,
Chennai - 600 040, Phone : 044-26200482 Fax : 044-26281457

Type III - Concentrate (to be used neat in the ratio 1 part of dispersant : 25 parts of oil)

COREXIT-9500 - (JAN 2003)
BG Exploration & Production India Ltd.
1st Floor, Midas Sahar Plaza
Kondivita, MV Road, Andheri (E) Mumbai -400 059
Phone : 022-28395841 Fax : 022-28395201

Challenger-OSD EF III - (Aug 2003)
Challenger Chemicals & Polymers Private Ltd.
PR No. 6917, 3 Balasundaram Lay Out
Siddhanaidu School Raod,
New Siddhanaidu, Coimbatore - 641 044
Phone : 044-2216224 Fax : 0422-2213181

Spilcare-O - (Dec 2004)
Spilcare - O Metaclean Pvt. Ltd
AB-146, 3rd Main Road, Anna Nagar,
Chennai - 600 040
Phone : 044-26200482 Fax : 044-26281457

NOVA CHEMICALS - (JUNE 2005)
Pragji Vrindavan CHS
Room No.50, 4th floor, 20/24 Old Hanuman Lane
Kalbadevi, Mumbai - 400 002. Phone/Fax : 022-56347337

ICG requirements for selection of OSD :

Physical State	:	Flowing clear and homogenous liquid free from suspended solid.
Stability	:	Between 100-90%
Efficiency	:	Above 60% for Type-III Above 50% for Type-II after dilution
Flash Point	:	60°C Minimum
Cloud Point	:	0 to -5°C
Shelf Life	:	5 to 10 years
Validity	:	Should be in possession of valid NIO evaluation certificate
Date of Manufacture	:	Within 3 months of date of supply

APPENDIX 14

(Refers to Para 8.1)

EQUIPMENT DETAILS AND LOCATION

Onboard Spill Response Vessel and OSRO Centre

Sr. No	ITEM	QTY	CAPACITY
1	Fast Response Troilboom GP 750	2200 mtrs	
2	Weir Skimmer – Terminator DOP	2	50 m3
3	Multi Skimmer – DBD 40	2	50 m 3
4	Vacuum Skimmer – Desmi Mini Max	2	30 m 3
5	Floating storage tank	2	10 m3
6	Oil spill dispersant spray	1	
7	Dispersant Type III		10 KL
8	Personal protective Gear	15	
9	Oil Absorbent Kits	2	

APPENDIX 15

(Refers to Para 8.2)

ADDITIONAL EQUIPMENT AND LOCATION

Sr. No.	EQUIPMENT	Qty	Year	Operational Status	Remarks / Location
1	**OIL BOOMS SECTIONS**				
	a. Heavy Duty HDB 1500, **Make:** Lamor, freeboard 20"/ draft 28"	500 Mtr	2007	OK	S/Sevak
	b. Heavy Duty Oil Boom-DH 10Y-2, **Make:** Canadyne, freeboard 18" / draft 24"	500 Mtr.	2006	OK	Hal Anant
	c. Compactable Oil Spill cotainment Boom, **make:** Kepner Plastics Fabricators, freeboard 16" / draft 20"	500 Mtr.	2007	OK	Malviya -36
	d. Sea curtain Compactable, **Make:** Kepner Plastics Fabricators, freeboard 46cm /61 cm	500 Mtr.	300 Mtr - 2003	OK	Seamec-II
2	**SKIMMER UNITS**				
	(a) Type - Brush skimmer unit, Capacity- 3x50.2 CUM/Hr. **Make** Lamor	1	2007	OK	S/Sevak
	(b) Type - Multi disc skimmer, Capacity - 11 CUM / Hr. **Make -** Canadyne	1	2006	OK	Hal-Anant
	(c) Type - Weir skimmer, Capacity - 400 gpm, **Make –** Kepner Plastic	1	2007	OK	Malviya – 36
	(d) Type - Weir skimmer, Capacity - 400 gpm, **Make –** Kepner Plastic	1	2011	OK	Seamec - II
3	**OSD spray unit**				
	a. Anti Pollution Chemical Sprayer, Make Istanbul turkey, Capacity- 60lpm	1	2010	OK	Samudra Seavk
	b. Anti Pollution Chemical Sprayer, Capacity- 80lpm	1	2006	OK	Hal Anant
	c. Anti pollution Chemical Sprayer, Capacity- 68lpm	1	2007	OK	Malviya 36
	d. Anti Pollution Chemical Sprayer , Make Vikoma Intl, Capacity- 150lpm	1	2011	OK	Seamec-II
	e. Anti Pollution Chemical Sprayer, Capacity- 50lpm	1	2010	OK	S/Prabha
4	**Storage tank capacity for recovered oil**				
	245 M^3				S/Sevak
	103 M^3				Hal-Anant
	75 M^3				Malviya - 36
	112 M^3				Seamec - II

APPENDIX 16

(Refers to Para 8.2)

LIST OF ADDITIONAL RESOURCES AND INTERNATIONAL OSROs

1. Australian Marine Oil Spill Centre

PO Box 305
Victoria 3214
Australia
Tel + 61 3 5272 1555 Fax + 61 3 5272 1839
Mail : amose@amosc.com.au Web : http://www.aip.com.au

2. Fast Oil Spill Team

c/o PIM 40 G 23
Tour Elf
92078 Paris- La Defense Cedex
France
Tel : + 33 1 4744 5636 Fax : + 33 1 4744 2677
Mail : giefost@club-internet.fr

3. Oil Spill Response Ltd

Oil Spill Services Centre
Lower William Street Northam
Southampton SOI 1 QE, UK
Tel : + 44 1703 331 551 Fax : + 44 1703 331 972
Mail : osrl@osrl.co.uk Web : http://www.oilsillresponse.com

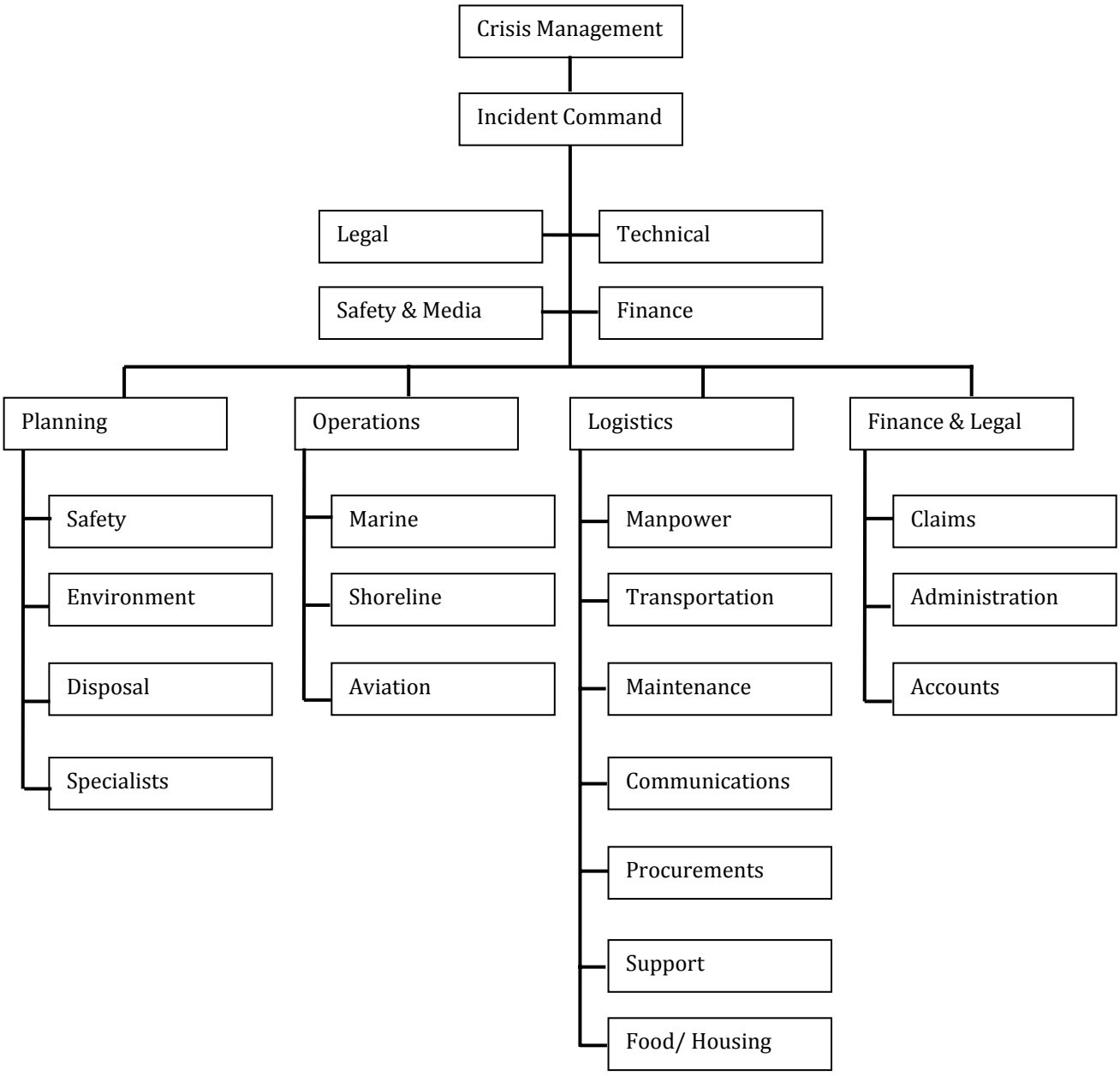
4. Petroleum association of Japan

Oil Spill response Department
Keidanren Building
9-4, 1 – Chome, Ohtemachi
Chiyoda- Ku,
Tokyo 100, Japan
Tel : + 81 3 3279 3819 Fax : + 81 3 3242 5688
Mail : mail@pcs.gr.ip Web : http://www.pcs.gr.ip

APPENDIX 17

(Refers to Para 9.2)

ORGANISATIONAL CHART



APPENDIX18

(Refers to Para 9.2)

COMPOSITION OF CRISIS MANAGEMENT TEAM

1. Mb PT

	DESIGNATION	APPOINTED MEMBER
	Chief Incident Controller(C IC)	Harbour Master
	Incident Controller(IC)/On Scene Commander	Respective operations/ dock /terminal in charge of JD/ PP / Indira Dock
	Member Admin & Finance	Dy Chief Accounts Officer
	Member HSE & Media	Port safety and Fire officer
	Member legal	Secretary
	Member Tech	Additional Chief Mechanical Engineer
	Incident Manager / Manager OSRO	To be appointed by OSRO, in case response being undertaken by OSRO
	OSRO/ Response Specialist	To be appointed by OSRO, in case response being undertaken by OSRO

APPENDIX18 A

(Refers to Para 9.2)

COMPOSITION OF CRISIS MANAGEMENT TEAM

2. JNPT

	DESIGNATION	APPOINTED MEMBER
	Chief Incident Controller(C IC)	Harbour Master
	Incident Controller(IC)/ On Scene Commander	Respective operations/ dock /terminal in charge at Sheva and JNPT berths
	Member Admin & Finance	Manager - Finance
	Member HSE & Media	Dy CMO
	Member legal	Secretary
	Member Tech	Manager-Technical
	Incident Manager / Manager OSRO	To be appointed by OSRO, in case response being undertaken by OSRO
	OSRO/ Response Specialist	To be appointed by OSRO, in case response being undertaken by OSRO

APPENDIX18 B

(Refers to Para 9.2)

COMPOSITION OF CRISIS MANAGEMENT TEAMS

3. ONGC

DESIGNATION	APPOINTED MEMBER
Chief Incident Controller(C IC)	Head HSE
Incident Controller(IC)/ On Scene Commander	Support Manager
Member Admin & Finance	Head - Finance
Member HSE & Media	Manager- Fire and safety ,Medical Officer
Member legal	Secretary
Member Tech	Head- Engineering services
Incident Manager / Manager OSRO	To be appointed by OSRO, in case response being undertaken by OSRO
OSRO/ Response Specialist	To be appointed by OSRO, in case response being undertaken by OSRO

APPENDIX 19

(Refers to Para 9.3.1)

PERSONAL LOG (ALL MEMBSERS OF SPILL RESPONSE ORGANISATION)

Incident Title ----------Number---------- ----(as per)

Date ----------

Name ----------Designation(as per C P)----------

Time of Rx / Forwarding Info	Activity requested by/ demanded of other member/s

Observations on days operations

Note – Copy of Personal Log is to be handed over to COC daily or as earliest as possible on completion of a schedule

APPENDIX 20

(Refers to Para 11.1.1)

IC/ OSC / VESSEL MASTER DAILY LOG

INCIDENT TITLE---------- NUMBER----------

DATE

Incident Severity - Minor/ Major/ Tier I/ Tier II/ Tier III

1. **RESPONSE RESOURCES AVAILABLE**

   VESSEL

   BOAT

   EQUPMENT

2. **ACTION INITIATED**

   CONTAINMENT

   EQPT DEPLOYED

3. **POLLUTANT COLLECTED and disposed**

   Today (Tonnes)

   Total (Tonnes)

4. **Reporting authority (Designation)**

APPENDIX 21

(Refers to Para 11.1.1)

INCIDENT LOG

INCIDENENT INFORMATION

INCIDENT TITLE (Name of Vessel)----------

Incident Number (Sq number/ d d /mm/ y y y y)----------

1.DETAILS

Time of recording …… (24 hr format) Date ……..

Day……

Person / Organisation reporting incident

Name …….. Designation ……..

Contact number ……

2.INCIDENT

Name of VESSEL …… Location ……..……..

Position (if not alongside) Latitude ……..

Longitude ……..……

Sounding……..

Incident details

Time …….. (of incident, 24 hrs format) Date ……..

Cause of spill

Type of oil

Estimated quantity of spill

Details of damage to vessel / installation

3.COMMENTS

1. Recorded by

Name ----------

Time ----------

Note: FOUR COPIES OF INFORMATION ARE TO BE RECORDED. RETAINING ONE FOR OFFICE RECORD, THREE COPIES ARE TO BE CIRCULATED ONE EACH TO -

CHIEF INCIDENT CONTROLER

OSC / RESPONDER/ INCIDENT CONTROLER

VESSEL MASTER

APPENDIX 22

(Refers to Para 11.1.1)

OIL SPILL REPORT FORM

Sl. No	DESCRIPTION	
1	Person	
2	Title	
3	Company	
4	Telephone number (Contact details)	
5	Fax number	
6	Date of spill	
7	Time of spill	
8	Type of oil	
9	Spill location	
10	Quantity	
11	Cause of spill	
12	Response	
13	Any other information	

APPENDIX 22 A

(Refers to Para 11.1.1)

CONTACT DETAILS OF SPILL INFORMATION CENTER

1. The Commander

   Coast Guard Region (West)
   Prabha Devi PO
   Mumbai - 400025
   Tel : 0 - 22 – 2437 9478
   0 – 22 – 2438 5089
   Fax : 0 – 22 24333727

2. The Commander

   Coast Guard Dist HQ 2
   Prabha Devi PO
   Mumbai – 400025
   Tel : 0-22 – 24222696
   Fax : 0 – 22 - 24222696

APPENDIX 23

Refers to Para 11.5)

CONTACT DETAILS OF LOCAL ADMINISTRATIVE AUTHORITIES

1. DISTRICT ADMINISTRATION

OFFICE	*ADDRESS*	*CONTACT*
RAIGAD	District Collector & District Magistrate District Collector's Office At/PO - Alibag District - Raigad Pin - 402 201	OFFICE 02141- 222001 RES 02141-222002 FAX 02141-222025 EPABX 02141-222118 collector_raigad@maharashtra.gov.in
Mumbai Suburban	Office of the Collector Mumbai Suburban District 10th Floor, Administrative Building, Bandra (E) Mumbai - 400 051	OFFICE 022- 26414742, 26556806 FAX (022) 26556805
MUMBAI CITY	Mumbai City Collectorate Old Custom House Fort , Mumbai - 400001.	OFFICE 022-22661231 22662440 FAX 022-22664232 collector.mumbaicity@maharashtra.gov.in mahbom@nic.in
THANE	Collector Office, Court Naka, Thane (West) Pin 400601	OFFICE 022 - 2534 3636 FAX 022 - 2534 9200 collector.thane@maharashtra.gov.in rdc.thane@thane.maharashtra.gov.in

2. FISHERIES

Maharashtra Fisheries Development Council
N.K.M. International House,
178, Backbay Reclamation,
Babubhai M. Chinai Marg,
Mumbai - 400 021.
Tel. / Fax No. : 022 - 22026014 / 20225022
Email - mfdc@rediffmail.com

3. STATE POLLUTION CONTROL BOARD – REGIONAL OFFICES

(i) MUMBAI

Maharashtra Pollution Control Board,
Raikar Chambers, "A" wing, 216, 2nd floor,
Deonar Gaon Road, Near Jain Mandir,
Govandi(E),
Mumbai-400 088
Tel : 022-22640346 Fax : 022-22640345
Mail : romumbai@mpcb.gov.in mpcbmumbai@mpcb.gov.in

(ii) NAVI MUMBAI

Maharashtra Pollution Control Board,
Raigad Bhavan, 7th floor,
Sector - 11, C.B.D Belapur,
Navi Mumbai
Tel : 022- 27572739 Fax : 022- 27571586
Mail : mpcbnavimumbai@mpcb.gov.in

(iii) RAIGAD

Maharashtra Pollution Control Board,
Raigad Bhavan,
6th floor, Sector - 11,
C.B.D Belapur, Navi Mumbai.
Tel : 022-27572620 Fax : 022-27562132
Mail : roraigad@mpcb.gov.in mpcbraigad@mpcb.gov.in

APPENDIX 24

(Refers to Para 11.6)

MEDIA COMMUNICATIONS

The degree of interest from the press in a specific oil pollution incident is unpredictable but normally closely related to the number of other news items at the time of the incident. Experience shows that even quite extensive pollution does not always attract the attention from the media, while minor, rather insignificant pollution can create a media storm when there is little else to report.

The media can be an effective means of ensuring that the public is kept informed of the incident, its effects and what is being done. Therefore, proper attention to the media and providing the correct information is very important.

The responsibilities of First Responders do **not** include dealing with the media. Though, it is advisable to refer all and any questions to the media liaison officer identified through the Contingency Plan, still the response leaders on all levels should be prepared to answer questions from the press because of media's persistence for news.

The lesson to be learned is that - unless otherwise instructed, it should always be remembered that even precise information can be misinterpreted or misunderstood. It is therefore recommended to obtain the name and telephone number of members of the press who have received information in order to verify or correct wrong news stories based on misunderstood information.

The basic questions from the press are likely to be:

- What happened?
- Why did it happen?
- What are the measures being taken by the authorities with respect to the pollution?
- What is being done to prevent such an incident happening again?

How to deal with these approaches is a matter of experience but the following guidelines can be used by First Responders:

- Tell the truth. If there is something you do not know, then say so to avoid getting chased by the press,
- comment only about your area of responsibility and do not speculate on other topics, avoid offering opinions,
- Emphasise the positive points of the operation like outcome of operations, objectives going to be achieved etc,
- Never make assumptions, your information must be verified and solid before released,
- Do not offer a personal opinion,
- Beware of language (e.g. it is better to say that two ships collided than one crashed into the other if it is not clear which was at fault),
- Be polite, patient and never get personal or sarcastic (you will normally be treated in the same way you treat a person and aggressive behaviour from your side can cause you a lot of unnecessary problems),
- Insist that the press observe local safety regulations.

RESTRICTED DOCUMENT **Ref No.AU/IRS/MS/231-2022 DT 22.11.2022**

Preparation of Local Level CRZ Map for the Proposed Widening of Container Berth at Jawaharlal Nehru Port Authority, Navi Mumbai, Maharashtra State by Superimposing on Approved CZMP as per CRZ Notification 2011

For
JAWAHARLAL NEHRU PORT AUTHORITY
ADMINISTRATION BUILDING, SHEVA
NAVI MUMBAI – 400 707

INSTITUTE OF REMOTE SENSING
ANNA UNIVERSITY, CHENNAI-25

November 2022

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Executive Summary

On the request of Jawaharlal Nehru Port Authority, Navi Mumbai – 400 707, a study was carried out to prepare local level CRZ map in 1:4,000 scale for the proposed widening of Container Berth at Jawaharlal Nehru Port Authority, Navi Mumbai, Maharashtra State by Superimposing on Approved CZMP as per CRZ Notification 2011. The satellite imagery of the project area was interpreted for topographic and geomorphic features in the vicinity of the project site. The project site falls in the vicinity of Arabian Sea.

The HTL and LTL along with setback lines as per approved CZMP (Map No: MH 77) vide CRZ notification 2011 were superimposed on to georeferenced cadastral maps to prepare a local level CRZ maps at 1:4,000 scale. The location of proposed widening of Container Berth at Jawaharlal Nehru Port Authority, Navi Mumbai, Maharashtra State as provided by the client has also been superimposed on the CRZ map. The co-ordinates of the HTL derived from approved CZMP at 1:25,000 scale in WGS84 system are presented in the Annexure-I and local level in CRZ maps 1:4,000 scale with the location of project site as per approved CZMP vide CRZ notification 2011 are furnished along with this report.

The proposed Widening of Container Berth at Jawaharlal Nehru Port Authority, Navi Mumbai, Maharashtra State lies entirely in CRZ-IVA area as per approved CZMP (Map No: MH 77) vide CRZ notification 2011 of MoEF & CC.

The co-ordinates of the HTL points derived from approved CZMP at 1:25,000 scale in WGS84 system are presented in the **Annexure-I**.The satellite imagery of the project site superimposed is given in **Annexure - II**. The map showing the project site superimposed on approved CZMP as per CRZ notification 2011 of Maharashtra is shown in **Annexure – III**. The map showing the CRZ status at 1:4000 scale for the project site is attached in **Annexure – IV**. Various coastal regulation zones in which the project site falls are presented in the conclusion section of this report.

PROJECT DATA SHEET

Title: Preparation of Local Level CRZ Map for the Proposed Widening of Container Berth at Jawaharlal Nehru Port Authority, Navi Mumbai, Maharashtra State by Superimposing on Approved CZMP as per CRZ Notification 2011

Project Ref No.	: Ref No.AU/IRS/MS/231-2022 DT 22.11.2022
Principal Consultant	: Dr. M. Shanmugam, Associate Professor
Co-Consultant	: Dr. D.Thirumalaivasan, Professor & Director
Done for	: JAWAHARLAL NEHRU PORT AUTHORITY ADMINISTRATION BUILDING, SHEVA NAVI MUMBAI – 400 707
Survey Team	: Mr.S.Sathishkumar, IRS, AU Mr.P. Sukumar, IRS, AU
Data Processing	: Mr. J. Prem Kumar, Project Technician
Report Preparation	: Dr. M. Shanmugam, Associate Professor
Quality Assessment Team	: Dr. R.Vidhya Professor, Mrs.M.Navamuniyammal, Assistant Professor Dr.R. Kanmani Shanmuga Priya, Assistant Professor

The Quality Assessment Committee for consultancy projects has scrutinized the local level CRZ map and corresponding text report of the above project on **08.11.2022.**The principal consultant of the project has presented the approach adopted, findings of the study to the committee. The committee has evaluated the CRZ Map and the report for different parameters against the standards prescribed for the mapping. The positional accuracy, attribute accuracy, completeness, semantic accuracy of the output were assessed and found satisfactory. The committee recommends the approval of the map and associated report.

Dr.M. Shanmugam
(Principal Consultant)

Dr. R. Vidhya
(QA member)

Mrs.M.Navamuniyamal
(QA member)

Dr.R. Kanmani Shanmuga Priya
(QA member)

DIRECTOR

Director
Institute of Remote Sensing
Anna University,
Chennai - 600 025.

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1.0 INTRODUCTION

1.1 Coastal Regulation Zone

The coastal zone is the area of interaction between land and sea. The coastal zone of Maharashtra has a very high concentration of population along with ecologically sensitive areas like mangroves. There is a spurt of developmental activities arising from residential colonies and tourism centres along the coast and in coastal zone. There is a need to protect the coastal environment while ensuring continuing production and development. This zone is extremely vulnerable and has to be managed judiciously striking a balance between ecological and developmental needs.

Government of India has issued a notification during February 1991 for regulating the developments along the coastal stretches of seas, bays, estuaries, creeks, rivers and backwaters which are influenced by tidal action. The land between 500 meters from the High Tide Line (HTL) and the Low Tide Line (LTL) is identified as Coastal Regulation Zone (CRZ). The coastal stretches within CRZ are classified into four categories, namely, Category I (CRZ-I), Category II (CRZ-II), Category III (CRZ-III) and Category IV (CRZ-IV). The notification has also laid down regulations to regulate the various activities in the coastal zone. The Ministry of Environment and Forests, Government of India, has approved a set of CRZ maps on 1:25,000 scale prepared from SPOT satellite imagery. On these maps, zones are demarcated as CRZ I, CRZ II and CRZ III, by Coastal Zone Management Authority.

Coastal Regulation Zone I includes the zone between High Tide Line and Low Tide Line. It also includes the areas that are ecologically sensitive and important, such as national parks/marine parks, sanctuaries, reserve forests, wildlife habitats, mangroves, corals/coral reefs, areas close to breeding and spawning grounds of fish and other marine life, areas of outstanding natural beauty/historically/heritage areas, areas rich in genetic diversity, areas likely to be inundated due to rise in sea level consequent upon global warming and such other areas as may be declared by the Central Government or the concerned authorities at the State/Union Territory level from time to time.

CRZ-II covers the areas that have already been developed up to or close to the shoreline. For this purpose, the "developed area" is referred to as that area within the municipal limits or in other legally designated urban areas which are already substantially built up and have been provided with drainage and approach roads and other infrastructural facilities, such as water supply and sewerage mains.

CRZ-III covers the areas that are relatively undisturbed and those which do not belong to either Category-I or II. These include the coastal zone in the rural areas (developed and undeveloped) and also areas within municipal limits or in other legally designated urban areas which are not substantially built up.

CRZ-IV refers to the coastal stretches in the Andaman and Nicobar, Lakshadweep and small islands other than those designated as CRZ-I, CRZ-II or CRZ-III.

The Ministry of Environment and Forest in the CRZ notification, 2011 declared the following areas as CRZ and imposed with effect from the date of the notification the restrictions on the setting up and expansion of industries, operations or processes and the like in the CRZ. The areas that are defined as CRZ as per CRZ notification, 2011 are as follows.

(i) The land area from High Tide Line (HTL) to 500 m on the landward side along the sea front.

(ii) CRZ shall apply to the land area between HTL to 100 m or width of the creek whichever is less on the landward side along the tidal influenced water bodies that are connected to the sea and the distance upto which development along such tidal influenced water bodies is to be regulated shall be governed by the distance upto which the tidal effects are experienced which shall be determined based on salinity concentration of 5 parts per thousand (ppt) measured during the driest period of the year and distance upto which tidal effects are experienced shall be clearly identified and demarcated accordingly in the Coastal Zone Management Plans.

(iii) The land area falling between the hazard line and 500 m from HTL on the landward side, in case of seafront and between the hazard line and 100 m line in case of tidal influenced water body. The word 'hazard line' denotes the line demarcated by Ministry of Environment and through the Survey of India taking into account tides, waves, sea level rise and shoreline changes.

(iv) Land area between HTL and Low Tide Line (LTL) which will be termed as the intertidal zone.

(v) The water and the bed area between the LTL to the territorial water limit (12 Nm) in case of sea and the water and the bed area between LTL at the bank to the LTL on the opposite side of the bank, of tidal influenced water bodies.

The Classification of the CRZ is also modified for the purpose of conserving and protecting the coastal areas and marine waters as CRZ - I, CRZ-II, CRZ-III and CRZ-IV. The CRZ-I include the areas that are ecologically sensitive and the geomorphological features which play a role in the maintaining the integrity of the coast like (a) Mangroves(b) Corals and coral reefs and associated biodiversity (c) Sand Dunes (d) Mudflats which are biologically active (e) National parks, marine parks, sanctuaries, reserve forests, wildlife habitats and other protected areas (f) Salt Marshes (g) Turtle nesting grounds (h) Horse shoe crabs habitats (i) Sea grass beds (j) Nesting grounds of birds (k) Areas or structures of archaeological importance and heritage sites and the area between Low Tide Line and High Tide Line. The CRZ-II includes areas that have been developed upto or close to the shoreline. The CRZ-III includes areas that are relatively undisturbed and those do not belong to either CRZ-I or II, which include coastal zone in the rural areas (developed and undeveloped) and also areas within municipal limits or in other legally designated urban areas, which are not substantially built up. The CRZ-IV includes the water area from

the Low Tide Line to twelve nautical miles on the seaward side and the water area of the tidal influenced water body from the mouth of the water body at the sea upto the influence of tide which is measured as five parts per thousand during the driest season of the year.

The Ministry of Environment and Forest has also provided guidelines for demarcation of High Tide Line in the CRZ notification, 2011. As per the guidelines, Cadastral (village) maps in 1:3960 or the nearest scale shall be used as the base maps. HTL and LTL will be demarcated in the cadastral map based on detailed physical verification using coastal geomorphological signatures or features in accordance with the CZM Maps approved by the Central Government. 500 m and 200 m lines shall be demarcated with respect to the HTL.

In order to facilitate the classification of Coastal Regulation Zones, Government of India have approved few agencies/institutions across the country vide Lr. No. J17011/8/92-1A III, dated 10.05.1999 of Ministry of Environment and Forests. Institute of Remote Sensing, Anna University being one of them, has been carrying out HTL and LTL mapping following the guidelines issued by Ministry of Environment & Forests, Government of India.

1.2 Background

JAWAHARLAL NEHRU PORT AUTHORITY, ADMINISTRATION, BUILDING, SHEVA, NAVI MUMBAI – 400 707 has requested Institute of Remote Sensing, Anna University to prepare local level CRZ maps in 1:4,000

scale for the proposed widening of Container Berth at Jawaharlal Nehru Port Authority, Navi Mumbai, Maharashtra State by superimposing on approved CZMP as per CRZ notification, 2011. The HTL and LTL for the Sea/Bay/tidal influenced water bodies and ecologically sensitive areas are to be transferred from approved CZMP (Map No. MH 77) at 1:25,000 scale to 1:4,000 scale in the vicinity of the proposed project site. In this context, the proposed project site needs to be evaluated to assess whether it falls under regulations of CRZ notification, 2011. Hence IRS has taken up the work of superimposing project site on approved CZMP prepared by NCSCM.

1.3 Objective

The objective of the present study is to examine the site and prepare maps & report for the proposed widening of Container Berth at JNPT, Navi Mumbai, Maharashtra state with reference to CRZ notification, 2011. Keeping in view of the requirements of notification, Institute of Remote Sensing, Anna University under took the project with the following agreed scope of work:

- Transfer of HTL and LTL for Arabian Sea indicated in existing approved CZMP as per CRZ notification, 2011 in the vicinity of the proposed project site on to georeferenced digital cadastral map.
- Transfer of HTL, LTL for Arabian Sea as indicated in approved CZMP in the vicinity of the project site by digitization from approved CZMP at 1:25,000 scale.

- Digitisation of ecologically sensitive entities, if any indicated in approved CZMP in the vicinity of project site.
- Superimposition of HTL, LTL and ecologically sensitive areas along with the project site on georeferenced cadastral map.
- Preparation of local level CRZ map at 1:4000 scale for the proposed project location.

1.4 Data Products

CZMP prepared as per CRZ notification 2011 and approved by MoEF & CC, New Delhi were used as reference for the transfer of HTL, LTL and ecologically sensitive areas in the vicinity of project site on to local level CRZ map. The data products used for the study and mapping include approved CZMP published by MCZMA (Map No: MH 77) vide CRZ notification 2011 and cadastral maps of the local area.

1.5 Methodology

The cadastral maps of project site have been used as the base maps. The geomorphology of the coastal zone has been studied from the temporal medium resolution satellite data. Coastal geomorphologic features and existence of permanent vegetation identified from the satellite imagery were used to transfer the HTL demarcated by NCSCM on approved CZMP. The approved CZMP was georeferenced using graticules available on the maps.

The cadastral maps of villages in the study area were digitized from approved CZMP to create a vector dataset of survey polygons in the vicinity of

project location. The same are superimposed on satellite imagery to identify the proposed project location. The HTL, LTL and ecologically sensitive areas in the vicinity of project location are digitized from georeferenced approved CZMP. 100m, 200m & 500m setback lines from HTL for Arabian Sea and 50m setback line from mangroves are generated using GIS buffering tool. The zones between LTL, HTL and setback lines are delineated to corresponding CRZ as per CRZ notification 2011.

2.0 STUDY AREA

2.1 Description of Study Area

The site for the proposed widening of Container Berth lies at Jawaharlal Nehru Port Authority, Navi Mumbai, Maharashtra State. The key map showing the project site location is given in Figure 1.

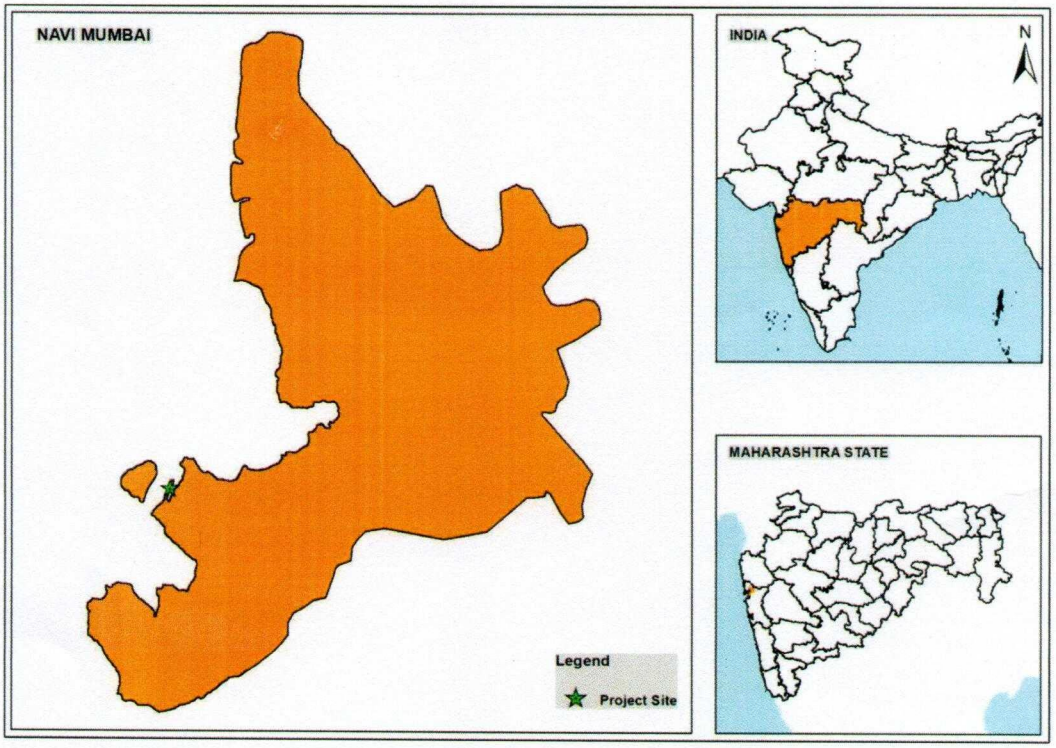

Fig 1. Location Map of the Project Site

The coordinates of proposed widening of container berth at JNPT are given in Table 1.

Table 1 Coordinates of Proposed Widening of Container Berth in WGS84

Label	Latitude	Longitude
A	18° 57' 28.290" N	72° 56' 53.922" E
B	18° 57' 28.088" N	72° 56' 54.389" E
C	18° 57' 25.686" N	72° 56' 53.644" E
D	18° 57' 25.926" N	72° 56' 52.977" E
E	18° 57' 25.491" N	72° 56' 52.769" E
F	18° 57' 25.202" N	72° 56' 53.435" E
G	18° 57' 19.078" N	72° 56' 50.305" E
H	18° 57' 19.294" N	72° 56' 49.806" E
I	18° 57' 18.640" N	72° 56' 50.113" E
J	18° 57' 18.863" N	72° 56' 49.600" E
K	18° 57' 13.291" N	72° 56' 47.691" E
L	18° 57' 13.562" N	72° 56' 47.070" E
M	18° 57' 13.138" N	72° 56' 48.041" E
N	18° 57' 12.599" N	72° 56' 49.285" E
O	18° 57' 12.027" N	72° 56' 49.010" E
P	18° 57' 12.563" N	72° 56' 47.769" E
Q	18° 57' 12.248" N	72° 56' 47.190" E
R	18° 57' 12.450" N	72° 56' 46.724" E
S	18° 57' 8.262" N	72° 56' 45.534" E
T	18° 57' 8.464" N	72° 56' 45.067" E

2.2 Status as per Approved CZMP vide CRZ Notification 2011

The proposed Widening of Container Berth at Jawaharlal Nehru Port Authority, Navi Mumbai, Maharashtra State lies entirely in CRZ-IVA areas as per approved CZMP (Map No: MH 77) vide CRZ notification 2011 of MoEF & CC.

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3.0 RESULTS AND CONCLUSIONS

3.1 Results

The HTL and LTL as indicated in approved CZMP were superimposed on to georeferenced cadastral map along with ecologically sensitive areas in the vicinity of project site. Setback lines for width of creek/ tidal influenced inland water body as indicated in approved CZMP were superimposed on to georeferenced base map to prepare local level CRZ map at 1:4.000 scale (Annexure IV). The co-ordinates of selected points on HTL line derived from approved CZMP in WGS 84 system are presented in Annexure I. The satellite imagery of project site is presented for reference (Annexure II). The approved CZMP at 1:25,000 scale superimposed with project activities is presented in Annexure III.

3.2 Conclusions

The proposed widening of Container Berth at Jawaharlal Nehru Port Authority, Navi Mumbai, Maharashtra State lies entirely in CRZ-IVA area as per approved CZMP (Map No: MH 77) vide CRZ notification 2011 of MoEF & CC.

The following disclaimers are followed in the CRZ map and report preparation:

1. Coastal Regulation Zone Map of the site is prepared considering Approved CZMP as per CRZ Notification 2011 of MoEF&CC, GoI

2. Superimposition of the project site on approved CZMP is subject to scale and generalisation error.

3. This report is to be referenced and used along with the map bearing the same reference no: Ref No.AU/IRS/MS/231-2022 DT 22.11..2022

4. The DGPS survey was carried out specific to the referred project site boundary only. Hence, validation of HTL and CRZ boundary is limited to the clearance of the same. Institute of Remote Sensing do not carry responsibility for CRZ status of other plots or neighbourhood.

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ANNEXURE I

Coordinates of HTL Reference Points(WGS 84)

HTL Point	Latitude	Longitude
1	18° 57' 15.768" N	72° 57' 18.192" E
2	18° 57' 29.392" N	72° 57' 24.689" E
3	18° 57' 35.742" N	72° 57' 05.476" E
4	18° 57' 27.800" N	72° 57' 01.600" E
5	18° 57' 19.053" N	72° 56' 57.427" E
6	18° 57' 09.813" N	72° 56' 52.800" E
7	18° 57' 03.721" N	72° 56' 49.282" E
8	18° 56' 52.839" N	72° 56' 43.942" E

Source: Approved CZMP 2011 (Map No : MH 77)

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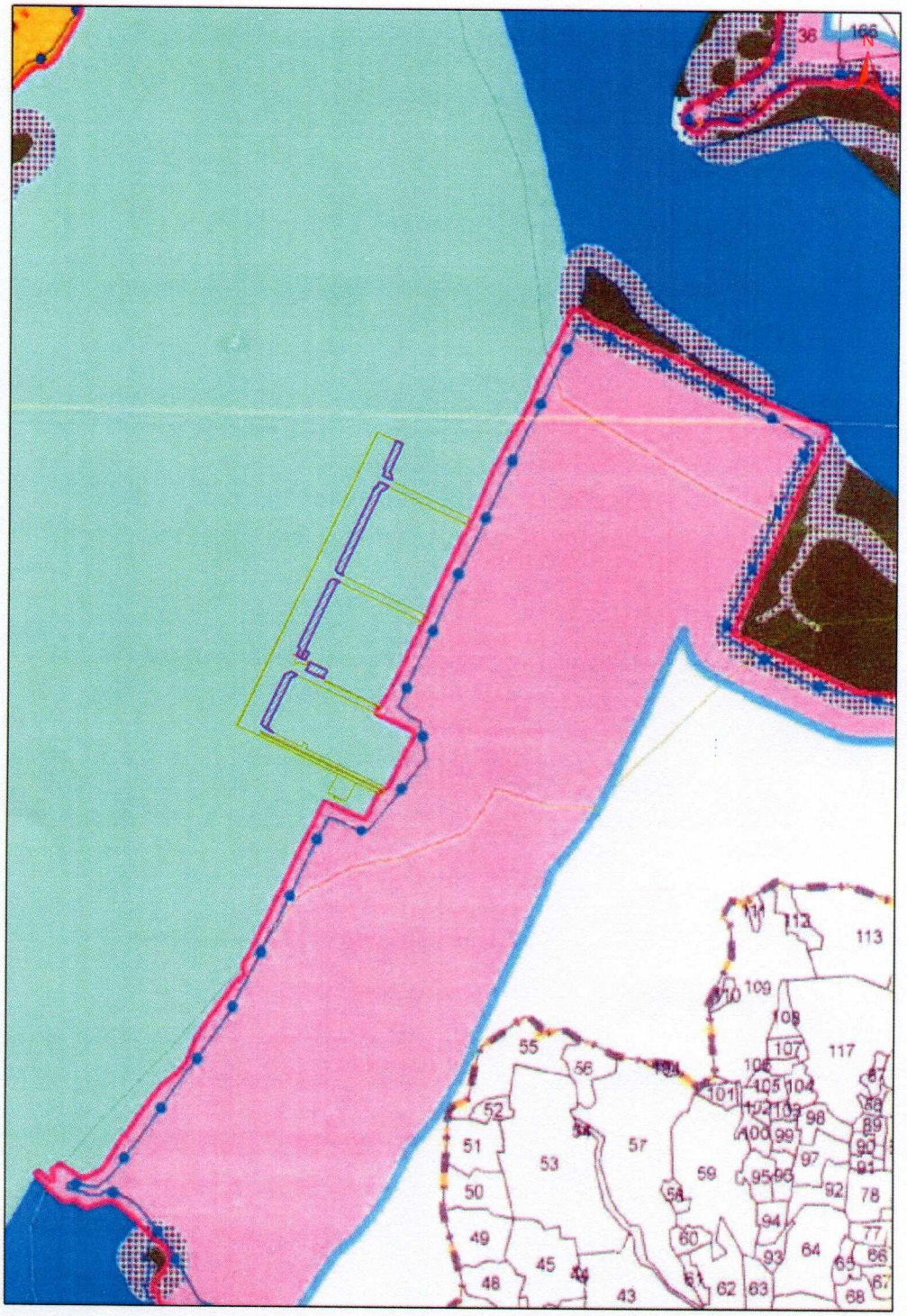
ANNEXURE II

Satellite Imagery of the project site*(Source: Google Earth)*

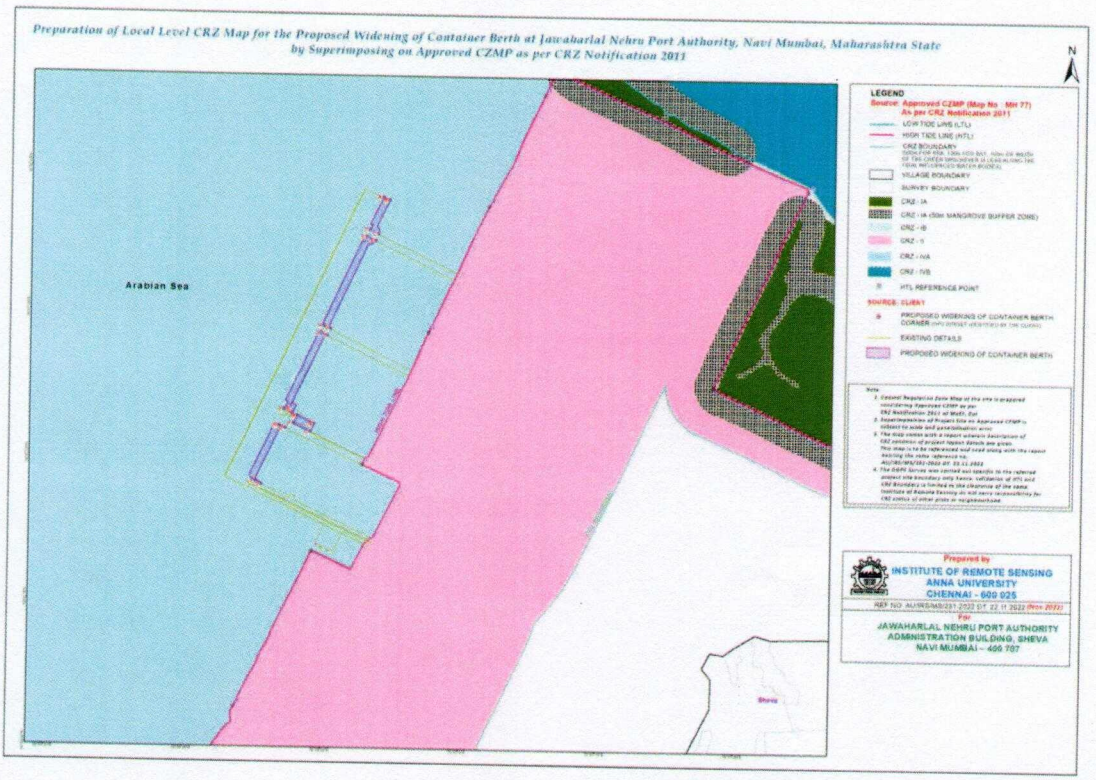
ANNEXURE III

Project site overlaid on Approved CZMP



ANNEXURE IV

Local Level Coastal Regulation Zone Map on 1: 4000 scale for the Project Site



Annexure - XVI

JAWAHARLAL NEHRU PORT TRUST

DISASTER MANAGEMENT PLAN (DMP)

By

IRCLASS
Indian Register of Shipping

February - 2020

This is to state that at the request of Jawaharlal Nehru Port Trust (JNPT), the undersigned surveyors have prepared Disaster Management Plan.

CONFIDENTIALITY CLAUSE

This work has been carried out for JNPT as per their work order dated 22nd October, 2019 and is confidential. No part of this report may be released to any outside organization unless explicitly advised by the owners in writing.

ISSUED BY:

Indian Register of Shipping

Prepared by

Mr. Dipak Sonawane **Mr. Sudarshan Daga** **Mr. Somesh Gupta**

Reviewed by

Mr. A.R. Kar

Approved by

Mr. N. Girish

REPORT REVISION RECORD

Revision No.	Revision Details	Date
Draft	Draft report issued for review and comment to JNPT.	08.01.2020
Final	Final report issued to JNPT	03-02-2020

Disclaimer

The tasks of preparation of Disaster Management Plan have been done by IRS as a consulting service at the request of JNPT. Conclusions and recommendations resulting from the consulting services have been formed in good faith and on the basis of the best information available from sources believed to be reliable.

IRS provides No warranty, express or implied, as for the completeness or correctness of the analysis and report preparation work. While IRS have made every attempt to ensure that the analysis, conclusions or recommendations contained in the Report are from reliable sources using reliable methodologies; IRS is not responsible for any errors or omissions, or for the results obtained from the use of the deductions or reports.

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The client(s) understand(s) and agree that IRS shall have no liability arising out of or in connection with the results, recommendations or omissions. In no event will IRS, its related partnerships or personnel or agents or employees thereof be liable to JNPT or anyone else for any decision made or action taken in reliance on the services provided by IRS including any consequential, special or similar damages, even if advised of the possibility of such damages.

It is concluded that any usage/implementation/interpretation of the recommendation is at the client's risk. In particular, the recommendations should not be considered as certified, legal or otherwise.

INTRODUCTION OF
INDIAN REGISTER OF SHIPPING (IRS)

IRS is a classification society established for the promotion of safety of life and protection of property at sea & promotion of knowledge base. It is therefore engaged in the Management of Safety & Reliability through Development of Rules and Regulations, Surveys, Audits, Certification and Training. It is a member of the 'International Association of Classification Societies' (IACS) which is a consultative body to International Maritime Organisation, a subsidiary body of the 'United Nations Organisation'.

IRS has been incorporated as a section 25 public limited company under the companies Act, 1956 with no shareholders and is collectively managed by the clients it seeks to serve; therefore, no single interest is dominant in its functioning. The Technical & other committees are also constituted of representatives of the industry enabling both financial & organizational independence. IRS is a not-for-profit organization; any surplus resulting from our operations is invested for R&D and growth, to promote its objectives.

IRS is a recognized R&D organization by the Department of Scientific and Industrial Research (DSIR), Ministry of Science & Technology, 'Govt. of India' for its research related to the maritime industry.

In NOS-DCP, IRS has been identified as one of the technical specialist (support agency) to provide advice relating to ship safety, structural integrity and stability of marine casualties and to depute representatives to attend to a casualty and salvage at the SMCU when established.

A strong team of highly qualified and experienced experts in various disciplines of engineering and marine sciences/technology is engaged in IRS to offer prompt technical solutions to marine and other industry.

IMPORTANT NOTE

The Disaster Management Plan (DMP) outlines the steps required for the management of responses to Natural and Man-Made disasters that are the responsibility of the JNPT and companies within port estate.

The DMP of JNPT is a comprehensive document covering all identified Hazards, Risk and Vulnerability analysis, Elements at risk and Level of impact. The plan provides clarity on the roles, delegation of authority and responsibility of each involved staff member in the organization.

It is intended that this plan would provide guidance for quick response in case of an emergency and help in realizing sustainable Disaster Damage Reduction for the Port.

This document should be read/ referred to in conjunction with the JNPT OSCP and NDMA Guidelines.

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ABBREVIATIONS

ADIOS	Automated Data Inquiry for oil spills.
AERB	Atomic Energy Regulatory Board
ATI	Advanced Training Institute
BARC	Bhabha Atomic Research Centre
BPCL	Bharat Petroleum Corporation Limited
CBRN	Chemical, Biological, Radiological and Nuclear
CCA	Central Coordinating Authority
CEC	Chief Emergency Controller
CMO	Chief Medical Officer
CIC	Chief Incident Controller
CICP	Oil Spill Contingency Plan
CISF	Central Industry Security Force
CMG	Crisis Management Group
CMV	Central Motor Vehicle
CWC	Cyclone Warning Centers
DCA	District Coordinating Authority
DCC	District Contingency Committee
DDMA	District Disaster Management Authority
DISH	Director of Industrial Safety and Health
DMP	Disaster Management Plan
EAP	Emergency Action Plan
EOC	Emergency Operation Centre
EPPR	Emergency Prevention, Preparedness and Response
FLOP	Fire Loss of Profit
F&SO	Fire and Safety Officer
GNOME	General NOAA (National Oceanic and Atmospheric Administration) Oil Modeling Environment
GPS	Global Positioning System
GTI-APM	Gateway Terminal India – A.P. Moller
HPC	High Powered Committee
HVLR	High Velocity Long Range
IDRN	Indian Disaster Resource Network
INCOIS	Indian National Centre for Ocean Information Services
IMD	India Meteorological Department
IMO	International Maritime Organization
IAP	Incident Action Plan
IRT	Incident Response Team
IOCL	Indian Oil Corporation Limited
IOTL	Indian Oil Tanking Limited
ITOPF	International Tanker Owners Pollution Federation
JNPCT	Jawaharlal Nehru Port Container Terminal
LCA	Lead Combat Agency

MARG	Mutual Aid Response Group
MbPT	Mumbai Port Trust
MCZMA	Maharashtra Coastal Zone Management Authority
MEFG	Medium Expansion Foam Generator
MLO	Media Liaison Officer
MLOP	Machinery Loss of Profit Insurance
MMD	Mercantile Marine Department
MoEF	Ministry of Environment & Forest
MPCB	Maharashtra Pollution Control Board
MRCC	Maritime Rescue Coordination Centre
MSDS	Materials Safety Data Sheet
MSEB	Maharashtra State Electricity Board
MSIHC	Manufacture, Storage and Import of Hazardous Chemical Rules
MWSSB	Maharashtra Water Supply and Sewerage Board
M&E	Mechanical and Electrical
NEC	National Executive Committee
NCMC	National Crisis Management Committee
NDMA	National Disaster Management Authority
NIDM	National Institute of Disaster Management
NSICT	Nhava Sheva International Container Terminal
NSIGT	Nhava Sheva (India) Gateway Terminal
OH&S	Occupational Health and Safety
OOSA	Online Oil Spill Advisory
OSRL	Oil Spill Response Limited
OSRO	Oil Spill Response Organization
OSTM	Oil Spill Trajectory Model
PAS	Public Address System
PESO	Petroleum and Explosives Safety Organisation
P&IR	Personnel and Industrial Relations
PHO	Port Health Organization
PNGRB	Petroleum and Natural Gas Regulatory Board
PO	Procurement Officer
POC	Port Operation Centre
PPD	Port Planning and Development
PUB	Port User Building
RADMMD	The Revenue Administration, Disaster Management and Mitigation Department
RMC	Regional Meteorological Centre
SA	Statutory Agency
SAR	Search and Rescue
SCMG	State Crisis Management Group
SEC	State Executive Committee
SIC	Site Incident Controller
SIDM	State Institute of Disaster Management

SMPV	Static and Mobile Pressure Vessel
SO	Safety Officer
SDMA	State Disaster Management Authority
UNDP	United Nations Development Programme
WMO	World Meteorological Organization

Part I

1.0 PRELIMINARIES

1.1 PROFILE OF THE PORT

Jawaharlal Nehru Port Trust is a port at Navi Mumbai (formerly known as the Nhava Sheva Port) within the Mumbai harbour on the west coast of Maharashtra, India. The port was commissioned on 26th May 1989.The port lies on the main land opposite to the city of Mumbai across the Thane creek. It is well connected to the major highways and rail networks in India. The nearest airport to JNPT is Mumbai (Chhatrapati Shivaji International) airport is about 57 km via NH348A.

Location of the port

Latitude: 18°56'43'' N; Longitude: 72°56'24''E

The port encompasses an area of 3000+ hectares. The port handles 56% (JNPT website) of India's container traffic.

The port has four container terminals, one shallow water berth, one liquid cargo jetty (BPCL jetty) and an anchorage area (ONGC). The operations related to different container berths/jetty at JNPT are as follows:

1.1.1 Jawaharlal Nehru Port Container Terminal (JNPCT)

JNPCT is JNPT's own container terminal.

Table 1.1: JNPCT Terminal details

Quay length (m)	600
Maximum Draft (m)	15
Capacity (In million TEUs)	1.35
Reefer Points (Nos.)	576
RMQCs (Nos.)	09
RTGCs (Nos.)	27
RMGCs (Nos.)	05
Tractor Trailers	100
Backup Area in Hectares (Container Yard)	61.49 (Including Shallow Birth area)
Reach Stackers	11 (Hired)
Railway Siding Tracks for ICD	04
Maximum Permissible LOA of The Vessel (m)	370

1.1.2 Gateway Terminal India (GTI- APM)

Gateway Terminals India (GTI) is a joint venture between APM Terminals and the Container Corporation of India Ltd (CONCOR). Incorporated in July 2004, GTI operates the third container terminal at Jawaharlal Nehru Port on a build, operate and transfer (BOT) basis for a period of 30 years. It commenced partial operations in March 2006 and became fully operational from October 2006.

Table 1.2: GTI-APM Terminal details

Quay length (m)	712
Maximum Draft (m)	15
Reefer Points (Nos.)	880
RMQCs (Nos.)	10
RTGCs (Nos.)	40
RMGCs (Nos.)	03
Yard Area (In Hectares)	47.24
Maximum Permissible LOA of The Vessel (m)	370
Empty Handlers	02
Twin Lift Spreaders (m) rated load	61

1.1.3 NSICT and NSIGT-DP WORLD TERMINAL

JN Port entered into a license agreement in July 1997 with M/s. Nhava Sheva International Container Terminal (NSICT) a consortium led by M/s. P & O Ports, Australia, for construction, operation and management of a new 2-berth container terminal on BOT basis for period of 30 years. The same was commissioned in April 1999. The project comprises construction of 600 meters quay length; reclamation of 25.84 hectares of area backup for container yards and requisite container handling equipment along with other related facilities. The present capacity of the terminal is currently assessed as 15.00 million tonnes per year.

Table 1.3: DP World Terminal details

	NSICT	**NSIGT**
Quay length (m)	600	330
Maximum Draft (m)	15	15
Reefer Points (Nos.)	772	320
RMQCs (Nos.)	08	04
RTGCs (Nos.)	29	16
RMGCs (Nos.)	03	03
Yard Area (In Hectares)	25.84	27
Maximum Permissible LOA of The Vessel (m)	370	370

1.1.4 Bharat Mumbai Container Terminal (BMCT) (Phase I – 3 berths)

BMCT - Fourth Container Terminal is developed on Design, Built, Fund, Operate and Transfer (DBFOT) basis for the concession period of 30 years. The work was awarded to M/s Bharat Mumbai Container Terminals Pvt. Ltd. (the subsidiary of Port of Singapore Authority) at the Revenue Share of 35.790%. The Concession Agreement was signed on 6th May 2014 and the Concession was awarded on 22nd December 2014.

The project is implemented in two Phases. i.e. Phase–I and Phase–II. The total capacity addition would be 4.8 Million TEUs, 2.4 Million TEUs in each phase.

Table 1.4: BMCT Terminal (Phase–I) details

Quay length (m)	1000
Maximum Draft (m)	16.5
Reefer Points (Nos.)	1620
RMQCs (Nos.)	04
RTGCs (Nos.)	36
RMGCs (Nos.)	04
Yard Area (In Hectares)	90
Maximum Permissible LOA of The Vessel (m)	370
Designed Capacity (million TEUs)	2.4

1.1.5 Shallow Water Berth

Shallow Draught Berth Commissioned 1st September 2002 of Total Length 445 meters. Vessels up to 183 meters LOA and up to 10 meters draught are being handled. Container Vessels, Cement, General Cargo and Liquid Cargo Vessels are being handled with a Capacity of about 0.15 Million TEUs Container & 0.9 Million Tons Other Cargo. Total 2.77 Million Tons.

Table 1.5: SWB details

Quay Length (m)	445
Maximum draft (m)	10-Max (Tidal)
Design capacity (Million TEUs Year) (Million Tonnes/Year)	 0.15 2.77
Max. Permissible LOA of The Vessel (m)	183
RMQCs (Nos.)	3

1.1.6 Liquid Cargo berth - BPCL Jetty

BPCL's Liquid Cargo Berth (LCB) is situated at Jawaharlal Nehru (JN) Port, Navi Mumbai inside Jawaharlal Nehru Port Trust (JNPT), Sheva, Navi Mumbai. M/s Bharat Petroleum Corporation Limited (BPCL) is the owner and Jetty operator of the LCB. The Jetty handles various liquid cargos viz. petroleum (Class A, Class B and Class C), non-petroleum, chemicals, etc. from ship to shore and vice-versa through close conduit system of pipeline network, using marine loading arms for POL products and hoses for non-POL products. The Jetty has two parking berths, one on sea side and the other on shore side to facilitate various marine ships/vessels. LCB is developed with large network of pipelines, intermediate lines, pig launchers, marine loading arms and loading hoses.

The total quay length is 300 m. The vessels can be handled at creek side as well as shore side. Vessels with a capacity of 85,000 DWT tankers (Creek side) and 35,000 DWT tankers (Shore side) respectively have been handled at the Jetty. The berths are in operation since February 2002. Water depth in front of berth is maintained at 12.3m during Monsoon 13.0m during fair weather for Creek side and 10.2m for Shore Side with respect to chart data. Three ships can be unloaded simultaneously, one at the shore side and two at the creek side.

LPG unloading facility is also present at this jetty, which receives at BPCL, Uran LPG Plant. Products such as Crude Oil, Naphtha, Motor Spirit, High speed Diesel (HSD), Phosphoric Acid, Ammonia etc. are handled by private tank farm owners respectively through unloading arm, flexible hoses and transferred through dedicated cross-country pipelines.

There are unloading arms installed on each side of the jetty. BPCL handles the chemicals using SS braided hoses. The hoses are flanged to the unloading pump installed in the ship and then laid across the jetty up to the fixed pipeline.

Six numbers of Marine unloading arms are installed on Creek Side & Four numbers Marine unloading arms are installed on Shore Side. There is also a provision for future installation of a Marine unloading arm on shore side and a Marine unloading arm on sea side.

The jetty operations are carried out round the clock. There is a BPCL office on the Jetty which takes care of the day to day operations.

The details of the unloading arm and hoses given in table below:
Table 1.6: Marine unloading arm/Hose details

MLA/Hose details		**Material**	**Pressure in bar (g)**	**Temperature (^{0}C)**
Dia.	**Company**			
16”	ONGC	Crude oil	3	Atm.
12”	IOCL	Black oil	3	Atm.
12”	IOCL	White oil	3	Atm.
12”	RIL	White oil	7	Atm.
12”	IMC	White oil	7	Atm.
12”	BPCL	LPG	7	-4
12”	BPCL	Fuel Oil	3	Atm.
8”	BPCL	LDO	3	Atm.
16”	Dipak fertilizers	Ammonia	6	-18
10”	IMC	Chemicals	7	Atm.
8”	GBL	Chemicals	7	Atm.
12” & 8”	IMC/Suraj	Base oil	7	Atm.
12”	IMC/Suraj	Edible oil	7	Atm.
12”	GBL	Edible oil	7	Atm.
12”	GBL	Edible oil	7	Atm.

Pipelines within the Liquid Cargo Jetty includes

- Two numbers of 24” White Oil Pipeline connecting LCB and IOC Terminal
- 24” Black Oil Pipeline connecting LCB and IOC Terminal
- 12” & 8” Furnace Oil Pipelines connecting LCB and BPCL Bunk Depot
- Two numbers of 12” LPG Pipeline connecting LCB and Uran LPG Plant
- 24” White Oil Pipeline connecting LCB and IOT Navghar Terminal
- 24” Black Oil Pipeline connecting LCB and IOT Navghar Terminal

- 16” White Oil Pipeline connecting LCB and RIL Terminal
- 12” Base Oil Pipeline connecting LCB and Shell Terminal
- 16” Phosphoric Acid Pipeline connecting LCB and Deepak Terminal
- 16” Ammonia Pipeline connecting LCB and Deepak Terminal
- 16” Black Oil Pipeline connecting LCB and IMC Terminal
- 12” Edible Oil Pipeline connecting LCB and IMC Terminal
- 10” Chemicals Pipeline connecting LCB and IMC Terminal
- 8” Base Oil Pipeline connecting LCB and IMC Terminal
- 18” & 12” Edible Oil Pipelines connecting LCB and Suraj Agro Terminal
- 8” Base Oil Pipeline connecting LCB and Suraj Agro Terminal
- 18” Edible Oil/ Molasses Pipeline connecting LCB and GBL Terminal
- 12” Edible Oil Pipeline connecting LCB and GBL Terminal
- 8” Chemicals Pipeline connecting LCB and GBL Terminal
- 30” Crude Oil Pipeline connecting LCB and ONGC Uran

1.1.7 Anchorage area

- Bunkering of HSD for ONGC vessels.

1.1.8 Utility Services

JNPT receives electrical power from Maharashtra State Electricity Distribution Company Ltd. (MSEDCL) at 220KV level from two independent express feeders at Master Unit Sub Station (MUSS) of the Port. Two independent express feeders at 220 KV level ensures 100 percent reliability of power supply from MSEDCL. Three transformers at MUSS ensure 100% redundancy and uninterrupted power to all terminals of JNPT. As green port initiative, total 822.6 KW of rooftop solar panels are installed at various public buildings of JNPT with generation capacity of approximately 10,00,000 units per year.

1.1.9 Ongoing Activity

JNPT has taken up the project of ‘Coastal Berth’. The work comprises of construction of 250 m long Coastal Berth with 2 trestles 94m long each with backup area reclamation of 11 hectares. Dredging to achieve dredged depth of 11 m at Berth pocket back side of the berth is also proposed for handling port crafts with dredged depth of 6m below CD. Capacity for handling liquid cargo of 1.5 MTPA and general coastal cargo of 1 MTPA. It will reduce the delays caused due to Port related paperwork and custom formalities thus save time and enhance overall Trade

1.1.10 Port Layout with HTL, LTL and CRZ mapping

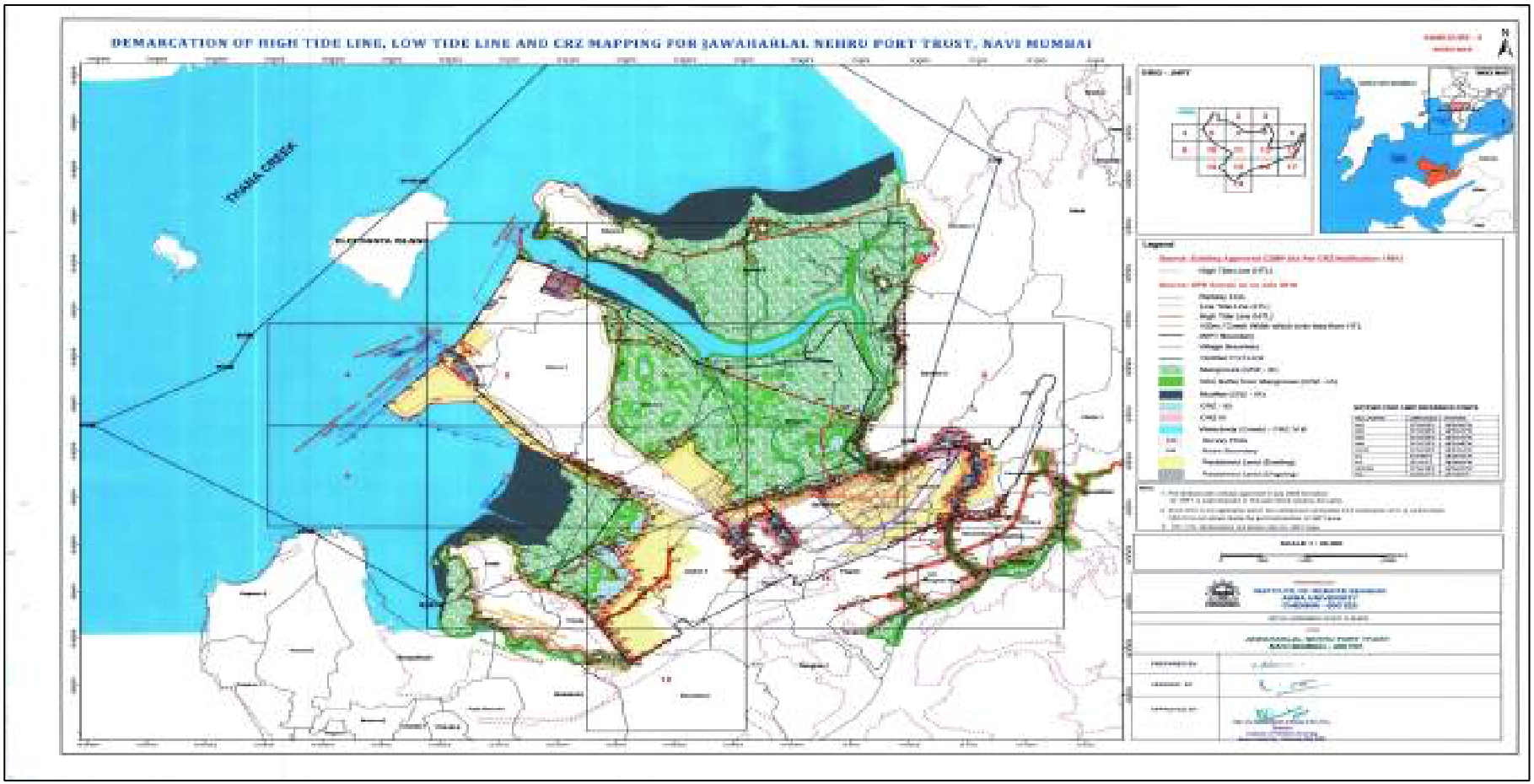


Figure 1.1: Demarcation of HTL, LTL and CRZ mapping

1.1.11 Port Layout

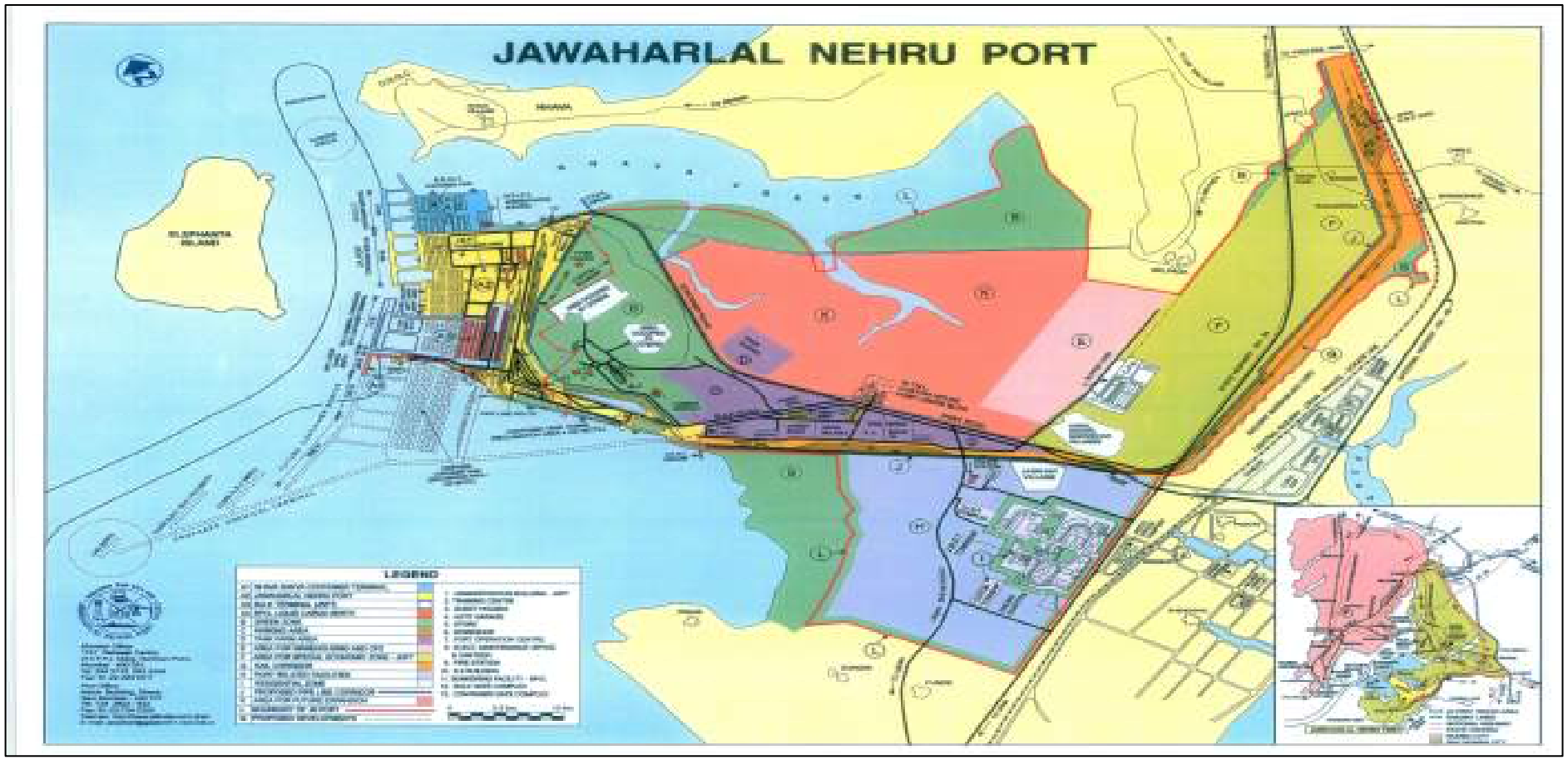


Figure 1.2: Layout of JNPT

1.1.12 Port Limit

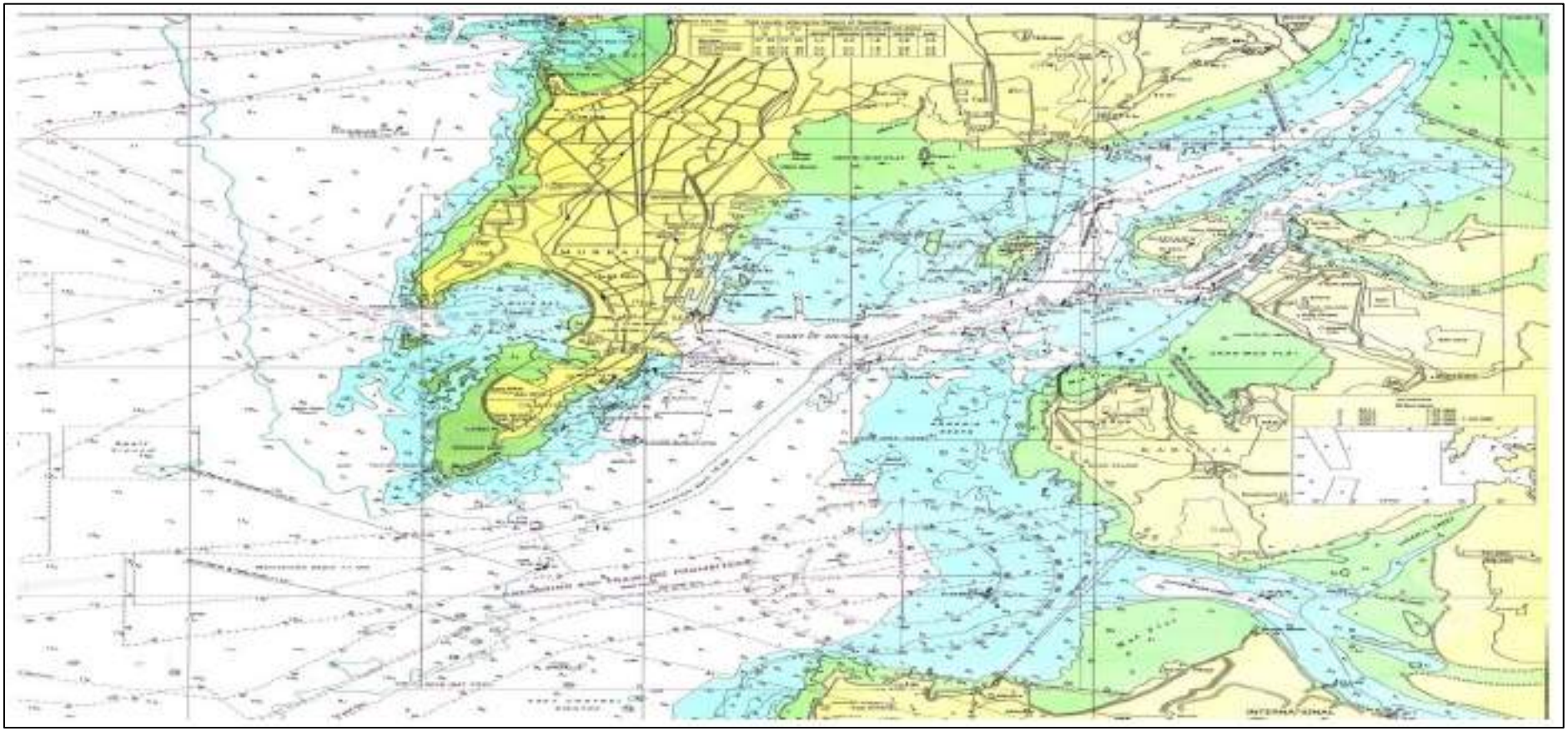


Figure 1.3: Port Limit

1.1.13 Port Area

Table 1.7: Port Area

Water Spread	50 sq. km
Land Area	3252 hectares including reclaimed area

1.1.14 Entrance Channel

Table 1.8: Entrance Channel

Length	:	22 km channel share with MbPT upto Jawahar Dweep + 7.2 km from Jawahar Dweep to JNPT.
Width	:	370 m at straight reach, 460 m at the berths

1.1.15 Berth Particulars

Table 1.9: Berth Particulars

Sr. No	Berth	Type	Maximum permissible draft/mtr	Quay length (mtr)	Maximum size of the vessel that can be accommodated length (mtr)
1.	JNPCT + SWB	Alongside	15	680+445	370 183
2.	NSICT	Alongside	15	600	370
3.	GTICT	Alongside	15	712	370
4.	NSIGT	Alongside	15	330	370
5.	BMCT (Phase I - 3 berths)	Alongside	16.5 m (depth)	1000 m	
6.	Liquid Cargo Terminal	Alongside (twin berth)	14 (Tidal) (outer berth), 10 (Tidal) (inner berth)	300	370 185

1.1.16 Establishments within the Port area

- Jawaharlal Nehru Port Container Terminal (JNPCT)
- DP world
  - Nhava Sheva International Container Terminal (NSICT)
  - Nhava Sheva (India) Gateway Terminal Pvt. Ltd. (NSIGT)
- Gateway Terminals India (GTI-APM terminal)
- Bharat Mumbai Container Terminal (BMCT)
- Bharat Petroleum Corporation Limited (BPCL terminal)
- Indian Oil Corporation Limited (IOCL) tank farm
- RIL tank farm
- IMC tank farm
- GBL tank farm
- Bharat Shell tank farm
- Suraj Agro tank farm
- Deepak Fertilizer tank farm

- Jawahar Customs House
- JNPT - CFS

1.1.17 Storage Facilities

Table 1.10: Storage facilities

Tank Farm	Product	Storage Tank (nos.)	Total capacity in KL
RIL	Naphtha, Motor Spirit (MS), Kerosene, N-Paraffin, Paraxylene, Mixed Xylene, HSD, Aviation Turbine Fuel (ATF), Light Diesel Oil (LDO), Aromatic Feed Stock (AFS), Aromatic Heavy Ends, Linear Alkyl Benzene	10	71,025
IMC	CBFS, CPO, CDSBO, BUTYL ACRYLATE, STYRENE, MDC, 2EH, ULTRA-6, EHC-110, HSD, MS,CSFO, CRUDE GLYCOL, 500 N, SN-600, 150N, SN150, AP/E CORE2500, PALMOLEIN, R600, J150	46	170,000
GBL	Acetic Acid, Acetone, Aniline, Butyl Acrylate, Butyl Acetate, CG, Chloroform, Crude Glycol, Cumene, EDC, IPA, LAB, MDC, MEG, MIBK, Mix Xylene, N Butanol, Phenol, Styrene Monomer, Tolune, VAM, Edible Oil, Base Oil, Bitumen	Phase I-41 Phase II-22	173819 --
IOCL	MS, BS-III HSD, BS-IV HSD, ATF, LSHF HSD	11	108,000
Deepak Fertilizer	Ammonia, Phosphoric Acid	03	29,000 14000 (KL Phos. acid) 15000 MT (Ammonia)
Bharat Shell	Base Oil	04	15,000
Suraj Agro	Edible Oil	15	65,100

Figure 1.4: Satellite image showing tank farm (from Land use plan)

Figure 1.5: Satellite image showing JNPT CFS (from Land use plan)

1.1.18 Stakeholders

1. Port Authority,
2. Ship owners and operators,
3. Container Terminal operators,
4. Tank farm operators,
5. Liquid Cargo operators,
6. Stevedoring companies,
7. Rail carriers/operators,
8. Truck and Shipping companies,
9. Contractors to support the day- to- day activities of the port.

1.1.19 Meteorological Parameters

1.1.19.1 Temperature and Rainfall

The temperature starts rising from March and May is generally the hottest month of the year with mean daily max temperature of 32.9°C. With the onset of monsoon by about first week of June there is an appreciable drop in temperature. The month of January is the coolest month of the year with mean daily maximum and minimum temperatures of 29.1°C and 19.3°C.

The region is subject to a regular seasonal climatic variation determined by the occurrence of two annual monsoons. The South-West monsoon period extends from June to September. Most of the annual rainfall occurs during South-West monsoon, the average monthly rainfall being about 45 cm. Rain during the North-East monsoon is slight.

The average rainfall in the area is about 2422 mm and annual mean number of rainy days is about 77.8. The period between June to September receives nearly 95% of the seasonal rain. The monthly variation in temperature and rainfall is as per table 1.11.

Table 1.11: Temperature and Rainfall

Month	Temperature		Rainfall (mm)	No of rainy days average
	Maximum °C	Minimum °C		
January	30.6	16.4	0.6	0.3
February	31.3	17.3	1.5	0.1
March	32.7	20.6	0.1	0.1
April	33.1	23.7	0.6	0.3
May	33.3	26.1	13.2	1.2
June	31.9	25.8	514.1	15.4
July	29.8	24.8	868.3	23.5
August	29.3	24.5	553	19.1
September	30.1	24	306.4	12.8
October	32.9	23.1	62.9	3.7
November	33.4	20.5	14.9	1
December	32	18.2	5.6	0.3

1.1.19.2 Wind

General direction of wind is from the North to the West quarter, with seasonal variations are as per table 1.12.

Table 1.12: Wind directions and Speeds

Months	Directions	Speeds
February to May	Mainly from N.W	Max 8 to 10 Beaufort Substantial 4-6 Beaufort
June to September	Mainly from W.N.W	Max 8 to 10 Beaufort Substantial 6-8 Beaufort
October to January	Mainly from N.N.W	Max 6 to 8 Beaufort Substantial 2-6 Beaufort.

Winds are generally light to moderate with some increase in force in the summer and monsoon seasons. During January to May wind strengthens in the afternoon. In the southwest monsoon season winds are mainly from west or north east. During rest of the years, winds are north easterly to easterly in the mornings and blow from directions between south west and northwest in the afternoons. Summary is as per table 1.13.

Table 1.13: Wind speeds

Month	Wind Speed (knots/hr)
January	9.1
February	9.3
March	10.4
April	10.5
May	10
June	12.8
July	14.8
August	13.4
September	10
October	8.5
November	8.2
December	8.5
Total/average	10.5

1.1.19.3 Waves

The predominant waves are the swell waves generated by deep sea storms.

These mainly arise just before and during the South West monsoon. The statistical analysis indicates that most wave periods fall between 6 seconds and 10 seconds.

During the continuance of the North-East monsoon, North-Easterly winds known as "Elephantas" blow for short durations during the months of October-November. As the fetch and duration of these winds are limited, the "Significant height" of the resulting waves is not likely to exceed 1 meter with period ranging from 3 to 5 seconds.

The predominant wave direction during monsoon is from south west to west. During this period, waves of 4 to 5 m height normally occur, however, waves of 8.0 m height and period of 14 seconds have also been reported. October and November are transition periods during which the predominant wave direction changes to north and north east. During December and January the waves mainly occur from north to north east and from February to May waves predominantly come from the north-west quadrant. The summary of wave data is as per table 1.14.

Table 1.14: Wave height

Parameter	Value	
	1 year	**100 year**
Significant wave height (m)	0.6	1.6
Significant wave period (years)	10	10
Max. wave height (m)	1	3

1.1.19.4 Currents

The currents in Mumbai harbour and the near shore zone are tide induced with reversal at high and low waters. The current strength ranges from 1.5 to 3 knots.
Current speeds and directions within the Bay and associated tributaries are largely due to the tidal movements and show little variation from non monsoon to monsoon. The maximum current speed in the outer Bay exceeds 1 m/s and the variation in the water column at any given time is not significant.
Lateral variations in the speed however occur with current in the eastern area being somewhat stronger. The maximum current speeds decrease in the inner creek and are typically around 0.8 m/s, decreasing markedly during neap tide.
As characterized for a tide dominated system, the alongshore components are fairly strong with the dominance of seaward component while cross-shore components are relatively weak. Their relative magnitude and directions are indicative of net seaward movement over a tidal cycle though shoreward drift can be significant around the change of tide.

Excursion lengths and average current speeds observed for the Bay based on the available drogue trajectories are as per table 1.15.

Table 1.15: Tide excursion at Mumbai Harbour

Tide	Excursion length (km)		Avg. Current speed (m/s)	
	Flood	Ebb	Flood	Ebb
Spring	11.5	11.5	0.5	0.55
Neap	5.5	6.0	0.25	0.3

Excursion lengths during flood and ebb are more or less of a similar magnitude as expected for tidal creeks devoid of large volumes of external water inputs. The overall circulation pattern suggests that the pollutants entering the creek upstream of the bridge at Vashi tend to oscillate within the creek system and flushing to the sea is a delayed process. These pollutants would however be considerably diluted under the influence of tide induced turbulence and advection.
During monsoon however, the creek receives voluminous land run-off and the discharge of near freshwater through the Ulhas estuary, which flushes the inner creek to a large extent.

1.1.19.5 Tides

The quality of water-spread area of the Bay is mainly influenced by tides which induce flushing and dispersion of pollutants entering the system. The tides in Mumbai harbour are characterized by occurrence of two high and two low waters with marked diurnal variation in the levels.

The monsoon freshwater flow, though important in flushing the inner zone, is not high enough to cause significant changes in the hydrography of the outer Bay. Tides (1.2 - 5 m) in the region are semi-diurnal type with an appreciable diurnal inequality. The flood tidal front advances in north-easterly direction and recedes to south-west.
The dominant tide in the *Mumbai Harbour* is the semi-diurnal tide with a period of 12 hours and 40 minutes. Table 1.16 gives the particulars of tidal levels related to Chart Datum.

Table 1.16: Tidal Levels

Tide	Above (+) or Below (-) datum
Highest High Water recorded	+5.39 m
Mean High Water Spring Tides	+4.42 m
Mean High Water Neap Tides	+3.30 m
Mean Sea Level	+2.5 m
Mean Low Water Neap Tides	+1.86 m
Mean Low Water Spring Tides	+0.76 m
Lowest Low Water recorded	-0.46 m
Highest Low Water	+2.74 m

Statistical studies indicate that all high tides exceed + 2.70 m. and about 5% of all high tides would be less than + 3.20 m.
Variations in tides in Mumbai estuary are as per table 1.17.

Table 1.17: Tide Variations

Location	Range (m)		Time lag from Apollo Bunder (min)
	Spring	Neap	
Apollo Bunder	5.0	1.6	-
Pir Pau	4.3	1.4	10-15
Vashi	4.2	1.2	10-30
Airoli	4.9	1.6	12-45
Thane	4.9	1.5	15-60

The tidal range decreases markedly up to Vashi as compared to that at the Apollo Bunder but increases in the inner creek, the range at Thane is only marginally lower than that at Apollo Bunder. This increase appears to be due to the funnel shape geometry of the Bay that is conducive for accumulation of seawater with the advance of tidal front in the lower creek. The tide at Thane lags by 30 to 45 min with respect to the tide at Apollo Bunder with the lag more pronounced for neap tide.
Spring tides are important for spill response as oil beached during this time is likely to remain stranded on the upper portion of the shoreline until the next spring tide (about 14 days) or storm event. If there is a storm surge during a spring tide, the oil can remain stranded for a much longer period.

1.1.20 Meteorological Station

Meteorological Station installed at 800 m away from the jetty at Port Control Station provides data on Air Quality, Pressure, Temperature, Humidity, Rainfall, Wind Speed and Direction and Tide level with the help of sensors as well as the forecast data and warning received from Regional Meteorological Centre (RMC) - Mumbai.

1.1.21 Population at JNPT terminals

Table 1.18: Population at JNPT terminals

Sr. No	Description	Population	
		Day	Night
1.	JNPCT	3600	1500
2.	NSICT	1453	-
3.	NSIGT		
4.	GTI-APM terminal	1685	-
5.	BMCT	399	100
6.	BPCL Liquid Cargo Jetty	50	-

1.1.22 Population at JNPT Tank Farms

Table 1.19: Population at JNPT tank farms

Sr. No	Description	Population	
		Day	Night
1.	RIL	37	8
2.	IMC	209	24
3.	GBL	100	25
4.	IOCL	25	8
5.	Deepak Fertilizer	40	12
6.	Bharat Shell	10	04
7.	Suraj Agro	23	10

1.1.23 Population data (approximate) for other areas

Table 1.20: Population data

Sr. No.	Location	Population	
		Day	Night
1	JNPT Township (Port quarters)	4500	4000
2	Administration Building Port Employee Contract Staff	260	05
3	Customs House EMP Agency	2000	--
4	PUB	2000	10
5	Guest House	50	30
6	Training centre	40	01

7	JNPT Hospital	50	10
8	South Gate Complex	150	50
9	Centre Gate Complex	300	200
10	North Gate Complex	300	200
11	CISF (G.G + R.G +B.G)	55	45
12	MTNL Office	--	--
13	Police Station	50	10
14	Custom Township	--	--
15	CISF Complex	300	300
16	Railway Quarters	--	--
17	Port Fire Station	26	18
18	Port Operation Centre	50	10
19	Ships at all berths @20 Crew/Ship	280	280
20	Jaskhar Village	2500	2500
21	Karal Village	3500	3000
22	Sonari Village		
23	Sawarkhar Village		
24	Ranjanpada Village	1000	1000
25	Belpada Village	2000	2000
26	JNPT CFS	300	200
27	Air Force Station	-	-

1.2 RATIONALE

1.2.1 Authority and relevant Regulations

- The Disaster Management Act, 2005;
- National Disaster Management Plan , 2019;
- Post 2015 – Global Framework;
- Prime Minister of India's Ten-Point Agenda for Disaster Risk Reduction.

1.2.1.1 The Disaster Management Act, 2005

The Disaster Management Act, 2005 (DM Act 2005) lays down institutional and coordination mechanism for effective Disaster Management (DM) at the national, state, district and local levels. As mandated by this Act, the GoI created a multi-tiered institutional system consisting of the National Disaster Management Authority (NDMA) headed by the Prime Minister, the State Disaster Management Authorities (SDMA) headed by the respective Chief Ministers and the District Disaster Management Authorities (DDMA) headed by the District Collectors/ District Magistrate and co-chaired by Chairpersons of the local bodies.

1.2.1.1.1 The Disaster Management Act 2005, Section 36

This section of the act lays down the primary responsibility of ministries in the GoI and departments with respect to institutional framework for prevention and mitigation of disasters, allocating sufficient funds and other resources to the National and State government agencies.

1.2.1.1.2 The Disaster Management Act 2005, Section 37

This section of the act lay down the primary responsibility of ministries in the GoI and departments with respect to preparation of Disaster Management Plan, their review, Updation and its approvals. Measures for financing the activities within the plan are also required to be spelled out in the plan.

1.2.1.1.3 The Disaster Management Act 2005, Section 41

This Act specifies the function of local authorities with regards to Disaster Management.

It includes the following functions:

- Ensure that its officers and employees are trained for disaster management;
- Ensure that the resources relating to DM are so maintained as to be readily available for use in the event of any threatening disaster situation or disaster;
- Ensure all construction projects under it or within its jurisdiction conform to the standards and specifications laid down for prevention of disasters and mitigation by National Authority, State Authority and District Authority;
- Carry out relief, rehabilitation and reconstruction activities in the affected area in accordance with the State Plan and District Plan.

1.2.1.2 National Disaster Management Plan, 2019

The National Disaster Management Plan (NDMP) provides a framework and direction to the government agencies for all phases of disaster management cycle. The NDMP is a “dynamic document” in the sense that it will be periodically improved keeping up with the emerging global best practices and knowledge base in disaster management. It is in accordance with the provisions of the DM Act 2005, the guidance given in the National Policy on Disaster Management (NPDM) 2009, and the established national practices.

1.2.1.3 Post 2015 – Global Framework

The Post-2015 goals and agenda are set forth in the three landmark global agreements reached in2015 – the Sendai Framework for Disaster Risk Reduction (Sendai, Japan, March 2015), Sustainable Development Goals (UN General Assembly, New York, September 2015) and Climate Change Agreement (Conference of Parties, COP21, Paris, December 2015). The three documents set the stage for future global actions on DRR, sustainable development and climate change.

1.2.1.4 Prime Minister of India – Ten-Point Agenda for Disaster Risk Reduction

1. All development sectors must imbibe the principles of disaster risk management
2. Risk coverage must include all, starting from poor households to SMEs to multi-national corporations to nation states
3. Women’s leadership and greater involvement should be central to disaster risk management
4. Invest in risk mapping globally to improve global understanding of Nature and disaster risks
5. Leverage technology to enhance the efficiency of disaster risk management efforts
6. Develop a network of universities to work on disaster-related issues

7. Utilize the opportunities provided by social media and mobile technologies for disaster risk reduction
8. Build on local capacity and initiative to enhance disaster risk reduction
9. Make use of every opportunity to learn from disasters and, to achieve that, there must be studies on the lessons after every disaster
10. Bring about greater cohesion in international response to disasters

1.2.2 Legal provisions to regulate Fire and Chemical risk in industries

1. Explosives Act, 1884;
2. Petroleum Act, 1934;
3. Factories Act, 1948;
4. Insecticides Act, 1968;
5. Environment Protection Act, 1986;
6. Motor Vehicles Act, 1988;
7. Public Liability Insurance Act, 1991;
8. Other relevant rules and its amendments
    - NDMA guidelines on Chemical Disaster Management,
    - MSIHC Rules,
    - EPPR Rules,
    - SMPV Rules,
    - CMV Rules,
    - Gas Cylinder Rules,
    - Hazardous Waste Rules, and
    - Dock Workers Rules.

1.2.3 Safety initiatives to address Natural Disasters

NDMA guidelines on Disasters like Wind & Cyclone, Tsunami, Earthquake and Floods Management are relevant and these have been prepared to provide the directions to ministries, departments and state authorities for the preparation of their detailed Disaster Management Plans.

1.3 SCOPE OF THE PLAN

1.3.1 Aim and Objective

This plan exhibits the organizations commitment to the safety of employees and increases the organizational safety awareness. It defines the roles and actions necessary to prepare for and respond to any disaster situation in a coordinated manner. Thus, minimize or avoid the potential losses from hazards and disasters caused due to human, technical or natural phenomena inside the Port and Port water limits, through the implementation of rapid, effective and appropriate response & recovery procedures.

DMP is intended to provide guidance to all concerned departments within the port with a general concept of potential emergency assignments before, during and following emergency situations in accordance with the priorities of SENDAI framework.

1.3.2 Disaster Management Cycle

Based on the culture of prevention and mitigation following a disaster or near disaster event, the capacity building measures are institutionalized.

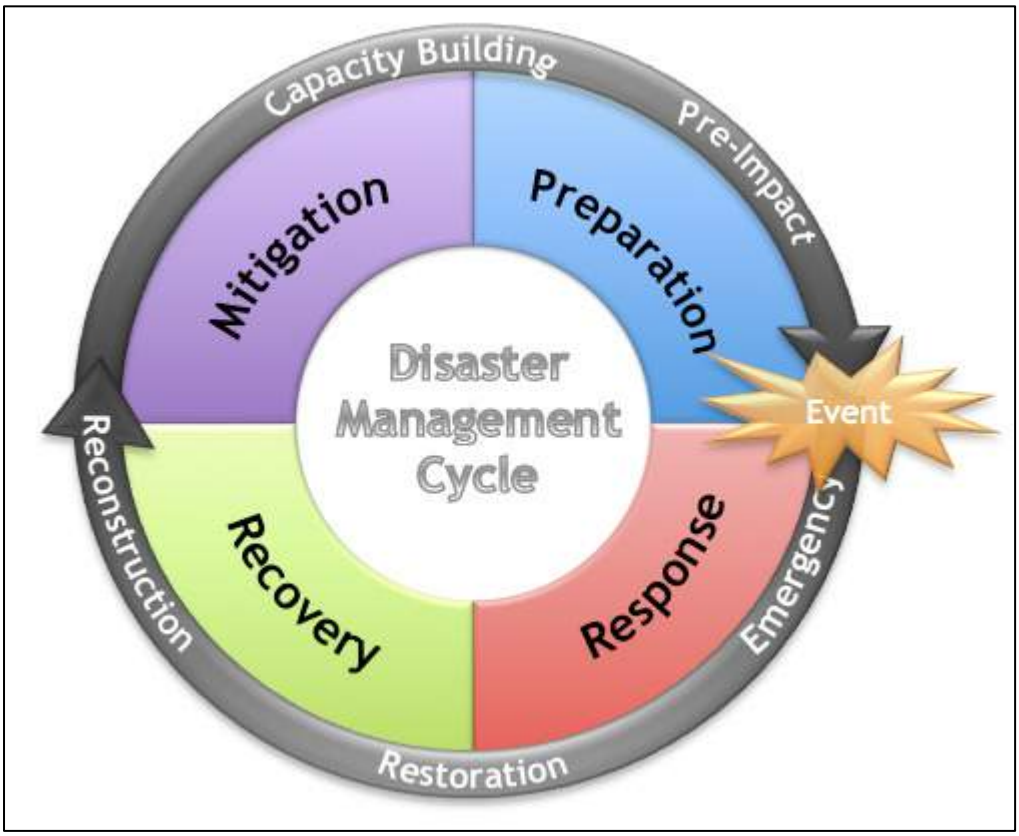


Figure 1.6: Disaster Management Cycle

The primary objectives of the DMP are to:

a. To contain and control the emergency incidents,
b. Proactively safeguard the lives of the JNPT employees, contractors, stakeholders, visitors and neighboring population,
c. Mitigate the effect and minimize the damage to the environment,
d. Limit damages of port assets,
e. To ensure that the JNPT responds according to the priorities set by the Chief Incident Controller (CIC) during response operation,
f. Safely restore operations back to normal as quickly as possible after occurrence of any accident, to enable business to be resumed at the earliest,
g. To initiate off-site emergency plan in-case of necessity as and when required.

The scope covers –

- The existing preventive and mitigation measures besides those that are additionally required to reduce the risk in time bound manner;
- Identification of potential scenarios that are likely to occur considering risk profile of port;
- the preparedness to develop plans for actions when disaster or emergencies occur;

- the responses that mobilize the necessary emergency services including responders like fire service, police service, medical service including ambulance, government as well as non-governmental agencies;
- the initiation of off-site emergency plan, should the situation escalate to call for support of civic administrations (district and/or state) and their resources;
- the post disaster recovery with aim to restore the affected area to its original conditions.

1.4 VISION

"To build, operate and maintain a safer and disaster resilient Port by a holistic, pro-active, technology driven and sustainable development strategy that involves all stakeholders and fosters a culture of prevention, preparedness and mitigation"

1.5 TIME FRAMES

Port is committed to establish required timeframes for capacity building, introducing research and experienced based steps for prevention and mitigation in accordance with SENDAI framework (2015-2030). As part of the effort to institutionalize such timeframes Hazard specific thematic areas and their timeframes have been tabulated in paragraph 3.2.

1.6 INSTITUTIONAL FRAMEWORK FOR DISASTER MANAGEMENT

1.6.1 National Level

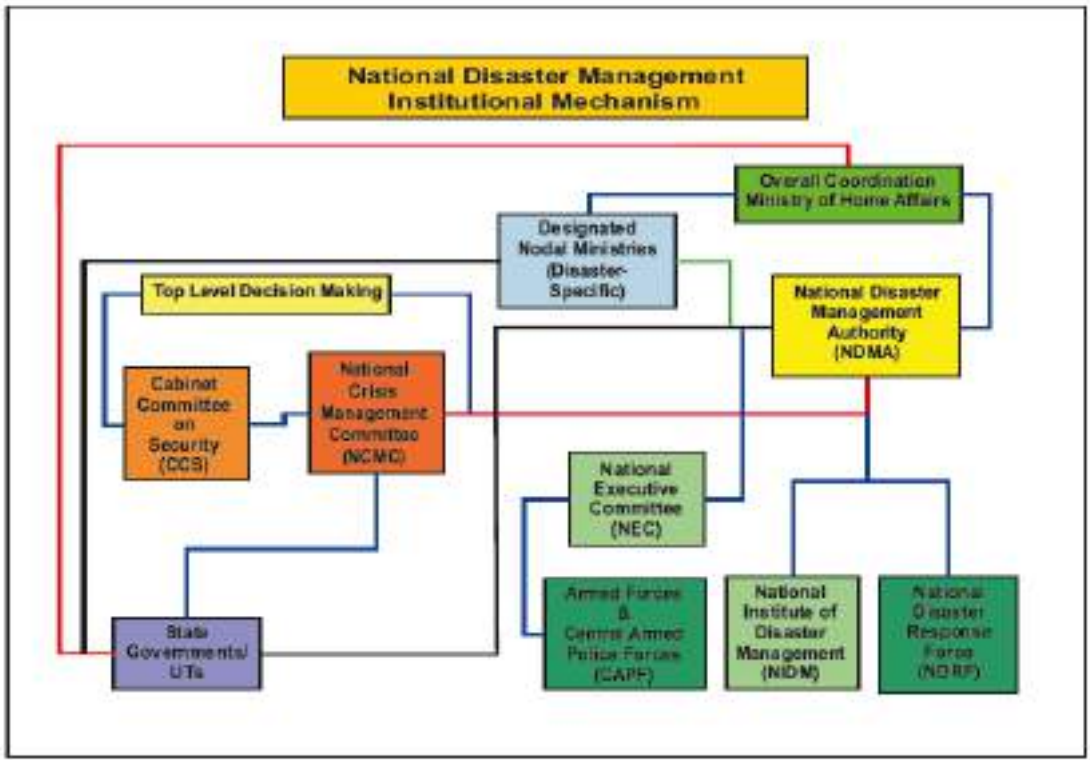


Figure 1.7: National –level disaster management – basic institutional framework

1.6.2 State Level

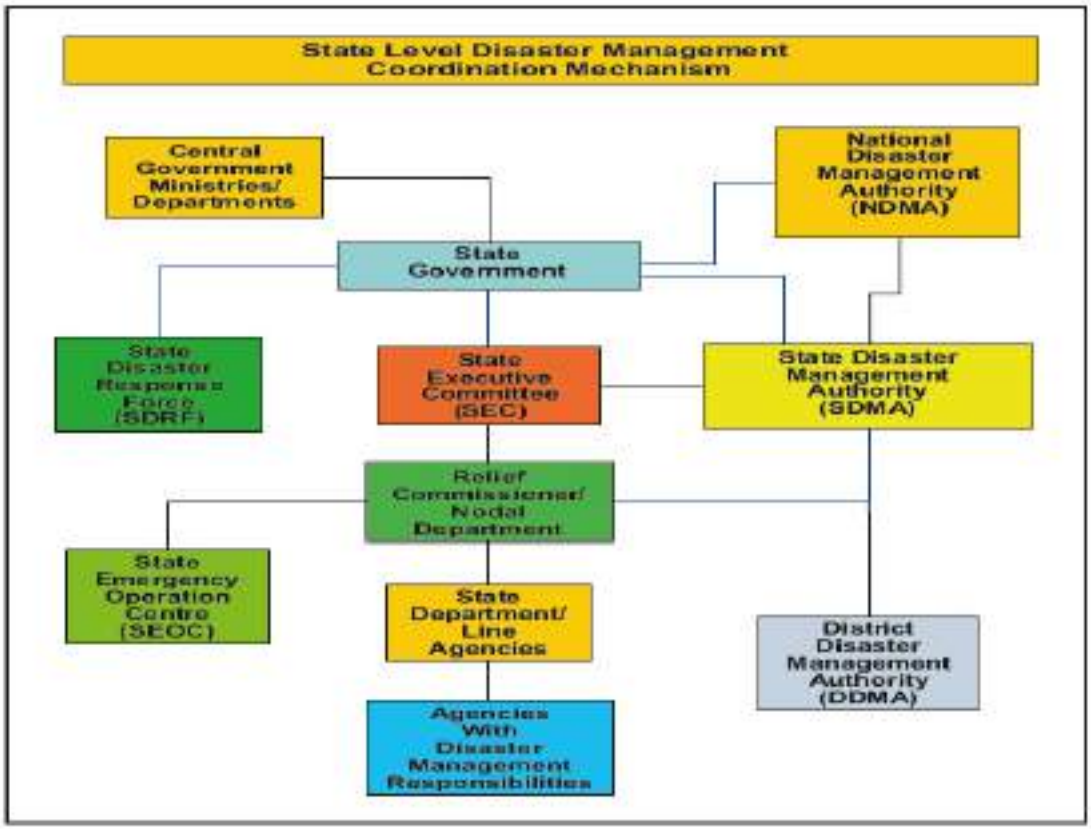


Figure 1.8: State –level disaster management – basic institutional framework

1.6.3 District Level

The DDMA will be headed by the District Collector, Deputy Commissioner, or District Magistrate as the case may be, with the elected representative of the local authority as the Co-Chairperson.

1.6.4 Incident Response Team at JNPT

IRT will be headed by the CIC with the elected representative of the Port department and various functional heads of stakeholders.

Refer **Figure 1.9 and Figure 1.10** for Onsite and Offsite Emergency Organization Chart.

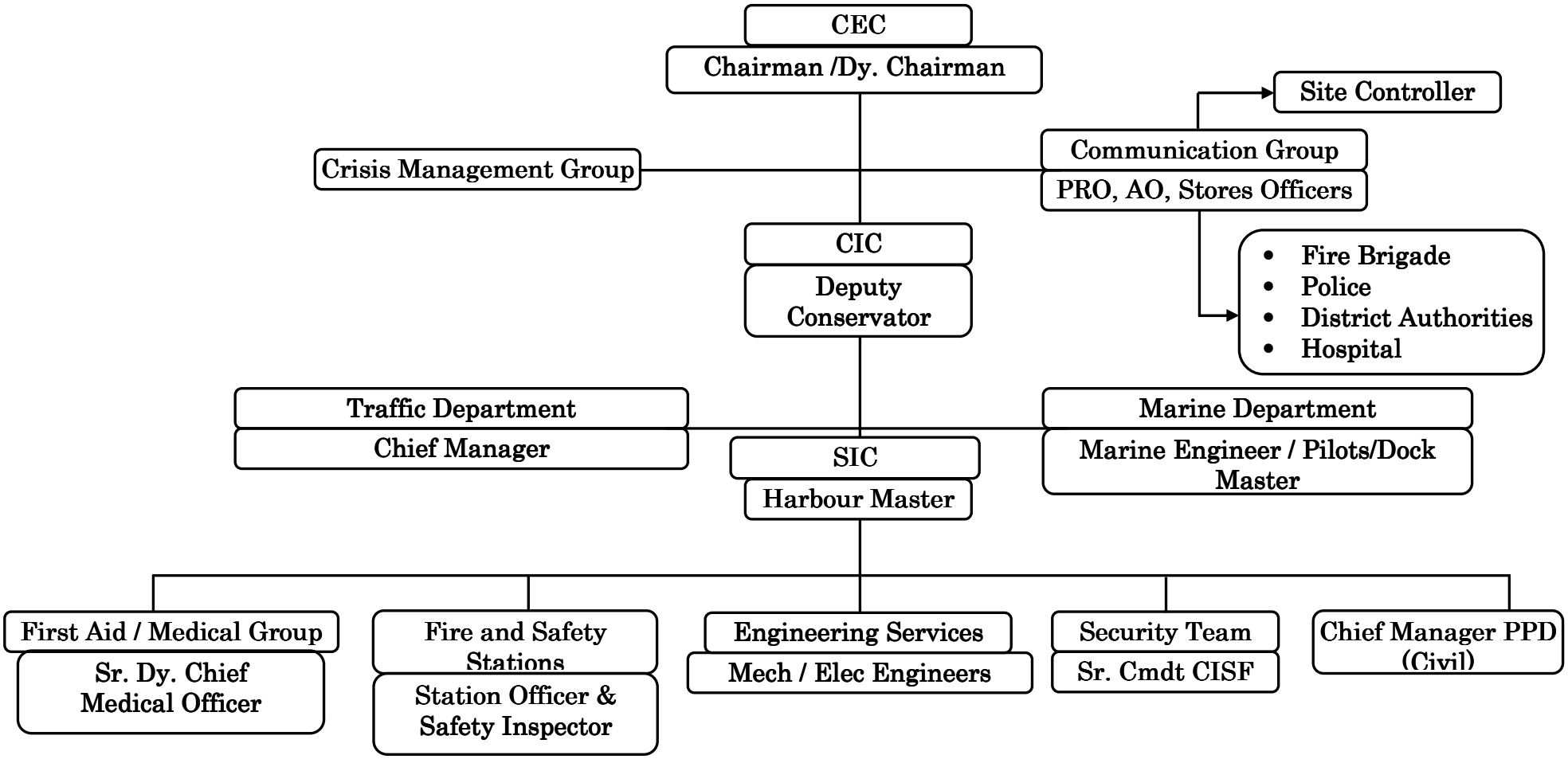


Figure 1.9: ONSITE EMERGENCY ORGANIZATION

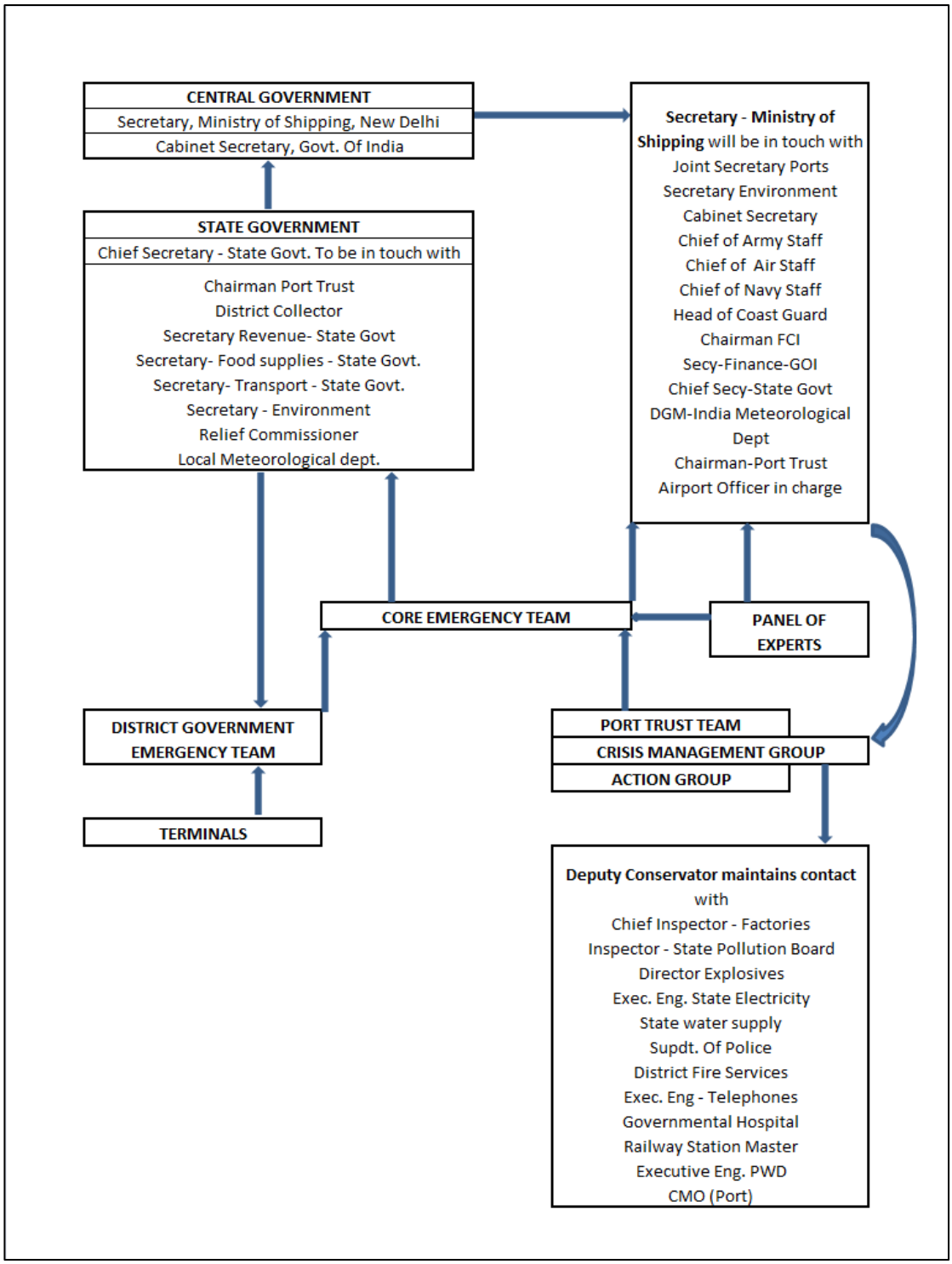


Figure 1.10: Off-Site Emergency Organization Chart – Level 2 and 3

2. HAZARD, RISK, VULNERABILITY & CAPACITY ANALYSIS

2.1DISASTER RISKS, VULNERABILITIES AND CHALLENGES

2.1.1 DISASTERS IN MAHARASHTRA

Table 2.1: Natural Disaster in Maharashtra (Source: Maharashtra Disaster Management Plan – April 2016)

Natural Disasters	Past History	Vulnerable Areas
Floods	33 districts in 2005 31 districts in 2006	All districts of the State
Cyclones	No major history	Six coastal districts including Mumbai
Earthquake	1967 Koyna 1993 Latur	High Risk : Ratnagiri , Raigad, Satara, Thane, Latur

2.1.2 History of Chemical Disaster

Table 2.2: Chemical Disaster in Maharashtra (Source: Ministry of Environment and Forests (Disaster Management of India – Ministry of Home Affairs GOI)

Sr. No	Year	State & Area	No. of Incidents	Fatalities/ injuries
1.	2002	Gujarat, Kerala, Maharashtra	06	05 deaths 31 injured
1.	2004	Andhra Pradesh, Gujarat, Haryana, Kerala, Madhya Pradesh, Maharashtra, Punjab, Tamil Nadu, Uttarakhand, West Bengal, Delhi	18	47 deaths 91 injured
2.	2006	Andhra Pradesh, Gujarat, Maharashtra, Kerala, Rajasthan, Uttarakhand, Uttar Pradesh, West Bengal	16	32 deaths 24 injured
3.	2007	Assam, Gujarat, Kerala, Madhya Pradesh, Maharashtra, Punjab, Uttarakhand, West Bengal	18	37 deaths 14 injured
4.	2008	Andhra Pradesh, Gujarat, Jharkhand, Kerala, Maharashtra, Uttar Pradesh	23	50 deaths 148 injured

2.1.3 Disasters Classification (as per NDMA)

- Man-Made Disasters
  - Chemical

- Natural Disasters
  - Wind and Cyclone
  - Earthquake
  - Tsunami
  - Flood

2.1.3.1 Chemical Disaster

Chemical disasters may be traumatic in their impacts on human beings and may have casualties and also damages nature and property. The elements which are at highest risks due to chemical disaster primarily include the Port, its employees & staff, adjacent industries, hazardous chemicals vehicles, the residents of nearby settlements, adjacent buildings, occupants and surrounding community.

Chemical disasters may arise in number of ways, such as:

1. Process and safety systems failures
    - Human errors
    - Technical errors
    - Management errors
2. Induced effect of natural calamities
3. Accidents during the transportation (Loading/Unloading/Pipeline/Tank truck)
4. Hazardous waste processing/ disposal
5. Terrorist attack/ unrest leading to sabotage.

2.1.3.2 Wind and Cyclone

In accordance with national and regional hazard map available with BMTPC the Raigarh district falls under moderate cyclone damage risk zone (max. wind speed of 44 m/s).

Cyclones can cause damage to port infrastructures including damage to mangroves, trees and flooding of low line and poor drainage affected areas. In addition, ships in the harbor can also sustain serious damage and grounding.

Cyclones are classified by

- Strength of associated winds,
- Storm surges
- Exceptional rainfall occurrences.

Table 2.3: Wind speed Criterion for deep depression and cyclonic storm

Type of Disturbances	Wind Speed in km/h	Wind Speed in Knots
Depression	31-49	17-27
Deep Depression	49-61	27-33
Cyclonic Storm	61-88	33-47
Severe Cyclonic Storm	88-117	47-63
Super Cyclone	More than 221	More than 120
1 knot - 1.85 km per hour		

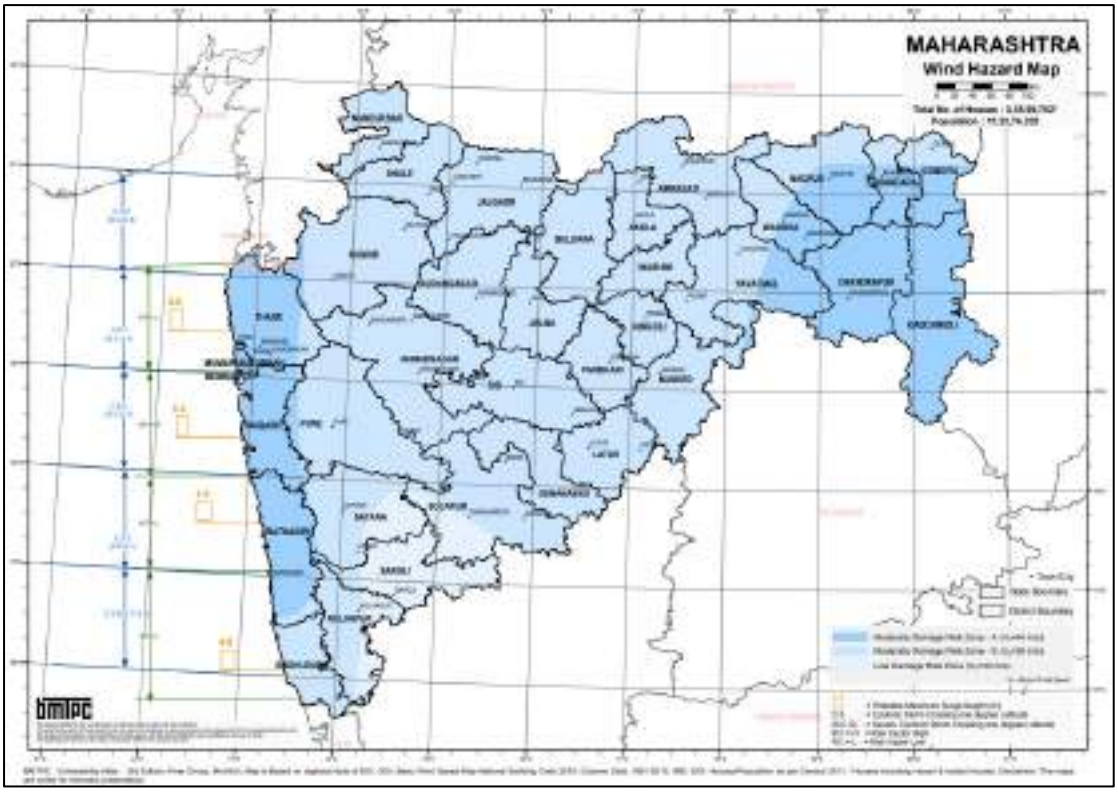


Figure 2.1: Wind Hazard Map (Source: Vulnerability Atlas of India)

2.1.3.3 Earthquake

Raigarh district which includes JNPT falls under **Moderate** earthquake damage Risk zone (zone category III).

Table 2.4: Classification of Earthquakes

Class	Scale
Great	8 or more
Major	7-7.9
Strong	6-6.9
Moderate	5-5.9
Light	4-4.9
Minor	3-3.9

The offices, utility buildings and berthing structures including cranes are required to be constructed for damage zone III. The relevant BIS standards are as follows:

a) For office and other utility buildings – 2016 (IS 1893)
b) For berthing structures -2002

Though the port is a newly developed port (about 30 years) some infrastructure has deteriorated with time due to wind weather effects and aging. A time bound strategy will be undertaken by the port to assess the condition and strengthening of the older buildings and quay side structures that might be affected. This also applies to quay cranes and RMGs. A strategy to counteract the effects of land settlement in the port industrial zone will be adopted to mitigate risk.

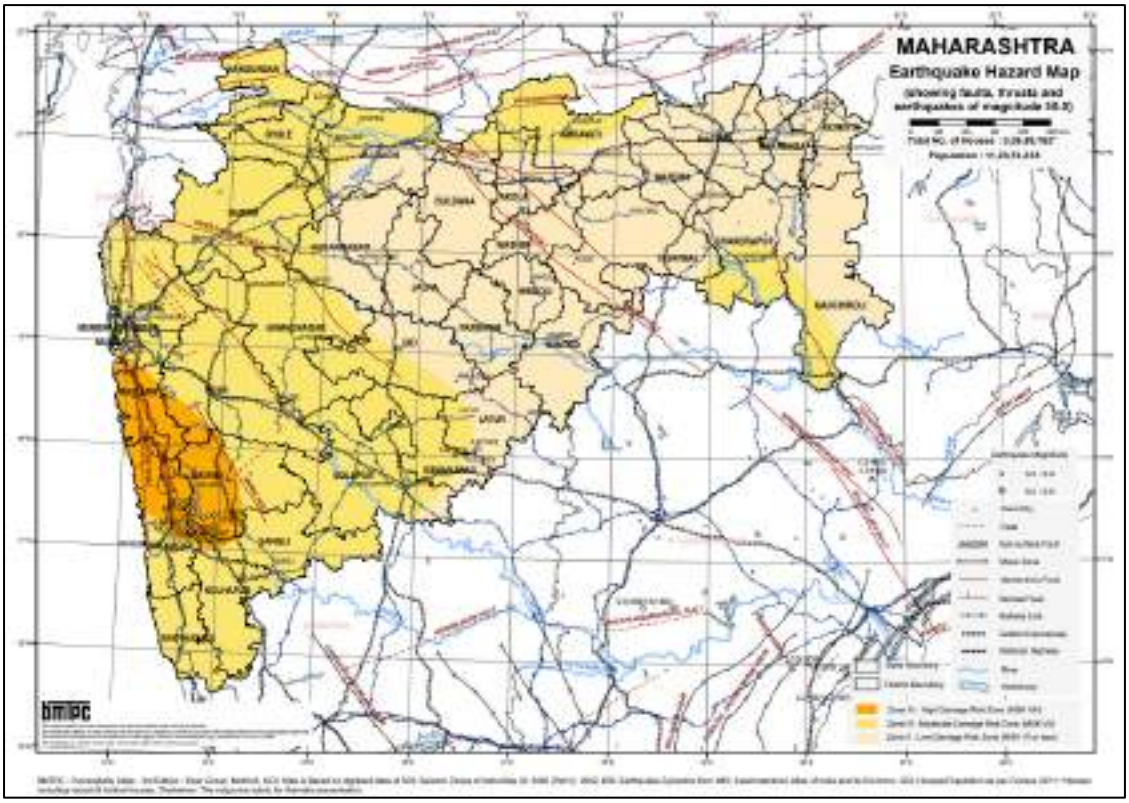


Figure 2.2: Earthquake Hazard Map (Source: Vulnerability Atlas of India)

2.1.3.4 Floods

JNPT being a coastal port in the Mumbai harbor region is bounded on the west by the waterfront, in the north and south by sea water quays. Therefore, has land boundary only on the eastern side. Flood prone areas are located in the latter zone. It comprises of villages where the drainage infrastructure is poor and instances of flooding have occurred in the past during heavy rainfall. The present port infrastructure as such does not face a flooding risk. A maximum surge height of 5 m has been recorded in the past for Raigad – Navi Mumbai coastal zone. The HTL & LTL has been demarcated by MCZMA in the published maps.

Port development plans for future expansion will take into account the strategy to take care of the HTL affected zones within the areas earmarked for expansion allowing sufficient and planned capacity of storm drainage and natural slopes including reservoirs if any that might come within the development zone.

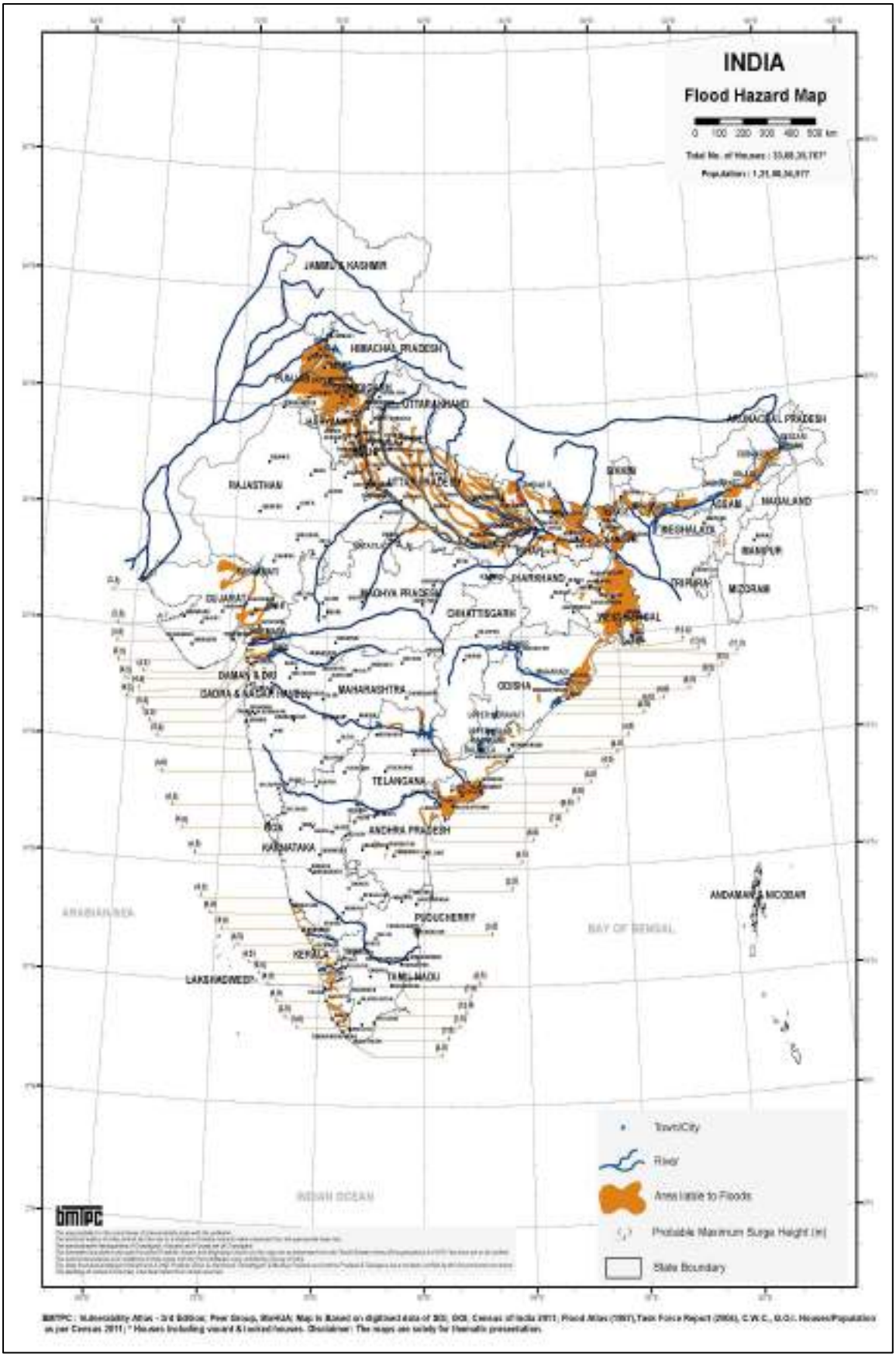


Figure 2.3: Flood Hazard Map (Source: BMTPC, India)

2.1.3.5 Tsunami

An Early Warning System for information related to earthquakes and generation of tsunami has been created under the Ministry of Earth Science, GOI.

A network of tsunami coastal stations has been setup which relay information to the center via satellites.

INCOIS provides such data to JNPT on a regular basis. Hence, adequate early warning will be available to the port. Necessary evacuation measures and provision of tsunami shelters will be provided.

2.2UNDERSTANDING DISASTER RISKS

In view of the complex nature of the navigational operations connected with pilotage of ships inside the narrow channel and their traffic regulation by VTMS, weather variations including tidal windows etc., berthing complexities, turning circles and usage of tugs; HAZID workshop with various stakeholders connected to marine department was carried out. As a result, a better understanding of navigational risk was achieved.

2.2.1 Chemical Disaster (Fire / Explosion/Toxicity) Risks

These can be caused due to loss of containment of hazardous cargo (LPG, Naphtha, Ammonia etc.) handled in the Port. Fire incidents can also occur in the admin building, Port users building, utility craft etc. This type of hazard can be due to both Man-Made and Natural Disasters.

Risk Assessment using software analysis has been carried out for the following scenarios. The impact zone results are placed in **Appendix E.**

Table 2.5: Potential Scenarios for liquid bulk cargoes

Sr. No.	Cargo handling activity	Location	Chemical leakage scenario
1	LPG unloading and transfer to Uran Plant	BPCL - LCB	Small leak and Full Bore Rupture of unloading arm of LPG from 12” marine unloading arm and 12” transfer pipeline.
2	Ammonia unloading and transfer to Dipak Fertilizer terminal	BPCL - LCB	Small leak and Full Bore Rupture of unloading arm of Ammonia from 16” unloading arm and 16” transfer pipeline.
3	Crude oil unloading and transfer pipeline	BPCL - LCB	Small leak and Full Bore Rupture of unloading arm of Crude Oil from 16” unloading arm and 32” transfer pipeline.
4	Naphtha unloading and transfer to Tank farm terminal	BPCL - LCB	Small leak and Full Bore Rupture of unloading arm of Naphtha from 12” marine unloading arm and 24” transfer pipeline.
5	MS unloading and transfer to Tank farm terminal	BPCL - LCB	Small leak and Full Bore Rupture of unloading arm of Naphtha from 16” marine unloading arm and 16” transfer pipeline.
6	Flammable[1]	BPCL -	Small leak and Full Bore Rupture of

	chemicals unloading and transfer to Tank farm terminal	LCB / Shallow water Berth - SWB	unloading flexible hose of chemicals from 8" flexible hose and 8" transfer pipeline.
7	Toxic[2] chemicals unloading and transfer to Tank farm terminal	BPCL - LCB / Shallow water Berth - SWB	Small leak and Full Bore Rupture of unloading flexible hose of chemicals from 8" flexible hose and 8" transfer pipeline.
8	Flammable[3] chemicals handled in tank containers	APMT / JNPCT / NSICT / NSIGT/ BMCT	Major leakage, Medium Leakage and Small leakage of the tank container.
9	Toxic[4] chemicals handled in tank containers	APMT / JNPCT / NSICT / NSIGT/ BMCT	Major leakage, Medium Leakage and Small leakage of the tank container.

1: e.g. Acetone, Acrylonitrile, Alkyl alcohol, Benzene, Cyclo-hexane, Ethylene, MTBE, Propylene, Toluene, Xylene, VAM etc.
2: e.g. Acrylonitrile, Benzene, Toluene etc.
3: e.g. Acrylonitrile, Benzene, Carbon Disulphide, Ethylene oxide, Methylamine, Heptane, Hexane, Propylene Oxide Toluene, Xylene etc.
4: e.g. Acrylonitrile, Benzene, Carbon Disulphide, Ethylene oxide, Methylamine, Propylene Oxide etc.

Potential scenarios for containers:

1. Loss of containment – Major leakage, a puncture or major loss of containment through 2.5"or more dia.
2. Loss of containment – Medium leakage, a puncture or major loss of containment through 1.0"or more dia.
3. Loss of containment – Small leakage, a puncture or major loss of containment through 0.2"or lesser dia.
4. Full Bore Rupture – BLEVE effect

Existing capacities for counter measures to deal with the above emergencies in the form of the firefighting arrangement (fixed and portable) and fire stations with trained man power can be found in **Appendix B**. In addition, MoA between JNPT and industries for fire and chemical disaster are also in place. Joint drills with all stakeholders are carried out periodically.
The shortfalls and gaps if any in these areas will be addressed through time bound measures as given in the hazard specific measures in paragraph 3.2.

2.2.2 Oil Spill Disaster Risk

An Oil Spill Contingency Plan (OSCP) for the port emergency is prepared by the port and the same will be applicable in case of an oil and chemical spill disaster. This plan is prepared in accordance with the requirements of National Oil Spill Disaster Contingency Plan (NOS-DCP). A capability analysis has been carried out as per ICG requirements and is given in the plan.

Collision and Grounding of ships have the potential for causing oil spills of magnitude of Tier 1 (700 tonnes) and above.

Potential scenarios considered in this plan are as follows:
Scenario 1: Collision with small craft - Tanker / Container/ Bulk Carrier in harbour
Scenario 2: Collision between two vessels in channel (Regulated traffic)
Scenario 3: Tanker /Container/ Bulk Carrier tug assisted berthing - Contact with jetty
Scenario 4: Grounding- Tanker/Container/ Bulk Carrier transiting in channel
Scenario 5: Grounding- during pilotage of deep draft vessel
Scenario 6: Collision with dredger within navigational channel
Scenario 7: Collision – passing vessel in port waters (unregulated traffic)
Scenario 8: Dragging anchor
Scenario 9: Contact - during operations in turning circle (large vessels)
Scenario 10: Collision with channel marking buoys
Scenario 11: Fire on vessel in the Navigational channel/Anchorage

2.2.3 Natural Disasters Risk

In view of the historical records and HRVCA profile of the port the following natural disasters are considered for the preparation of the plans and their implementation.

1. Wind and Cyclone
2. Flood
3. Earth quake
4. Tsunami

The port is committed to update plans for the above mentioned geological and meteorological disasters on a periodical basis. Such updates include preparation/Updation of SOPs, structural assessments, project planning, environmental and utility management and provision of emergency equipment. These steps will highlight the strengths and weakness of the capabilities and thus creating resilience. The remedial steps if any will form part of institutional capability building as described in chapter 3 and contained in the paragraph 3.2 of hazard specific preventive and mitigative measures.

2.2.4 CBRN/ Terrorism risk

Considering the threats of nuclear / radiological risk due to concealment of cargoes and mis-declaration, the port will take actions as directed by MoS and equipment and capability provided within the ambit of such directives. The steps for mitigation of risk due to terrorism will be considered separately as part of Port Facility Security Plan (PFSP).

2.2.5 Hazard Assessment worksheet

The above identified hazards have been assessed considering the history of incidents, vulnerability and risk assessment and are placed in the following Hazard Assessment worksheet.

Table 2.6: HAZARD ASSESSMENT WORKSHEET

Scenario No. *	Area #	Category	Hazard /Disaster Detail	Possible Causes	Hazard Reduction Barriers	MCS	WCS	Hazard/Disaster Assessed										Mitigation
								Most Credible					Worst Credible					
								Impact					Impact					
								People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency	
1, 2,6	4	**Leakage - Fire/Explosion**	Fire /Explosion due to LPG/POL/ Chemical leakage	Leakage at the connections of the hose/unloading arm to the manifold, damage to the pipeline, Static Electricity	Standard Operating Procedure, Ship-Shore checklist, Mobile/or fixed fire-fighting system	Minor Damage to vessel &/or other vessels/ Shore structures, injury to personnel	Major damage to shore structures e.g. loading arms etc, Major damage to vessel & pollution, Capsizing & port closure, fatality	**3**	**3**	**2**	**2**	**2**	**4**	**4**	**3**	**3**	**3**	Shipboard emergency procedure, Activation of port DMP, POLREP, Activation of port OSCP

Scenario No. *	Area #	Category	Hazard /Disaster Detail	Possible Causes	Hazard Reduction Barriers	MCS	WCS	Hazard/Disaster Assessed										Mitigation
								Most Credible					Worst Credible					
								Impact					Impact					
								People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency	
3,4	4	Toxic	Toxic gas (Ammonia & Acrylonitrile) leak during operation – on Ship or Ashore	Leakage at the connections of the loading arm to the manifold, valves.	Standard Operating Procedure, Ship-Shore checklist, Mobile/or fixed fire-fighting system	Minor health issue to personnel, Minor environment damage	Serious health issue to personnel	3	1	2	3	2	4	2	3	4	3	Shipboard emergency procedure, Activation of port DMP
5	4	Corrosive	Corrosive acid (Phosphoric) leakage	Leakage at the connections of the hose to the manifold	Standard Operating Procedure, Ship-Shore checklist	Minor Damage to vessel, Shore structures, minor injury to personnel	Major damage to shore structures e.g. hoses, Major damage to vessel & pollution, Serious injury to personnel	2	1	1	1	2	3	2	2	2	3	Shipboard emergency procedure, Activation of port DMP, POLREP, Activation of port OSCP

Scenario No. *	Area #	Category	Hazard /Disaster Detail	Possible Causes	Hazard Reduction Barriers	MCS	WCS	Hazard/Disaster Assessed										Mitigation
								Most Credible					Worst Credible					
								Impact					Impact					
								People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency	
7	5	**Fire/Leakage**	Fire/leakage due to Crane Accidents (Container drop/ crane fall)	Human Error, Equipment failure	Emergency Shutdown system, Overload alarm, Standard Operating Procedure	Minor Damage to container and Jetty(Crane), Injury to personnel/ vessel	Major Damage to container and Jetty, Serious injury to personnel, Terminal closure	**2**	**2**	**0**	**1**	**2**	**3**	**3**	**1**	**2**	**2**	Activation of terminal DMP and port DMP
8	8	**Fall**	Containers falling into water in case of extreme weather, vessel collision or grounding	Latch Failure, Listing of vessel, Collision with other vessel, Bad weather conditions	Secured Arrangements of containers	Temporary passage block	Channel blockage, HAZMAT Pollution	**1**	**1**	**0**	**1**	**3**	**2**	**3**	**1**	**3**	**4**	Shipboard emergency procedure, Activation of port DMP, POLREP, Activation of port OSCP
9	1	**Fire**	Fire in engine room floating craft	Fire due to fuel leakage, Fire during assisting in extinguishing other fires.	Continuous Manning, Automatic Fire detection and fire extinguishing system	Minor Damage to the craft, Serious injury to the person	Major damage, Fatality	**1**	**1**	**0**	**1**	**2**	**2**	**2**	**1**	**1**	**3**	Activation of port DMP

Scenario No. *	Area #	Category	Hazard /Disaster Detail	Possible Causes	Hazard Reduction Barriers	MCS	WCS	Hazard/Disaster Assessed										Mitigation
								Most Credible					Worst Credible					
								Impact					Impact					
								People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency	
10.1	2	**Collision**	Collision with small craft – Tanker/ Container /BC in channel	Vessel equipment failure/ malfunction (navigational, propulsion, steering, auxiliary, tugs), Human error (pilot, master, tug), Language communication issues, Failure to follow Collision Regulations, Environmental conditions (poor visibility, high current flow, unpredicted current eddies, channel size/depth, rough weather, high wind speed)	Exchange of information between Pilot & Master (Pilot exchange card), VTS, Training of personnel, Security boat, Navigational channel is buoyed & well marked, weather monitoring, suspension of operation on increase of wind speed beyond 30 knots.	Avoiding action fails resulting in glancing blow with moderate damage to one or both vessel, Delay to berthing	Penetration to oil tanker/Container/BC, Oil pollution, serious damage to small craft, possible total loss and life of personnel	**1**	**2**	**0**	**1**	**2**	**3**	**3**	**1**	**3**	**3**	Incident report, Activate port DMP, SOPEP, POLREP, Activate port OSCP

Scenario No. *	Area #	Category	Hazard /Disaster Detail	Possible Causes	Hazard Reduction Barriers	MCS	WCS	Hazard/Disaster Assessed										Mitigation
								Most Credible					Worst Credible					
								Impact					Impact					
								People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency	
10.2	2	**Collision**	Collision between two vessels in Channel (Regulated)	Non-compliance with collision regulation, Human error, Lack of communication, Ship's equipment breakdown, Local congestion, difficulty in communication, maneuvering to (dis)embark pilot, absence of VTS control, Multiple vessel convergence especially in poor visibility, Incomplete passage plan	VTS, VHF, proper communication, Security boat, Pilot information exchange card, Designated anchorage area & designated boarding area & designated channel for port operation & pilot (designated VHF frequency)	Moderate damage to one or both vessel, Delay to berthing	Serious damage to vessels and oil pollution, Vessel(s) stranded, Fire and Explosion , Blockage of the navigational Channel	**2**	**2**	**0**	**2**	**1**	**4**	**4**	**3**	**4**	**3**	Incident report, Activation of port DMP, PLOREP, Activation of port OSCP

Scenario No. *	Area #	Category	Hazard /Disaster Detail	Possible Causes	Hazard Reduction Barriers	MCS	WCS	Hazard/Disaster Assessed										Mitigation
								Most Credible					Worst Credible					
								Impact					Impact					
								People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency	
10.3	1	Contact	Tanker/Container/BC tug assisted berthing – Contact with jetty	Mechanical failure (steering or main engine), Vessel blackout, Misjudgment by pilot/master/tug master, Bad weather (wind speed, poor visibility), Break down of tugs, Parting of tow line, Inadequate illumination at berth	Assistance of tugs and use of anchor, Use of electronic aids and proper bridge team management, VTS, Pilot information card, Use of anchor and engines, Weather monitoring, tug assistance, Use of ship's and tugs illumination for night berthing	Minor damage to side shell plating of vessel, No loss of cargo, Minor damage to quay or fendering system	Serious damage to side shell plating of vessel, Serious damage to quay/fender, Loss of cargo containment, pollution, fire/explosion, personnel injury or loss of life	1	1	0	1	2	3	3	1	3	3	Incident report, Remove vessel from damage areas and reberth, Activate port DMP, POLREP, Activate port OSCP.

Scenario No. *	Area #	Category	Hazard /Disaster Detail	Possible Causes	Hazard Reduction Barriers	MCS	WCS	Hazard/Disaster Assessed										Mitigation
								Most Credible					Worst Credible					
								Impact					Impact					
								People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency	
10.4	3	**Grounding**	Grounding – Tanker/Container/ BC transiting in channel	Vessel equipment failure, Misjudgment, Human failure, Adverse weather conditions, Fishing vessel small craft impedes passage	Use of electronic aids and proper bridge team management, Weather monitoring VTS, Use of Anchor, Proper ship signal, Use of security boat signals, Assistance of tugs	Damage to shell plating – possible water ingress & increase in draught, No loss of cargo	Major hull damage, Vessel stranded, Oil pollution, Possible loss of cargo if machinery disabled or extended stranding, Blockage of Channel	**1**	**2**	**0**	**3**	**3**	**3**	**3**	**3**	**4**	**4**	Incident report, Shipboard emergency procedure, Activate port DMP, POLREP, Activate port OSCP

Scenario No. *	Area #	Category	Hazard /Disaster Detail	Possible Causes	Hazard Reduction Barriers	MCS	WCS	Hazard/Disaster Assessed										Mitigation
								Most Credible					Worst Credible					
								Impact					Impact					
								People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency	
10.5	2	**Grounding**	Grounding – During pilotage of deep draft vessel	Engine Failure/Steering Failure, Incorrect assessment taken of vessel's draught & squat during under keel clearance calculations, Vessel transiting too fast, Incorrect chart datum assessed (hydrographic survey outdated), Bad weather condition, Improper maintenance of navigational aids.	Use of Anchor, Master-Pilot info exchange card, Vessel to transit in safe maneuvering speed, Updated navigational chart to be used at all times, Maximum 30 knots wind speed operational limit, Postpone movement, proper maintenance of navigational aids, exchange of information with MbPT.	Tugs required to pull vessel clear, Indentation of bottom hull plating	Breach of hull plating & oil pollution, fire/explosion, Blockage of Channel	**1**	**1**	**0**	**3**	**3**	**2**	**4**	**2**	**4**	**4**	Incident report, Port/Local towage capability, Navigational aids, Pilotage communication, Shipboard emergency procedure, Activate port DMP, POLREP, Activate port OSCP

Scenario No. *	Area #	Category	Hazard /Disaster Detail	Possible Causes	Hazard Reduction Barriers	MCS	WCS	Hazard/Disaster Assessed										Mitigation
								Most Credible					Worst Credible					
								Impact					Impact					
								People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency	
10.6	2	**Collision**	Collision with dredger within the navigational channel	Vessel equipment failure/ malfunction (navigational propulsion, steering, auxiliary), Human error, improper communication, Environmental conditions (poor visibility, high current flows, unpredicted current eddies, channel size/ depth), results of avoiding action (eg. Small craft or vessel), navigation failure (markers, lights)	Emergency shipboard procedure, VTS, training, adequate work/rest hour, situational awareness, weather monitoring, port marine operation procedure, PMS	Temporary grounding without hull damage	Grounding or sinking of either vessel, Oil/chemical pollution, Fire and Explosion, Blockage of navigational channel	**0**	**1**	**0**	**1**	**3**	**4**	**4**	**2**	**4**	**4**	Incident report, Shipboard emergency procedure, Port DMP activation, POLREP, Port OSCP activation

Scenario No. *	Area #	Category	Hazard /Disaster Detail	Possible Causes	Hazard Reduction Barriers	MCS	WCS	Hazard/Disaster Assessed										Mitigation
								Most Credible					Worst Credible					
								Impact					Impact					
								People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency	
10.7	2	**Collision**	Collision - passing vessel in navigation channel (unregulated traffic)	Non-compliance with COLREGS, vessel equipment failure, communication error or lack of communication causing misjudgment, result of avoiding action (eg. Small craft or vessel), Human error.	Shipboard navigational aids, VTS, PMS, shipboard emergency procedure, security patrolling boats, training, adequate work/hour, situational awareness.	Avoiding action fails resulting in glancing blow with moderate damage to one or both vessel, No loss of cargo, No serious injury	Severe damage to one or both vessel, Oil pollution and/ or loss of cargo, Fire / explosion, loss of life	**1**	**2**	**0**	**1**	**2**	**3**	**3**	**2**	**4**	**3**	Incident report, Shipboard emergency procedure, Activation of port DMP, POLREP, Activation of port OSCP

Scenario No. *	Area #	Category	Hazard /Disaster Detail	Possible Causes	Hazard Reduction Barriers	MCS	WCS	Hazard/Disaster Assessed										Mitigation
								Most Credible					Worst Credible					
								Impact					Impact					
								People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency	
10.8	3	**Collision**	Collision – Anchor dragging	Bad weather, Poor monitoring, Poor holding ground, Insufficient scope of anchor chain, Human error, vessel equipment failure	Met. warning through VTS, Use of all Navigational aids, Vessel to drop anchor in designated anchorage area, Vessel to ensure that sufficient chain is paid out, use of all navigational aids, PMS, shipboard emergency procedure	Minor Damage to vessels and/or other vessels	Grounding and oil pollution, Grounding and capsizing, Blockage of channel	**1**	**1**	**0**	**1**	**3**	**3**	**4**	**3**	**4**	**4**	Incident report, Shipboard emergency procedure, Port/Local towage capability, Activation of port DMP, POLREP, Activation of port OSCP

Scenario No. *	Area #	Category	Hazard /Disaster Detail	Possible Causes	Hazard Reduction Barriers	MCS	WCS	Hazard/Disaster Assessed										Mitigation
								Most Credible					Worst Credible					
								Impact					Impact					
								People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency	
10.9	1	**Contact**	Contact – During operations in turning circle (large vessels)	Wind effect, Illumination inadequate at berth, Excessive load on tug rope, High rate of turn, Misjudgment, Human error (fatigue, lack of knowledge, etc.), Break down of tugs, vessel equipment failure, maneuvering constraint of vessel	Suspend operation at Max-30 knots wind speed, postpone movement, ensure proper illumination at berth, Use of support vessel illumination, Use of additional tugs, Use of electronic aid, proper bridge team management, use of all navigational aids, PMS, Shipboard emergency procedure	Minor Damage to vessel &/or other vessels/ Shore structures	Major damage to shore structures e.g. cranes, Major damage to vessel & pollution, Capsizing & port closure	**0**	**1**	**0**	**1**	**2**	**3**	**4**	**3**	**4**	**4**	Incident report, Shipboard emergency procedure, Activation of port DMP, POLREP, Activation of port OSCP

Scenario No. *	Area #	Category	Hazard /Disaster Detail	Possible Causes	Hazard Reduction Barriers	MCS	WCS	Hazard/Disaster Assessed										Mitigation
								Most Credible					Worst Credible					
								Impact					Impact					
								People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency	
10.10	2	**Collision**	Collision with channel marking buoys	Vessel equipment failure/ malfunction (navigational propulsion, steering, auxiliary), human error, improper communication, environmental conditions (poor visibility, high current flows, unpredicted current eddies, channel size/ depth),results of avoiding action (eg. small craft or vessel), navigational failure (markers, lights)	Emergency shipboard procedure, VTS, training, adequate work/rest hour, situational awareness, weather monitoring, port marine operation procedure, PMS	Minor Damage to vessel &/or buoy	Grounding or sinking of vessel, Oil pollution, Blockage of navigation al channel	**0**	**1**	**0**	**1**	**2**	**3**	**4**	**3**	**4**	**4**	Incident report, Shipboard emergency procedure, Port DMP activation, POLREP and Port OSCP

Scenario No. *	Area #	Category	Hazard /Disaster Detail	Possible Causes	Hazard Reduction Barriers	MCS	WCS	Hazard/Disaster Assessed										Mitigation
								Most Credible					Worst Credible					
								Impact					Impact					
								People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency	
10.11	2	Fire	Fire on vessel in the navigation-nal channel	Fire caused by faulty equipment, fire caused by human error, inadequate precautions during hot work, failure to take appropriate precautions with gas bottles and/or inflammable vapour, failure to take the appropriate precaution when handling specific cargoes.	Emergency shipboard procedure, VTS, training, adequate work/rest hour, situational awareness, SMS, PMS, fire fighting assistance from tugs.	Minor damage to vessel, Injury to personnel, Loss of power	Major damage to vessel, Multiple injury and/or fatality to personnel, Loss of cargo, Loss of vessel control.	2	1	0	2	2	4	4	3	4	4	Incident report, Shipboard emergency procedure, Port DMP activation, POLREP and Port OSCP

Scenario No. *	Area #	Category	Hazard /Disaster Detail	Possible Causes	Hazard Reduction Barriers	MCS	WCS	Hazard/Disaster Assessed										Mitigation
								Most Credible					Worst Credible					
								Impact					Impact					
								People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency	
11	2	Blockage of Navigational Channel	Blockage of due to Ground/ Sinking of vessel (Wreckage)	Collision, Bad Weather, Fire, Explosion	Shipboard emergency procedure, assistance from tugs, Port fire fighting system	Temporary grounding, Limited flooding/listing	Sinking of vessel, Loss of life, Loss of cargo, Pollution	0	1	0	2	3	3	3	2	4	4	Incident report, Shipboard emergency procedure, Port DMP activation, POLREP and Port OSCP

Scenario No. *	Area #	Category	Hazard /Disaster Detail	Possible Causes	Hazard Reduction Barriers	MCS	WCS	Hazard/Disaster Assessed										Mitigation
								Most Credible					Worst Credible					
								Impact					Impact					
								People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency	
12	9	Fire/Explosion/Toxic	Emergency/ Disaster in Tank farm	Leakage leading to fire/explosion due to Short circuit, Hot work, smoking, absence of spark arrester in vehicles.	Emergency Shutdown system, Fire extinguishers, Fire tenders, Fire-fighting system.	Minor fire /toxicity incident, injury to the personnel.	Major fire/explosion /toxicity incident, Property damage, Environmental damage, Fatality	2	1	0	1	2	4	4	3	4	4	Activation of individual tank terminal DMP
13	7	Fire	Fire in CFS -Warehouse	Short Circuit, Hot Work, Smoking, leakage leading to fire/explosion.	Fire extinguishers, Fire Tender, Fire-fighting system.	Minor fire incident, injury to the person present	Major fire/explosion incident, Property damage, Fatality	1	1	0	1	2	3	3	1	2	3	Activation of CFS EAP and port DMP
14	6	Fire	Fire in the Admin building/ Port User building/ Custom House/POC	Short circuit, Smoking	Fire extinguishers, Fire-fighting system	Minor fire incident, injury to the person present	Major fire incident, Property damage, Fatality	1	1	0	1	2	4	3	1	4	3	Activation of port DMP

Scenario No. *	Area #	Category	Hazard /Disaster Detail	Possible Causes	Hazard Reduction Barriers	MCS	WCS	Hazard/Disaster Assessed										Mitigation
								Most Credible					Worst Credible					
								Impact					Impact					
								People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency	
15, 16	1 to 9	Civil Disturbance	Fire/ Explosion	War and Terrorism, Bomb Threat	Continuous Monitoring on News channel, Radio, Newspapers, mails	Damage to vessels, Shore structures	Major damage to shore structures e.g. cranes, Major damage to vessel & Oil pollution, Capsizing & port closure	3	3	3	4	4	4	4	4	4	5	Activation of port and terminal DMP, POLREP, Activation of port and terminal OSCP

Scenario No. *	Area #	Category	Hazard /Disaster Detail	Possible Causes	Hazard Reduction Barriers	MCS	WCS	Hazard/Disaster Assessed										Mitigation
								Most Credible					Worst Credible					
								Impact					Impact					
								People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency	
17.1	1 to 9	Natural Disaster	Cyclone	Natural cause	Weather Monitoring and Public Warning system	Minor Damage to tugs, pilot boats, Shore structures, Injury to personnel	Major damage to shore structures e.g. loading arms etc, Major damage to tugs, pilot boats & pollution, Capsizing & port closure, Serious injury to personnel	3	2	1	3	2	4	4	2	4	4	Shipboard emergency procedure, Activation of port and terminal DMP, POLREP, Activation of port and terminal OSCP

Scenario No. *	Area #	Category	Hazard /Disaster Detail	Possible Causes	Hazard Reduction Barriers	MCS	WCS	Hazard/Disaster Assessed										Mitigation
								Most Credible					Worst Credible					
								Impact					Impact					
								People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency	
17.2	4 to 9	Natural Disaster	Flood	Natural cause	Weather Monitoring and Public Warning system	Minor Damage to tugs, pilot boats, Shore structures & port property, Injury to personnel	Major damage to shore structures e.g. loading arms etc, Major damage to tugs, pilot boats & pollution, Capsizing & port closure, Serious injury to personnel	2	2	1	3	2	4	3	4	4	4	Shipboard emergency procedure, Activation of port and terminal DMP, POLREP, Activation of port and terminal OSCP

Scenario No. *	Area #	Category	Hazard /Disaster Detail	Possible Causes	Hazard Reduction Barriers	MCS	WCS	Hazard/Disaster Assessed										Mitigation
								Most Credible					Worst Credible					
								Impact					Impact					
								People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency	
17.3	1 to 9	Natural Disaster	Tsunami	Natural cause	Weather Monitoring and Public Warning system	Minor Damage to tugs, pilot boats, Shore structures & port property, Injury to personnel	Major damage to shore structures e.g. loading arms etc, Major damage to tugs, pilot boats & pollution, Capsizing & port closure, Serious injury to personnel	3	2	1	3	3	4	4	2	4	5	Shipboard emergency procedure, Activation of port and terminal DMP, POLREP, Activation of port and terminal OSCP

Scenario No. *	Area #	Category	Hazard /Disaster Detail	Possible Causes	Hazard Reduction Barriers	MCS	WCS	Hazard/Disaster Assessed										Mitigation
								Most Credible					Worst Credible					
								Impact					Impact					
								People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency	
17.4	4 to 9	Natural Disaster	Earthquake	Natural cause	Weather Monitoring and Public Warning system	Minor damage to properties/ structures/ cranes, Injury to personnel	Major damage to shore structures e.g. loading arms etc, Major damage properties/ structures/ cranes, port closure, Serious injury to personnel	2	1	0	3	3	4	4	4	4	5	Shipboard emergency procedure, Activation of port and terminal DMP, POLREP, Activation of port and terminal OSCP

* Refer Section 9.3- Hazard Specific Incident Action Plan (IAP)
#Area 1: Inner harbour (inner basin)
Area 2: Navigational Channel
Area 3: Anchorage Area.
Area 4: Liquid Cargo Berths (BPCL jetty/SWB)
Area 5: Container Terminal
Area 6: Admin Building/Port User Building/Custom House/POC
Area 7: CFS Warehouse
Area 8: Entire Port limit
Area 9: Tank Farms

2.2.6 Risk Estimation

Table 2.7: Scale of Impact (I0 – I4)

Scale	People	Property	Environment	Port Business
I0	No injury	No damage	Negligible environmental impact	Negligible
I1	Minor (Single slight injury)	Minor damage	Minor Tier 1 oil spill, Minimal environmental harm	Minor
I2	Slight (multiple minor or single major injury)	Local damage	Moderate Tier 2 (limited outside assistance) oil spill or environmental amenity impaired, Moderate environmental impact	Moderate Bad local publicity or short term loss of dues, revenue, etc.
I3	Serious (multiple major injuries or single fatality)	Major damage	Serious Tier 2 (regional assistance) oil spill, localized flooding or multiple amenities impaired, Long term or serious environmental damage	Serious Bad widespread publicity, temporary port closure or prolonged restriction of navigation
I4	Major (More than one fatality)	Total loss	Major Tier 3 (national assistance) oil spill, widespread flooding or extensive damage to amenities, Major environmental harm. e.g. major pollution incident causing significant damage or potential to health or the environment	Major Port closes, navigation seriously disrupted for more than 1-2 days. Long term loss of trade

Table 2.8: Frequency scale (F1- F5)

Category	Descriptive term	Definition
F1	Frequent	An event occurring once a week to once an operating year
F2	Likely	An event occurring once a year to once every 10 operating years
F3	Remote	An event occurring once every 10 operating years to once in 100 operating years
F4	Unlikely	An event occurring once every 100 operating years to once in 1000 operating years
F5	Rare	Considered to occur once in more than 1000 operating years

2.2.6.1 Risk Assessment Matrix

For each identified hazard, risk quantification is done based on a scale of 1 (low risk) to 10 (high risk) as described in the Table 2.9 as below:

Table 2.9: Risk Assessment Matrix

Impact	**I4**	**5**	**6**	**7**	**8**	**10**
	I3	**4**	**5**	**6**	**7**	**9**
	I2	**3**	**3**	**4**	**6**	**8**
	I1	**1**	**2**	**2**	**3**	**6**
	I0	**0**	**0**	**0**	**0**	**0**
Frequency		**F5**	**F4**	**F3**	**F2**	**F1**

Where: -

0 & 1 - Negligible Risk
2 & 3 - Low Risk
4, & 5 – Assessed to be in ALARP region
6 – Heightened Risk
7, 8 & 9 - Significant Risk
10- High Risk

Based on the values of frequency and impact as assessed, Risk Ranking have been done in Table 2.10 for each of the four impact entities as described in Table 2.7 both for the ‘most likely’ and the ‘worst credible’ scenarios as mentioned in Table 2.6 Hazard Assessment Worksheet.

2.2.6.2 Risk Ranking

The risk score of each of the four categories (People, Property, Environment and Business) is analyzed to obtain four indices for each hazardous scenario as follows:

a) The average risk value of the four categories in the ‘most likely’ set.
b) The average risk value of the four categories in the ‘worst credible’ set.
c) The maximum risk value of the four categories in the ‘most likely’ set.
d) The maximum risk value of the four categories in the ‘worst credible’ set.

The hazardous scenarios list is then sorted in order of the aggregate of the four indices to produce an Assessed Risk Ranking List, in descending order, with the highest risk scenario prioritized at the top.

Table 2.10: Risk ranking for JNPT for identified hazards

Scenario No.	Rank No.	Area	Category	Hazard Detail	Assessed Risk							
					Most Credible				Worst Credible			
					People	Property	Environment	Business	People	Property	Environment	Business
10.2	1	2	**Collision**	Collision between two vessels in channel (Regulated)	**8**	**8**	**0**	**8**	**7**	**7**	**6**	**7**
1,2, 6	2	4	**Leakage-Fire/Explosion**	Fire /Explosion due to LPG/POL/ Chemical leakage	**7**	**7**	**6**	**6**	**7**	**7**	**6**	**6**
3,4	3	4	**Toxic**	Ammonia/Acrylonitrile leak at liquid cargo jetty during operation – on Ship or Ashore	**7**	**3**	**6**	**7**	**7**	**4**	**6**	**7**
17.2	4	8	**Natural Disaster**	Flood	**6**	**6**	**3**	**7**	**6**	**5**	**6**	**6**
8	5	8	**Fall**	Containers falling into water in case of extreme weather, vessel collision or grounding	**2**	**2**	**0**	**2**	**3**	**5**	**2**	**5**
17.1	6	8	**Natural Disaster**	Cyclone	**7**	**6**	**3**	**7**	**6**	**6**	**3**	**6**
7	7	5	**Fire/Leak**	Crane Accidents (Load drop/crane fall) at Container terminals	**6**	**6**	**0**	**3**	**7**	**7**	**3**	**6**
10.7	8	2	**Collision**	Collision – passing vessel in port waters (un-regulated traffic)	**3**	**6**	**0**	**3**	**6**	**6**	**4**	**7**
10.11	9	2	**Fire**	Fire on vessel in navigational channel	**6**	**3**	**0**	**6**	**6**	**6**	**5**	**6**
15, 16	10	8	**Civil Disturbance**	Fire/Explosion (War and Terrorism, Bomb Threat)	**5**	**5**	**5**	**6**	**5**	**5**	**5**	**5**
12	11	9	**Fire/Explosion /Leakage**	Emergency/Disaster within the tank farm facility	**6**	**3**	**0**	**3**	**6**	**6**	**5**	**6**
10.4	12	2	**Grounding**	Grounding– Tanker/Container/BC transiting in channel	**2**	**4**	**0**	**6**	**5**	**5**	**5**	**6**
5	13	4	**Corrosion**	Phosphoric acid leakage at BPCL Jetty	**6**	**3**	**3**	**3**	**6**	**4**	**4**	**4**
10.1	14	2	**Collision**	Collision with small craft – Tanker/Container/BC in channel	**3**	**6**	**0**	**3**	**6**	**6**	**2**	**6**
17.3	15	8	**Natural Disaster**	Tsunami	**6**	**4**	**2**	**6**	**5**	**5**	**3**	**5**

10.5	16	2	**Grounding**	Grounding – During pilotage of deep draft vessel	**2**	**2**	**0**	**6**	**3**	**6**	**3**	**6**
17.4	17	8	**Natural Disaster**	Earthquake	**4**	**2**	**0**	**6**	**5**	**5**	**5**	**5**
14	18	6	**Fire**	Fire in the Admin building/PUB/Custom House/POC	**3**	**3**	**0**	**3**	**7**	**6**	**2**	**7**
11	19	2	**Blockage of Navigational Channel**	Blockage of Navigational Channel due to Ground/Sinking of vessel (Wreckage)	**0**	**2**	**0**	**4**	**5**	**5**	**3**	**6**
10.3	20	1	**Contact**	Tanker/Container/BC tug assisted berthing – Contact with jetty	**3**	**3**	**0**	**3**	**6**	**6**	**2**	**6**
10.9	21	1	**Contact**	Contact – During operations in turning circle (large vessels)	**0**	**3**	**0**	**3**	**5**	**6**	**5**	**6**
10.10	22	2	**Collision**	Collision with channel marking buoys	**0**	**3**	**0**	**3**	**5**	**6**	**5**	**6**
13	23	7	**Fire**	Fire in CFS Warehouse	**3**	**3**	**0**	**3**	**6**	**6**	**2**	**4**
10.8	24	3	**Collision**	Collision – Anchor dragging	**2**	**2**	**0**	**2**	**5**	**6**	**5**	**6**
10.6	25	2	**Collision**	Collision with dredger within navigational the channel	**0**	**2**	**0**	**2**	**6**	**6**	**3**	**6**
9	26	1	**Fire**	Fire in Engine room of floating craft	**3**	**3**	**0**	**3**	**4**	**4**	**2**	**2**

3. HAZARD SPECIFIC PREVENTION & MITIGATION MEASURES

3.1 PREVENTIVE AND MITIGATION MEASURES

In accordance with the guiding principle of Sendai Framework, Disaster Risk Reduction (DRR) requires responsibilities to be shared by different divisions/departments of port and various stakeholders. The effectiveness in disaster risk reduction will depend on coordination mechanisms within and across departments and with relevant stakeholders at all levels. For each identified hazard/disaster, the approach used in DM plan incorporates the four priorities enunciated in the Sendai Framework into the framework for DRR under the six thematic areas for action as follows

1. Understanding Risk
2. Inter-Agency Coordination
3. Investing in DRR – Structural Measures
4. Investing in DRR – Non-Structural Measures
5. Capacity Development
6. Climate change risk management

3.1.1 Understanding Risk

This thematic area for action focuses on understanding disaster risk, the Priority-1 in the Sendai Framework integrates into it numerous actions needed for strengthening disaster resilience. The major themes for action are: a) Observation Networks, Information Systems, Research, Forecasting, b) Zoning / Mapping, c) Monitoring and Warning Systems, d) Hazard Risk and Vulnerability Assessment (HRVA), and e) Dissemination of Warnings, Data, and Information. Having adequate systems to provide warnings, disseminate information, and carry out meaningful monitoring of hazards are crucial to disaster risk reduction, and improving resilience. They are also an integral part of improving the understanding of risk.

3.1.2 Inter-Agency Coordination

Inter-agency coordination is a key component of strengthening the disaster risk governance -Priority-2 of the Sendai Framework. The major themes for action required for improving the top level interagency coordination are a) Overall disaster governance b) Response c) Providing warnings, information, and data and d) Non-structural measures.

3.1.3 Investing in DRR – Structural Measures

Undertaking necessary structural measures is one of the major thematic areas for action for disaster risk reduction and enhancing resilience. These consist of various physical infrastructure and facilities required to help communities cope with disasters. The implementation of these measures is essential to enhance disaster preparedness, a component of Priority-4 of the Sendai Framework. It is also an important component of investing in disaster risk reduction for resilience, which is Priority-3 of Sendai Framework.

3.1.4 Investing in DRR – Non-Structural Measures

Sets of appropriate laws, mechanisms, and techno-legal regimes are crucial components in strengthening the disaster risk governance to manage disaster risk, which is Priority-2 of the Sendai Framework. These non-structural measures comprising of laws, norms, rules, guidelines, and techno-legal regime (e.g., building codes) framework and empowers the authorities to mainstream disaster risk reduction and disaster resilience into development activities.

3.1.5 Capacity Development

Capacity development is a theme in all the thematic areas for action. The Sendai Priority-2 (Strengthening DRR governance to manage DR) and Priority-3 (Investing in DRR for resilience) are central to capacity development. The capacity development includes training programs, curriculum development, large-scale awareness creation efforts, and carrying out regular mock drills and disaster response exercises. The capability to implement, enforces, and monitors various disaster mitigation measures has to be improved at all levels from the local to the higher levels of governance. It is also strengthening the DRR governance at all levels to better manage risk and to make the governance systems more responsive.

3.1.6 Climate change risk management

Climate change significantly alters the geographic spread, frequency and intensity of hydrometrological extreme events. It can also exacerbate their impacts. Investments in DRR can play an important role in supporting communities to adapt to climate change.

3.2 HAZARD-WISE RESPONSIBILITY MATRICES FOR DISASTER RISK MITIGATION

For the successful implementation of DM plans, it is necessary to identify various stakeholders within the port and clearly specify their roles and responsibilities. For each hazard/disaster, in the subsections that follow, themes for action are presented in a separate responsibility matrix for each of the five thematic areas for action. The port will play a pro-active role in disaster situations. In the domains of DM planning, preparedness, and capacity building, the port will constantly work to upgrade DM systems and practices. This section covers the matrices for the identified hazards relevant to JNPT as listed below:

Hazard	Chemical Disaster					
1. Thematic area	Understanding Risk					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Information Systems and Research	Support and coordination	• JNPT, • Tank farms, • Container terminals, • Liquid Bulk terminals, • CFS.	• Inventory of chemicals handled, • Coordination with vessel for port entry - Ship to Shore checklist and valid certification as per IBC code, • Containers as per IMDG code.	Centralized Mechanism for reporting the hazardous container inventory information.		
		Online information system on HAZCHEM conforming to international standards	• JNPT, • Tank farms, • Container terminals, • Liquid Bulk terminals, • CFS.	• MSDS copy maintained, • Hazardous Waste Management Plan.			
		Information on (operation and during emergency) dealing with HAZCHEM	• JNPT • Tank farms, • Container terminals, • Liquid Bulk terminals, • CFS.	Online system like CAMEO chemicals is used.			
		Chemical Accident	• JNPT, • Tank farms,	Incidents records maintained with individual tank farm and container	Centralized Mechanism for		

Hazard		Chemical Disaster					
1. Thematic area		Understanding Risk					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
		Information Reporting System	• Container terminals, • Liquid Bulk terminals, • CFS.	terminals and liquid bulk terminal operators (JNPT Safety Operating Procedure for ensuring statutory compliance related to safety and environment at JNPT-Tank farm area and pipeline corridors).	reporting the incident information.		
		Hazardous Waste (import) Information System	• JNPT, • Tank farms, • Container terminals, • Liquid bulk terminals, • CFS.	Information maintained with individual container terminals.			
2	Zoning/ Mapping	Industrial zones on basis of hazard potential and effective disaster management for worst case scenarios	• JNPT - Marine and PPD	Zoning of the tank farm and container terminals, Liquid Bulk terminal already in place with respect to the risk assessment (design consideration).			
			• JNPT - Marine and PPD	Up-dation of zoning carried out regularly after any addition or up-gradation of the facility.			

Hazard		Chemical Disaster					
1. Thematic area		Understanding Risk					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
		Carry out the mapping and related studies in collaboration with central agencies/ technical organizations	• JNPT - Marine • JNPT - PPD			Adhere to CRZ mapping	JNPT Comprehensive Land Use Plan
3	Monitoring	Monitoring compliance with safety norms for HAZCHEM and proper disposal of hazardous waste	• JNPT, • CISF, • Tank farms, • Container terminals, • Liquid Bulk terminals • CFS	• Checklist, • Standard Operating Procedure, • CCTV surveillance.			
		Disposal of hazardous waste	• JNPT, • Tank farms, • Container terminals, • Liquid Bulk terminals,	• Recording and Monitoring of generation hazardous waste , • Regularly providing details to MPCB through MPCB-Annual Statement, • Disposal of waste through			

Hazard		Chemical Disaster					
1. Thematic area		Understanding Risk					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
			• CFS.	MPCB approved waste management parties.			
4	Hazard Risk Vulnerability and Capacity Assessment (HRVCA)	Undertake and provide technical support to HRVCA as part of preparing and periodic revision of DM plans	• JNPT – Marine department, • Tank farms, • Container terminals, • Liquid Bulk terminal, • CFS.	• Port DMP as per Disaster Management Act -2005, NDMA Guidelines and NDMP • Emergency Action Plan (EAP), • Emergency Response Disaster Management Plan	Update plans		
		Constitute/ strengthen the mechanism for consultation with experts and stakeholders	• JNPT – Marine department, • JNPT – Engineering Department, • JNPT – PPD.	Mechanism for strengthening of the port disaster management through • Periodical inspection, • Audits (Structural, Fire and Safety) , • JNPT Safety Operating Procedure for ensuring statutory compliance related to safety and environment at JNPT-Tank farm area and pipeline corridors ,			

Hazard	Chemical Disaster						
1. Thematic area	Understanding Risk						
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
				• Capacity analysis, • Drills, • Training and Awareness, • Land use planning, • Traffic analysis (taken data from IPA / Sagarmala report).			

Hazard		Chemical Disaster					
2. Thematic area		Inter- agency coordination					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Overall disaster governance	Providing coordination, technical inputs, and support, Periodical inspection from government agencies.	• JNPT, • CISF, • Tank Farms , • Container terminals, • Liquid Bulk terminals, • CFS.	• Emergency Operation Centre • Coordination with DRR Cell (at MoS level), • JNPT Safety Operating Procedure for ensuring statutory compliance (e.g. MPCB, PNGRB, DISH, DGFASLI, OISD, AERB, PESO etc.) related to safety and environment at JNPT-Tank farm area and pipeline corridors			
		Address/ identify gaps in equipment/ infrastructure and human resources with DM tasks	• JNPT, • Tank Farms, • Container terminals, • Liquid Bulk terminals, • CFS.	• Developmental project reports	Gap analysis / Periodic reviews in equipment/infrastructure and human resources		

Hazard	Chemical Disaster					
2. Thematic area	Inter- agency coordination					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
2	Response	Organizing and coordinating with Government agencies and stakeholders of the port	• JNPT, • Vessel Master, • Tank Farms, • Container terminals, • Liquid bulk terminal, • CISF.	• Coordinating with CMG group, • Coordinating with MbPT, • Coordinating with Vessel Master, • Coordinating with Govt. Agencies (DG shipping, NDMA, ICG, MMD, PESO, MPCB, Navy, etc.), • Mutual aid agreement with relevant stakeholders.			
3	Warnings, Information, data	Effective coordination and seamless communication among various stakeholders	• JNPT, • CISF, • Tank Farms, • Container terminals, • Liquid bulk terminal , • Vessel Master	• VHF/UHF, • Mobile, • Landline, • PA system, • Emergency Siren.			
		Dissemination of warnings and information	• JNPT, • Tank Farms, • Container terminals,	Dissemination of information to/from • Vessel Master, • CMG, • DG shipping, NDMA, ICG,			

Hazard		Chemical Disaster					
2. Thematic area		Inter- agency coordination					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
			• Liquid Bulk terminal , • Vessel Master, • Local and District Authority, • CISF.	MMD, PESO, MPCB, Navy, Local Police Authority, • CISF, • Any other relevant authority.			

Hazard	Chemical Disaster					
3. Thematic area	Investing in DRR – Structural measures					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Evacuation and support facilities. Multiple routes for reliable access and escape. Decontamination facilities	• Identification hospitals and first aid	• JNPT, • CISF, • Stakeholders, • Local Authorities.	• JNPT Hospital, • Tie up with nearby hospitals, • First Aid centers.			
		• Ensuring fresh water storage facilities for drinking purpose	• JNPT	• Water supply from CIDCO and MJP (Maharashtra Jeevan Pradhikaran), • Elevated Service Reservoir (ESR) , • Ground Service Reservoir (GSR), • Water tanker supply.			
		• Providing wide roads and multiple routes to allow quick access by first responders and to ensure	• JNPT, • CIDCO, • Tank farms, • Container terminals, • Liquid bulk terminals, • CFS.	**Evacuation by Land facilities** • Gate complexes available, • Periodic maintenance of internal roads, • JNPT Port and hired vehicles as per **Appendix B**, • Individual container terminals, Liquid Bulk terminal, Tank farm terminals, CFS vehicles available, • Coordination with state			

Hazard		Chemical Disaster					
3. Thematic area		Investing in DRR – Structural measures					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
		escape pathways		transport for additional vehicles, • Land Use Planning, • Vehicle Traffic SOP, • Parking facility available. **Evacuation by sea route facilities** • JNPT owned/hired crafts and Other terminal owned crafts (details provided in the **Appendix B**), • Landing Jetties, • Vessel Traffic Management system.			
		• Establish decontamination facilities	• JNPT, • Stakeholders.	Personnel decontamination • Hospitals , • Tie up with nearby hospitals, • Eyewash and Safety Showers available.			

Hazard	Chemical Disaster					
3. Thematic area	Investing in DRR – Structural measures					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
2	Disaster Response equipment	Ensuring (as per OISD and other relevant requirements) and maintaining fire-fighting equipment	• JNPT, • Tank Farms, • Container Terminals, • Liquid Bulk terminal, • JNPT Hospital, • PUB, • Customs House.	• Procuring and maintaining fire-fighting equipment as per the OISD and other relevant requirements, • JNPT Fire Station , • Mutual Aid Agreement with the Stakeholders , • Fire Water storage facilities available at individual tank farms and container terminals, CFS, PUB, Customs House, JNPT Hospital and Fire Station. • FIFI Tugs.			
		Ensuring (as per ICG requirements) and maintaining oil pollution response equipment	• JNPT , • MbPT, • Oil Companies as mentioned in Mutual Aid Agreement.	• O & M (common with MbPT) of Pollution response equipment as per the requirement, • Contract for O &M the equipment given to OSRO, • Mutual Aid Agreement with the Stakeholders.			

Hazard	Chemical Disaster						
4. Thematic area	Investing in DRR – Non- Structural measures						
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Laws Regulations, Techno Legal regimes Enforcement, compliance and Monitoring Institutional arrangements	Formulate/ strengthen the SOP for the compliance w.r.t. the statutory requirements ensuring greater safety in hazardous industries and reduce the likelihood of disasters	• JNPT – Marine, • JNPT – PPD, • Tank Farms, • Container terminals, • Liquid bulk terminal, • CFS.	• Study the relevant guidelines issued by Pollution Control Board, Government of Maharashtra and other departments regarding safety control, coastal zone regulation, handling & storage of cargo terminals and land use. • Periodic audit of Tank farms, Pipeline corridor and Oil Jetty as per the JNPT SOP, • Structural Audit, • Fire Audit, • Safety Audit, • Risk Assessment, • Safety committee meetings.			
2	Risk Transfer	Insurance	• JNPT, • Tank Farms, • Container terminals, • Liquid Bulk terminals, • CFS.	• Workmen Compensation Policy, • Public Liability Insurance, • Property Insurance.			

Hazard	Chemical Disaster					
5. Thematic area	Capacity Development					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Training	• Training and orientation programs on management (handling, storage and transfer) and disposal of HAZCHEM • Incorporating disaster response , search and rescue in the training programs	• JNPT, • CISF, • Tank Farms, • Container terminals, • Liquid Bulk terminal, • CFS.	• IMO level training (OSR) for the identified personnel , • ISO and OHSAS training , • Simulation training provided for crane operators, • Fire-fighting training, • Safety Training, • First Aid training.			

Hazard	Chemical Disaster					
5. Thematic area	Capacity Development					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
2	Mock drills/ Exercises	• Planning and execution of emergency drills by all the stakeholders	• JNPT, • CISF, • Tank Farms, • Container terminals, • Liquid Bulk terminal, • CFS.	Conduct mock drills with all the stakeholders (as per PNGRB regulation, OISD and MSIHC rules) as applicable.			
		• Joint planning and execution of emergency drills	• JNPT , • CISF, • MbPT, • Tank Farms, • Container terminals, • Liquid Bulk terminal, • CFS.	Organize (involving all the stakeholders) mock-drills through various government agencies like CISF, NDRF, Local authorities, Civil defense, ICG, MbPT etc.			
3	Documentation	Ensure accurate documentation of all aspects of disaster events for	• JNPT, • Tank Farms, • Container terminals, • Liquid Bulk terminal,	• Maintenance of the incident and near miss record by JNPT, individual tank farm terminals, container terminals, Liquid Bulk terminal and JNPT owned CFS. • Accident/incident reporting,			

Hazard	Chemical Disaster					
5. Thematic area	Capacity Development					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
		creating good historical records for future research and Risk Management planning	• CFS, • PUB, • Custom House, • Hospital.	analysis, investigation and implementation of recommendations.			
4	Awareness	Promote culture of disaster risk prevention, mitigation, and better risk management	• JNPT, • Tank Farms, • Container terminals, • Liquid Bulk terminal, • CFS, • PUB, • Custom House, • Hospital.	• Safety day/week celebration, • Award and recognition, • Safety Bulletins, • Periodic Health Check- up (PME Periodical medical examination).			

Hazard	Fire (Offices, Hospital, electrical substations, Control Rooms, etc.)						
1. Thematic area	Understanding Risk						
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Information Systems and Research	Support and coordination	• JNPT – Fire department, • JNPT Marine and electrical department, • Tank farms, • Container terminals, • CFS, • Liquid Bulk terminal.	• Fire system layout and equipment details, • Electrical system layout and equipment details, • Fire Station.			
2	Zoning/ Mapping	Mapping of sites that pose fire and explosion (LPG cylinders) risks	• JNPT – Fire department, • JNPT Marine and electrical department, • Tank farms, • Container terminals, • CFS, • Liquid Bulk terminal.	• JNPT layout (latitude and longtitude), • Individual terminal layout.			

Hazard	Fire (Offices, Hospital, electrical substations, Control Rooms, etc.)					
1. Thematic area	Understanding Risk					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
3	Monitoring	Monitoring compliance with safety norms	• JNPT – Fire department, • JNPT Marine and electrical department, • Tank farms, • Container terminals, • CFS, • Liquid Bulk terminal.	As per Maharashtra Fire Safety Act and National Building Code, Continuous monitoring with the • Fire and smoke detection system, • 24*7 CCTV surveillance, • Manning of the areas.			
4	Hazard Risk Vulnerability and Capacity Assessment (HRVCA)	Undertake HRVCA as part of preparing and periodic revision of DM plans	• JNPT – Marine department, • Tank farms, • Container Terminals, • Liquid Bulk terminal.	• Port DMP as per Disaster Management Act -2005, NDMA Guidelines and NDMP, • Emergency Action Plan (EAP), • Emergency Response Disaster Management Plan (ERDMP).	Update plans		
		Constitute/ strengthen the mechanism for consultation	• JNPT – Marine department • JNPT – Engineering Department	Mechanism for strengthening of the port disaster management through • Periodical inspection and testing of response equipment,			

Hazard		Fire (Offices, Hospital, electrical substations, Control Rooms, etc.)					
1. Thematic area		Understanding Risk					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
		with experts and stakeholders	• Tank farms, • Container terminals, • Liquid Bulk terminal.	• Fire Audit , • JNPT Safety Operating Procedure for ensuring statutory compliance related to safety and environment at JNPT-Tank farms area and pipeline corridors , • Capacity analysis, • Drills, • Training and Awareness.			

Hazard	Fire (Offices, Hospital, electrical substations, Control Rooms, etc.)					
2. Thematic area	Inter- agency coordination					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Overall disaster governance	Identify and address the gaps in existing capabilities, equipment, infrastructure, and human resources	• JNPT, • CISF, • Tank Farms, • Container terminals, • Liquid Bulk terminal, • CFS, • PUB, • Custom House, • Hospital.	• Fire-fighting team, • Fire-fighting equipment, • Fire Station.	• Recruitment/ outsource of fire-fighting personnel • Procurement of Port Fire tender		
		Establish fire stations	• JNPT, • Tank farms, • Container terminals, • Liquid Bulk terminal, • CFS, • Hospital, • Admin building, • PUB, • Customs House.	• Established Port Fire station , • Identified list of nearby Fire Stations as per **Appendix B**, • Individual fire fighting system with the tank farms, container terminals, Liquid Bulk terminal, CFS, Hospital, Admin building, PUB and Customs House.	Fire fighting system OISD 156 at shallow water berth.		

Hazard		Fire (Offices, Hospital, electrical substations, Control Rooms, etc.)					
2. Thematic area		Inter- agency coordination					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
		Implementation of DM plans	• JNPT, • Tank farms, • Container terminals, • Liquid Bulk terminal, • CFS, • PUB, • Custom House, • Hospital.	• Conducting fire and evacuation drills, • Training and Awareness.			
2	Response	Organizing and coordinating the immediate response Coordinate with Government agencies and stakeholders of the port	• JNPT, • CISF, • Tank farms, • Container terminals, • Liquid Bulk terminal, • CFS, • PUB, • Custom House, • Hospital.	• Activation of DM Plan, • Coordinating with Fire station (JNPT & External e.g. CIDCO, ONGC, MSEB).			

Hazard	Fire (Offices, Hospital, electrical substations, Control Rooms, etc.)						
2. Thematic area	Inter- agency coordination						
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
3	Warnings, Information, data	Effective coordination and seamless communication	• JNPT, • CISF, • Tank farms, • Container terminals, • Liquid Bulk terminal, • CFS, • PUB, • Custom House, • Hospital.	Coordination among various port stakeholders and CMG to ensure quick, clear, effective dissemination of warnings, information and data via • VHF /UHF, • Landline, • PA system, • Mobile Phones, • Emergency Siren.			

Hazard	Fire (Offices, Hospital, electrical substations, Control Rooms, etc.)					
3. Thematic area	Investing in DRR – Structural measures					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Fire Fighting systems	Procurement and maintenance of fire Fighting systems as per relevant rules	• JNPT, • Tank farms, • Container terminals, • Liquid Bulk terminal, • CFS, • PUB, • Custom House, • Hospital.	• Periodical up-gradation and maintenance of the fire fighting system.			• Overhead water tank and pump house (2026-2030 plan) • Water sump for fire-fighting (2026-2030 plan)
2	Evacuation and support facilities. Multiple routes for reliable access and escape.	Identification of Assembly points	• JNPT, • CISF, • Tank farms, • Container terminals, • Liquid Bulk terminal, • CFS, • PUB, • Custom House, • Hospital.	Identified assemble points.	Updation of assembly points and sign boards		
		Providing vehicles for	• JNPT, • Tank farms,	• Passenger vehicles of JNPT as per **Appendix B**.			

Hazard		Fire (Offices, Hospital, electrical substations, Control Rooms, etc.)					
3. Thematic area		Investing in DRR – Structural measures					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
		safe transportation	• Container terminals, • Liquid Bulk terminal, • CFS.	• Passenger vehicles in container terminals, liquid bulk terminal, Tank farms, CFS. • Vehicle traffic Management SOP – Local Administration.			
3	First aid and Decontamination facilities	• Establish First aid and decontamination facilities • Identification of hospital	• JNPT, • Tank Farms, • Container terminals, • Liquid Bulk terminal, • CFS, • PUB, • Custom House, • Hospital.	Personnel first aid and decontamination • JNPT Hospital, • Other identified hospitals as per **Appendix B**, • First aid facility of JNPT as per **Appendix B**, • First aid facility of individual tank farms, Liquid Bulk terminal, CFS, PUB, Customs House.			

Hazard	Fire (Offices, Hospital, electrical substations, Control Rooms, etc.)						
4. Thematic area	Investing in DRR – Non- Structural measures						
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Rules, laws, guidelines	Strict implementation and strengthening of fire safety rules	• JNPT, • Tank Farms, • Container Terminals, • Liquid Bulk terminal, • CFS, • PUB, • Custom House, • Hospital.	• Fire fighting and evacuation plan, • Safety Committee Meeting, • Environment, Health and Safety Policy, • Safety Manual, • Safety budget, • Work Permit System.			
2	Fire safety audit of structures and buildings	Carry out fire safety audit of buildings and critical infrastructure	• JNPT, • Tank Farms, • Container terminals, • Liquid Bulk terminal, • CFS, • PUB, • Custom House, • Hospital.	Periodic Fire audit.			

Hazard	Fire (Offices, Hospital, electrical substations, Control Rooms, etc.)						
4. Thematic area	Investing in DRR – Non- Structural measures						
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
3	Risk Transfer	Insurance	• JNPT , • Tank Farms, • Container terminals, • Liquid Bulk terminal, • CFS, • PUB, • Custom House, • Hospital.	• Workmen Compensation Policy, • Public Liability Insurance, • Property Insurance.			

Hazard		Fire (Offices, Hospital, electrical substations, Control Rooms, etc.)					
5. Thematic area		Capacity Development					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Training	Incorporating disaster response in the training programs	• JNPT, • Tank Farms, • Container terminals, • Liquid Bulk terminal, • CFS, • PUB, • Custom House, • Hospital.	• Fire Induction/Refresher Training, • Fire fighting training, • First Aid training.	Advanced Training at NCDC - Nagpur		
2	Mock drills/ Exercises	Planning and execution of emergency drills by all the stakeholders Joint planning and execution of emergency drills	• JNPT, • Tank Farms, • Container terminals, • Liquid Bulk terminal, • CFS, • PUB, • Custom House, • Hospital.	Annual Drill schedule			

Hazard		Fire (Offices, Hospital, electrical substations, Control Rooms, etc.)					
5. Thematic area		Capacity Development					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
3	Documentation	Ensure accurate documentation of all aspects of disaster events for creating good historical records for future research and Risk Management planning	• JNPT, • Tank Farms, • Container Terminals, • Liquid Bulk terminal, • CFS, • PUB, • Custom House, • Hospital.	• Maintenance of the incident and near miss record by JNPT, individual tank farms terminals, container terminals, Liquid Bulk terminal and JNPT CFS, • Accident/incident reporting, analysis, investigation and implementation of recommendations.			
4	Awareness	Promote culture of disaster risk prevention, mitigation, and better risk management	• JNPT, • Tank Farms, • Container terminals, • Liquid Bulk terminal, • CFS, • PUB, • Custom House, • Hospital.	• Safety day/week celebration, • Award and recognition, • Safety Bulletin, • Periodical Health Check up.			

Disaster		Earthquake					
1. Thematic area		Understanding Risk					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Seismic Zoning/ Mapping	Identification of the vulnerable areas	Not applicable to JNPT for zoning and mapping	Earthquake hazard map as given in BIS standard 1893 -2016.	The requirements of BIS standard 1893- 2016 are to be complied with for seismic zone III.		
2	Hazard Risk Vulnerability and Capacity Assessment (HRVCA)	Undertake HRVCA as part of preparing and periodic revision of DM plans	• JNPT– Marine department, • Tank Farms, • Container Terminals, • Liquid bulk terminal, • CFS.	• Port DMP as per Disaster Management Act -2005, NDMA Guidelines and NDMP, • Emergency Action Plan (EAP) , • Emergency Response Disaster Management Plan (ERDMP).	Update Plans		

Disaster	Earthquake					
2. Thematic area	Inter- agency coordination					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring /Regular measures**	**Short term**	**Medium term**	**Long term**
1	Overall disaster governance	Providing coordination, technical inputs, and support	• JNPT, • CISF, • Tank Farms , • Container terminals, • Liquid Bulk terminals, • CFS.	• Emergency Operation Centre, • As per National Disaster Management Guidelines for Earthquakes.			
		Address/ identify gaps in equipment and infrastructure with seismic zone and standards	• JNPT, • Tank Farms, • Container terminals, • Liquid Bulk terminals, • CFS.	• Developmental project reports	Gap analysis / Periodic reviews in infrastructure		
2	Response	Coordinating with port stakeholders and Government agencies	• JNPT, • Tank Farms, • Container terminals, • Liquid Bulk terminals, • CFS, • CISF.	• CMG group, • NDRF, SDRF, Civil Defense, Local authorities.			

Disaster		Earthquake					
3. Thematic area		Investing in DRR – Structural measures					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Strengthening and seismic retrofitting of prioritized critical structures and buildings	Implementation strengthening and seismic retrofitting as per recommendations of structural safety audits	• JNPT, • Tank Farms, • Container terminals, • Liquid Bulk terminals, • CFS.	• Seismically safe design and construction of jetties, wharfs, trestles, office buildings, utilities, township, • Seismically safe design and construction for industrial zones.	Inspection of critical structures and buildings and prioritization for repairs including areas of ground settlement.	Undertake repair and retrofitting	

Disaster	Earthquake						
4. Thematic area	Investing in DRR – Non- Structural measures						
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring /Regular measures**	**Short term**	**Medium term**	**Long term**
1	Structural safety audit of lifeline structures and buildings	Carry out structural safety audit of lifeline buildings and critical infrastructure	• JNPT, • Tank Farms, • Container terminals, • Liquid Bulk terminals, • CFS.	Structural safety audit of critical buildings and infrastructure.			
2	Risk Transfer	Insurance	• JNPT , • Tank Farms, • Container Terminals, • Liquid Bulk terminals, • CFS.	• Workmen Compensation Policy, • Public Liability Insurance, • Property Insurance.	Renewals of Policies		

Disaster	Earthquake						
5. Thematic area	Capacity Development						
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring /Regular measures**	**Short term**	**Medium term**	**Long term**
1	Training	Training and awareness regarding earthquake related emergencies and do's and don't's **Reference documents:** NDMA guidelines for earthquake	• JNPT, • Tank Farms, • Container Terminals, • BPCL Jetty, • CFS.				
2	Mock drills/ Exercises (Evacuation and rescue)	Joint planning and execution of emergency drills	• JNPT , • Tank Farms, • Container Terminals, • BPCL Jetty, • CFS.	Exercises in accordance with the District and State Disaster Management Plan.			

Disaster	Wind and Cyclone						
1. Thematic area	Understanding Risk						
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring /Regular measures**	**Short term**	**Medium term**	**Long term**
1	Observation networks, Information systems, Research, Forecasting, Early warning	Enhancement of Observational Network Stations (ONS)	JNPT Marine Department	• VTMS, • AIS, • GMDSS, • Microwave, • VHF.			
		Establishment of at least one High Wind Speed Recorder and one surge recorder		Locations at which anemometer is installed, RADAR locations, Admin building (with recorder), On all cranes RMQCs, Shift in-charge office, Maintenance office (indicator with Sirens).			
2	Zoning / Mapping	Identification of the vulnerable areas	Not applicable to JNPT for zoning and mapping.	Cyclone hazard map as given in Maharashtra DMP (Moderate zone- 44m/s).			
3	Monitoring	System to monitor cyclone	JNPT– Marine department	Monitoring via • TV /Radio, • IMD bulletins.			
4	Hazard Risk Vulnerability and Capacity	Undertake HRVCA as part of	• JNPT– Marine department, • Tank Farms,	• Port DMP as per Disaster Management Act -2005, NDMA Guidelines and	Update Plans		

Disaster		Wind and Cyclone					
1. Thematic area		Understanding Risk					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring /Regular measures**	**Short term**	**Medium term**	**Long term**
	Assessment (HRVCA)	preparing and periodic revision of DM plans	• Container Terminals, • Liquid bulk terminal, • CFS.	NDMP, • Emergency Action Plan (EAP), • Emergency Response Disaster Management Plan (ERDMP).			
		Constitute/ strengthen the mechanism for consultation with experts and stakeholders	• JNPT – Marine department, • JNPT – Engineering Department, • JNPT – PPD, • Tank Farms, • Container Terminals, • Liquid bulk terminal, • CFS.	Mechanism for strengthening through • SOP, • Preventive inspection of cranes, high mast lighting, communication towers and antennae, • Stacking of containers as per wind criteria, • Effective storm drainage system.	Land use planning		

Disaster	Wind and Cyclone					
2. Thematic area	Inter- agency coordination					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Overall disaster governance	Providing coordination, technical inputs, and support.	• JNPT, • Tank Farms , • Container terminals, • Liquid Bulk terminals, • CFS.	Emergency Operation Centre			
				Standard Operating Procedure (SOP)	Review of SOP		
		Address/identify gaps in equipment/ infrastructure and human resources with DM tasks	• JNPT, • Tank Farms, • Container terminals, • Liquid Bulk terminals, • CFS.	• Developmental project reports	Gap analysis / Periodic reviews in infrastructure and human resources.		
2	Response	Coordinating with port stakeholders and Government agencies	• JNPT, • Vessel Master.	• CMG group, • MbPT, • Vessel Master, • NDRF, SDRF, Civil Defense, Local authorities.	Review for adequacy and continue existing MoUs		

Disaster	Wind and Cyclone						
2. Thematic area	Inter- agency coordination						
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
3	Warnings, Information, data collection	Effective coordination and seamless communication among various port stakeholders, Vessel Master and owner, CMG and Port to ensure quick, clear, effective dissemination of warnings, information and data.	• JNPT, • Vessel Master, • Tank Farms, • Container terminals, • Liquid Bulk terminals, • CFS.	• VHF channels, • Mobile Phones, • PA System, • Display of cyclone signals.			

Disaster	Wind and Cyclone						
3. Thematic area	Investing in DRR – Structural measures						
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Multi-Purpose Cyclone Shelters	Identification of safe buildings and sites with basic facilities like drinking water, food and first aid to serve as temporary shelters for people evacuated from localities at risk	• JNPT	• Multipurpose Hall – JNPT Township, • JNPT Hospital, • St. Mary's JNP School - JNPT Township, • JNP Vidyalaya – JNPT Township, • Officers and Staff club in Township.	Periodic inspection		
2	Hospitals and First Aid centres	• Identification hospitals and first aid	• JNPT, • Tank Farms , • Container terminals, • Liquid Bulk terminals, • CFS.	• JNPT Hospital - trauma centre and casualty ward , • Tie up with nearby hospitals, • First Aid centers.			

Disaster	Wind and Cyclone					
4. Thematic area	Investing in DRR – Non- Structural measures					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Laws Regulations Enforcement mechanisms Techno-Legal regimes Institutional Arrangements Codes for disaster risk reduction Compliance monitoring	Complying with the coastal zone laws	• JNPT, • Tank Farms, • Container Terminals, • Liquid Bulk terminals, • CFS.	• SOP for Cyclone, • Load test of cranes.	Land-use planning as per the CRZ notification.		
		Consider shoreline erosion, risk to structures, monitoring shoreline changes paying attention to the preservation of natural barriers	• JNPT			Construction of seawalls in erosion prone areas of Elephanta and Panje village.	
2	Risk Transfer	Insurance	• JNPT , • Tank Farms, • Container	• Workmen Compensation Policy, • Public Liability Insurance,	Renewals of Policies		

Disaster	Wind and Cyclone						
4. Thematic area	Investing in DRR – Non- Structural measures						
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
			Terminals, • Liquid Bulk terminals, • CFS.	• Property Insurance.			

Disaster	Wind and Cyclone						
5. Thematic area	Capacity Development						
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Training	Training and awareness regarding cyclone related emergencies and do's and don'ts **Reference documents:** NDMA guidelines for cyclones	• JNPT, • Tank Farms, • Container Terminals, • Liquid Bulk terminals, • CFS.			Training by Civil Defense and other agencies	
2	Mock drills/ Exercises	Joint planning and execution of emergency drills	• JNPT , • Tank Farms, • Container Terminals, • Liquid Bulk terminals, • CFS.				
3	Awareness			To the local fisherman and all concerned stakeholders			
3	Empowering following	Emergency evacuation	• JNPT, • Tank Farms,	• Display plan and areas of employment for special			

Disaster	Wind and Cyclone						
5. Thematic area	Capacity Development						
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
	categories of employees • Women • disabled	facilities	• Container Terminals, • Liquid Bulk terminals, • CFS.	category employees, • Provision of transports.			

Disaster	Wind and Cyclone						
6. Thematic area	Climate change risk management						
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Climate change adaptation (CCA)	Sensitization and awareness creation	• JNPT , • Tank Farms, • Container Terminals, • Liquid Bulk terminals, • CFS.	JN Port has prepared an action plan related to environmental protection as part of Green Port Initiative from GoI. This includes new • Sewage Treatment Plant, • Development of Eco Park, • Use of renewable energy, • Comprehensive plantation, • Prohibition of disposal of all kind of garbage in sea, • Greenhouse gas emission control , • Vapour emission control systems.			

Disaster		Flood					
1. Thematic area		Understanding Risk					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Observation networks, Information systems, Research, Forecasting, Early warning	Assessment and Monitoring	• JNPT	• Tide table, • Sea level monitoring, • IMD bulletins.			
2	Zoning/ Mapping and classification of flood prone areas	Identification of the vulnerable areas	JNPT for zoning and mapping	Coastal zone map of MCZMA indicating HTL and LTL are available. Port HTL and LTL demarcated by IRS Anna University-Chennai			
3	Hazard Risk Vulnerability and Capacity Assessment (HRVCA)	Undertake HRVCA as part of preparing and periodic revision of DM plans	• JNPT– Marine department, • Tank Farms, • Container Terminals, • Liquid bulk terminal, • CFS.	• Port DMP as per Disaster Management Act -2005, NDMA Guidelines and NDMP • Emergency Action Plan (EAP) • Emergency Response Disaster Management Plan (ERDMP)	Update Plans		

Disaster		Flood					
1. Thematic area		Understanding Risk					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
		Constitute/ strengthen the mechanism for consultation with experts and stakeholders	• JNPT – Marine department, • JNPT – Engineering Department, • JNPT – PPD, • Tank Farms , • Container Terminals, • Liquid bulk terminal, • CFS.	Mechanism for strengthening through • Project development reports incorporating effective draining and anti-flooding measures.	Assessment of anti-flooding and drainage system in newly completed projects.	Land use planning	

Disaster		Flood					
2. Thematic area		Inter- agency coordination					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Overall disaster governance	Providing coordination, technical inputs, and support	• JNPT, • CISF • Tank Farms , • Container terminals, • Liquid Bulk terminals, • CFS.	Emergency Operation Centre			
		Address/identify gaps in infrastructure with DM tasks	• JNPT	Developmental project reports	Gap analysis / Periodic reviews in infrastructure		
2	Response	Coordinating With port stakeholders and Government agencies	• JNPT, • CISF • Tank Farms, • Container terminals, • Liquid Bulk terminals, • CFS.	• CMG group, • SDRF, Civil Defense, Local authorities.			
3	Warnings, Information,	Effective coordination	• JNPT, • CISF,	• VHF/ UHF, • Mobile Phones,			

Disaster		Flood					
2. Thematic area		Inter- agency coordination					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
	data	and seamless communication among various port stakeholders, CMG and Port to ensure quick, clear, effective dissemination of warnings, information and data.	• Tank Farms, • Container terminals, • Liquid Bulk terminals, • CFS.	• PA System, • Tide tables.			

Disaster		Flood					
3. Thematic area		Investing in DRR – Structural measures					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Multi-Purpose Shelters	Identification of safe buildings and sites with basic facilities like drinking water, food and first aid to serve as temporary shelters for people evacuated from localities at risk	• JNPT	• Multipurpose Hall – JNPT Township, • JNPT Hospital, • St. Mary's JNP School - JNPT Township, • JNP Vidyalaya – JNPT Township , • Officers and Staff club in Township.	Periodic inspection		
2	Hospitals and First Aid centres	Identification hospitals and first aid	• JNPT, • Tank Farms, • Container terminals, • Liquid Bulk terminals, • CFS.	• JNPT Hospital - trauma centre and casualty ward • Tie up with nearest hospitals • First Aid centres			
3	Civil works	Upgrade and maintenance of the existing	• JNPT, • Tank Farms,	• Drainage system, • Boundary walls.	Repair and Maintenance of the existing		

Disaster		Flood					
3. Thematic area		Investing in DRR – Structural measures					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
		drainage and storm water systems	• Container terminals, • Liquid Bulk terminals, • CFS.		drainage system		

Disaster	Flood						
4. Thematic area	Investing in DRR – Non- Structural measures						
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Operation and Maintenance of Drainage Systems	Budgetary Provision	• JNPT	Adequate budget to be provided to take care of the men, material, equipment and machinery for O&M of drainage systems on a periodic basis.			
2	Regulation and enforcement of laws, norms, regulations, guidelines	Complying with the coastal zone laws	• JNPT	• Implementing land-use regulation as per flood control norms.	Land-use planning as per the CRZ notification		
3	Risk Transfer	Insurance	• JNPT , • Tank Farms, • Container Terminals, • Liquid Bulk terminals, • CFS.	• Workmen Compensation Policy, • Public Liability Insurance, • Property Insurance.	Renewals of Policies		

Disaster	Flood						
5. Thematic area	Capacity Development						
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Training	Training and awareness regarding flood related emergencies and do's and don't's **Reference documents:** NDMA guidelines for Flood	• JNPT, • Tank Farms, • Container Terminals, • Liquid Bulk terminals, • CFS.				
2	Mock drills/ Exercises	Joint planning and execution of emergency drills	• JNPT, • Tank Farms, • Container Terminals, • Liquid Bulk terminals, • CFS.	Exercises in accordance with the District and State Disaster Management Plan.			

Disaster	Tsunami						
1. Thematic area	Understanding Risk						
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Zoning/ Mapping	Identification of the vulnerable areas	• JNPT	Mapping of areas of flooding with a tide level of 5.1m (maximum HTL).	Mapping of areas of flooding with a significant wave height of deemed wave specified in NDMA Tsunami standards.		
2	Receipt of warnings, data and information	Monitor periodic bulletins from agency	JNPT- Marine department	Monitoring via • Forecasting agencies, • INCOIS.			
3	Hazard Risk Vulnerability and Capacity Assessment (HRVCA)	Undertake HRVCA as part of preparing and periodic revision of DM plans	• JNPT– Marine department, • Tank Farms, • Container Terminals, • Liquid bulk terminal, • CFS.	• Port DMP as per Disaster Management Act -2005, NDMA Guidelines and NDMP, • Emergency Action Plan (EAP) , • Emergency Response Disaster Management Plan (ERDMP).	Update Plans		

Disaster	Tsunami						
2. Thematic area	Inter- agency coordination						
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Overall disaster governance	Providing coordination, technical inputs, and support	• JNPT, • Tank Farms, • Container terminals, • Liquid Bulk terminals, • CFS.	Emergency Operation Centre			
2	Response	Coordinating with port stakeholders and Government agencies	• JNPT, • Tank Farms, • Container terminals, • Liquid Bulk terminals, • CFS.	• CMG group, • Vessel Master, • NDRF, SDRF, Civil Defense, Local authorities.			

Disaster		Tsunami					
2. Thematic area		Inter- agency coordination					
3	Warnings, Information, data	Effective coordination and seamless communication among various port stakeholders, Vessel Master and owner, CMG and Port to ensure quick, clear, effective dissemination of warnings, information and data.	• JNPT, • Vessel Master, • Tank Farms, • Container terminals, • Liquid Bulk terminals, • CFS.	• VHF/UHF, • Mobile Phones, • PA System, • Display of Tsunami signals.			

Disaster		Tsunami					
3. Thematic area		Investing in DRR – Structural measures					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Strengthening and retrofitting of prioritized vulnerable and critical structures	Ensure compliance with relevant building codes or hazard resistant construction	• JNPT	Implementation in compliance with relevant building codes/ standards/ technical guidance.			
		• Identification and repair/ retrofitting of houses and buildings as per the recommendations of structural audit • Detailed assessment of tsunami hazard to the structure and foundation	• JNPT	• Periodic inspection of vulnerable/critical structures (power stations, warehouse, fire stations, oil and other storage tanks, public buildings, marine structures etc.). • Repairs/ retrofitting done as and when required for tsunami resistance.			

Disaster		Tsunami					
3. Thematic area		Investing in DRR – Structural measures					
		and the benefits of strengthening					
2	Multi-Purpose Tsunami Shelters	• Identification of safe buildings and sites with basic facilities like drinking water, food and first aid to serve as temporary shelters for people evacuated from localities at risk	• JNPT	• Multipurpose Hall – JNPT Township, • JNPT Hospital, • St. Mary's JNP School - JNPT Township, • JNP Vidyalaya – JNPT Township , • Officers and Staff club in Township.	Periodic inspection		
3	Hospitals and First Aid centres	Identification hospitals and first aid	• JNPT, • Tank Farms, • Container terminals, • Liquid Bulk terminals,	• JNPT Hospital - trauma centre and casualty ward , • Tie up with nearest hospitals, • First Aid centres.			

Disaster		Tsunami					
3. Thematic area		Investing in DRR – Structural measures					
			• CFS.				

Disaster		Tsunami					
4. Thematic area		Investing in DRR – Non-Structural measures					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Regulation and enforcement of relevant laws	Ensure compliance with coastal environment protection laws and regulations such as the CRZ	• JNPT	Implementation of coastal zone regulation			
2	Non-structural shore stabilization measures and bio-shields	Establishment of bio-shields like mangroves, as natural defense	• JNPT - PPD	• Plantation of mangroves			

3	Risk Transfer	Insurance	• JNPT , • Tank Farms, • Container Terminals, • Liquid Bulk terminals, • CFS.	• Workmen Compensation Policy, • Public Liability Insurance, • Property Insurance.	Renewals of Policies		

Disaster		Tsunami					
5. Thematic area		Capacity Development					
Sr. No	**Sub-thematic area**	**Plan components**	**Responsible section**	**Recurring / Regular measures**	**Short term**	**Medium term**	**Long term**
1	Training	Training and awareness regarding Tsunami related emergencies and do's and don'ts **Reference documents:** NDMA guidelines for Tsunami	• JNPT	Training of local administration in forecasting warning dissemination and evacuation techniques.			
2	Mock drills/ Exercises (Evacuation and Rescue)	Joint planning and execution of emergency drills	• JNPT	Organizing drills on regular basis to check the viability of all plans and to check the readiness of all concerned.			

4. MAINSTREAMING DISASTER RISK REDUCTION

The objective of mainstreaming is ensuring the ongoing and new development projects of the port lead to integration measures. The sub-thematic areas where such measures can lead to DRR are as follows:

1. Awareness and understanding of disaster risk;
2. Disaster governance;
3. Disaster risk transfer;
4. Institutional arrangements and capacity development;
5. Budget allocations for integrating DRR into development programs;
6. Project appraisals, scrutiny of development plans, effective and detailed land-use plans, from the point of view of expected hazards;
7. Setting targets and monitoring mechanisms.

4.1 INVESTING IN DRR – STRUCTURAL MEASURES

Port sector in general implements the building code as per IS standards. Hence, engineered buildings and structures are designed and constructed taking into account various loads including seismic criterion. As such, only the older buildings which suffer degradation on account of aging related factors will require reassessment and strengthening. Damage of buildings and structures also depends upon the soil conditions e.g. settlement and topology of the area.

However, few areas which may include village populations and non-industrial pockets inside the port land use zone may not be designed as per the required building codes. The civil authority of the State Govt. will need to assess the vulnerability aspects for the villages sonari, karal, jaskhar, sawarkhar,ranjanpada,belpada.

4.2 INVESTING IN DRR – NON-STRUCTURAL MEASURES

4.2.1 Land Use Planning

Port micro zonation planning for rural population may be required. It will help to guide modify land use planning accordingly.

4.2.2 Capacity Building

The port undertakes consultative measures with expert agencies such as IITs, Govt. Departments, technical Universities and private institutions for advice in Land use planning, port development, projects implementation, environmental management and training of personnel. It also conducts awareness programme through agencies such CISF, Civil Defence, NDRF, SDRF, NDMA, DGFASLI, etc.

4.2.3 Risk Transfer Insurance

The port assets are insured for incidents like tsunami, cyclone etc. and has a consultative committee constituted by IPA in this regard. The details of such arrangements are given in chapter 11.

In disaster management cycle, preparedness and mitigation are the two important stages before the occurrence of disaster. It has a great importance in reduction of loss of life and property if proper preparedness and mitigation strategies are followed.

4.3 STRATEGIES FOR SUSTAINABLE DEVELOPMENT PRACTICES FOLLOWED IN THE PORT

Port's developmental plans are synchronized with the Coastal Zone Management and Land Use plans.

The CZMP is meets the goals of the ICZM, viz

1. Maintaining the functional integrity of the coastal resource systems.
2. Reducing resource-use conflicts.
3. Maintaining the health of the environment.
4. Facilitating the progress of multi-sectoral development.

The CZMP of the port has been approved in the year 2005 and periodically updated.

4.4 DISASTER RISK GOVERNANCE PROGRAMMES AND PRACTICES OF THE PORT

4.4.1 Environmental macro level-Coastal zone monitoring

The macro level monitoring includes following aspects.

1. Master planning of the port facilities with respect to the traffic forecast and identification of projects.
2. Environmental impact analysis, land use planning and finalisation of the location of the projects.
3. Finalisation of the Port's conceptual plan for future development.
4. The port's Integrated Management System (IMS), includes ISO-14001 Environment Management System.
5. The IMS policy and the objectives also address the environmental concerns of the Port.
6. Obtaining statutory permissions like Environmental Clearance, Consent to Establish/Operate from the MoEF&CC and State Pollution Control Board.

4.4.2 Micro Level Monitoring

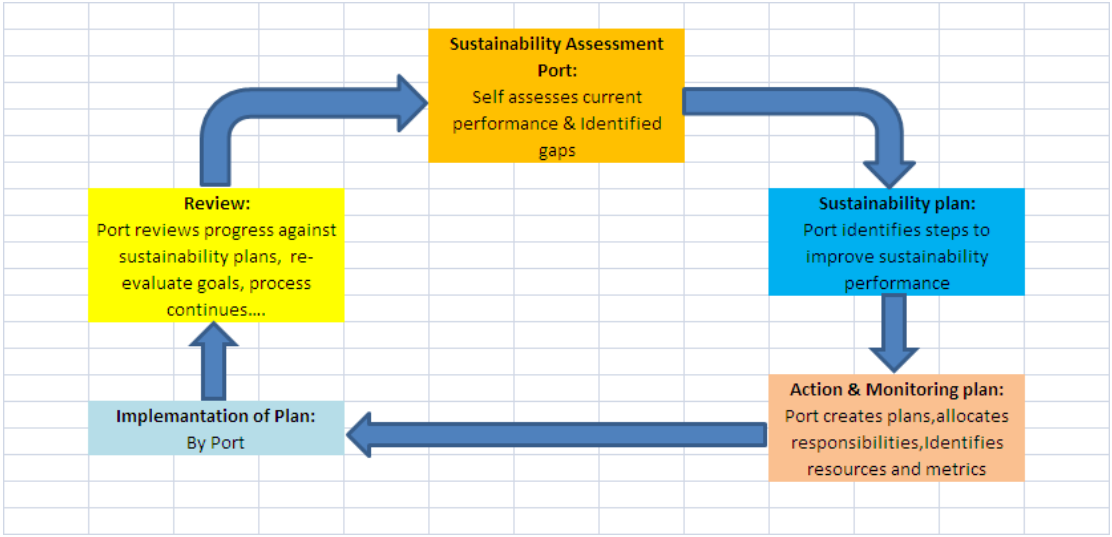
The port further carries out environmental monitoring on actual site as a micro level monitoring. The Port has taken up many resources for this, which areas under.

1. Obtaining environmental clearances for a project and monitoring of the pollutants during the execution of the project as per the approved Environmental Management Plan (EMP).
2. Continuous monitoring of the effects of the Port's working on the environmental parameters, to check the pollutant's level with respect to the EMP, which has been in progress form the last 20 years.
3. Comparing the monitoring results with respect to the standards adopted in the EMP and Identification of the nonconformities.
4. Finalisation of the corrective and preventive actions to be taken to mitigate the non-conformities found. Inclusion of the necessary works for such mitigations.
5. Provision of appropriate Budget allocations for execution of the works identified.
6. Maintenance of the existing green cover of the Port.
7. Plantation and related allied environmental works.
8. Implementing non-conventional energy sources applications in the port working, to reduce emission of the Green House gases.
9. Eco friendly techniques in its workings and environmental safeguard have remained the major policy of the port since inception.
10. The private terminal operators of the Port keenly follow the good

environmental practices in their working.

The macro and micro monitoring gives the actual environmental efforts taken at the ground level and also provides a long term data. This ultimately helps in analysing the effects of the port's working and development on the environmental attributes.

4.5 SUSTAINABILITY DEVELOPMENT CYCLE



Following the above path (Sustainability Development cycle) can help reduce disaster losses and control the risk level consequent to development/expansion programs.

5. INCLUSIVE DRR

The port functions as a developed model port with design and development based on national and international standards of safety and as such the stakeholders do not generally include socially vulnerable groups. However, there is a community of project affected persons (PAP) which include few villages inside the port boundary. This population is a mix of rich-poor, social mix of men, women and children's including some domestic animals. The port will continuously liaise with the district administration regarding their relief and rehabilitation measures including disaster relief. Such communities are covered in the district and state disaster relief plans.

Development of parking plazas and complexes catering for day to day shopping stalls/restaurants will be facilitated and designed accordingly keeping in the needs of the floating population.

6. COHERENCE OF DISASTER RISK MANAGEMENT ACROSS RESILIENT DEVELOPMENT AND CLIMATE CHANGE ACTION

As per the Sendai Framework, it is necessary to address existing challenges and prepare for future ones by focusing on monitoring, assessing, and understanding disaster risk and sharing relevant information.

- The framework notes that, to cope with disasters, it is "urgent and critical ***to anticipate, plan for and reduce disaster risk***".
- It requires the ***strengthening of disaster risk governance and coordination*** across various institutions and sectors.
- It requires the full and meaningful ***participation of relevant stakeholders*** at different levels.
- It is necessary to ***invest in the economic, social, health, cultural and educational resilience*** at all levels.
- It requires ***investments in research*** and the use of technology to enhance multi-hazard Early Warning Systems (EWS), preparedness, response, recovery, rehabilitation, and reconstruction.

While the above stipulations in the Sendai framework have been made and directing member states to undertake planning and execution based on the above fundamental thrust areas, the port has undertaken the above in the implementation of DMP as follows.

In the chapter 3 of Hazard Specific Prevention and Mitigation Measures, the hazards have been identified and thematic areas of Sendai framework introduced, so that the development responsibility in each of these thematic areas is properly addressed indicating present and planned arrangement and who is responsible to address each of these.

In the chapter 2 of HRVCA, the risk profile of the port has been assessed through detailed planning steps. This includes chemical and oil disaster plan in accordance with national guidelines (NOS-DCP). The capacity analysis and any short falls have been indicated. As a result of this plan (OSCP) the Net Environment Benefit Analysis (NEBA) was prepared to indicate specific measures that would be required to meet the challenge of the oil/chemical spill. Methodology for assessing environment impact of a disaster for claims settlement has also been described. Neighboring marginal communities including fishermen likely to be impacted and their claim settlements have been assessed. Thus, building resilience for oil and chemical disasters. The gap analysis for equipment's is a continuous process which the port will undertake through periodic reviews.

With regard to natural disaster, the vulnerability profiling has been prepared and areas requiring immediate actions are identified. For NAT-CHEM disasters the vulnerability areas have been identified.

With regard to the participation of stakeholders in the risk governance the following mechanisms are in place:

- Availability of Mutual Aid Agreement for disaster situations;

- Joint planning and execution of mock drills at unit level (individual facility) and also at the level of the entire port (including non-custom bound area);
- To combat the oil spill around JNPT and Mumbai Harbour, a common oil spill response Tier- I facility (spillage upto 700 MT) is set up at Jawahar Dweep, Mumbai Port Trust through OSRO agency.

In respect of aspects relating to climate change the following issues have been identified having bearing on disaster risk reduction and resilience:

- Sea level rise – Minimum height of landside construction has been kept at 7.1 m above Mean Sea Level (MSL) which is considered adequate for developmental activities.
- Heavy rain fall (cloudburst) and flooding – Land use planning and the detailed development thereafter will meticulously factor-in the requirements of natural slope, land topography, storm water drainage, height and width of culverts, natural drainage for ponds.
- High wind and cyclone – Meticulous implementation of SOPs for preventing damage during an event.

7. CAPACITY DEVELOPMENT AND COMMUNICATION

7.1CAPACITY DEVELOPMENT

The capacity development covers all aspects of disaster management. The key aspects and broad thematic areas for capacity development applicable are summarized in Table 7.1. The hazard-specific capacity development needs for prevention and response are given in the plan matrix of the Chapter-3. The effort will be to follow the industry best practices especially in the area of oil spill response and chemical disaster response which affect the ports in a major way.

Table 7.1: Summary of Broad Capacity Development Themes

	Capacity Development Themes
Key Aspect	**Thematic Areas**
Prevention or mitigation for disaster risk reduction	Hazards, Risk, and Vulnerability Assessment • Safety awareness and training • Improve the awareness and preparedness of stakeholders at all levels Documenting lessons from previous disasters and ensuring their wide dissemination • Preparing DM plans, regular updating, and mock drills • Institutional arrangements, policies, legal support, and regulatory framework • Developing appropriate risk transfer instruments by collaborating with insurance companies and financial Institutions • Mainstreaming of disaster risk assessment, mapping and management into development plans and programs • Retrofitting as per relevant standards • Rapid visual surveys for safety evaluation of buildings • Training and skill development for dock operators, crane operators, truck drivers, management staff. • Promoting community-based DM taking into account specific needs, • Disaster resilience by maintaining list of nearby hospitals and health care centres • Business resilience of productive assets by strengthening the supply chains and service providers, ensuring continuity of services • Integrate disaster risk management into business models and practices Preparedness and response plans at all levels

Effective preparedness and response	Emergency response capabilities – EOCs, infrastructure, equipment upgrades and adoption of best available technologies • Strengthening of the Fire and Emergency Service through revamping, institutional reforms, and modernization • Adoption and adaptation of emerging global good practices • Early warnings, maps/ satellite data/ effective dissemination of information • Table-top exercises, simulations, and mock drills to improve operational readiness of the plans • Housing and Temporary shelters • Power and fuel supply management • Transportation systems and network • Logistics and supply chain management
Recovery and Build Back Better	• Port infrastructure damage assessment mechanism and award of reconstruction projects, contracting including revised specifications for resilient infrastructure • Studies on past disasters and recovery to draw useful lessons

7.1.1 Training

Regular training should be provided to all personnel who have a role in planning and operational response to an emergency. The goal of training for emergencies is to enable the participants to understand their roles in the response organization, the tasks associated with each position and the procedures for maintaining effective communications with other response functions and individuals.

The training objectives are:

1. To familiarize personnel with the contents and manner of implementation of the Plan and its procedures,
2. To train personnel in the performance of the specific duties assigned to them in the plan and in the applicable procedures,
3. To keep personnel informed of any changes in the plan,
4. To maintain a high degree of preparedness at all levels of the emergency response organization,
5. Train new personnel who may have moved within organization,

A well co-ordinated programme of training exercises includes activities of varying degrees of interaction and complexity.

The SIC is responsible for the development and maintenance of emergency capabilities of the IRT through ongoing development and rehearsal of emergency response procedures and plans. Specific inductions are to be provided for all team members and support personnel to ensure they are conversant with the roles and responsibilities outlined in this plan prior to their appointment in any capacity.

Personnel allocated to the IRT should undergo skills training over and above that received by other personnel of the port. The skills training are delivered by external service providers to national competency standards in the following areas;

- First aid
- Self Contained Breathing Apparatus
- Rescue from heights
- Rescue from confined spaces

- Fire fighting
- Rescue from water
- Handling Oil and Hazardous Material Spills

7.1.2 Drills & Exercises

Emergency drills and integrated exercises have the following objectives.

1. To test the adequacy of the effectiveness, timing, and content of the plan and implementing procedures,
2. To ensure that the emergency organization personnel are familiar with their duties and responsibilities by demonstration,
3. Provide hands-on experience with the procedures to be implemented during emergency,
4. Maintain emergency preparedness.

The frequency of the drills should vary depending on the severity of the hazard. However, drills should be conducted at least once a year. Scenarios may be developed in such a manner as to accomplish more than one event objective

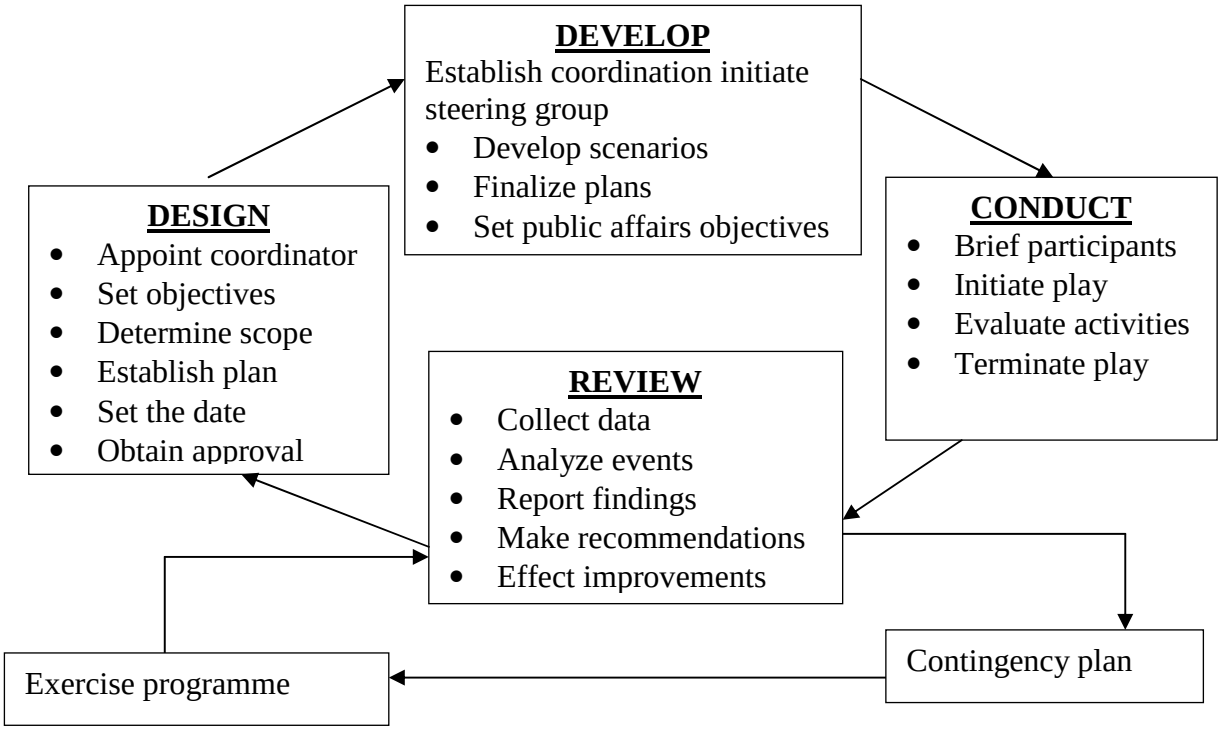
- **Notification exercises**
  - Test communication systems, frequency, public warning system

- **Tabletop exercises**
  - To check availability of participants and check response time

- **Equipment deployment exercises**
  - Alarm systems to be tested,
  - Frequent tests of fire fighting and other response equipment.

- **Incident management exercises**
  - Simulated emergencies like fire, gas leakage, oil spillage, cyclone and vessel related emergencies like grounding, collusion, leakage, Pollution etc., to be conducted and monitored and feedback to be documented.
  - Evacuation practice
  - Deployment of Machineries

Figure 7.1: The Exercise Planning Process



The evaluation of a drill or exercise shall be submitted by Asst. Manager (F&S) to CIC/SIC for review and acceptance who shall then determine the corrective actions to be taken and assign the responsibility to appropriate personnel. Thus, gap identification in terms of resources and procedures can be made and exercise plan amended accordingly.

Records of drills, exercises, evaluations, and corrective actions should be duly maintained.

The SIC shall prepare an Incident response exercise and training schedule for the forthcoming year, in consultation with the CIC and all the HODs of the Port and stakeholders.

Business Continuity Framework – The CIC/SIC is responsible for ensuring that a program exists for training new staff and refreshing existing staff on the Port Business Continuity and that Managers ensure appropriate personnel complete the training.

7.2COMMUNICATION STRATEGY

7.2.1 Communication Flowchart

Figure 7.2: Cyclone /Tsunami/Flood/Earthquake

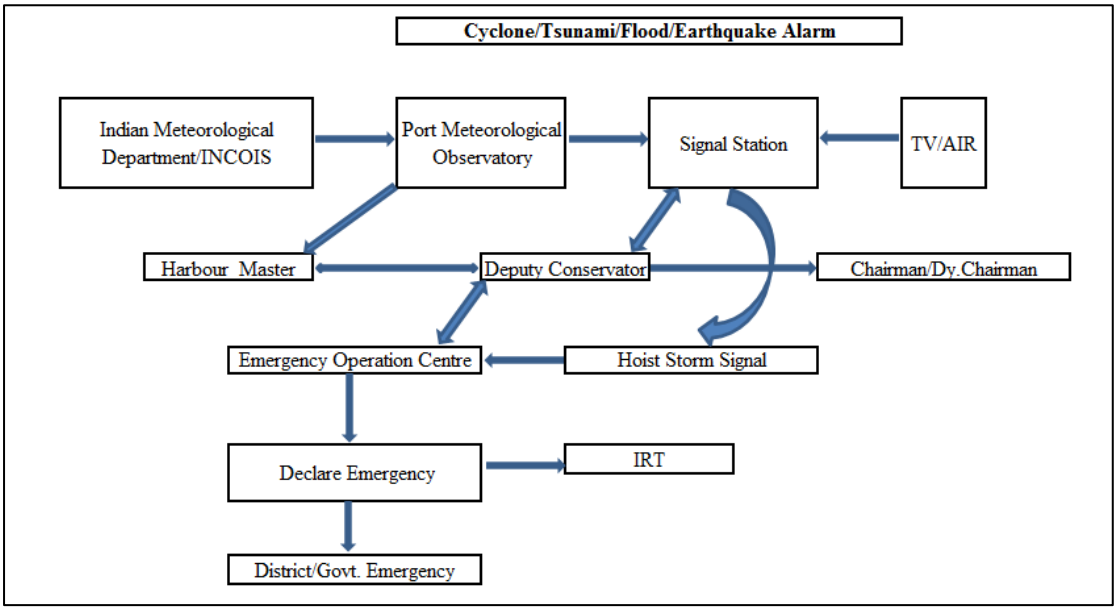
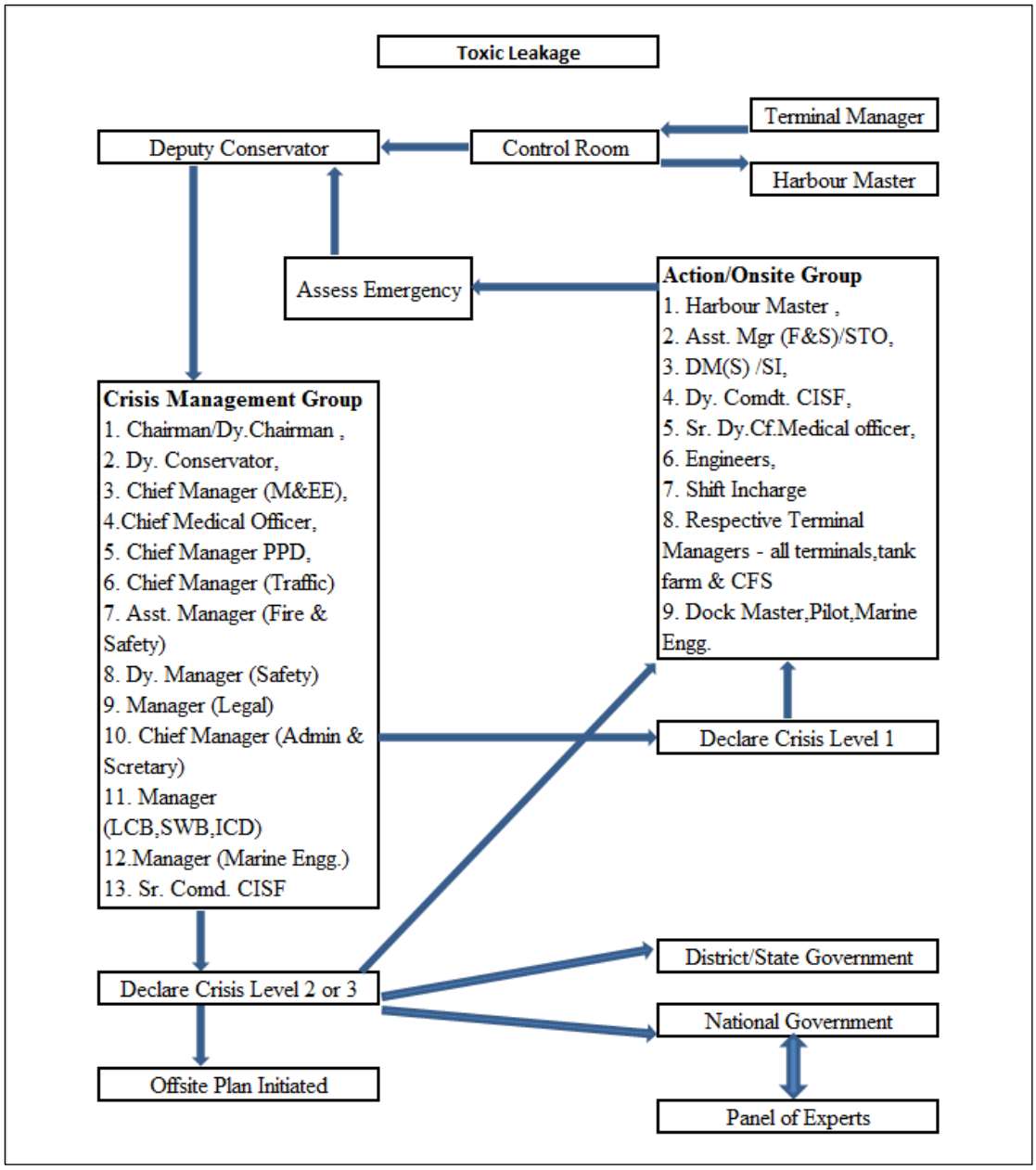
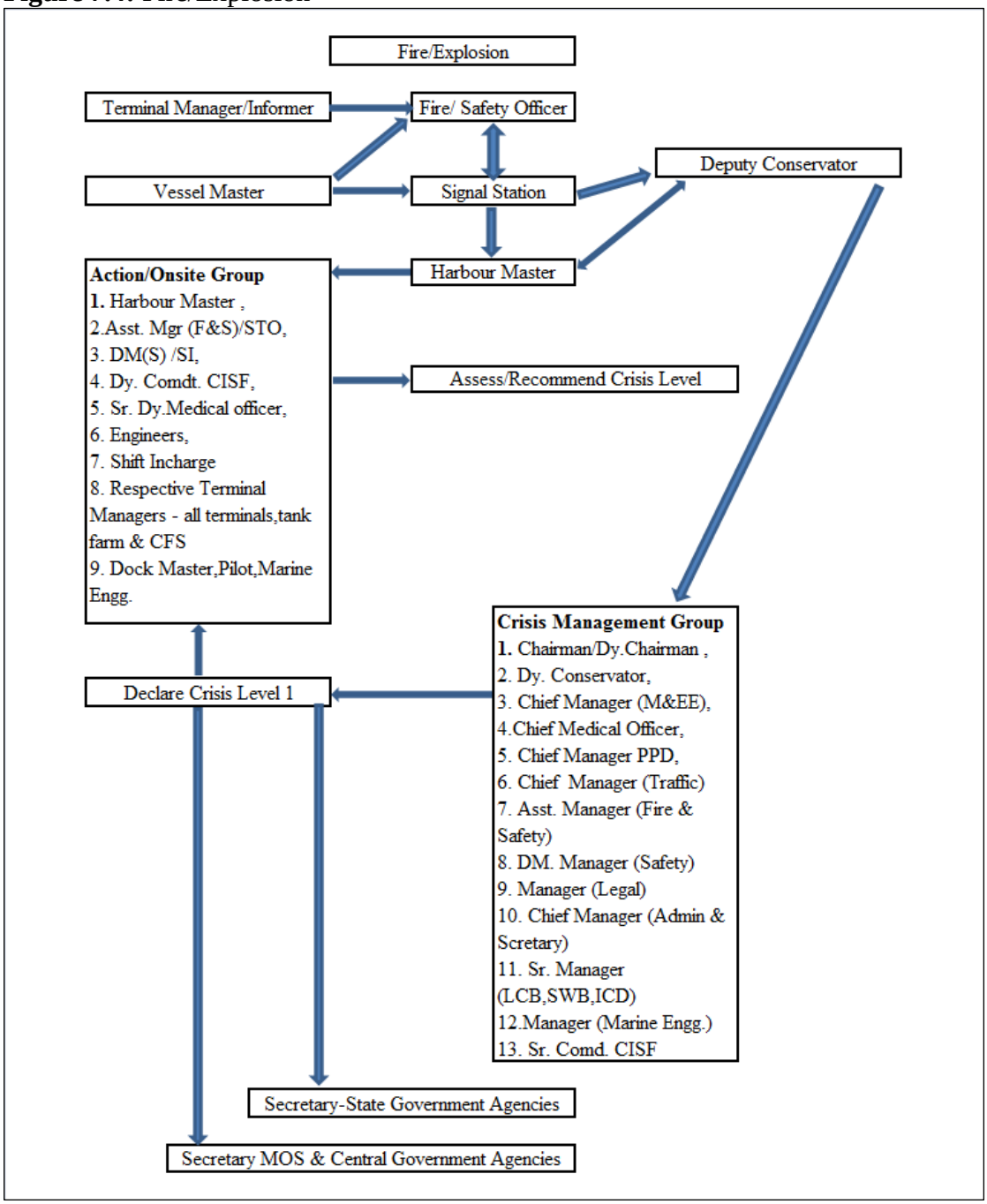


Figure 7.3: Toxic Leakage



Note: *For Level of disaster refer paragraph 9.1.2.*

Figure 7.4: Fire/Explosion



Note: *For level of disaster refer paragraph 9.1.2.*

8. COORDINATION – HORIZONTAL AND VERTICAL LINKAGES

Dealing with a major disaster requires resources from outside the port. When the capacities of a port administration are overwhelmed, higher levels of aid assistance is required. Likewise, assets and capabilities in the industries and non-governmental organizations available around the port will have to be brought to use. There are many actions undertaken by participants in disaster management that support this goal, both pre-disaster (to reduce potential damage) and post-disaster (to recover from actual damage). For achieving this objective, the plan has a pre-established and practiced mechanism for Inter, intra and extra agency coordination.
Communication is the most important tool for effective coordination. Emergency Operation Centre (EOC) is the enabler of communication and coordination. Port Authority and stakeholders will coordinate with all heads of department at the local level, district & state level groups, CMG, Expert Groups, NGOs for effective implementation of DM Plans. Port authority should also have a link with neighbouring industries in case of disasters.

Coordination with the following external agencies would be required

- Local Crisis Group-Uran and Patalganga,
- District Crisis Group,
- State and National Crisis Group,
- Indian Coast Guards,
- DD, AIR for media briefing,
- MSEB, MWSSB, MSRTC,
- Meteorological Department, MERI,
- Co-ordinate with the NGOs and aid agencies (contact nos.),
- Enlist services of GOI/GOM laboratories and expert institutions for Specialized services.(contact nos.) e.g. BARC emergency response centre in case of radiological emergencies, DRDO for CBRN emergencies.

9. PREPAREDNESS AND RESPONSE

9.1PREPAREDNESS

9.1.1 Emergency Organization

9.1.1.1 Crisis Management Group

The Crisis Management Group consists of all HOD`s under the head of the Chairman which lays down the policies and decisions.

- Chairman/Dy. Chairman;
- Dy. Conservator (CIC/Nodal Officer);
- Chief Manager (M & E Engineering);
- Sr. Dy. Chief Medical Officer;
- Chief Manager - PPD;
- Dy. Manager (Safety);
- Assistant Manager (Fire and Safety);
- Manager (Legal);
- Chief Manager (Administration and Secretary);
- Chief Manager (Traffic);
- Manager (MCB, LCB & SWB I & II,ICD,SWB-III);
- Manager (Marine Engineer);
- Sr. Commandant CISF;
- Respective Terminal Manager – All terminals, Tank farms & CFS.

9.1.1.2 Action Group (Incident Response Team)

The action group carries out the decisions made by CMG. It shall be formed at the time of crisis with Harbour Master as the head.

- Harbour master (SIC/alternate Nodal Officer - will act as Nodal Officer in the absence of Dy. Conservator);
- Dock Master;
- Station Officer (Fire and Safety);
- Safety Inspector;
- Engineers-Mechanical and Electrical;
- Managers (PP&D);
- Sr. Dy. Chief Medical Officer;
- Assistant Manager (Traffic) – Shift In-charge;
- Deputy Manager (IR);
- Pilot;
- Sr. Dy. Marine Engineer;
- Dy. Commandant CISF;
- Dy. Manager (MCB, LCB & SWB I & II,ICD,SWB-III);
- Respective Terminal Manager – All terminals, Tank farms & CFS.

Refer **Figure 1.9** and **Figure 1.10** for Onsite and Offsite Emergency Organization Chart respectively.

9.1.2 Level of Disasters

L - Defines the different levels of disasters in order to facilitate the responses and assistances to ports.

L0 – denotes normal times which will be utilized for close monitoring, documentation, prevention and preparatory activities. Training on search and rescue, drills, evaluation and inventory updating for response activities will be carried out during this time

L1 – specifies disaster that can be managed at Port level, however, the terminals and district will remain in the state of readiness.

L2 – disaster situations are those, which require assistance and active participation of the port, terminals within port limit and district/State.

L3 – disaster situation is in case of large scale disaster where the state and district authorities have been overwhelmed and require assistance from the Central Government for rescue, relief, and other response and recovery measures. In most cases, the scale and intensity of the disaster as determined by the concerned technical agency like IMD, INCOIS etc. are sufficient for the declaration of L3 disaster.

9.1.3 Roles and Responsibilities of Berth Operators and Port Authority

Role	Berth Operators – Containers & Liquid Cargo	Port Authority
Prevention	•Prepare, revise, test and exercise own facility EAP/ERDMP. •Train own staff.	• Prepare DM Plan, •Conduct emergency exercises, •Guideline to encourage all Port Facility Operators to have Emergency Management Plans.
During Response	Undertake following: •First Aid, •Advise staff, •Contain (if possible), •Evacuation (as appropriate), •Partial or Full Shutdown (as appropriate), •Security. When external emergency services arrive: •Provide specialist advise/liaison, •Media Advise as required, •Advise Port, Security, and Harbour Master as required, •Advice neighbouring facilities as required.	•Monitor •Make Strategic decisions regarding: o Shipping movements o Threats to Port facility operators and effects on their business operations •Advice and assist ~~to~~ affected Port facility Operators on matters where qualified to do so. •Escalate response level by obtaining assistance from Local Crisis Groups.
Recovery and	•Advice and assistance to own staff	•Assist Port facility

reconstruction	in resuming operations. • Implement respective BCPs.	operators &/or shipping to resume operations. •Establish continuity of port business.

9.1.4 Roles and Responsibility key personnel

CHECKLIST -1		**CHIEF EMERGENCY CONTROLLER (CEC)**	
Phase		**Action**	**Time**
Mobilization /Activation	1	Obtain details of incident and of any mitigative actions taken from CIC.	
	2	Communicate with and coordinate with	
		a. Local, District, State and National Authorities	
		b. Mumbai Port Trust	
		c. Crisis Management Group (CMG)	
		d. Chief Incident Controller (CIC)	
		e. Media Liaison officer	
		f. Ship's Authority	
Establishing Control	3	Nominate alternate person if any functionary is not available.	
	4	Establish radio or telephone contact with CIC and CMG.	
Planning	5	Advice and provide support to CIC on	
		a. Propriety of response level	
		b. Location of EOC	
		c. Additional Human Resource	
	6	Advice CIC on activation of DMP.	
Ongoing Response	7	Activate Off Site Plan, if necessary.	
	8	To issue Media briefings when required.	
Response Termination	9	Terminating response advice given to CIC if conditions are met.	
	10	Receive incident reports from CIC/ nominated alternate person.	
	11	Analyze and advise on further course of action in consultation with CIC/ nominated alternate person.	

END CEC CHECKLIST

CHECKLIST -2		**CHIEF INCIDENT CONTROLLER (CIC)**	
Phase		**Action**	**Time**
Mobilization / Activation	1	Obtain details of incident and of any mitigative actions taken.	
	2	Start recording of events in the Personal Log.	
	3	Communicate and coordinate with	
		a. Chairman/Dy. Chairman	
		b. IRT and CMG	

		c.	CISF	
		d.	Local, District, State and National Authorities	
		e.	Respective Terminal Managers	
Establishing Control	4		Assess the Incident and authorize any immediate action by SIC (Raising appropriate alarm) and on-site staff as required.	
	5		Proceed to the EOC.	
	6		Mobilize IRT (as required) to the EOC and assign IRT roles.	
	7		Establish radio or telephone contact with Local, District, State and National Authorities.	
Evaluation	8		Determine resources at risk.	
	9		Evaluate the assessment of the incident, in consultation with the SIC.	
Planning	10		Arrange for monitoring of the event/incident.	
	11		Convene planning meeting.	
	12		Instruct Procurement Officer to make a list of required needs: Personnel, equipment, transport etc. Authorize acquisition.	
Ongoing Response	13		Implement response actions as per OSCP and DMP.	
	14		Continue to monitor incident.	
	15		Monitor the response by scheduling and undertaking regular briefings/debriefings of IRT.	
	16		Amend the SOP and Action Plan as required.	
	17		Ensure that IRT is supplied with necessary personal needs such as PPE, food etc.	
	18		Arrange for shift/rotation of IRT members.	
	19		Monitor OH&S performance.	
	20		Monitor casualties, traffic movements, and waste volumes.	
	21		Communicate media statements from the PRO.	
	22		Terminate response if conditions are met.	
Response Termination	23		Advise the SIC and inform CEC.	
	24		Ensure that all IRT members, combat and support agencies are informed of termination of response.	
	25		Monitor to ensure safe and complete demobilization.	
	26		Debrief IRT.	
	27		Attend debrief with Chairman.	
	28		Ensure that all records are collated and stored.	

END CIC CHECKLIST

CHECKLIST -3		SITE INCIDENT CONTROLLER (SIC)	
Phase		**Action**	**Time**
Mobilization /Activation	1	Obtain details of incident and of any mitigative actions taken.	
	2	Start recording of events in the Personal Log.	
	3	Initiate	
		a. DMP	
	4	Communicate and coordinate with	
		a. CIC	
		b. IRT	
		c. CMG	
		d. Master of the vessel	
		e. Terminal and Berth Managers	
Establishing Control	5	Assess the severity of the Risk.	
	6	Conduct initial briefing.	
	7	Authorize any immediate action required by on site staff and contract agencies.	
	8	Establish radio or telephone contact with CIC and CMG.	
Planning	9	Arrange for	
		a. Deployment of Pollution and Fire-extinguishing response equipment.	
		b. Multi Purpose Vessels	
		c. Tugs, etc.	
		d. Ensure evacuation of personnel to assembly areas.	
	10	Assist Procurement Officer to compile a list of needs: Personnel, equipment, transport etc.	
Ongoing Response	11	Implement response actions as per OSCP and DMP.	
	12	Continue to monitor incident.	
	13	Monitor the response as per CIC schedule and undertake regular briefings/debriefings of IRT.	
	14	Coordinate Search and Rescue operations.	
	15	If necessary, call for additional resources.	
	16	Arrange relief for IRT members & Monitor OH&S performance.	
	17	Monitor waste volumes, if any.	
Response Termination	18	Terminate response if conditions are met on permission of CIC.	
	19	Ensure that all IRT members, Contract Agencies and CIC are informed of termination of response.	
	20	Monitor to ensure safe and complete demobilization.	

	21	Ensure that all records are collated and stored.	

END SIC CHECKLIST

CHECKLIST -4		**DOCK MASTER (DM)**	
Phase		**Action**	**Time**
Mobilization / Activation	1	Communicate and coordinate with	
		a. CEC	
		b. CIC	
		c. SIC	
		d. Port Control Room	
		e. Pilot and Marine Engineers	
		f. Master of the vessel	
		g. Meteorological department	
Initial Action	2	Ensure telephone operator / signal room communicate with entire emergency team.	
	3	Keep the switchboard open for emergency calls and transmit the same to the concerned personnel effectively.	
	4	On receipt of instructions from SIC, notify the fire brigade/Police/Hospitals/District Collector/ Mutual Aid Partners.	
	5	Refrain from exchanging information with any person other than authorized to do so by the CIC.	
Ongoing Response	6	Coordinate with SIC and provide necessary information.	
Response Termination	7	Terminate response on instructions of CIC/SIC	
	8	Ensure that all records are collated and stored.	

END DM CHECKLIST

CHECKLIST -5		**ASSISTANT MANAGER (F&S)/STO**	
Phase		**Action**	**Time**
Mobilization / Activation	1	Obtain details of spill/fire and of any mitigative actions taken.	
	2	Start recording of events in the Personal Log.	
	3	Communicate and coordinate with	
		a. SIC	
		b. CIC	
		c. Port Control room and Fire Station	
		d. Terminal and Berth Managers	
	4	Activate Fire Station.	
Establishing Control	5	Lead Fire Fighting Team	
	6	Establish radio or telephone contact with SIC	
Initial Actions	7	Announce Fire Incident Point on PAS.	
	8	Be updated about wind direction.	

	9	Arrange for		
		a.	• Fire Extinguishers • Maintain sufficient water pressure in fire hydrant system.	
		b.	Safety Equipment	
		c.	Rescue of injured persons to medical centers	
		d.	In consultation with SIC evacuate workers to assembly areas.	
	10	Assist SIC to compile a list of needs: personnel, equipment, transport etc.		
Response Actions	11	Implement response actions as per OSCP and DMP as per SIC/CIC instructions.		
	12	If necessary, call for additional resources		
Response Termination	13	Terminate response if conditions are met on consultation with SIC.		
	14	Ensure safe return of response personnel.		
	15	Ensure that all records are collated and stored.		

END F&S/STO CHECKLIST

CHECKLIST -6		**DY. MANAGER (SAFETY) /SAFETY INSPECTOR**		
Phase		**Action**		**Time**
Mobilization / Activation	1	Start recording of events in the Personal Log.		
	2	Communicate and coordinate with		
		a.	CIC	
		b.	SIC	
		c.	Ship owners / Agents / C & F agents / stevedores.	
		d.	Terminal and Berth Managers	
		e.	Salvage Association	
		f.	Waste/ Sludge disposal agencies	
Establishing Control	3	Establish radio or telephone contact with CIC and SIC.		
	4	Furnish information to the SIC with regards to the safety.		
	5	Inform MPCB and other environmental agencies about the incident for getting necessary guidance.		
Initial Action	6	Prepare consolidated list of dangerous goods including tankers in port.		
	7	To collect necessary evidences required for detailed investigation of any accidents.		
	8	Ensure proper accountability of the Cargo Handling Workers and the Private workers engaged by various agencies present at the time of crisis.		
	9	Coordinate with the salvage association and waste/sludge disposal agencies.		
Ongoing Response	10	Assist in the safe evacuation of personnel.		

Response Termination	11	Terminate response if conditions are met on permission of CIC/SIC.	
	12	Submit detailed report regarding the accidents to CIC/SIC.	
	13	Ensure that all records are collated and stored.	

END DM(S)/SI CHECKLIST

CHECKLIST -7		**ENGINEERS (MECHANICAL) (EM)**	
Phase		**Action**	**Time**
Mobilization / Activation	1	Start recording of events in the Personal Log.	
	2	Communicate and coordinate with	
		a. CIC	
		b. SIC	
		c. Maintenance engineers	
Establishing Control	3	Depute engineers on-site.	
	4	Establish radio or telephone contact with CIC and SIC.	
Initial Action	5	Maintain sufficient stock of required equipment/materials.	
	6	Coordinate with nearby CIC, SIC, Fire Officer & Procurement officer.	
	7	Ensure water supply to the hydrants.	
Ongoing Response	8	Provide necessary advice and supports.	
	9	Arrange for Bulldozers, mobile cranes, forklifts or any other specialized equipment.	
	10	Mobilize cargo handling equipments.	
Response Termination	11	Terminate response if conditions are met on permission of CIC/SIC.	
	12	Ensure that all records are collated and stored.	

END EM CHECKLIST

CHECKLIST -8		**ENGINEERS (ELECTRICAL) (EE)**	
Phase		**Action**	**Time**
Mobilization / Activation	1	Start recording of events in the Personal Log.	
	2	Communicate and coordinate with	
		a. CIC	
		b. SIC	
		c. State Electricity Board	
Establishing Control	3	Depute engineers on-site.	
	4	Establish radio or telephone contact with CIC and SIC.	
Initial Action	5	Implements elaborate plans for providing continuity of emergency supplies and services such as, electric power, emergency lighting etc.	

	6	Keep alert on duty for any electrical isolation of equipment during an emergency.	
	7	Suggests optimal strategies for conducting emergency isolation operations of damaged equipment, the emergency transfer of materials and all other process related emergency operations	
	8	Coordinate with nearby CIC, SIC, Fire Officer & Procurement officer.	
	9	Arrange Public Address system to caution the public.	
Ongoing Response	10	Provide necessary advice and supports.	
	11	Provide lighting facilities wherever necessary.	
Response Termination	12	Terminate response if conditions are met on permission of CIC/SIC.	
	13	Ensure that all records are collated and stored.	

END EE CHECKLIST

CHECKLIST -9	**ENGINEERS (CIVIL) (EC) – (PP&D)**		
Phase		**Action**	**Time**
Mobilization / Activation	1	Start recording of events in the Personal Log.	
	2	Communicate and coordinate with	
		a. CIC	
		b. SIC	
	3	Depute engineers on-site.	
Establishing Control	4	Establish radio or telephone contact with CIC and SIC.	
	5	Coordinate with CIDCO and MJP if required.	
Initial Action	6	Arrange sand bags, Diesel pumps, sufficient quantities of bleaching powder etc., for the event of Cyclone/flood. Plans/strategy, as contemplated, to be forwarded to higher levels.	
	7	Determines the level of contamination of the site as a result of the accident and hire barges for collecting the spilled oil, if any.	
	8	Identify local contractors and keep them as standby to meet emergency requirements such as man power, equipment etc.	
	9	Render and Monitor assistance for extricating trapped personnel by cutting structures etc.	
	10	To ensure that adequate clean water is available in the reservoirs.	
	11	Instruct the contractors to carry out urgency civil works if required.	
	12	Coordinate with CIC, SIC, Fire Officer & Procurement officer.	
Ongoing	13	Provide necessary advice and support.	

Response	14	In case of fire and especially if the fire involves toxic/flammable materials, contain the run off fire water and other water from the damaged units.	
	15	Cooperate with IRT to conduct the actual cleanup work during and after the emergency.	
Response Termination	16	Terminate response if conditions are met on permission of CIC/SIC.	
	17	Ensure that all records are collated and stored.	

END EC CHECKLIST

CHECKLIST -10		**MAINTENANCE COORDINATOR (MC)**	
Phase		**Action**	**Time**
Mobilization / Activation	1	Communicate and coordinate with	
		a. CIC	
		b. SIC	
		c. M& E dept.	
		d. PP&D	
Initial Action	2	Gather necessary information	
Ongoing Response	3	Instruct maintenance staff	
	4	Recommend the appropriate procedures to isolate damaged units without introducing new hazards and provide resources both in terms of personnel and equipment to accomplish this.	
	5	Provide the necessary utilities during the emergency, isolating or recommending emergency isolation procedures to prevent utility distribution to damaged parts of the facility. If required, activate back up emergency generators, pumps, welding services and underwater diving.	
	6	Render and monitor assistance for extricating trapped personnel by cutting structures, wires etc.	
	7	Remain alert on duty for any electrical isolation of equipment.	
	8	In case of fire and if the fire involves toxic/flammable materials, assist in containing the run off fire water and other water from the damaged units.	
	9	During natural disaster, coordinate with PPD and arrange for sand bags.	
Response Termination	10	Assist in accident investigation.	
	11	Terminate response if conditions are met on permission of CIC/SIC.	
	12	Ensure that all records are collated and stored.	

END MC CHECKLIST

CHECKLIST-11		PILOT (MARINE ENGINEER) (PO)	
Phase		**Action**	**Time**
Mobilization / Activation	1	Upon callout, report to CIC/SIC.	
	2	Start recording of events in the Personal Log.	
	3	Attend Initial Briefing.	
Assessment	4	Assist SIC/ Dock Master to obtain and collate available data re:	
		a. Weather.	
		b. Tides, currents.	
		c. Latest update on action taken.	
Planning	5	Determine field response equipment/ labor/ transport requirements and provide to CIC.	
Ongoing Response	6	Direct and coordinate marine response activities.	
	7	Prepare all tugs/crafts for mobilization at the earliest.	
	8	Prepare directive for marine response teams.	
	9	Ensure that field response teams receive required	
		a. Information i.e. Briefings/Inductions/Weather.	
		b. Personal protective equipment (PPE).	
		c. Essential supplies (e.g. food, first aid etc.).	
		d. Weather conditions.	
		e. Monitoring of response activities.	
	10	Coordinate dispersant operations when permitted.	
	11	Seek for necessary means for aerial observation, containment and recovery actions and vessel dispersant spraying operations.	
	12	Inform Dy. Manager Safety of anticipated waste quantity and type.	
Response Termination	13	Advise for termination of response operation.	
	14	Ensure safe return of response personnel.	
	15	Ensure that all equipment are cleaned and returned to stores.	
	16	Attend debriefing.	
	17	Ensure that all records are collated and stored.	

END PO CHECKLIST

CHECKLIST-12		CHIEF COMMANDANT - CISF (CCC)	
Phase		**Action**	**Time**
Mobilization / Activation	1	Obtain details of incident and of any mitigative actions taken.	
	2	Start recording of pertinent facts and figures in the Personal Log.	
	3	Communicate and coordinate with	
		a. CIC	

		b.	SIC	
		c.	Police Authorities	
Establishing Control	4	Authorize any immediate action required by on site staff.		
	5	Establish radio and telephone contact with CIC and SIC		
Initial Action	6	Obtain necessary instructions from SIC.		
Ongoing Response	7	Control entry of unauthorized persons.		
	8	Facilitate entry of authorized persons, agencies.		
	9	Facilitate entry of emergency vehicles such as ambulance etc.		
	10	Assist in Search and Rescue operation.		
	11	Ensures that residents within port area are notified about disaster and instructions to evacuate if necessary.		
Response Termination	12	Carry out a reconnaissance of the evacuated area before declaring the same as evacuated.		
	13	Terminate response if conditions are met on permission of CIC or SIC.		
	14	Ensure that all records are collated and stored.		

END CCC CHECKLIST

CHECKLIST -13		**SR. DY. CHIEF MEDICAL OFFICER (CMO)**		
Phase		**Action**		**Time**
Mobilization / Activation	1	Start recording of events in the Personal Log.		
	2	Communicate and coordinate with		
		a.	CIC	
		b.	SIC	
		c.	ICLO, Nearby Hospitals and Health care professionals.	
		d.	Port Control Room and Fire Station.	
Establishing Control	3	Activate Hospital Emergency Action Plan and depute doctors on-site to give first aid to the injured.		
	4	Establish radio or telephone contact with CIC and SIC and understand the emergency situation.		
	5	Advise CIC on industrial hygiene and make sure that the frontline personnel are not exposed to unacceptable levels of toxic substances.		
	6	Inform hospitals of the situation in case of a toxic release and apprise them of the antidotes necessary for the treatment		
	7	Coordinate with ICLO. Along with the District Administration and health care professionals, ICLO will facilitate infection control programme in the event of a natural disaster.		

Initial Action	8	Maintain sufficient stock of medicines, antidotes, oxygen, stretchers etc and arrange for ambulance.	
	9	Suggest and provide an antidote in the event of toxic release	
	10	Coordinate with nearby hospitals and doctors.	
Ongoing Response	11	Provide necessary advice and supports for appropriate treatment of the injured persons.	
Response Termination	12	Terminate response if conditions are met on permission of CIC/SIC.	
	13	Ensure that all records are collated and stored.	

END CMO CHECKLIST

CHECKLIST -14		**CHIEF MANAGER - TRAFFIC (TM)**	
Phase		**Action**	**Time**
Mobilization / Activation	1	Start recording of events in the Personal Log.	
	2	Communicate and coordinate with	
		a. CIC	
		b. SIC	
		c. Tank Truck contractors	
		d. Terminal and Berth Managers	
Establishing Control	3	Prepares vessels to vacate from berth.	
	4	Establish radio or telephone contact with CIC and SIC.	
Initial Action	5	Prepare consolidated list of dangerous goods including tankers in port and provide details to SIC.	
	6	Arranges to protect cargo in vicinity from damage.	
	7	Arranges to segregate and shift cargo in sheds.	
Ongoing Response	8	Coordinate with the tank truck contractors.	
	9	Provide necessary advice and supports.	
Response Termination	10	Terminate response if conditions are met on permission of CIC/SIC.	
	11	Ensure that all records are collated and stored.	

END TM CHECKLIST

CHECKLIST -15		**BERTH MANAGER (BM) (MCB, LCB, SWB, ICD)**	
Phase		**Action**	**Time**
Mobilization / Activation	1	Start recording of events in the Personal Log.	
	2	Communicate and coordinate with	
		a. CIC	
		b. SIC	
		c. Ship owners / Agents / C & F agents / stevedores.	
		d. Terminal Managers	
Establishing	3	Prepares vessels to vacate from berth.	

Control	4	Establish radio or telephone contact with CIC and SIC.	
Initial Action	5	Prepare consolidated list of dangerous goods including tankers in port.	
	6	Arranges to protect cargo in vicinity from damage.	
	7	Arranges to segregate and shift cargo in sheds.	
Ongoing Response	8	Coordinate with ship owners/agents/C&F agents/stevedores.	
	9	Provide necessary advice and supports.	
Response Termination	10	Terminate response if conditions are met on permission of CIC/SIC.	
	11	Ensure that all records are collated and stored.	

END BM CHECKLIST

CHECKLIST -16		**SECRETARY (SEC)**	
Phase		**Action**	**Time**
Mobilization / Activation	1	Communicate and coordinate with	
		a. CEC	
		b. Media (preparing brief)	
Initial Action	2	Arranges for food and water and accommodation	
	3	Arranges for transport	
	4	Arranges to communicate with relatives of employees	
Response Termination	5	Liaises with media under guidelines provided by the CEC.	

END SEC CHECKLIST

CHECKLIST -17		**Legal (L)**	
Phase		**Action**	**Time**
Mobilization / Activation	1	Communicate and coordinate with	
		a. CEC	
		b. CIC	
Initial Action	2	Gather information	
Ongoing Response	3	To issue notice under Major Port Trust Act, Indian Ports Act, Major Port Prevention and Control of Pollution Rules etc. to the defaulters.	
Response Termination	4	Arrange for settlement of related claims	
	5	Liaises with media under guidelines provided by the CEC.	

END L CHECKLIST

9.2EARLY WARNING/ ALERT SYSTEM

9.2.1 Receiving and managing alerts

Information of the occurrence of incidents in and around JNPT area may come from a variety of sources. On receipt of information designated Personnel must carry out investigation to confirm the incident and gather as many details and as quickly as possible:

- Prepare an incident report.
- Immediately forward the report to and inform the Dy. Conservator/Harbourmaster.

The information so collected shall be maintained by making hourly log entry in a register.

9.2.2 Activation of EOC and initial resource coordination

9.2.2.1 Establishing the Emergency Operational Centre

9.2.2.1.1 Location

The EOC will be located in the Port Control room or secondary control room which is Chamber of Chief Manager (Admin) & Secy. located in the Admin building or as directed by the Chairman).

For small scale or short duration responses, the local EOC will be used inside the port. For larger scale responses, where external help is needed the Main Office Area will be utilized along with local EOC.

9.2.2.1.2 Muster Point

IRT personnel will muster at the nominated EOC unless otherwise directed by the SIC.

9.2.2.1.3 First Person On-Site

The person who arrives first at the EOC premises will commence preparation for the meeting.

9.2.2.1.4 Responsibility

The designated CIC/SIC will mobilize IRT members.

9.2.2.1.5 Resource mobilization

The CIC/SIC will ensure mobilization sufficient equipment and personnel resources required to manage the response.

9.2.2.1.6 Direction, control and coordination – Function coordination amongst IRT

The overall responsibility of the Emergency management lies with the Dy. Conservator, JNPT. He assumes the responsibility of CIC on receipt of the information of an impending emergency.

Some of the critical functions are:

- Activation of the EOC,
- An ongoing emergency assessment, including upgrading or downgrading of the emergency alarm level,
- Notification of outside governmental agencies,
- The decision to ask for outside help and resources,
- The decision to evacuate people,

- Decisions involving the safety of offsite vulnerable points (e.g recommendations to evacuate or take shelter, in the case of a toxic vapour release).

PROCEDURE-A			**ESTABLISHING THE EMERGENCY OPERATION CENTRE (EOC)**	
Task			**Action**	**Status**
1.0			Obtain and/or assign EOC equipment.	
1.1			Communications.	
	A		Telephone lines. (1 Hot line linking Dy. Commissioner of the district)	
	B		Fax lines.	
	C		Radio frequency (as required).	
1.2			Information Display.	
	A		Set of forms (minimum of 5 sets).	
	B		Regional Maps and Charts:	
		i	Nautical charts.	
		ii	Topographic maps	
	C		Overhead projector (in nominated briefing room).	
	D		Whiteboards.	
1.3			Copy(s) of the JNPT DMP and OSCP.	
1.4			Computer and Printer.	
1.5			Stationary: Markers, Pens, Pencils and A4 white paper.	
1.6			Tables and chairs	
1.7			Order and obtain any items needed (1.1-1.6)	
1.8			Advise reception to direct incoming calls to the EOC.	

9.2.2.1.7 Emergency Operating Room Equipment

As a general guideline the following equipment should be catered to

- Flip up of maps should be available-preferably a digitized map on the computer,
- Terminals storing toxic chemicals and terminals storing flammable chemicals,
- Transportation map depicting transportation route for LPG and chemical tankers by road,
- Map showing saltpans (if any),
- Map depicting densely populated areas,
- Map depicting fishing area zones,
- Emergency lights and torches,
- Computer,
- Fax,
- Printer,
- Telephone,
- Portable PA Sets,
- Walkie talkies / mobile telephone,
- Chemical protective suit,

- Loud hailer,
- VHF sets,
- Binoculars,
- Copy of Disaster Management plan, Oil Spill Emergency Plan and Business Continuity Plan,
- Reference books-chemical Encyclopedia,
- Table-seating,
- Chairs,
- Stationery,
- Gas masks with canisters,
- Safety goggles,
- Self contained breathing apparatus.

Refer **Appendix B** for details of the EOC equipment with JNPT.

9.2.3 Competent Agencies

Table 9.1: Competent agencies for issuing warnings

Disaster	Agencies
Earthquakes	IMD
Floods	Central Water Commission
Cyclones	IMD, Regional Specialized Meteorological Centre (RSMC) – Arabian Sea
Tsunami and Storm Surge	INCOIS

These agencies shall be responsible for keeping track of developments in respect of specific hazards assigned to them and inform the designated authorities/agencies at National, State and District levels about the impending disasters. All these agencies have developed guidelines for early warning of disasters.

9.2.3.1 Cyclone

Indian Meteorological Department (IMD) has a developed detailed procedure for Four Stage Warning of Cyclone

1. **Pre-Cyclone Watch**: Pre-cyclone watch is an early warning issued about 72 hrs. in advance of the commencement of bad weather. This is issued by the IMD Headquarters to all designated authorities including the Cabinet Secretary and other senior officers of Govt. of India and the Chief Secretaries of concerned Maritime States, media and all Cyclone Warning Centers (CWS) of IMD.

2. **Cyclone Alert**: Cyclone Alert is issued to all designated authorities/Agencies as far as possible, 48 hours before the expected commencement of adverse weather.

3. **Cyclone Warning**: Cyclone warning are issued to all designated Authorities/Agencies including the Chief Secretaries of the maritime States and the District Magistrates/Collectors of the coastal districts and the immediate interior districts expected to be affected by the cyclone. Cyclone

Warning is also issued to the designated railway officials and defence personnel. After initial warning , cyclone warning are issued to above officials twice a day by high priority telegrams based on 0830 IST and 1730 IST charts till the weather improves.

4. **Post Landfall Outlook**: Post landfall outlook is issued at least 12 hours in advance of the landfall by concerned CWCs. On the basis of this outlook, the concerned Meteorological Centre will also issue cyclone warnings for the interior areas.

9.2.3.1.1 Cyclone Warning Dissemination System (CWDS)

Cyclone Warning Dissemination System (CWDS) receivers have been established in vulnerable coastal areas using INSAT/METSAT. The system is being used extensively on operational basis during cyclone. The cyclone warning message is originated from Area Cyclone Warning Centre (ACWC) Colaba, Mumbai whenever a storm is observed. Warning messages are received in local languages directly by CWDS receivers located in areas likely to be affected by the cyclone.

In addition Cyclone Warning is disseminated through the following means:

a. Police Wireless network
b. Warnings through All India Radio (AIR) Bulletins
c. Television
d. Press Bulletins
e. Aviation Warning
f. Telephone and Fax
g. Telex
h. Telegrams

9.2.3.2 Tsunami

In the aftermath of the Indian Ocean Tsunami of 26 December 2004, the Ministry of Earth Sciences has set up an Indian Tsunami Early Warning Center at the Indian National Centre for Ocean Information Services (INCOIS) Hyderabad. The Center is mandated to provide advance warnings on Tsunamis likely to affect the coastal areas of the country.

Tsunami Warning (RED) contains information about the earthquake and a tsunami evaluation message indicating that tsunami is expected. This is the highest level wherein immediate actions are required to move public to higher grounds. Message also contains information on the travel times and tsunami grade (based on run-up estimates) at various coastal locations.

Tsunami Alert (ORANGE) contains information about the earthquake and a tsunami evaluation message indicating that tsunami is expected. This is the second highest level wherein immediate public evacuation is not required. Public should avoid beaches since strong current are expected. Local officials should be prepared for evacuation if it is upgraded to warning status. Message also contains information on the travel times and tsunami grade at various coastal locations.

Tsunami Watch (YELLOW) contains information about the earthquake and a tsunami evaluation message indicating that tsunami is expected. This is the third

highest level wherein immediate public evacuation is not required, Local officials should be prepared for evacuation if it is upgraded to warning status. Message also contains information on the travel times and tsunami grade at various coastal locations.

Tsunami cancellation (GREEN) will be issued if the tsunami warning was issued on the basis of erroneous data or if the warning center determines from subsequent information that only an insignificant wave has been generated. In addition, tsunami warning may be cancelled on a selective basis when a significant wave that has been generated clearly poses no threat to one or more of the areas the warning center warns, either because of intervening continents or islands which screen them or because the orientation of the generating area causes the tsunami to be directed away from these areas.

Tsunami All Clear (GREEN) bulletin indicates that the 'Tsunami Threat' is passed and no more dangerous waves are expected.

9.2.3.3 Flood

Central Water Commission has developed a network of flood forecasting stations and issues Daily Flood Bulletins to all designated Authorities/Agencies of the Central Government and State Governments/ district Administration during the South East Monsoon season for all the major river basins in the following categories:

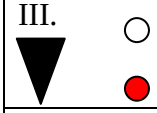
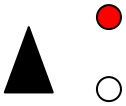
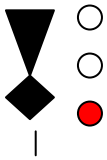
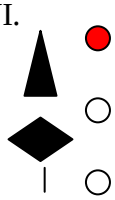
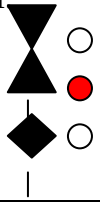
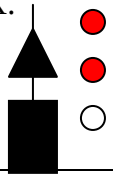
Category IV:
Low Flood (Water level between Warning Level and Danger Level)

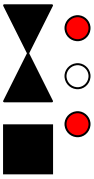
Category III:
Moderate Flood (Water Level below 0.50m. less than HFL and above Danger Level)

Category II:
High Flood (Water Level less than Highest Flood Level but still within 0.50m. of the HFL)

Category I:
Unprecedented Flood (Water Level equal and above Highest Flood Level (HFL))

Table 9.2: Storm Warning Signals

SIGNAL NO.	DESCRIPTION	ACTION
D/N		
I	**DISTANT CAUTIONARY :** There is a region of squally weather in which a storm may be forming.	Monitor weather report, TV news Internet and keep close watch.
II	**DISTANT WARNING :** A storm has formed.	Monitor weather report, TV news, Internet and keep close watch inform all.
III. 	**LOCAL CAUTIONARY :** The Port is threatened by squally weather.	Inform all. Warn fishermen
IV. 	**LOCAL WARNING :** The Port is threatened by a storm but it does not appear that the danger is as yet sufficient great to justify extreme measures of precaution.	Alert all concerned to be ready and available.
V. 	**DANGER :** The Port will experience weather from a storm of slight or moderate intensity that is expected to cross the Coast to the South of the Port	Implement Contingency Plan.
VI. 	**DANGER :** The Port will experience sever weather from a storm of slight or moderate intensity that is expected to cross the Coast to the North of the Port.	Implement Contingency Plan.
VII 	**DANGER :** The Port will experience severe weather from a storm of slight or moderate intensity that is expected to cross the Coast over or near to the Port.	Implement contingency Plan.
	NOTE: this signal is also hoisted when a storm is expected to skirt the Coast without (actually) crossing it.	
IX. 	**GREAT DANGER :** The Port will experience severe weather from a storm of greater intensity that is expected to cross the Coast to the North of the Port.	Implement contingency Plan.
X.	**GREAT DANGER :** The Port will experience severe weather from a	Implement contingency Plan.

	storm of great intensity that is expected to cross over or near the Port.	
	NOTE: This signal is also hoisted when a severe storm is expected to skirt the Coast without (actually) crossing it.	
XI.	**FAILURE OF COMMUNICATION :** Communications with the Meteorological Warning Centre have broken down and the local Officer considers that there is danger of bad weather.	
	NOTE: Squally weather is meant to cover occasional/frequent squalls with rain or persistent type of storage gusty winds (mean wind speed not less than 20 knots) accompanied by rain. Such conditions are associated with low pressure systems or onset strengthening of monsoon. Mean wind speeds exceeding 33 knots associated with cyclonic storms are generally covered by signal higher than LC.III. The word generally has been added to permit hoisting of LC.III at Ports outside the inner storm area where wind speeds may exceed 33 knots.	

9.2.4 PUBLIC WARNING

The capabilities and processes the Port has in place to information collection and disseminates warning messages to the stakeholders and all the personnel as to the nature of the hazard, the timing, and the recommended or required protective/preventive actions which are to be implemented by the action group are described in the following sections.

9.2.4.1 Message content

The message needs to be announced at least in local language which may be for example Evacuate, Assemble etc.

9.2.4.2 Public Warning System

The various types of warnings through hooters/sirens with indication locally and in control room, depending on the location of emergency as specified below:

- **Siren for declaring Emergency**

  1. On receipt of the information about the Emergency, the control station will authorize CISF at Central Gate Complex to actuate the Emergency Siren as follows: -
     - Siren to be sounded continuously for 30 Seconds with an interval of 5 seconds to be repeated 10 times.

- **Siren declaring Evacuation from the Port area**

  1. On receipt of the orders from the Deputy Conservator or in his absence the Harbour Master the port control room will authorize CISF at Central Gate Complex to actuate the Siren as follows:
     - Siren declaring Evacuation from the Port area: Siren to be sounded for 5 seconds till the area is evacuated by people or for ½ hour whichever is less

- **Siren declaring All Clear and returning to the work**

  1. On receipt of the information from the Deputy Conservator or in his absence Harbour Master the port control room will authorize CISF at Central Gate Complex to actuate the Siren as follows:
     - Continuous ringing of siren for 5 minutes

9.3 HAZARD SPECIFIC RESPONSE PLAN

Following potential scenarios have been identified in accordance with the risk assessment for the port. The action flowchart and action plan for each scenario has been prepared in accordance with the Incident Response System (NDMA).

Sr. No.	Scenarios	Page No.
1.	Fire/explosion due to LPG leakage at BPCL Liquid Cargo Jetty during operation – on Ship or Ashore	166
2.	Fire due to leakage of POL/Chemical at BPCL Liquid Cargo Jetty – on ship or ashore	174
3.	Toxic gas (Liquid Ammonia) leak at BPCL Liquid Cargo Jetty during operation – on Ship or Ashore	182
4.	Toxic gas (Acrylonitrile) leak at SWB during operation – on Ship or Ashore	191
5.	Corrosive Acid - Leakage (Phosphoric acid) at BPCL Liquid Cargo Jetty during operation – on Ship or Ashore	200
6.	Fire /Explosion at Shallow Water Berth during handling of Chemicals – on Ship or Ashore	208
7.	Fire /leakage due to Crane Accidents (Container drop/crane fall) at Terminal - NSICT, NSIGT, JNPCT, GTI-APM, BMCT	216
8.	Containers falling into water in case of extreme weather, vessel collision or grounding	222
9.	Fire in Engine room of Floating Craft	228
10.	Ship Grounding/Collision within JNPT port limit	234
11.	Blockage of Navigational Channel due to Ground/Sinking of vessel (Wreckage)	241
12.	Emergency/Disaster within the facility (Reliance/IMC/GBL/Deepak Fertilizer/Suraj Agro/IOCL/Bharat Shell) inside the port limit	250
13.	Fire in CFS – Warehouse	251
14.	Fire in Port Administration building/PUB/Customs House/Port Operation Centre	257
15.	War and Terrorism	263
16.	Bomb Threat	269
17.	Natural Disaster (Cyclone, Earthquake, Flood, Tsunami)	276

S1: Scenario 1
Part A:

1. **Fire/explosion due to LPG leakage at BPCL Liquid cargo jetty during operation – on Ship or Ashore**

2. **Precautions:** MSDS, SOP, Berthing and un-berthing procedures and House-keeping.
   Leaks from LPG pump glands, pipes flanges or pipeline ruptures or from vent emissions due to cargo tank over-pressure or relief valve failure will initially produce vapour. This vapour will not ignite immediately but, if the vapour production is large, there is a hazard of the resultant cold and dense vapour cloud of LPG spreading to a source of ignition before it is diluted below the lower explosive limit. Therefore, in case of release of large quantity of flammable vapour cloud, immediate effort should be directed to eliminate such source of ignition. In such event, eliminate all sources of ignitions i.e. open flames, welding, cutting, operation etc. in the entire port area.

3. **Impact Zone:** Refer **Appendix E** and Risk Assessment report.
   Consequence analysis indicates that the LPG (Propane) leak from pipeline would cover approx. 1000 meters for Vapor cloud explosion (VCE) scenario.

4. **Resources required:** Organizational setup enumerated in Figure S1.2 and major material and equipment resources as given in **Appendix B**.

Figure S1.1: Action Flow Chart

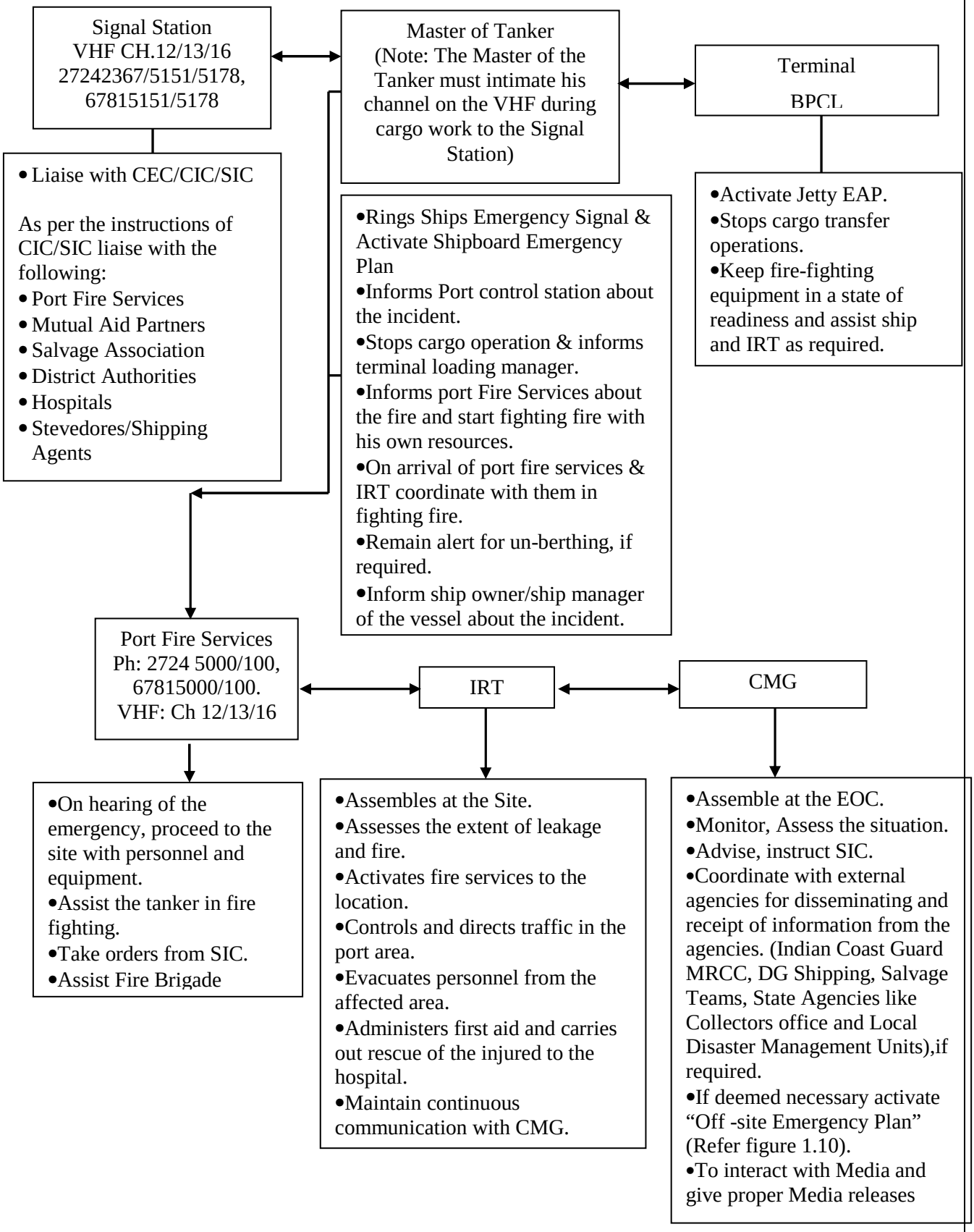
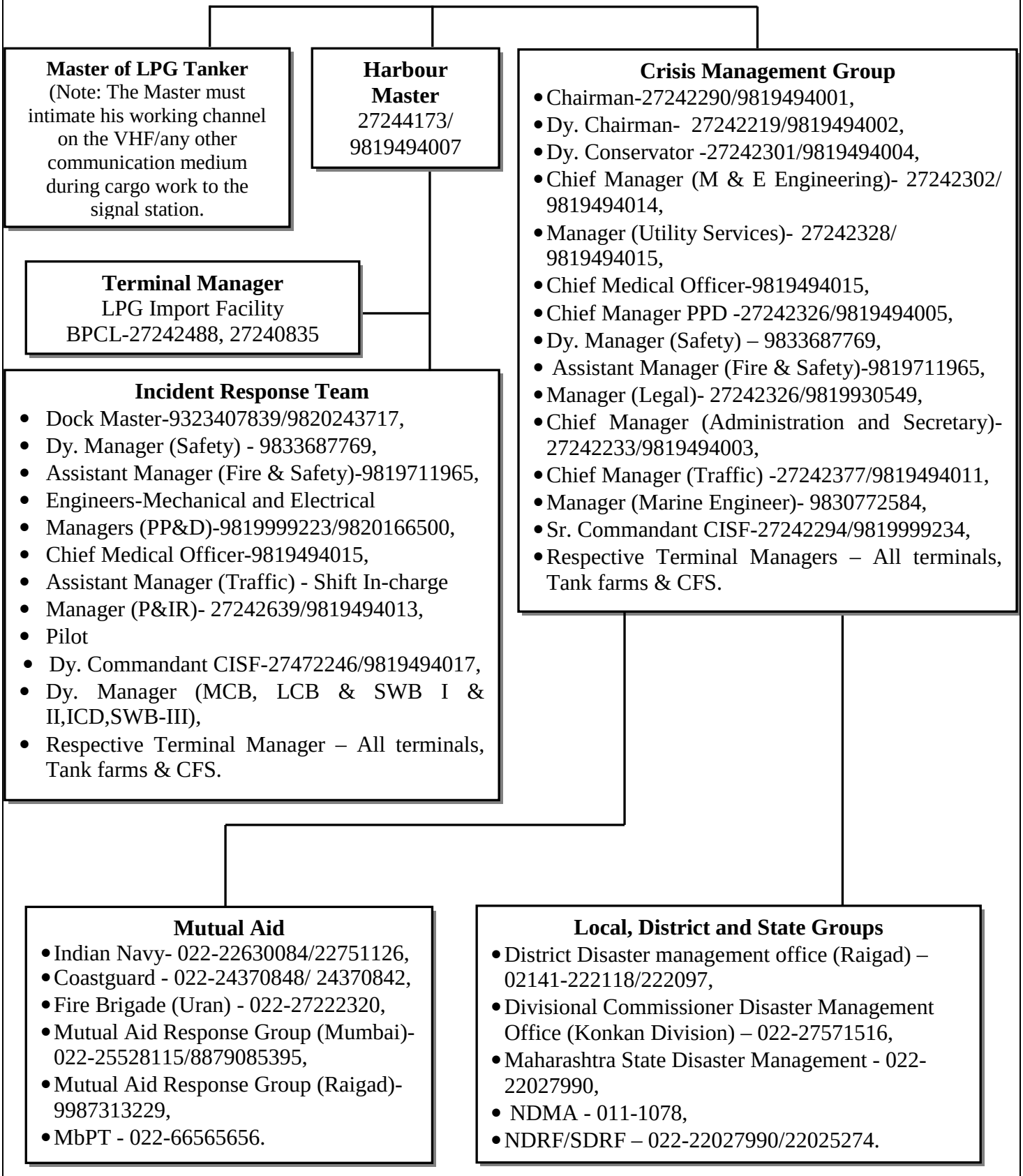


Figure S1.2: Action group



Part B: Action Plan

The vessel upon berthing at the BPCL jetty will follow standard procedures. However, in a less likely scenario, a leak from the pipeline system may occur at the jetty leading to self-detection by vessel personnel or by the terminal automatic alarm and detection system. Further in a more unlikely situation, due to a possible ignition the leakage might catch fire and lead to explosion. The following actions will be required

1. The Master of the Ship (Alternate: Chief Officer)

Response Action	Contact
a. Should raise ships emergency alarm and activate ship board emergency action plan.	
b. Stop LPG transfer operation (as per SOP of the ship).	
c. Terminal, Vessel in the vicinity and Port should be informed of any incident on the ship without delay.	• BPCL • Port Control Station • Vessels in the vicinity
d. Personnel to remain stand by to disconnect metal arms.	
e. Shall be responsible for fighting the fire with ships own resources as well as with the available support from IRT.	
f. Also, to remain prepared to un-berth the ship to the safe area (high sea).	
g. The siren should be continued till the ship is taken to a safe location as per CIC instructions.	

2. The terminal personnel should

Response Action	Contact
a. Activate Jetty EAP (prepared by the terminal) and inform JNPT.	• Port Control Station
b. Shut off isolation valve on LPG pipeline at the berth (action as per SOP of the terminal).	
c. Area should be cordoned off.	
d. Pour Dry Chemical Powder.	
e. Assist IRT and provide all necessary equipment.	• SIC
f. He will direct operation staff. Coordinate with the ship in-charge/C&F agents/stevedores.	

3. Deputy Conservator (Alternate: Harbour Master) should

Response Action	Contact
a. Assess the level of disaster and activate the DMP.	
b. Establish EOC and be stationed to review & assess possible developments to determine the most necessary course of action.	

c. Give necessary instructions to SIC and Port Control Station & arrange for external aid as necessary.	• SIC • Port Control Station
d. Review the situation and accordingly inform to the Chairman/ DY. Chairman.	• Chairman • Dy. Chairman
e. Assess the condition of site and of potential affected area and take decision on evacuation in consultation with SIC.	• SIC
f. Be in constant touch with District and Local Administration for rescue and relief operation.	
g. Terminate the response and debrief before allowing normal operation.	

4. The Port Control Station

Response Action	Contact
a. Gather information related to the weather conditions. Monitor the wind directions and accordingly convey the message to CIC/SIC and Fire & Safety Officers.	• CIC • SIC • F&SO
b. Liaise with Master of the Vessel/Pilot.	• Master of the vessel • Pilot
c. Listening watch to be maintained on VHF channel-16 and walkie-talkie channel-12.	
d. Notify to CIC, SIC and the vessels moving into, through and inside the port. Keep CIC/SIC informed of all the messages received by telephone, VHF sets or by messenger.	• CIC • SIC
e. Notify the other Authorities and stakeholders within Port as per instructions of CIC/SIC.	• Navy • Coastguard • Stakeholders
f. Notify the information to the owner of the vessel as per the instruction of CIC/SIC/ Master of the Vessel.	

5. The Fire-fighting Personnel should

Response Action	Contact
a. Raise Alarm (siren)	
b. Start the pumps as per the requirement	
c. Use water sprays and portable nozzles to maintain curtain and to disperse LPG vapors.	
d. Ensure the gas leak has been stopped. Allow the gas to burn rather than extinguishing.	
e. Open the water curtain valve to protect shore installations from heat radiation.	
f. Inform fire officers to arrange for fire float fire-fighting tug and Marine Engineer to arrange for tugs , as required	• Fire Officer • Marine Engineer

g. Ensure all the ignition sources in the vicinity are extinguished if fire has not occurred.	
h. If the fire is under control and extinguished, give all clear signal	

6. Duties of IRT

Designated Officer	Role	Duties	Alternate Officer
Harbour Master	Site Incident Controller	During Emergency shall proceed to the scene & communicate & collect all information from the Master of the Tanker, Berth Manager and Terminal Manager.	Dock Master
		Conduct initial Briefing.	
		Report the situation to the CIC/CMG and assist CIC in assessing the incident.	
		Initiate DMP.	
		Alert vessels within the vicinity.	
		Assess the condition of site and of potential affected area and take decision on evacuation in consultation with CIC.	
		Extend all necessary help to the Master of the ship to fight the fire.	
		Instruct the Asst. Manager (Fire and Safety) to keep the fire fighting installation in a state of readiness & activate if required.	
		Instruct Dock Master/Marine Engineer(s) to keep tugs ready for fire fighting.	
		Coordinate with all functional heads to take actions.	
Dock Master	Port Control Room Coordinator	Shall monitor the communication on VHF/any other communication medium & convey and relay messages on the advice from CIC /SIC.	Duty Supervisor
		Organize tugs, mooring boats and Pilots for rescue.	
		Hire additional crafts, as necessary.	
		Maintain Log of events.	

Asst. Manager (Fire and Safety)	Fire Coordinator	Shall take orders from the SIC. Lead the fire-fighting team and mobilize fire tenders, men & fire-fighting equipment to the scene & extend all necessary support to the Master of the vessel/Terminal Manager/Berth Manager for fire-fighting. Inform SIC for arrangement of any additional equipment as required.	Station Officer
Dy. Manager (Safety)	Marine Pollution Control Coordinator	Shall take orders from the SIC. Ensure responsible actions for containing the run off fire water and other water from the damaged units. Assist in evacuation of the personnel to the assembly point or as directed by SIC. Conduct clean- up work during and after the emergency as quick as possible.	Safety Inspector
Sr. Commandant-CISF	Security and Evacuation	Shall take orders from the SIC. Cordon off the area. Controls & Directs gate security and traffic in the area. Shall facilitate evacuation, transport, first aid and rescue of personnel from the scene at the time of emergency. Control the entry of unauthorized persons and vehicles. Check for entry of emergency vehicles. Liaise with the Police authorities. Responsible for the head count of the personnel.	Dy. Commandant-CISF
Chief Manager (Traffic)	Traffic Coordinator	Shall take orders from SIC and assist Manager LCB. Submits consolidated list of dangerous goods in port including tankers in port and tank farms in port area. Regulate the traffic in the area.	Asst. Manager (Traffic)

Chief Manager (Port, Planning and Development)	Civil Coordinator	Inform MPCB and other environmental agencies and take necessary guidance.	Manager (I,II)
		Shall mobilize and dispatch sufficient number of vehicles to the site of emergency.	
		Shall be responsible to carry out urgent civil works as required.	
Chief Manager (Mechanical & Electrical)	In charge of Electrical Installation	Shall be responsible for uninterrupted electrical supply to vital equipment and utility at the berth.	Asst. Engineer
		Shall remain alert on duty for any electrical isolation of equipment during emergency.	
		Liaise with SIC and assist Terminal Manager.	
Sr. Dy. Chief Medical Officer	Medical Coordinator	Shall be responsible to organize and keep first aid team with ambulance & necessary medicines to attend to any injured person at the site of the accident.	Alternate Officer
		Shall coordinate with the local hospitals.	
Duty Pilot	In Charge of Pilotage	Shall be ready on site for taking the ship out of berth and be ready for providing any assistance on site.	Standby Pilot
Manager (Marine Engg.)	ME Coordinator	Responsible for organizing tugs for combating the fire and rescue.	Sr. Dy. Manager (Marine Engg.)
		Hire additional crafts as necessary.	

S2: Scenario 2
Part A

1. **Fire due to leakage of POL/Chemical at BPCL Liquid Cargo Jetty – on ship or ashore.**

2. **Precautions:** MSDS, SOP of terminal and berthing and un-berthing procedure.

3. **Impact Zone:** Refer **Appendix E** and Risk Assessment report.
   Consequence analysis indicates that the MS leak from pipeline would cover approx. 1350 meters for Vapor cloud explosion (VCE) scenario.

4. **Resources required:** Organizational setup enumerated in Figure S2.2 and major material and equipment resources as given in **Appendix B**.

Figure S2.1: Action Flow Chart

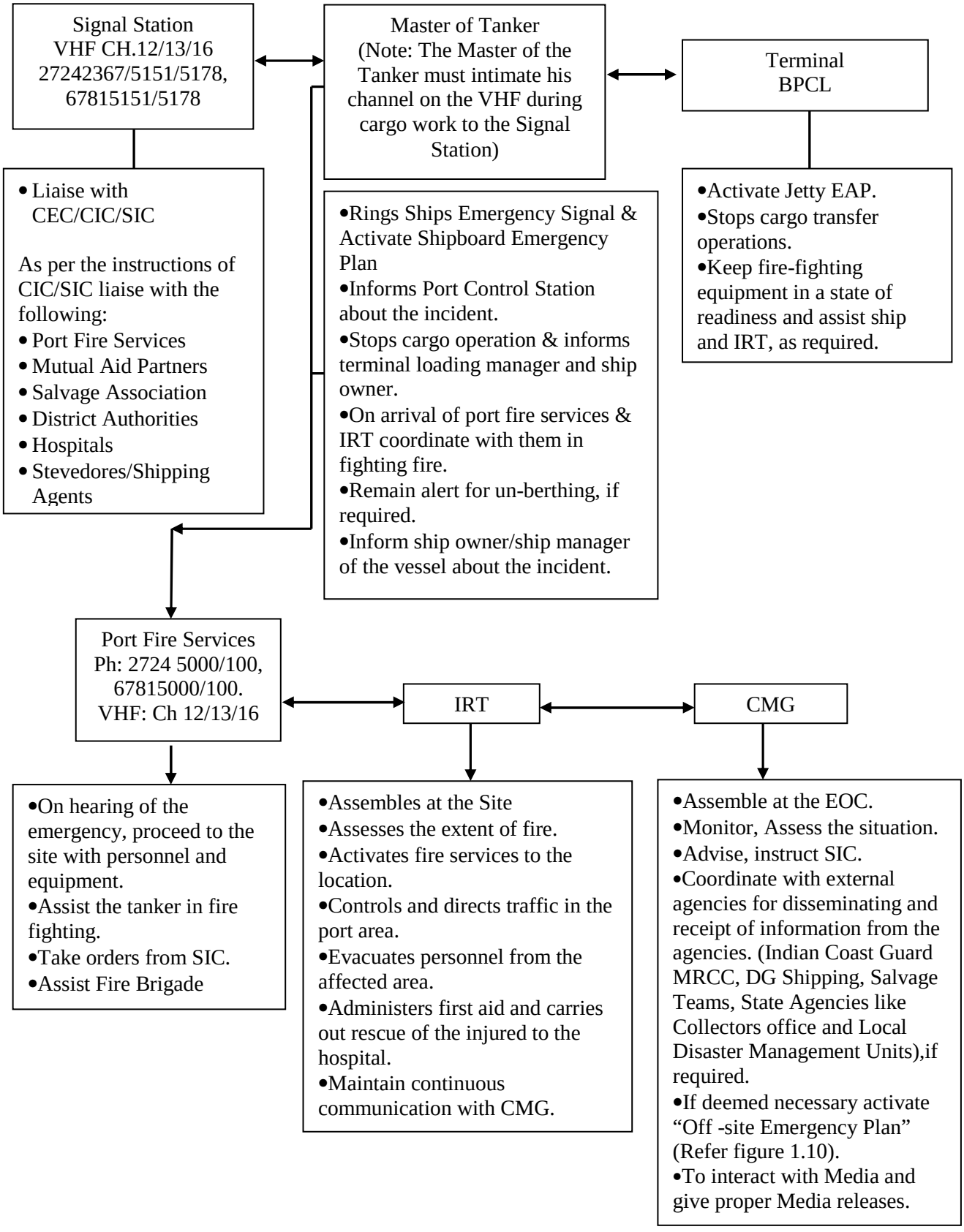
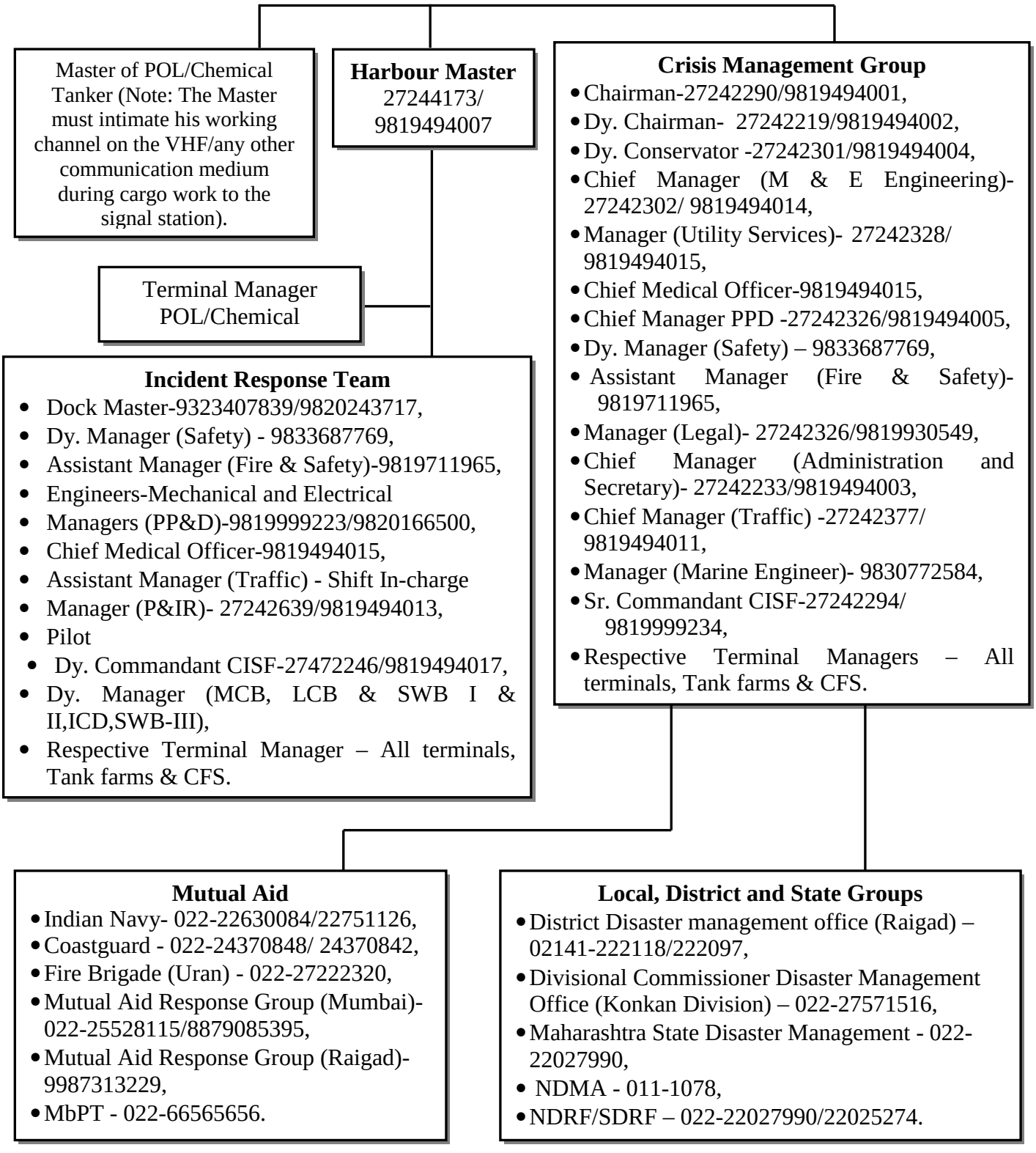


Figure S2.2: Action group



Part B: Action Plan

The vessel upon berthing terminal will follow standard procedures. However, in a less likely scenario a leak from the pipeline system may occur at the jetty leading to self-detection by vessel personnel or by the terminal automatic alarm system. Further in a more unlikely situation due to a possible ignition the leakage might catch fire and leading to explosion. The following action will be required

1. The Master of the Ship (Alternate: Chief Officer)

Response Action	Contact
a. Should raise ships emergency alarm and activate ship board emergency action plan.	
b. Stop POL/Chemical transfer operation (as per SOP of the ship).	
c. Terminal, Vessel in the vicinity and Port should be informed of any incident on the ship without delay.	• Terminal • Port Control Station
d. Personnel to remain stand by to disconnect hoses.	
e. Shall be responsible for fighting the fire with ships own resources as well as with the available support from IRT.	
f. Also, to remain prepared to un-berth the ship to the safe area (high sea).	
g. The siren should be continued till the ship is taken to a safe location as per CIC instructions.	

2. The terminal persons tasked with POL/Chemical cargo operations at the Jetty should

Response Action	Contact
a. Activate Jetty EAP (prepared by the terminal) and inform JNPT.	Port Control Station
b. Shut off isolation valve on POL/Chemical pipeline at the berth (action as per SOP of the terminal).	
c. Area should be cordoned off.	
d. Pour foam/dry chemical powder on POL/Chemical spillage to reduce rate of vaporization.	
e. Assist IRT and provide all necessary equipment.	
f. He will direct operation staff. Coordinate with the ship in-charge/C&F agents/stevedores.	

3. Deputy Conservator (Alternate: Harbour Master)

Response Action	Contact
a. Assess the level of disaster and activate the DMP.	
b. Establish EOC and be stationed to review & assess possible developments to determine the most necessary course of action.	

c. Give necessary instructions to SIC and Port Control Station & arrange for external aid as necessary.	• SIC • Port Control Station
d. Review the situation and accordingly inform to the Chairman/ Dy. Chairman.	• Chairman • Dy. Chairman
e. Assess the condition of site and of potential affected area and take decision on evacuation in consultation with SIC.	• SIC
f. Be in constant touch with District and Local Administration for rescue and relief operation.	
g. Terminate the response and debrief before allowing normal operation.	

4. The Port Control Station

Response Action	Contact
a. Gather information related to the weather conditions. Monitor the wind directions and accordingly convey the message to CIC/SIC and F& SO.	• CIC • SIC • F&SO
b. Liaise with Master of the Vessel/Pilot.	• Master of the Vessel • Pilot
c. Listening watch to be maintained on VHF channel-16 and walkie-talkie channel-12.	
d. Notify to CIC, SIC and the vessels moving into, through and inside the port. Keep CIC/SIC informed of all the messages received by telephone, VHF sets or by messenger.	• CIC • SIC
e. Notify the other Authorities and stakeholders within Port as per instructions of CIC/SIC.	• Navy • Coastguard • Stakeholders
f. Notify the information to the owner of the vessel as per the instruction of CIC/SIC/ Master of the Vessel.	

5. The Fire-fighting personnel should

Response Action	Contact
a. Raise Alarm (siren)	
b. Start the pumps as per the requirement	
c. Use water sprays and portable nozzles to maintain curtain.	
d. Open the valves of the monitors and direct the jet on the seat of fire.	
e. Inform fire officers to arrange for fire-fighting tug and Marine Engineer to arrange for tugs , as required	• F&SO • Marine Engineer
f. In case of fire onboard assist Master in fighting fire as per Masters Instructions.	

g. Ensure all the ignition sources in the vicinity are extinguished if fire has not occurred.	
h. If the fire is under control and extinguished, give all clear signal.	

6. Duties of IRT

Designated Officer	Role	Duties	Alternate Officer
Harbour Master	Site Incident Controller	During Emergency shall proceed to the scene & communicate & collect all information from the Master of the Tanker, Berth Manager and Terminal Manager.	Dock Master
		Conduct initial Briefing.	
		Report the situation to the CIC/CMG and assist CIC in assessing the incident.	
		Initiate DMP.	
		Alert vessels within the vicinity.	
		Assess the condition of site and of potential affected area and take decision on evacuation in consultation with CIC.	
		Extend all necessary help to the Master of the ship to fight the fire.	
		Instruct the Asst. Manager (Fire and Safety) to keep the fire fighting installation in a state of readiness & activate if required.	
		Instruct Dock Master/ Marine Engineer(s) to keep tugs ready for fire fighting.	
		Coordinate with all functional heads to take actions.	
Dock Master	Port Control Room Coordinator	Shall monitor the communication on VHF/any other communication medium & convey and relay messages on the advice from CIC /SIC.	Duty Supervisor
		Responsible for organizing tugs, mooring boats and pilots for combating the fire and rescue.	
		Hire additional crafts as necessary.	
		Maintain Log of events.	

Tank Terminal Manager	Cargo Work	Shall be responsible of shutting down of cargo operation & coordinating with JNPT and rendering necessary assistance to the SIC by providing additional fire fighting & emergency equipment as required.	Assistant Terminal Manager
Asst. Manager (Fire and Safety)	Fire Coordinator	Shall take orders from the SIC. Lead the fire fighting team and mobilize fire tenders, men & fire-fighting equipment to the scene & extend all necessary support to the Master of the vessel/Terminal Manager/Berth Manager for fire fighting. Inform SIC for arrangement of any additional equipment as required.	Station Officer
Dy. Manager (Safety)	Marine Pollution Control Coordinator	Shall take orders from the SIC. Ensure responsible actions for containing the run off fire water and other water from the damaged units. Assist in evacuation of the personnel to the assembly point or as directed by SIC. Conduct clean- up work during and after the emergency as quick as possible.	Safety Inspector
Sr. Commandant-CISF	Security and Evacuation	Shall take orders from the SIC. Cordon off the area. Controls & Directs gate security and traffic in the area. Shall facilitate evacuation, transport, first aid and rescue of personnel from the scene at the time of emergency. Control the entry of unauthorized persons and vehicles. Check for entry of emergency vehicles. Liaise with the Police authorities. Responsible the head count of the personnel.	Dy. Commandant-CISF
Chief Manager (Traffic)	Traffic Coordinator	Shall take orders from SIC and assist Manager LCB.	Asst. Manager (Traffic)

		Submits consolidated list of dangerous goods in port including tankers in port and tank farms in port area.	
		Regulate the traffic in the area.	
Chief Manager (Port, Planning and Development)	Civil Coordinator	Inform MPCB and other environmental agencies and take necessary guidance.	Manager (I, II)
		Shall mobilize and dispatch sufficient number of vehicles to the site of emergency.	
		Shall be responsible to carry out urgent civil works as required.	
Chief Manager (Mechanical & Electrical)	In charge of Electrical Installation	Shall be responsible for uninterrupted electrical supply to vital equipment and utility at the berth.	Asst. Engineer
		Shall remain alert on duty for any electrical isolation of equipment during emergency.	
Sr. Dy. Chief Medical Officer	Medical Coordinator	Shall be responsible to organize and keep first aid team with ambulance & necessary medicines to attend to any injured person at the site of the accident.	Alternate Officer
		Shall coordinate with the local hospitals.	
Duty Pilot	In Charge of Pilotage	Shall be ready on site for taking the ship out of berth and be ready for providing any assistance on site.	Standby Pilot
Manager (Marine Engg.)	ME Coordinator	Responsible for organizing tugs for combating the fire and rescue.	Sr. Dy. Manager (Marine Engg.)
		Hire additional crafts as necessary.	

S3: Scenario 3
Part A:

1. **Toxic gas (Liquid Ammonia) leak at BPCL Liquid Cargo Jetty during operation – on Ship or Ashore.**

2. **Precautions:** MSDS**,** SOP of terminal and berthing and un-berthing procedures. Stay upwind and wear positive-pressure breathing apparatus and full protective clothing, as necessary.

3. **Impact Zone:** Consequence analysis indicates that the Ammonia leak from pipeline would cover to the 9 KM for toxic dispersion with IDLH level of 300 ppm.

4. **Resources required:** Organizational setup enumerated in Figure S3.2 and major material and equipment resources as given in **Appendix B**.
   Important: Trained medical personnel and fire fighters as ammonia is toxic.

Figure S3.1: Action Flow Chart

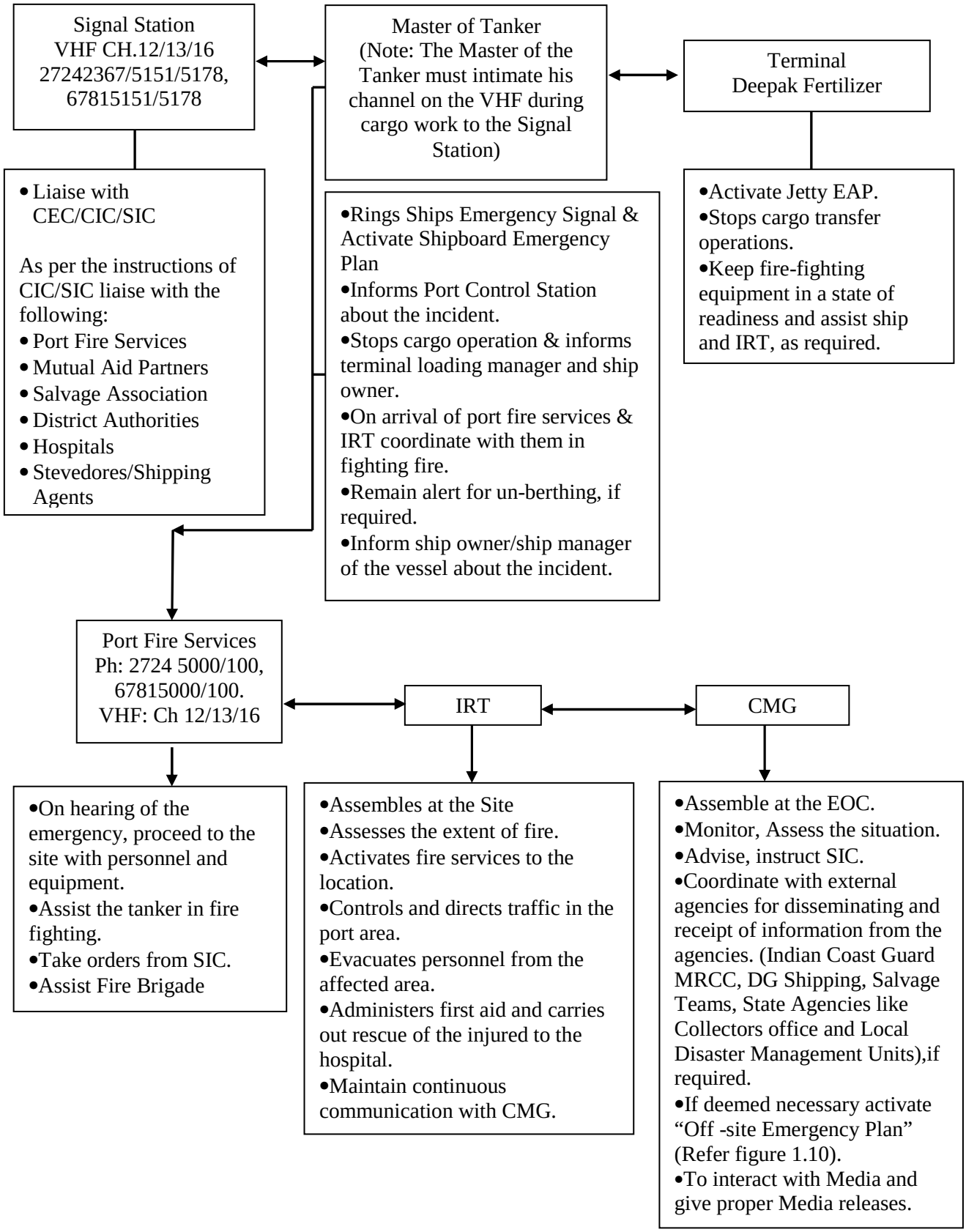
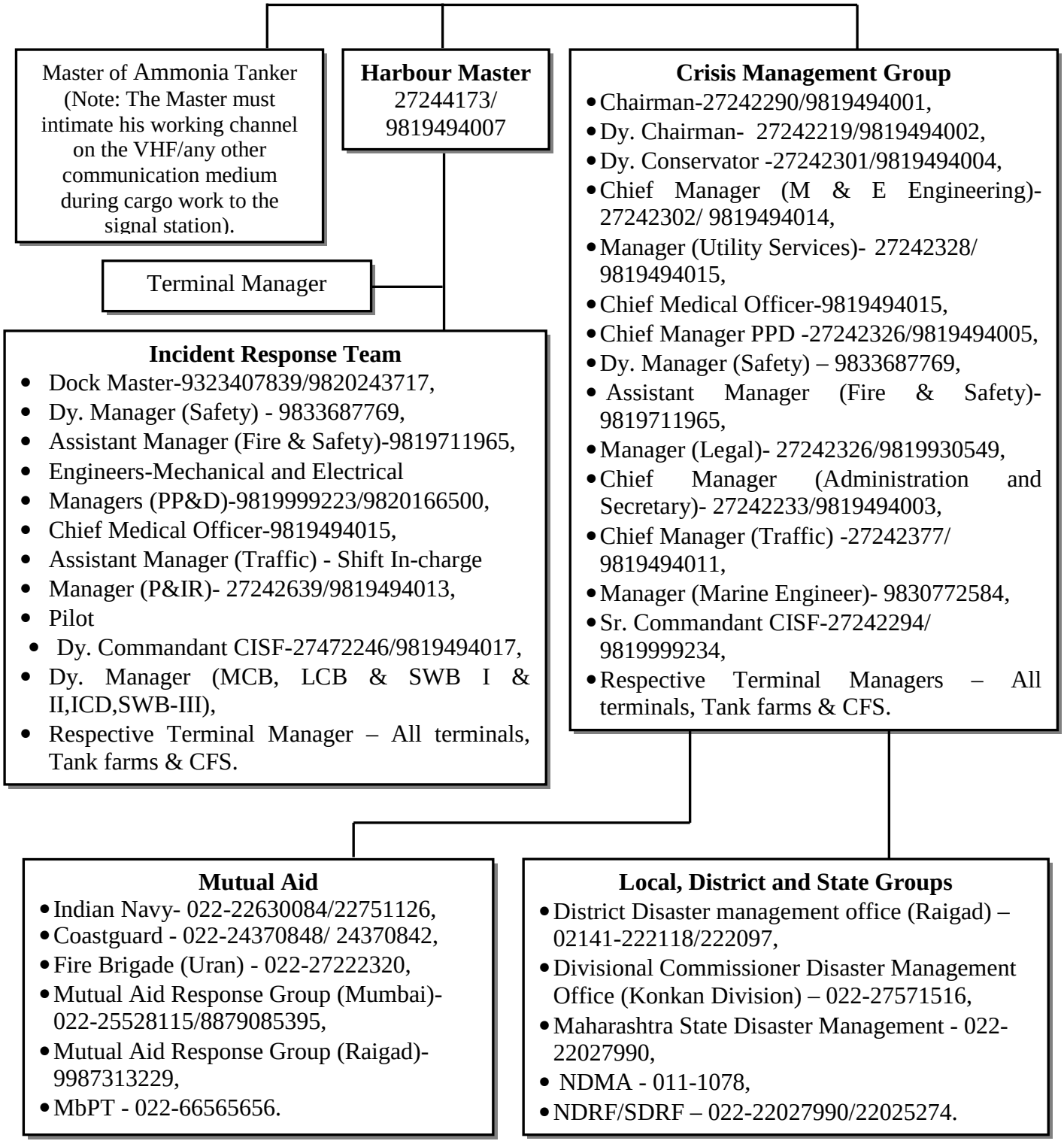


Figure S3.2: Action group



Part B: Action Plan

The vessel upon berthing terminal will follow standard procedures. However, in a less likely scenario a leak from the pipeline system may occur at the jetty leading to self-detection by vessel personnel or by the terminal automatic alarm system. The following action will be required

Spill handling: Evacuate and restrict person's not wearing protective equipment from area of spill or leak until cleanup is complete. Remove all ignition sources. Stop the flow of gas if it can be done safely. Stay upwind; keep out of low areas. Wear positive pressure breathing apparatus and full protective clothing.

1. The Master of the Ship (Alternate: Chief Officer)

Response Action	Contact
a. Should raise ships emergency alarm and activate ship board emergency action plan.	
b. Stop Ammonia transfer operation (as per SOP of the ship).	
c. Terminal, Vessel in the vicinity and Port should be informed of any incident on the ship without delay.	• Terminal • Vessel in the vicinity • Port Control Station
d. Personnel to remain stand by to disconnect metal arms;	
e. Shall be responsible to arrest the leak and for fighting the fire with ships own resources as well as with the available support from IRT.	
f. Also, to remain prepared to un-berth the ship to the safe area (high sea).	
g. The siren should be continued till the ship is taken to a safe location as per CIC instructions.	

2. The terminal persons tasked with Ammonia cargo operations at the Jetty should

Take personal precautions, protective equipment and follow emergency procedures. Wear respiratory protection. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapors accumulating to form explosive concentrations. Vapors can accumulate in low areas. Environmental precautions: Prevent further leakage or spillage if safe to do so.

Contain spillage, and then collect with an electrically protected vacuum cleaner (vehicle mounted in some cases) or by wet-brushing and place in container for disposal.

Response Action	Contact
a. Activate Jetty EAP (prepared by the terminal) and inform JNPT.	• Port Control Station
b. Shut off isolation valve on ammonia pipeline at the berth	

(action as per SOP of the terminal).	
c. Area should be cordoned off.	
d. Assist IRT and provide all necessary equipment.	
e. He will direct operation staff. Coordinate with the ship in-charge/C&F agents/stevedores.	

3. Deputy Conservator (Alternate: Harbour Master)

Response Action	Contact
a. Assess the level of disaster and activate the DMP.	
b. Establish EOC and be stationed to review & assess possible developments to determine the most necessary course of action.	
c. Give necessary instructions to SIC and Port Control Station & arrange for external aid as necessary.	• SIC • Port Control Station
d. Review the situation and accordingly inform to the Chairman/ Dy. Chairman.	• Chairman • Dy. Chairman
e. Consult with Chairman / Dy. Chairman and decide on clearing of ships in close proximity to the incident location or to sail the ammonia tanker to the higher seas and evacuating the people from the likely affected zone.	
f. Take decision on evacuation in consultation with SIC.	• SIC
g. Be in constant touch with District and Local Administration for rescue and relief operation.	
h. Terminate the response and debrief before allowing normal operation.	

4. The Port Control Station

Response Action	Contact
a. Gather information related to the weather conditions. Monitor the wind directions and accordingly convey the message to Master of the vessel, CIC/SIC and F& SO.	• Master of the vessel, CIC • SIC • F& SO
b. Liaise with Master of the Vessel/Pilot.	• Master of the Vessel • Pilot
c. Listening watch to be maintained on VHF channel-16 and walkie-talkie channel-12.	
d. Notify to CIC, SIC and the vessels moving into, through and inside the port. Keep CIC/SIC informed of all the messages received by telephone, VHF sets or by messenger.	• CIC • SIC
e. Notify the other Authorities and stakeholders within Port	• Navy

as per instructions of CIC/SIC.	• Coastguard • Stakeholders
f. Notify the information to the owner of the vessel as per the instruction of CIC/SIC/ Master of the Vessel.	

5. The Fire-fighting Personnel should

Response Action	Contact
a. Raise Alarm (siren).	
b. Start the pumps as per the requirement.	
c. Use water sprays and portable nozzles to maintain curtain and dilution.	
d. Open the valves of the monitors and direct the jet on the seat of fire, in case of fire.	
e. Inform fire officers to arrange for fire-fighting tug and Marine Engineer to arrange for tugs, as required.	• F&SO • Marine Engineer
f. In case of leakage/fire onboard assist Master in arresting the leak/diluting the vapour/ fighting fire as per Masters Instructions.	
g. Announce in mobile van with PA system in the effecting zones to evacuate the zone. Ensure complete evacuation and report to the EOC.	
h. Ensure all the ignition sources in the vicinity is extinguished if fire has not occurred.	
i. If the situation is under control, give all clear signals.	

6. Duties of IRT

Designated Officer	Role	Duties	Alternate Officer
Harbour Master	Site Incident Controller	During Emergency shall proceed to the scene & communicate & collect all information from the Master of the Tanker, Berth Manager and Terminal Manager.	Dock Master
		Conduct initial Briefing.	
		Report the situation to the CIC/CMG and assist CIC in assessing the incident.	
		Initiate DMP.	
		Alert vessels within the vicinity.	
		Shall assess and decide on the evacuation of the personnel considering the direction of wind and dispersion and will instruct Safety Officer and CISF to carry	

		out the evacuation in a safe manner.	
		He will extend all necessary help to the Master of the ship to fight the fire.	
		Instruct the Asst. Manager (Fire and Safety) to keep the fire- fighting installation in a state of readiness & activate if required to fight fire or for disperse the vapour cloud.	
		Instruct Dock Master/ Marine Engineer(s) to keep tugs ready for fire fighting.	
		Coordinate with all functional heads to take actions.	
Dock Master	Port Control Room Coordinator	Shall monitor the communication on VHF/any other communication medium & convey and relay messages on the advice from CIC /SIC.	Duty Supervisor
		Responsible for organizing tugs, mooring boats and Pilots for combating the fire and rescue.	
		Hire additional crafts as necessary.	
		Maintain Log of events.	
Terminal Managers- BPCL and Deepak Fertilizer	Cargo Work	Shall be responsible of shutting down of cargo operation & coordinating with JNPT and rendering necessary assistance to the SIC by providing additional emergency equipment as required.	Assistant Terminal Manager
Asst. Manager (Fire and Safety)	Fire Coordinator	Shall take orders from the SIC.	Station Officer
		Lead the fire fighting team and mobilize fire tenders, men & fire-fighting equipment to the scene & extend all necessary support to the Master of the vessel/Terminal Manager/Berth Manager for fire fighting.	
		Inform SIC for arrangement of any additional equipment as required.	
Dy. Manager (Safety)	Marine Pollution Control Coordinator	Shall take orders from SIC.	Safety Inspector
		Assist in evacuation of the personnel to the assembly point or as directed by SIC.	

Sr. Commandant-CISF	Security and Evacuation	Shall take orders from the SIC.	Dy. Commandant-CISF
		Cordon off the area.	
		Controls & Directs gate security and traffic in the area.	
		Shall facilitate evacuation, transport, first aid and rescue of personnel from the scene at the time of emergency.	
		Control the entry of unauthorized persons and vehicles.	
		Check for entry of emergency vehicles.	
		Liaise with the Police authorities.	
		Responsible the head count of the personnel.	
Chief Manager (Traffic)	Traffic Coordinator	Shall take orders from SIC and assist berth Manager.	Asst. Manager (Traffic)
		Submits consolidated list of dangerous goods in port including tankers in port and tank farms in port area.	
		Regulate the traffic in the area.	
Chief Manager (Port, Planning and Development)	Civil Coordinator	Inform MPCB and other environmental agencies and take necessary guidance.	Manager (I, II)
		Shall mobilize and dispatch sufficient number of vehicles to the site of emergency.	
		Shall be responsible to carry out urgent civil works as required.	
Chief Manager (Mechanical & Electrical)	In charge of Electrical Installation	Shall be responsible for uninterrupted electrical supply to vital equipment and utility at the berth.	Asst. Engineer
		Shall remain alert on duty for any electrical isolation of equipment during emergency.	
Sr. Dy. Chief Medical Officer	Medical Coordinator	Shall be responsible to organize and keep first aid team with ambulance & necessary medicines to attend to any injured person at the site of the accident.	Alternate Officer
		Shall coordinate with the local hospitals.	
Duty Pilot	In Charge of	Shall be ready on site for taking	Standby Pilot

	Pilotage	the ship out of berth and be ready for providing any assistance on site.	
Manager (Marine Engg.)	ME Coordinator	Responsible for organizing tugs for combating the fire and rescue.	Sr. Dy. Manager (Marine Engg.)
		Hire additional crafts as necessary.	

S4: Scenario 4
Part A:

1. **Toxic gas (Acrylonitrile) leak at Shallow water berth during operation – on Ship or Ashore.**

2. **Precautions:** MSDS**,** SOP of terminal and berthing and un-berthing procedures. Stay upwind and wear positive-pressure breathing apparatus and full protective clothing, as necessary.

3. **Impact Zone:** Consequence analysis indicates that the Acrylonitrile leak from pipeline would cover to the 5 KM for toxic dispersion with IDLH level of 85 ppm.

4. **Resources required:** Organizational setup enumerated in Figure S4.2 and major material and equipment resources as given in **Appendix B**.
   Important: Trained medical personnel and fire fighters as Acrylonitrile is toxic.

Figure S4.1: Action Flow Chart

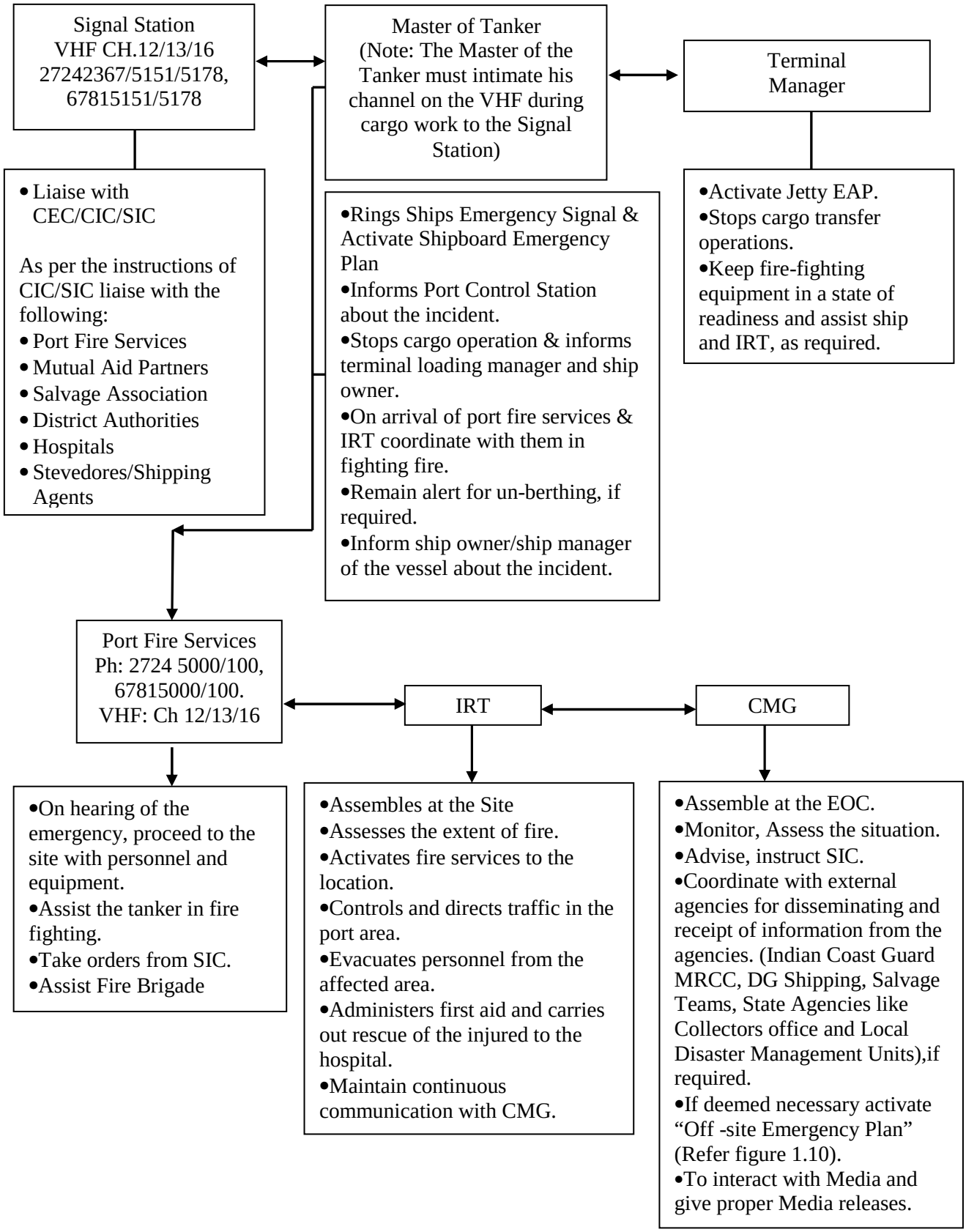
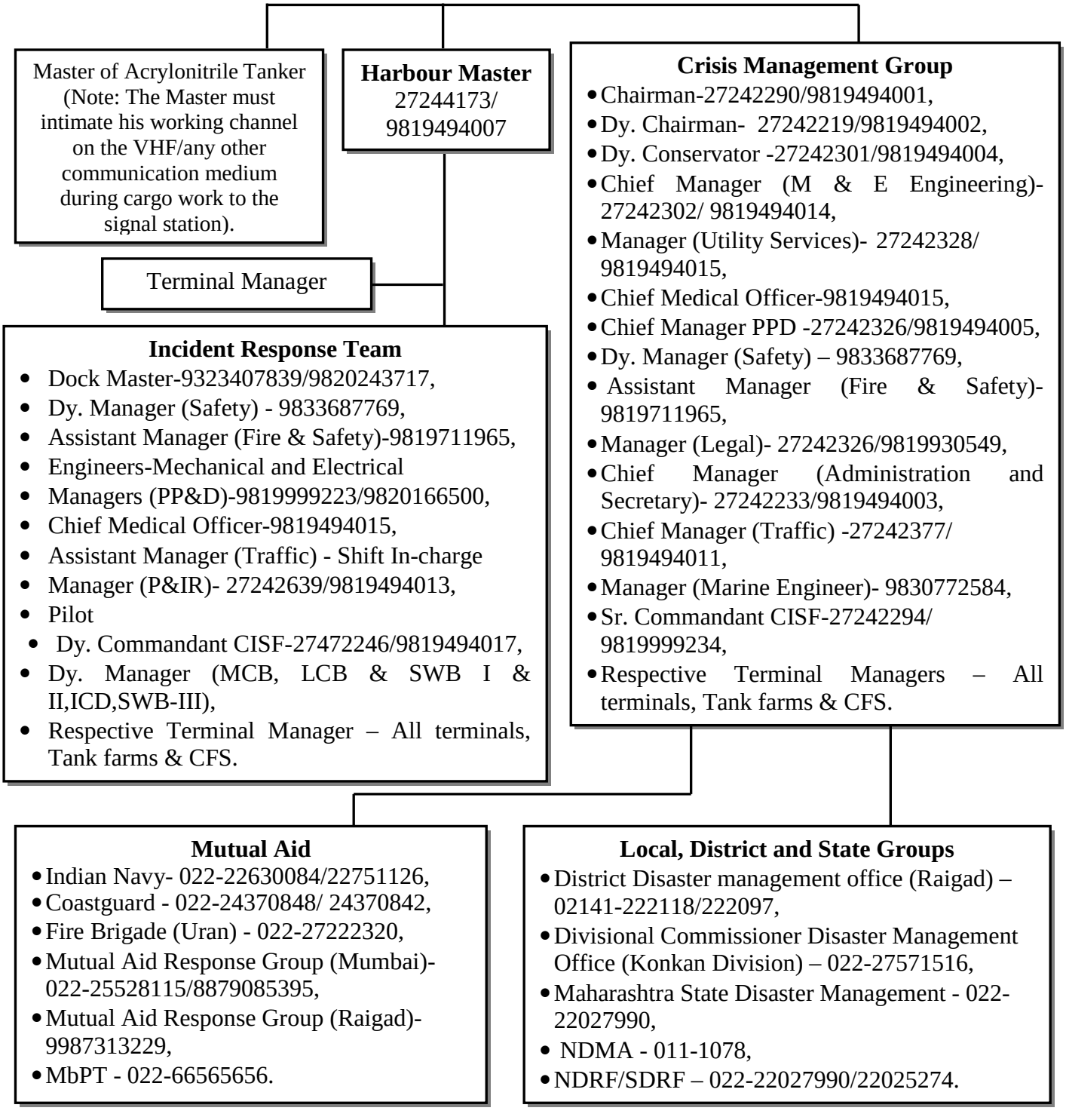


Figure S4.2: Action group



Part B: Action Plan

The vessel upon berthing terminal will follow standard procedures. However, in a less likely scenario a leak from the pipeline system may occur at the jetty leading to self-detection by vessel personnel or by the terminal automatic alarm system. The following action will be required

Spill handling: Evacuate and restrict person's not wearing protective equipment from area of spill or leak until cleanup is complete. Remove all ignition sources. Stop the flow of gas if it can be done safely. Stay upwind; keep out of low areas. Wear positive pressure breathing apparatus and full protective clothing.

1. The Master of the Ship (Alternate: Chief Officer)

Response Action	Contact
a. Should raise ships emergency alarm and activate ship board emergency action plan.	
b. Stop transfer operation (as per SOP of the ship).	
c. Terminal, Vessel in the vicinity and Port should be informed of any incident on the ship without delay.	• Terminal • Vessel in the vicinity • Port Control Station
d. Personnel to remain stand by to disconnect metal arms;	
e. Shall be responsible to arrest the leak and for fighting the fire with ships own resources as well as with the available support from IRT.	
f. Also, to remain prepared to un-berth the ship to the safe area (high sea).	
g. The siren should be continued till the ship is taken to a safe location as per CIC instructions.	

2. The terminal persons tasked with cargo operations at the berth should

Take personal precautions, protective equipment and follow emergency procedures. Wear respiratory protection. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapors accumulating to form explosive concentrations. Vapors can accumulate in low areas. Environmental precautions: Prevent further leakage or spillage if safe to do so.

Contain spillage, and then collect with an electrically protected vacuum cleaner (vehicle mounted in some cases) or by wet-brushing and place in container for disposal.

Response Action	Contact
a. Activate Jetty EAP (prepared by the terminal) and inform JNPT.	• Port Control Station
b. Shut off isolation valve on pipeline at the berth (action as per SOP of the terminal).	
c. Area should be cordoned off.	

d. Assist IRT and provide all necessary equipment.	
e. He will direct operation staff. Coordinate with the ship in-charge/C&F agents/stevedores.	

3. Deputy Conservator (Alternate: Harbour Master)

Response Action	Contact
a. Assess the level of disaster and activate the DMP.	
b. Establish EOC and be stationed to review & assess possible developments to determine the most necessary course of action.	
c. Give necessary instructions to SIC and Port Control Station & arrange for external aid as necessary.	• SIC • Port Control Station
d. Review the situation and accordingly inform to the Chairman/ Dy. Chairman.	• Chairman • Dy. Chairman
e. Consult with Chairman / Dy. Chairman and decide on clearing of ships in close proximity to the incident location or to sail the tanker to the higher seas and evacuating the people from the likely affected zone.	
f. Take decision on evacuation in consultation with SIC.	• SIC
g. Be in constant touch with District and Local Administration for rescue and relief operation.	
h. Terminate the response and debrief before allowing normal operation.	

4. The Port Control Station

Response Action	Contact
a. Gather information related to the weather conditions. Monitor the wind directions and accordingly convey the message to Master of the vessel, CIC/SIC and F& SO.	• Master of the vessel, CIC • SIC • F& SO
b. Liaise with Master of the Vessel/Pilot.	• Master of the Vessel • Pilot
c. Listening watch to be maintained on VHF channel-16 and walkie-talkie channel-12.	
d. Notify to CIC, SIC and the vessels moving into, through and inside the port. Keep CIC/SIC informed of all the messages received by telephone, VHF sets or by messenger.	• CIC • SIC
e. Notify the other Authorities and stakeholders within Port as per instructions of CIC/SIC.	• Navy • Coastguard • Stakeholders

f. Notify the information to the owner of the vessel as per the instruction of CIC/SIC/ Master of the Vessel.	

5. The Fire-fighting Personnel should

Response Action	Contact
a. Raise Alarm (siren).	
b. Start the pumps as per the requirement.	
c. Use water sprays and portable nozzles to maintain curtain and dilution.	
d. Open the valves of the monitors and direct the jet on the seat of fire, in case of fire.	
e. Inform fire officers to arrange for fire-fighting tug and Marine Engineer to arrange for tugs, as required.	• F&SO • Marine Engineer
f. In case of leakage/fire onboard assist Master in arresting the leak/diluting the vapour/ fighting fire as per Masters Instructions.	
g. Announce in mobile van with PA system in the effecting zones to evacuate the zone. Ensure complete evacuation and report to the EOC.	
h. Ensure all the ignition sources in the vicinity is extinguished if fire has not occurred.	
i. If the situation is under control, give all clear signals.	

6. Duties of IRT

Designated Officer	Role	Duties	Alternate Officer
Harbour Master	Site Incident Controller	During Emergency shall proceed to the scene & communicate & collect all information from the Master of the Tanker, Berth Manager and Terminal Manager.	Dock Master
		Conduct initial Briefing.	
		Report the situation to the CIC/CMG and assist CIC in assessing the incident.	
		Initiate DMP.	
		Shall assess and decide on the evacuation of the personnel considering the direction of wind and dispersion and will instruct Safety Officer and CISF to carry out the evacuation in a safe manner.	

		Alert vessels within the vicinity. He will extend all necessary help to the Master of the ship to fight the fire.	
		Instruct the Asst. Manager (Fire and Safety) to keep the fixed Fire-fighting installation in a state of readiness & activate if required to fight fire or for disperse the vapour cloud.	
		Instruct Dock Master/ Marine Engineer(s) to keep tugs ready for fire fighting.	
		Coordinate with all functional heads to take actions.	
Dock Master	Port Control Room Coordinator	Shall monitor the communication on VHF/any other communication medium & convey and relay messages on the advice from CIC /SIC.	Duty Supervisor
		Responsible for organizing tugs, mooring boats and Pilots for combating the fire and rescue.	
		Hire additional crafts as necessary.	
		Maintain Log of events.	
Terminal Manager	Cargo Work	Shall be responsible of shutting down of cargo operation & coordinating with JNPT and rendering necessary assistance to the SIC by providing additional emergency equipment as required.	Assistant Terminal Manager
Asst. Manager (Fire and Safety)	Fire Coordinator	Shall take orders from the SIC.	Station Officer
		Lead the fire fighting team and mobilize fire tenders, men & fire-fighting equipment to the scene & extend all necessary support to the Master of the vessel/Terminal Manager/Berth Manager for fire fighting.	
		Inform SIC for arrangement of any additional equipment as required.	
Dy. Manager (Safety)	Marine Pollution Control Coordinator	Shall take orders from SIC.	Safety Inspector
		Assist in evacuation of the personnel to the assembly point or as directed by SIC.	

Sr. Commandant-CISF	Security and Evacuation	Shall take orders from the SIC. Cordon off the area. Controls & Directs gate security and traffic in the area. Shall facilitate evacuation, transport, first aid and rescue of personnel from the scene at the time of emergency. Control the entry of unauthorized persons and vehicles. Check for entry of emergency vehicles. Liaise with the Police authorities. Responsible the head count of the personnel.	Dy. Commandant-CISF
Chief Manager (Traffic)	Traffic Coordinator	Shall take orders from SIC and assist berth Manager. Submits consolidated list of dangerous goods in port including tankers in port and tank farms in port area. Regulate the traffic in the area.	Asst. Manager (Traffic)
Chief Manager (Port, Planning and Development)	Civil Coordinator	Inform MPCB and other environmental agencies and take necessary guidance. Shall mobilize and dispatch sufficient number of vehicles to the site of emergency. Shall be responsible to carry out urgent civil works as required.	Manager (I, II)
Chief Manager (Mechanical & Electrical)	In charge of Electrical Installation	Shall be responsible for uninterrupted electrical supply to vital equipment and utility at the berth. Shall remain alert on duty for any electrical isolation of equipment during emergency.	Asst. Engineer
Sr. Dy. Chief Medical Officer	Medical Coordinator	Shall be responsible to organize and keep first aid team with ambulance & necessary medicines to attend to any injured person at the site of the accident. Shall coordinate with the local hospitals.	Alternate Officer

Duty Pilot	In Charge of Pilotage	Shall be ready on site for taking the ship out of berth and be ready for providing any assistance on site.	Standby Pilot
Manager (Marine Engg.)	ME Coordinator	Responsible for organizing tugs for combating the fire and rescue.	Sr. Dy. Manager (Marine Engg.)
		Hire additional crafts as necessary.	

S5: Scenario 5
Part A

1. **Corrosive Acid - Leakage (Phosphoric acid) at BPCL Liquid Cargo Jetty during operation – on Ship or Ashore.**

2. **Precautions:** MSDS, SOP of terminal and berthing and un-berthing procedures.

3. **Impact Zone:** Respective Jetty.

4. **Resources required:** Organizational setup enumerated in Figure S5.2 and major material and equipment resources as given in **Appendix B**.

Figure S5.1: Action Flow Chart

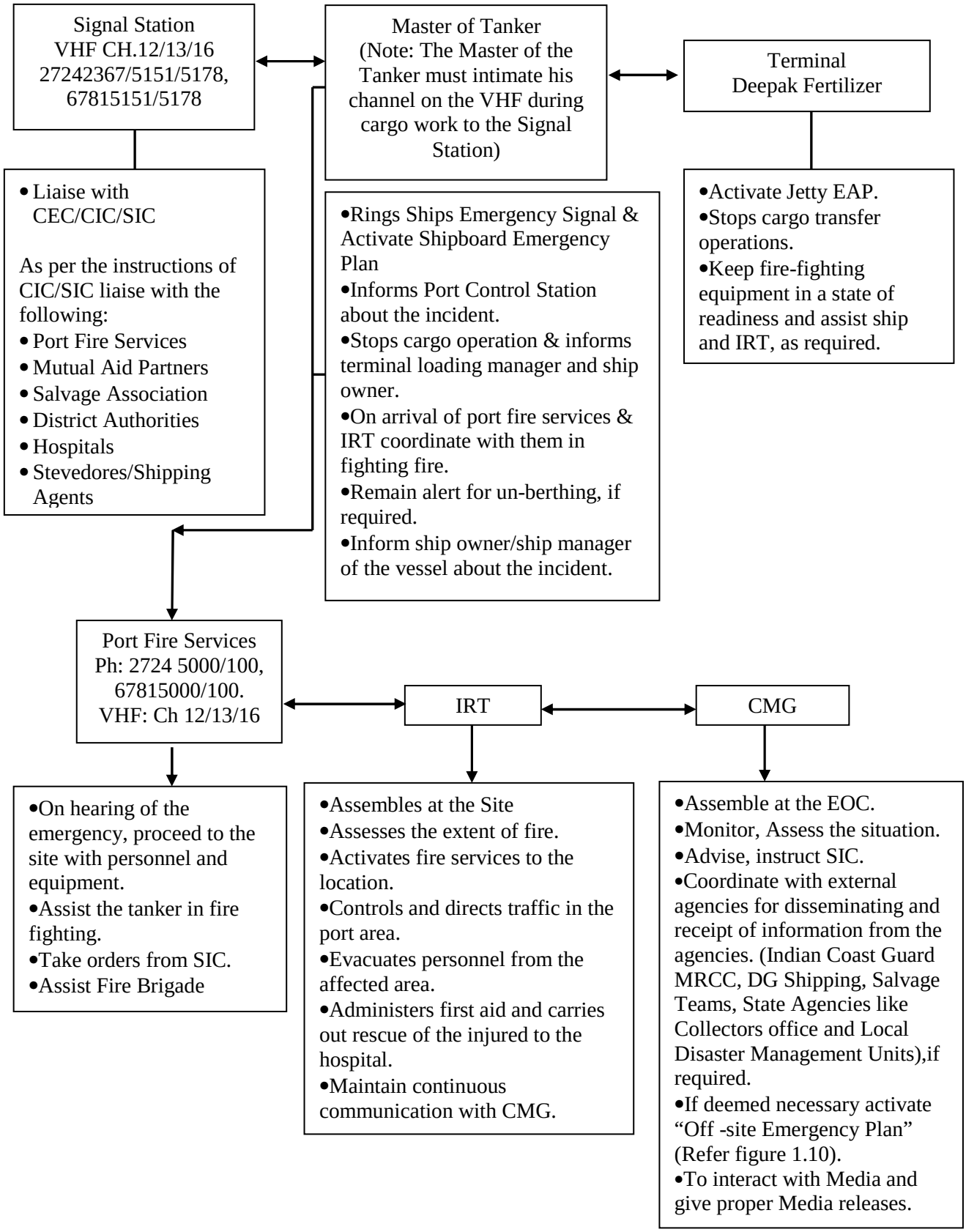
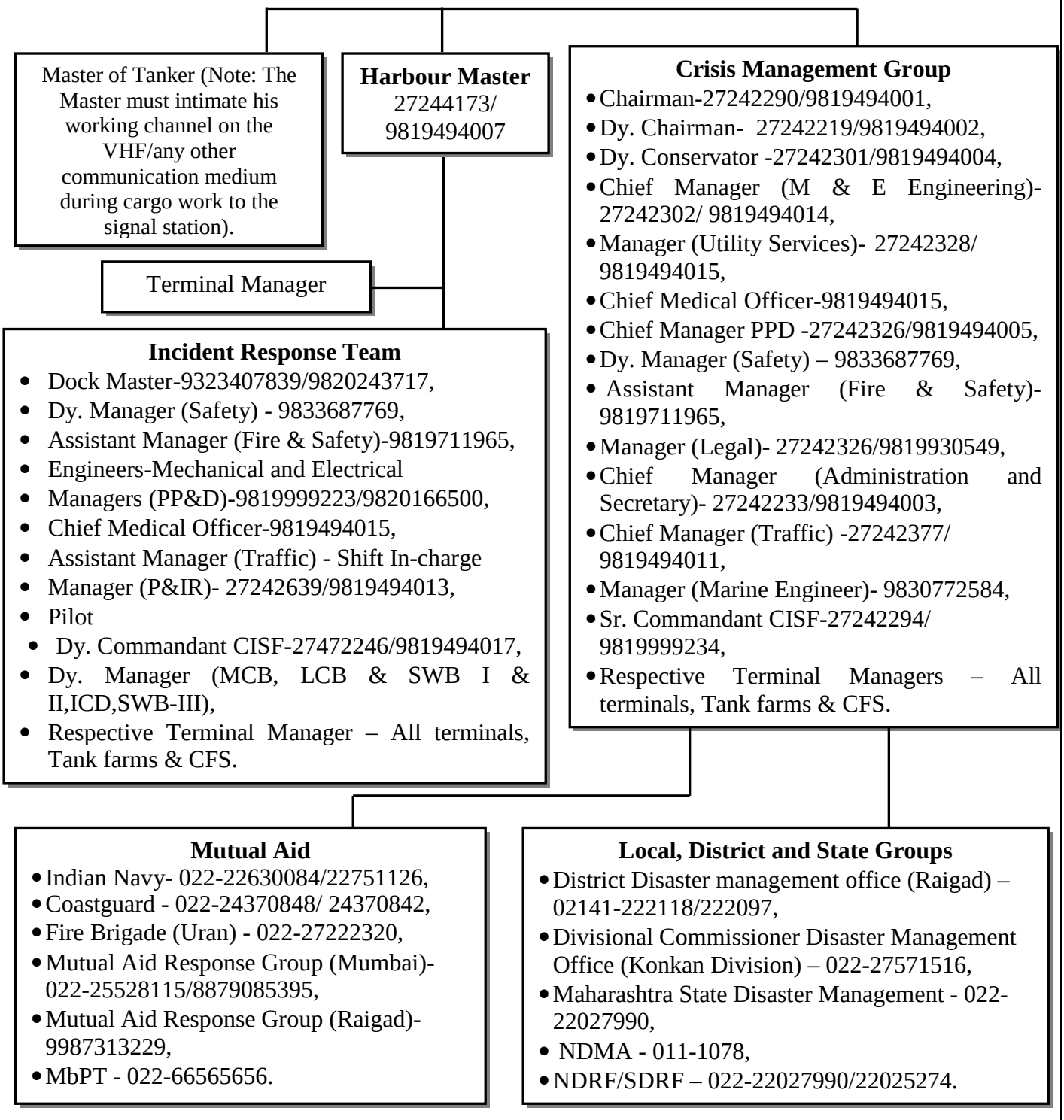


Figure S5.2: Action group



Part B: Action Plan

The vessel upon berthing terminal will follow standard procedures. However, in a less likely scenario a leak from the pipeline system may occur at the jetty leading to detection by vessel personnel or by the terminal alarm system. The following action will be required.

1. The Master of the Ship (Alternate: Chief Officer)

Response Action	Contact
a. Should raise ships emergency alarm and activate ship board emergency action plan.	
b. Stop transfer operation (as per SOP of the ship).	
c. Terminal, Vessel in the vicinity and Port should be informed of any incident on the ship without delay.	• Terminal • Vessel in the vicinity • Port Control Station
d. Personnel to remain stand by to disconnect hoses;	
e. Shall be responsible to arrest the leak with ships own resources as well as with the available support from IRT.	
f. Also, to remain prepared to un-berth the ship to the safe area (high sea).	
g. The siren should be continued till the ship is taken to a safe location as per CIC instructions.	

2. The terminal persons tasked with cargo operations at the Jetty should

Response Action	Contact
a. Activate Jetty EAP (prepared by the terminal) and inform JNPT.	• Port Control Station
b. Shut off isolation valve on pipeline at the berth (action as per SOP of the terminal).	
c. Area should be cordoned off.	
d. Assist IRT and provide all necessary equipment.	
e. Responsible for diluting and neutralizing the acids and disposal of the neutralized liquids down the drain.	
f. He will direct operation staff. Coordinate with the ship in-charge/C&F agents/stevedores.	

3. Deputy Conservator (Alternate: Harbour Master)

Response Action	Contact
a. Assess the level of disaster and activate the DMP.	
b. Establish EOC and be stationed to review & assess possible developments to determine the most necessary course of action.	
c. Give necessary instructions to SIC and Port Control	• SIC

Station & arrange for external aid as necessary.	• Port Control Station
d. Review the situation and accordingly inform to the Chairman/ Dy. Chairman.	• Chairman • Dy. Chairman
e. Decide on clearing of ships in close proximity to the incident location or to sail the tanker to the higher seas and evacuating the people from the likely affected zone.	
f. Assess the condition of site and take decision on evacuation in consultation with SIC.	• SIC
g. Be in constant touch with District and Local Administration for rescue and relief operation.	
h. Terminate the response and debrief before allowing normal operation.	

4. The Port Control Station

Response Action	Contact
a. Gather information related to the vessel type, cargo quantity and position.	
b. Gather information related to the weather conditions. Monitor the wind directions and accordingly convey the message to Master of the vessel, SIC and F& SO.	• Master of the vessel • SIC • F& SO
c. Liaise with Master of the Vessel/Pilot.	• Master of the Vessel • Pilot
d. Listening watch to be maintained on VHF channel-16 and walkie-talkie channel-12.	
e. Notify to CIC, SIC and the vessels moving into, through and inside the port. Keep CIC/SIC informed of all the messages received by telephone, VHF sets or by messenger.	• CIC • SIC
f. Notify the other Authorities and stakeholders within Port as per instructions of CIC/SIC.	• Navy • Coastguard • Stakeholders
g. Notify the information to the owner of the vessel as per the instruction of CIC/SIC/ Master of the Vessel.	

5. Duties of IRT

Designated Officer	Role	Duties	Alternate Officer
Harbour Master	Site Incident Controller	During Emergency shall proceed to the scene & communicate & collect all information from the Master of the Tanker, Berth Manager and Terminal Manager.	Dock Master
		Conduct initial Briefing.	
		Report the situation to the CIC/CMG and assist CIC in assessing the incident.	
		Initiate DMP.	
		Assess the condition of site and take decision on evacuation in consultation with CIC.	
		Alert vessels within the vicinity.	
		Extend all necessary help to the Master of the ship.	
		Instruct the Asst. Manager (Fire and Safety) to keep the fixed fire fighting installation in a state of readiness & activate if required.	
		Instruct Dock Master/ Marine Engineer(s) to keep tugs ready for fire fighting.	
		Coordinate with all functional heads to take actions.	
Dock Master	Port Control Room Coordinator	Shall monitor the communication on VHF/any other communication medium & convey and relay messages on the advice from CIC /SIC.	Duty Supervisor
		Responsible for organizing tugs for rescue.	
		Hire additional crafts as necessary.	
		Maintain Log of events.	
Master of the tanker	In Charge of fire fighting operation on board vessel	Coordinate with action group leader and will be responsible for shutting down all cargo operation on board in coordination with terminal In Charge.	Chief Officer of Tanker
		Shall unberth the vessel as per the instruction of SIC, if required.	
Terminal	Cargo Work	Shall be responsible of shutting	

Managers- BPCL and Deepak Fertilizer		down of cargo operation & coordinating with JNPT and rendering necessary assistance to the SIC by providing additional emergency equipment as required.	Assistant Terminal Manager
Asst. Manager (Fire and Safety)	Fire Coordinator	Shall take orders from the SIC. Lead the fire fighting team and mobilize fire tenders, men & fire-fighting equipment to the scene & extend all necessary support to the Master of the vessel/Terminal Manager/Berth Manager. Inform SIC for arrangement of any additional equipment as required.	Station Officer
Dy. Manager (Safety)	Marine Pollution Control Coordinator	Shall take orders from the SIC. Assist in evacuation of the personnel to the assembly point or as directed by SIC. Conduct clean- up work during and after the emergency as quick as possible.	Safety Inspector
Sr. Commandant- CISF	Security and Evacuation	Shall take orders from the SIC. Cordon off the area. Controls & Directs gate security and traffic in the area. Shall facilitate evacuation, transport, first aid and rescue of personnel from the scene at the time of emergency. Control the entry of unauthorized persons and vehicles. Check for entry of emergency vehicles Liaise with the State Police. Responsible the head count of the personnel.	Dy. Commandant- CISF
Chief Manager (Traffic)	Traffic Coordinator	Shall take orders from SIC and assist Manager SWB. Regulate the traffic in the area.	Asst. Manager (Traffic)
Chief Manager (Port, Planning and Development)	Civil Coordinator	Inform MPCB and other environmental agencies and take necessary guidance. Shall mobilize and dispatch sufficient number of vehicles to the site of emergency.	Manager (I, II)

		Shall be responsible to carry out urgent civil works as required.	
Chief Manager (Mechanical &Electrical)	In charge of Electrical Installation	Shall be responsible for uninterrupted electrical supply to vital equipment and utility at the berth. Shall remain alert on duty for any electrical isolation of equipment during emergency.	Asst. Engineer
Sr. Dy. Chief Medical Officer	Medical Coordinator	Shall be responsible to organize and keep first aid team with ambulance & necessary medicines to attend to any injured person at the site of the accident. Shall coordinate with the local hospitals.	Alternate Officer
Duty Pilot	In Charge of Pilotage	Shall be ready on site for taking the ship out of berth and be ready for providing any assistance on site.	Standby Pilot
Manager (Marine Engg.)	ME Coordinator	Responsible for organizing tugs for rescue. Hire additional crafts as necessary.	Sr. Dy. Manager (Marine Engg.)

S6: Scenario 6
Part A:

1. **Fire /Explosion at Shallow Water Berth (SWB) during handling of Chemicals – on Ship or Ashore.**

2. **Precautions:** MSDS, SOP of terminal and berthing and un-berthing procedure.

3. **Impact Zone:** Refer **Appendix E** and Risk Assessment report.
   Consequence analysis indicates that the MTBE leak from pipeline would cover approx. 500 meters for Vapor cloud explosion (VCE) scenario.

4. **Resources required:** Organizational setup enumerated in Figure S6.2 and major material and equipment resources as given in **Appendix B**.

Figure S6.1: Action Flow Chart

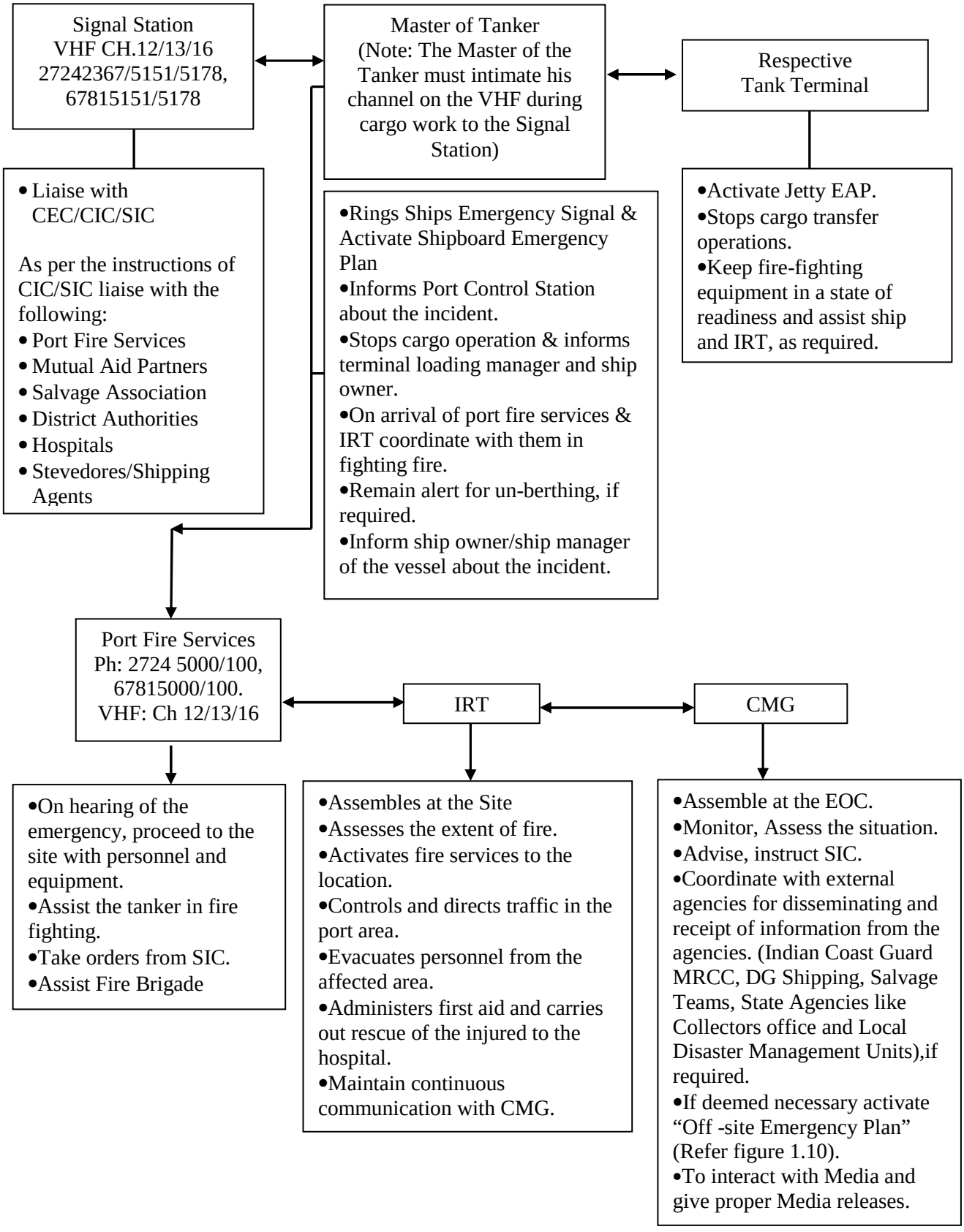
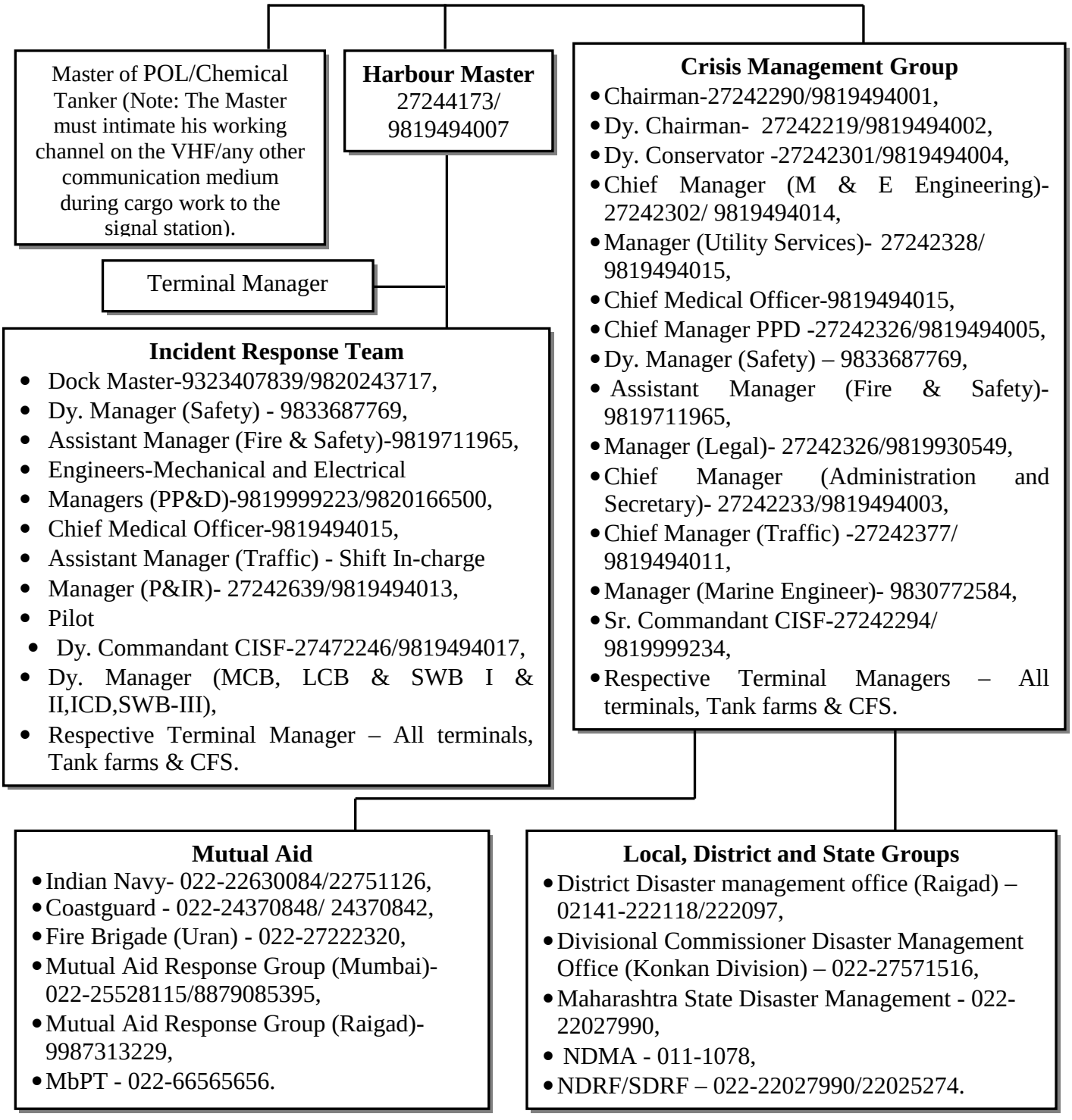


Figure S6.2: Action group



Part B: Action Plan

The vessel upon berthing terminal will follow standard procedures. However, in a less likely scenario a leak from the pipeline system may occur at the jetty leading to self-detection by vessel personnel or by the terminal automatic alarm system. Further in a more unlikely situation due to a possible ignition the leakage might catch fire and leading to explosion. The following action will be required

1. The Master of the Ship (Alternate: Chief Officer)

Response Action	Contact
a. Should raise ships emergency alarm and activate ship board emergency action plan.	
b. Stop Chemical transfer operation (as per SOP of the ship).	
c. Terminal, Vessel in the vicinity and Port should be informed of any incident on the ship without delay.	• Terminal • Port Control Station
d. Personnel to remain stand by to disconnect hoses.	
e. Shall be responsible for fighting the fire with ships own resources as well as with the available support from IRT.	
f. Also, to remain prepared to un-berth the ship to the safe area (high sea).	
g. The siren should be continued till the ship is taken to a safe location as per CIC instructions.	

2. The terminal persons tasked with Chemical cargo operations at the Jetty should

Response Action	Contact
a. Activate Jetty EAP (prepared by the terminal) and inform JNPT.	Port Control Station
b. Shut off isolation valve on Chemical pipeline at the berth (action as per SOP of the terminal).	
c. Area should be cordoned off.	
d. Pour foam/dry chemical powder on Chemical spillage to reduce rate of vaporization.	
e. Assist IRT and provide all necessary equipment.	
f. He will direct operation staff. g. Coordinate with the ship in-charge/C&F agents/stevedores.	

3. Deputy Conservator (Alternate: Harbour Master)

Response Action	Contact
a. Assess the level of disaster and activate the DMP.	
b. Establish EOC and be stationed to review & assess possible developments to determine the most necessary course of action.	

c. Give necessary instructions to SIC and Port Control Station & arrange for external aid as necessary.	• SIC • Port Control Station
d. Review the situation and accordingly inform to the Chairman/ Dy. Chairman.	• Chairman • Dy. Chairman
e. Assess the condition of site and of potential affected area and take decision on evacuation in consultation with SIC.	• SIC
f. Be in constant touch with District and Local Administration for rescue and relief operation.	
g. Terminate the response and debrief before allowing normal operation.	

4. The Port Control Station

Response Action	Contact
a. Gather information related to the weather conditions. Monitor the wind directions and accordingly convey the message to CIC/SIC and F& SO.	• CIC • SIC • F&SO
b. Liaise with Master of the Vessel/Pilot.	• Master of the Vessel • Pilot
c. Listening watch to be maintained on VHF channel-16 and walkie-talkie channel-12.	
d. Notify to CIC, SIC and the vessels moving into, through and inside the port. Keep CIC/SIC informed of all the messages received by telephone, VHF sets or by messenger.	• CIC • SIC
e. Notify the other Authorities and stakeholders within Port as per instructions of CIC/SIC.	• Navy • Coastguard • Stakeholders
f. Notify the information to the owner of the vessel as per the instruction of CIC/SIC/ Master of the Vessel.	

5. The Fire-fighting personnel should

Response Action	Contact
a. Raise Alarm (siren)	
b. Start the pumps as per the requirement	
c. Use water sprays and portable nozzles to maintain curtain.	
d. Open the valves of the monitors and direct the jet on the seat of fire.	
e. Inform fire officers to arrange for fire-fighting tug and Marine Engineer to arrange for tugs , as required.	• F&SO • Marine Engineer
f. In case of fire onboard assist Master in fighting fire as per Masters Instructions.	

g. Ensure all the ignition sources in the vicinity are extinguished if fire has not occurred.	
h. If the fire is under control and extinguished, give all clear signal.	

6. Duties of IRT

Designated Officer	Role	Duties	Alternate Officer
Harbour Master	Site Incident Controller	During Emergency shall proceed to the scene & communicate & collect all information from the Master of the Tanker, Berth Manager and Terminal Manager.	Dock Master
		Conduct initial Briefing.	
		He will report the situation to the CIC/CMG and assist CIC in assessing the incident.	
		Initiate DMP.	
		Alert vessels within the vicinity.	
		Assess the condition of site and take decision on evacuation in consultation with CIC.	
		Extend all necessary help to the Master of the ship to fight the fire.	
		Instruct the Asst. Manager (Fire and Safety) to keep the fixed fire fighting installation in a state of readiness & activate if required.	
		Instruct Dock Master/ Marine Engineer(s) to keep tugs ready for fire fighting.	
		Coordinate with all functional heads to take actions.	
Dock Master	Port Control Room Coordinator	Shall monitor the communication on VHF/any other communication medium & convey and relay messages on the advice from CIC /SIC.	Duty Supervisor
		Responsible for organizing tugs for rescue.	
		Hire additional crafts as necessary.	
		Maintain Log of events.	
Tank Terminal Manager	Cargo Work	Shall be responsible of shutting down of cargo operation & coordinating with JNPT and	Assistant Terminal

		rendering necessary assistance to the SIC by providing additional fire fighting & emergency equipment as required.	Manager
Asst. Manager (Fire and Safety)	Fire Coordinator	Shall take orders from the SIC.	Station Officer
		Lead the fire fighting team and mobilize fire tenders, men & fire-fighting equipment to the scene & extend all necessary support to the Master of the vessel/Terminal Manager/Berth Manager for fire fighting.	
		Inform SIC for arrangement of any additional equipment as required.	
Dy. Manager (Safety)	Marine Pollution Control Coordinator	Shall take orders from the SIC. Ensure responsible actions for containing the run off fire water and other water from the damaged units.	Safety Inspector
		Assist in evacuation of the personnel to the assembly point or as directed by SIC.	
		Conduct clean- up work during and after the emergency as quick as possible.	
Sr. Commandant-CISF	Security and Evacuation	Shall take orders from the SIC.	Dy. Commandant-CISF
		Cordon off the area.	
		Controls & Directs gate security and traffic in the area.	
		Shall facilitate evacuation, transport, first aid and rescue of personnel from the scene at the time of emergency.	
		Control the entry of unauthorized persons and vehicles.	
		Check for entry of emergency vehicles.	
		Liaise with the Police authorities.	
		Responsible the head count of the personnel.	
Chief Manager (Traffic)	Traffic Coordinator	Shall take orders from SIC and assist Manager LCB.	Asst. Manager (Traffic)

		Submits consolidated list of dangerous goods in port including tankers in port and tank farms in port area.	
		Regulate the traffic in the area.	
Chief Manager (Port, Planning and Development)	Civil Coordinator	Inform MPCB and other environmental agencies and take necessary guidance.	Manager (I, II)
		Shall mobilize and dispatch sufficient number of vehicles to the site of emergency.	
		Shall be responsible to carry out urgent civil works as required.	
Chief Manager (Mechanical & Electrical)	In charge of Electrical Installation	Shall be responsible for uninterrupted electrical supply to vital equipment and utility at the berth.	Asst. Engineer
		Shall remain alert on duty for any electrical isolation of equipment during emergency.	
Sr. Dy. Chief Medical Officer	Medical Coordinator	Shall be responsible to organize and keep first aid team with ambulance & necessary medicines to attend to any injured person at the site of the accident.	Alternate Officer
		Shall coordinate with the local hospitals.	
Duty Pilot	In Charge of Pilotage	Shall be ready on site for taking the ship out of berth and be ready for providing any assistance on site.	Standby Pilot
Manager (Marine Engg.)	ME Coordinator	Responsible for organizing tugs for combating the fire and rescue.	Sr. Dy. Manager (Marine Engg.)
		Hire additional crafts as necessary.	

S7: Scenario 7
Part A

1. **Damage due to Crane Accidents (Container drop/crane fall) at Container Terminal- NSICT, NSIGT, JNPCT, GTI-APM, BMCT.**

2. **Precautions:** Trained personnel for operation of crane, SOP of the terminal.

3. **Impact Zone:** Surrounding area.

4. **Resources required:** Organizational setup enumerated in Figure S7.2 and major material and equipment resources as given in **Appendix B**.

Figure S7.1: Action Flow Chart

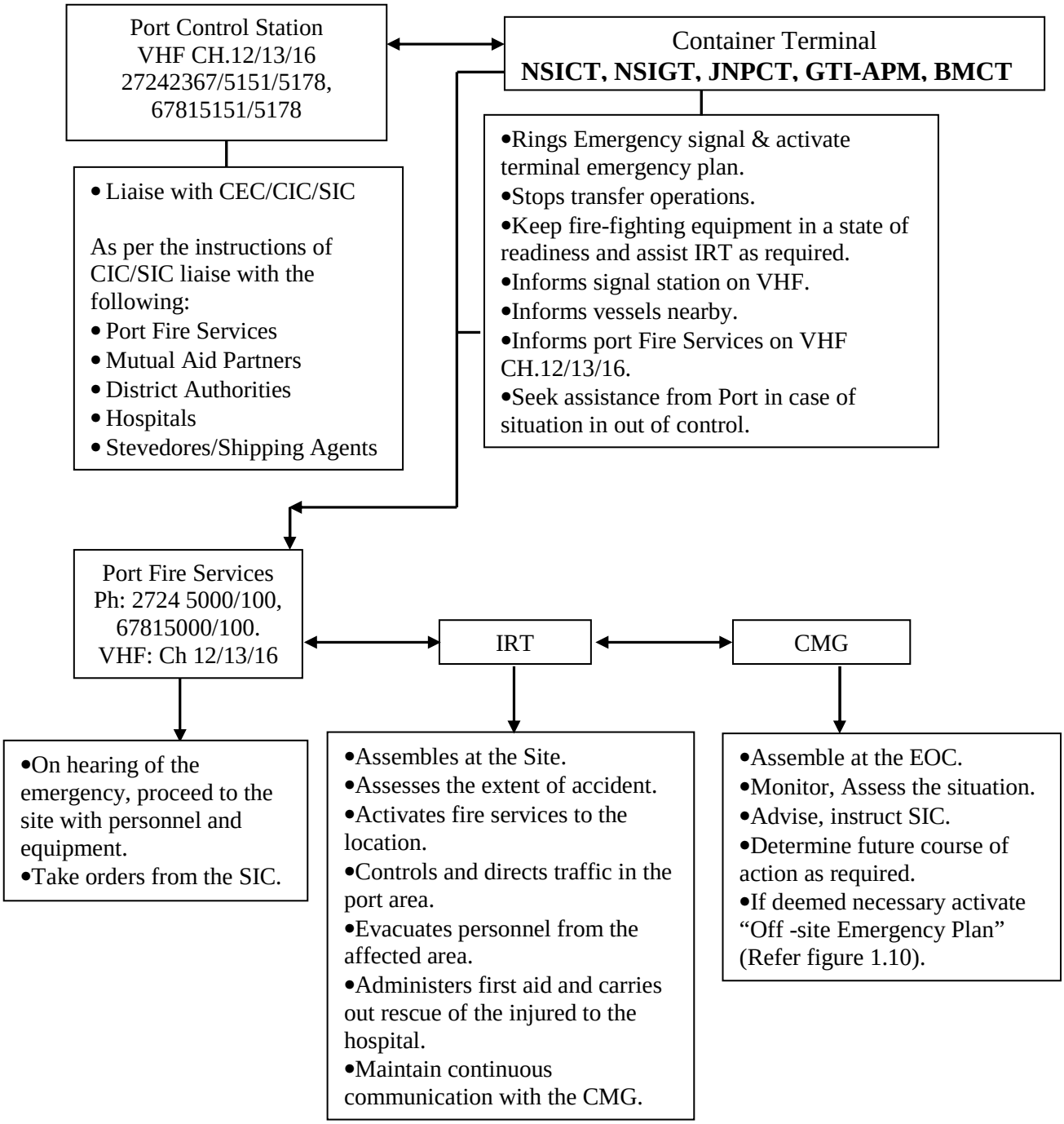
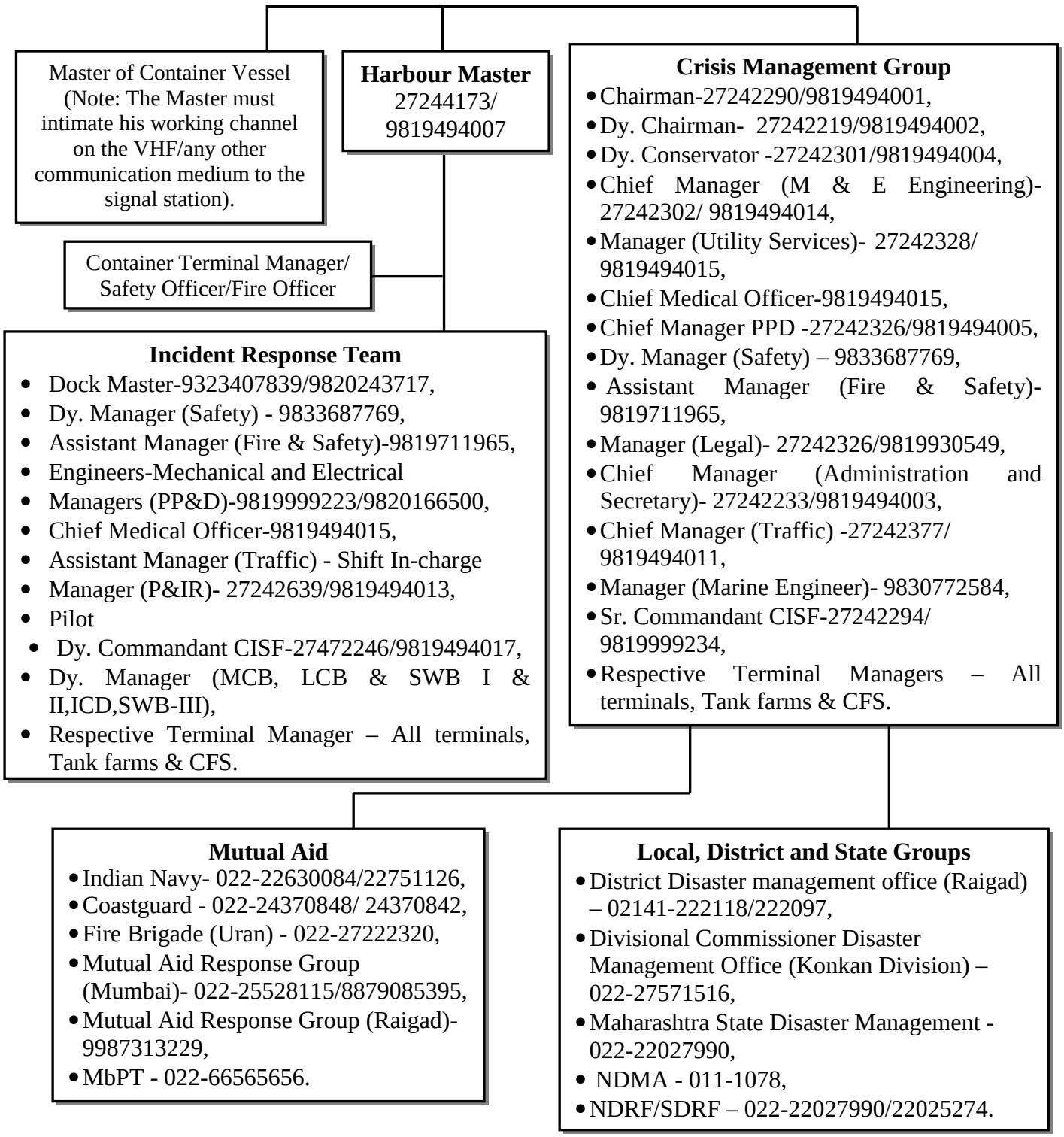


Figure S7.2: Action group



Part B: Action Plan

1. The crane operator

a. Should raise emergency alarm and inform Terminal Manager and Port Control Station.

2. The terminal person at the Jetty should

Response Action	Contact
a. Activate EAP (prepared by the terminal) and inform JNPT and ask for assistance.	• Port Control Station
b. Area should be cordoned off.	
c. Stop transfer operations at the berth.	
d. Manage Truck movements.	
e. Assist IRT and Master of the Ship and provide all necessary equipment.	
f. He will direct operation staff.	
g. Interview operator and witnesses.	
h. Survey and cost damage to port installation. Complete maritime accident report. Give press reports.	
i. Distribute final report to concerned authorities.	

3. Deputy Conservator (Alternate: Harbour Master)

Response Action	Contact
a. Will be stationed at the EOC to review & assess possible developments to determine the most necessary course of action.	
b. He will give necessary instructions to SIC & arrange for external aid as necessary.	
c. Provide assistance to the Terminal.	

4. The Port Control Station

Response Action	Contact
a. Gather information regarding the incident and accordingly convey the message to CIC/SIC and F& SO.	• CIC • SIC • F& SO
b. Liaise with Master of the Vessels/Pilot.	• Master of the Vessels • Pilot
c. Listening watch to be maintained on VHF channel-16 and walkie-talkie channel-12.	
d. Keep CIC/SIC informed of all the messages received by telephone, VHF sets or by messenger.	• CIC • SIC
e. Notify the other Authorities and stakeholders within Port as per instructions of CIC/SIC.	• Navy • Coastguard

	• Stakeholders

5. Duties of IRT

Designated Officer	Role	Duties	Alternate Officer
Harbour Master	Site Incident Controller	During Emergency shall proceed to the scene & communicate & collect all information from the crane operator/terminal manager.	Dock Master
		Assess and report the situation to the CIC/CMG (if required).	
		Alert vessels/trucks within the vicinity.	
		Instruct the Asst. Manager (Fire & Safety) to keep the fire fighting installation in a state of readiness & activate if required.	
Dock Master	Port Control Room Coordinator	Shall monitor the communication on VHF/any other communication medium & convey and relay messages on the advice from CIC/SIC.	Duty Supervisor
		Shall prepare vessels to vacate from berth (if required).	
		Responsible for organizing tugs for rescue. Instruct Pilot/Marine Engineers.	
		Hire additional crafts as necessary.	
		Maintain Log of events.	
Asst. Manager (Fire & Safety)	Fire Coordinator	Shall take orders from the SIC.	Station Officer
		Mobilize fire tenders, men & fire fighting equipments to the scene & extend all necessary support in case of fire.	
Dy. Manager (Safety)	Marine Pollution Control Coordinator	Investigate the incident and provide necessary guidance.	Safety Inspector
		Assist in Rescue.	
Sr. Commandant-CISF	Security Officer	Controls & Directs traffic in the area.	Dy. Commandant-CISF
		Shall supervise evacuation of personnel from the scene at the time of emergency.	

Chief Manager (PPD)	Civil Coordinator	Immobilizes faulty crane, informs manufacturer representative, port workshop superintendent / surveyor to inspect and investigate.	Manager (I, II)
Chief Manager (Mechanical & Electrical)	In-charge of Electrical Installation	Shall be responsible for Electrical supply to vital equipment and systems. Arrange additional alternative shore cranes-power supply, wire slings blocks, shackles etc.	Asst. Engineer
Sr. Dy. Chief Medical Officer	Medical Coordinator	Shall be responsible to organize and keep first aid team with ambulance & necessary medicines to attend to any injured person at the site of the accident.	Alternate Officer
Chief Manager (Traffic)	Traffic Coordinator	Shall mobilize and dispatch sufficient number of vehicles to the site of emergency. Coordinates with SIC and Terminal manager.	Asst. Manager (Traffic)
Duty Pilot	In-Charge of Pilotage	Shall be ready on site for providing any assistance.	Standby Pilot
Manager (Marine Engg.)	ME Coordinator	Responsible for organizing tugs for combating the fire and rescue. Assist Dock Master.	Sr. Dy. Manager (Marine Engg.)

S8: Scenario 8
Part A:

1. **Containers falling into water in case of extreme weather, vessel collision or grounding.**

2. **Precautions:** Navigational Aid, Designated Pilots, Continuous monitoring and communication with the Port Control Centre and Pilot. Depending on the level of incidents involving containers falling and their recovery will require a team of tugs and floating cranes apart from measures such as medical assistance to the stricken vessel. Offsite plan in terms of alerting the fishing vessels and normal shipping traffic, coast guard and Indian navy will have to be activated. Port will remain in touch with vessel and provide assistance within its jurisdiction. Near coastal villages and township authorities need to be alerted. The type of cargo hazardous/ non-hazardous is to be ascertained and communicated by the concerned vessel to the port. Temporary closure of navigation in vicinity of the incident may be required. Radars deployed for monitoring and reporting the floating containers by nearby vessels in port zone. Wreck marking incase of sink age of container will be required.

3. **Impact Zone:** Incident Location and vicinity of the coastline involved.

4. **Resources required:** Organizational setup enumerated in Figure S8.2 and major material and equipment resources as given in **Appendix B**.

Figure S8.1: Action Flow Chart

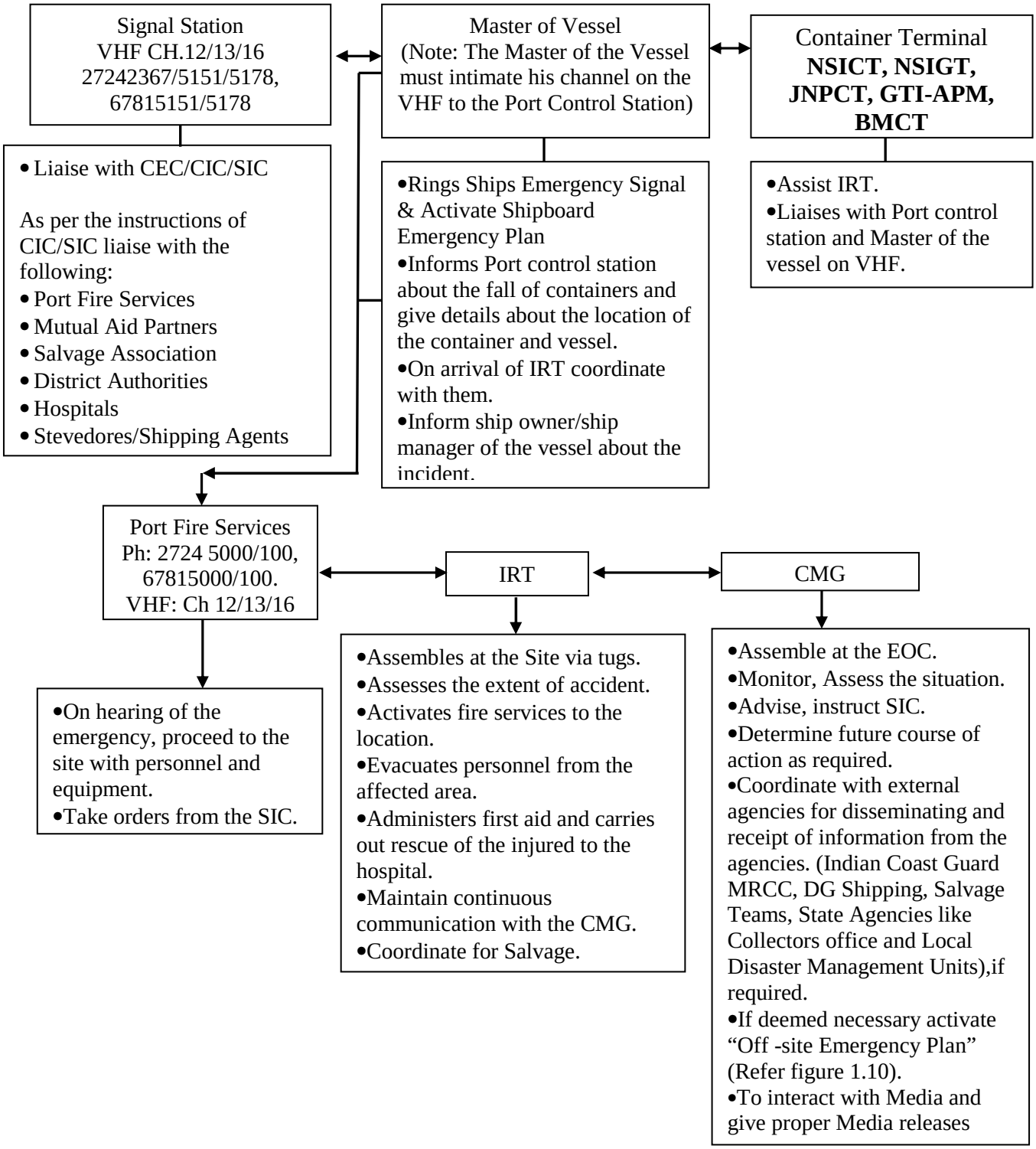
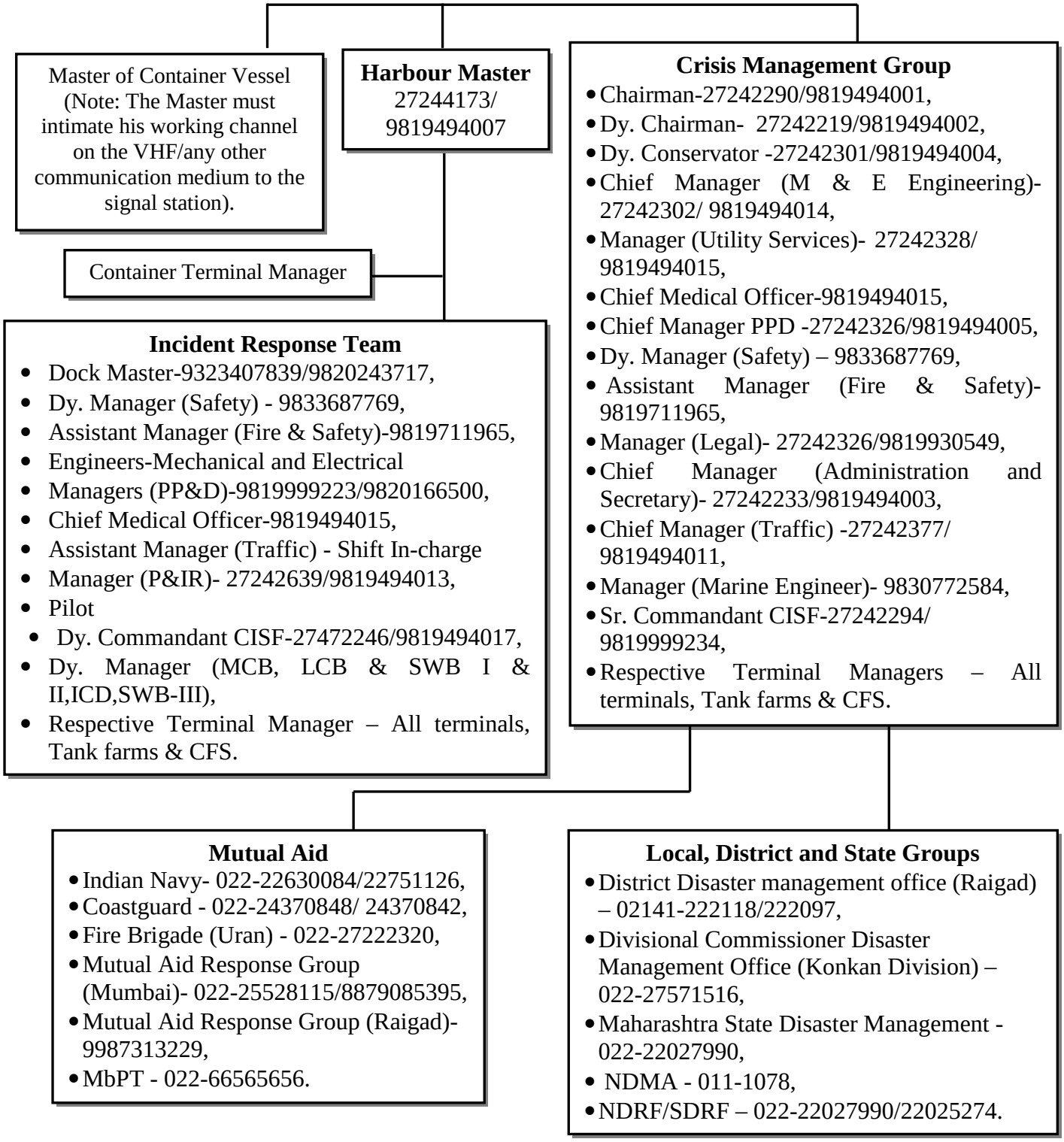


Figure S8.2: Action group



Part B: Action Plan

1. The Master of the Vessel (Alternate: Chief Officer)

Response Action	Contact
a. Should raise ships emergency alarm and activate ship board emergency action plan.	
b. Terminal, Vessel in the vicinity and Port should be informed of any incident on the ship without delay.	• Terminal • Vessel in the vicinity • Port Control Station
c. Details of the location and type of the container and vessel, type of cargo and quantity and time of incident should be given to the Port control station and the terminal.	
d. Inform ship owner/ship manager of the vessel about the incident.	

2. Port Control Station should

Response Action	Contact
a. Gather information related to the vessel position, container position and time of incident.	
b. Notify to CIC, SIC and the vessels moving into, through and near the casualty and inside the port.	• CIC • SIC • Navy • Coastguard • DG Shipping
c. Gather information about the weather and tide and notify CIC/SIC.	

3. Deputy Conservator (Alternate: Harbour Master)

Response Action	Contact
a. Assess the level of disaster and activate the DMP.	
b. Establish EOC and be stationed to review & assess possible developments to determine the most necessary course of action.	
c. Give necessary instructions to SIC and Port Control Station & arrange for external aid as necessary.	• SIC • Port Control Station
d. Review the situation and accordingly inform to the Chairman/ Dy. Chairman.	• Chairman • Dy. Chairman
e. Decide on clearing of ships in close proximity to the incident location.	
f. Be in constant touch with District and Local Administration for rescue and relief operation.	

g. Terminate the response and debrief before allowing normal operation.	

4. Duties of IRT

Designated Officer	Role	Duties	Alternate Officer
Harbour Master	Site Incident Controller	During Emergency shall proceed to the scene & communicate & collect all information from the crane operator/terminal manager.	Dock Master
		Assess and report the situation to the CIC/CMG (if required).	
		Initiate DMP.	
		Alert vessels within the vicinity.	
		Extend all necessary help to the Master of the vessel.	
		Instruct Dock Master/ Marine Engineers to keep tugs ready.	
		He will coordinate with all functional heads to take actions.	
Dock Master	Port Control Room Coordinator	Shall monitor the communication on VHF/any other communication medium & convey and relay messages on the advice from CIC/SIC.	Duty Supervisor
		Shall prepare vessels to vacate from berth (if required).	
		Responsible for organizing tugs, mooring boats and Pilots. Instruct Marine Engineers.	
		Hire additional crafts as necessary.	
		Assist SIC and maintain Log of events.	
Container Terminal Manager	Terminal Fire Coordinator	Provide assistance to port and vessel.	Assistant Officer
Dy. Manager (Safety)	Marine Pollution Control Coordinator	Investigate the incident and provide necessary guidance.	Safety Inspector
		Assist in Rescue.	
Sr. Commandant-	Security Officer	Controls & Directs traffic in the area.	Dy. Commandant-

CISF		Shall supervise evacuation of personnel from the scene at the time of emergency.	CISF
Chief Manager (PPD)	Civil Coordinator	Liaise with SIC.	Manager (I, II)
Chief Manager (Mechanical & Electrical)	In-charge of Electrical Installation	Arrange for specialized equipment if required as per the instruction of the SIC.	Asst. Engineer
Sr. Dy. Chief Medical Officer	Medical Coordinator	Shall be responsible to organize and keep first aid team with ambulance & necessary medicines to attend to any injured person at the site of the accident.	Alternate Officer
Chief Manager (Traffic)	Traffic Coordinator	Coordinates with Terminal manager. Shall mobilize and dispatch sufficient number of vehicles to the site of emergency.	Asst. Manager (Traffic)
Duty Pilot	In-Charge of Pilotage	Shall be ready on site for providing any assistance and be ready for providing any assistance on site.	Standby Pilot
Manager (Marine Engg.)	ME Coordinator	Responsible for organizing tugs for combating the fire and rescue. Assist Dock Master.	Sr. Dy. Manager (Marine Engg.)

S9: Scenario 9
Part A

1. **Fire in Engine room of Floating Craft**

2. **Precautions:** Crew trained for Fire Fighting, Periodic Maintenance and Inspection, House Keeping.

3. **Impact Zone:** Craft and immediate surroundings.

4. **Resources required:** Organizational setup enumerated in Figure S9.2 and major material and equipment resources as given in **Appendix B**.

Figure S9.1: Action Flow Chart

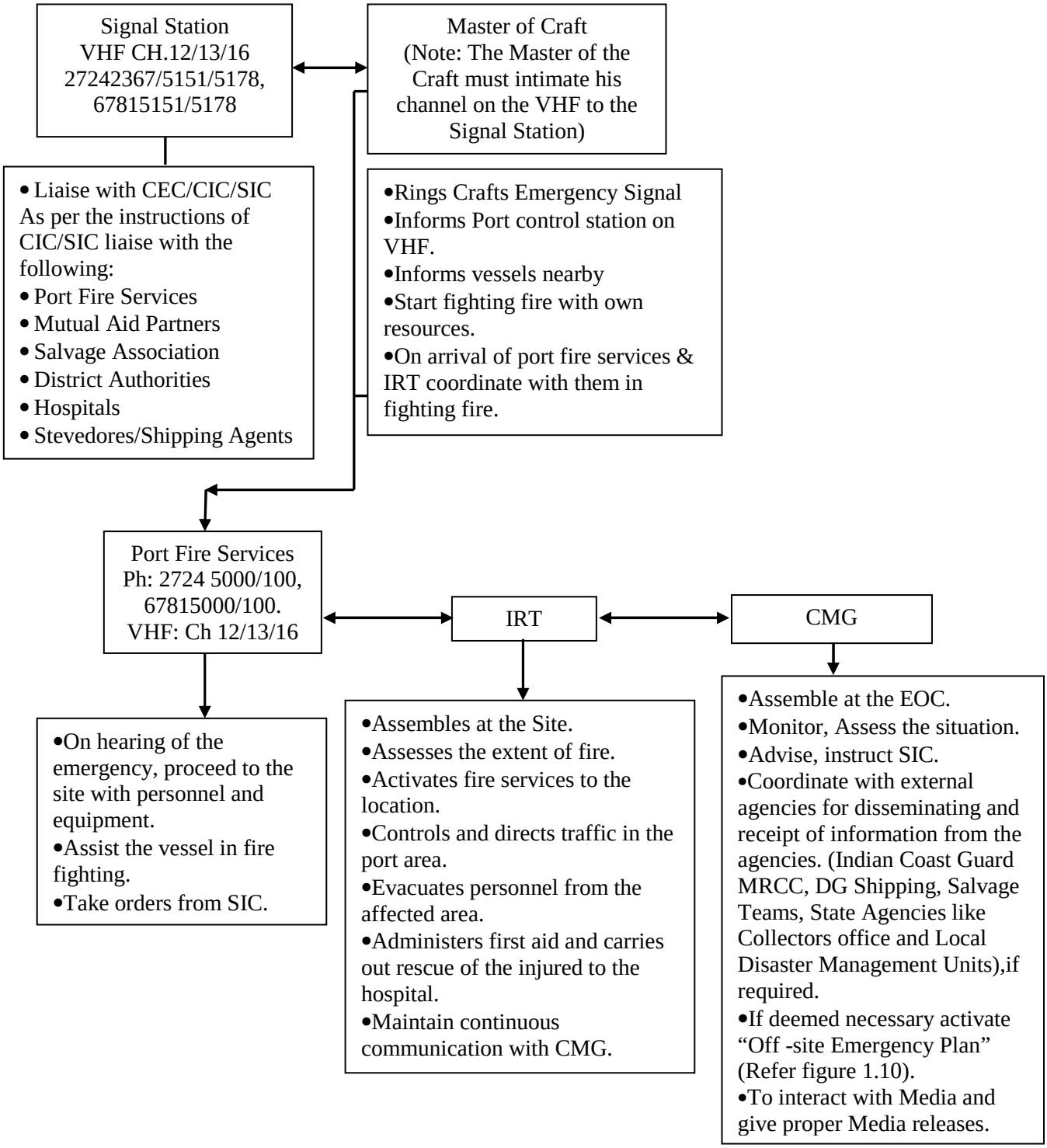
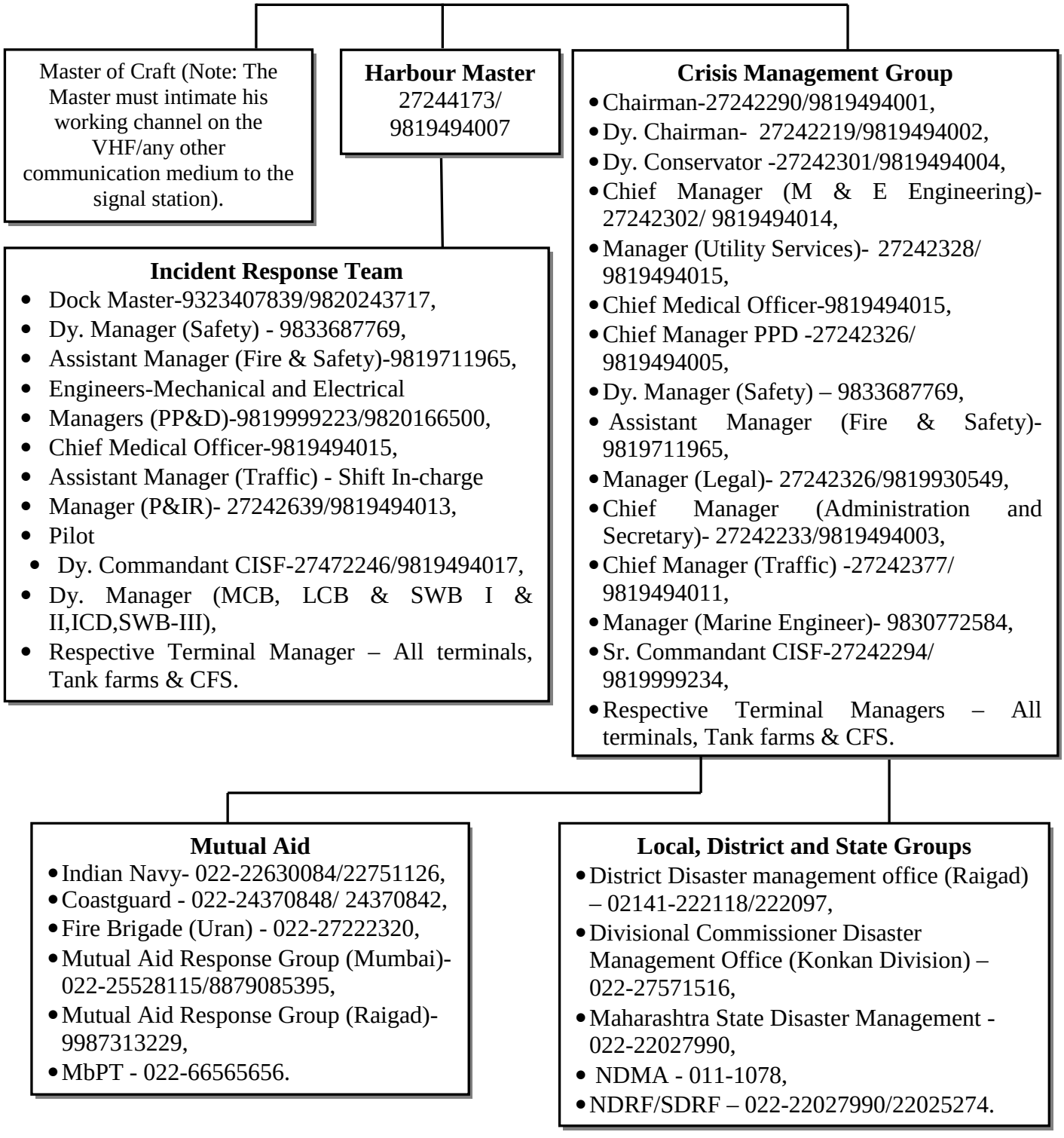


Figure S9.2: Action group



Part B: Action Plan

1. The Master of the Craft

Response Action	Contact
a. Should raise crafts emergency alarm and activate craft board emergency action plan.	
b. Vessel in the vicinity and Port should be informed of any incident on the craft without delay. Try to keep craft away from any vessel/craft in the vicinity.	• Vessel in the vicinity • Port Control Station
c. Shall be responsible for fighting the fire with craft own resources as well as with the available support from IRT.	

2. Port Control Station should

Response Action	Contact
a. Gather information related to the vessel position, and time of incident.	
b. Notify to CIC, SIC and the vessels moving into, through and near the casualty and inside the port.	• CIC • SIC • Navy • Coastguard • DG Shipping
c. Gather information about the weather and tide and notify CIC/SIC.	• CIC • SIC

3. Deputy Conservator (Alternate: Harbour Master)

Response Action	Contact
a. Assess the level of disaster and activate the DMP.	
b. Establish EOC and be stationed to review & assess possible developments to determine the most necessary course of action.	
c. Give necessary instructions to SIC and Port Control Station & arrange for external aid as necessary.	• SIC • Port Control Station
d. Review the situation and accordingly inform to the Chairman/ Dy. Chairman.	• Chairman • Dy. Chairman
e. Decide on clearing of ships in close proximity to the incident location.	
f. Be in constant touch with District and Local Administration for rescue and relief operation.	
g. Terminate the response and debrief before allowing normal operation.	

4. The Fire-fighting Personnel (F &ASO-I) should (Alternate: F &ASO-II)

Response Action	Contact
a. Collect the information from Port Control Station and SIC.	• SIC • Port Control Station
b. Assist Master in fighting fire as per Masters Instructions.	
c. He will mobilize fire fighting tugs, personnel & fire fighting equipments to the scene & extend all necessary support in case of fire, if required.	
d. Assist in evacuation of the personnel as directed by SIC.	
e. Inform SIC for arrangement of any additional equipment as required.	

5. Duties of IRT

Designated Officer	Role	Duties	Alternate Officer
Harbour Master	Site Incident Controller	During Emergency shall proceed to the scene & communicate & collect all information from the master of the craft.	Dock Master
		He will report the situation to the CIC/CMG.	
		Alert vessels/craft within the vicinity.	
		Extend all necessary support to the Master of the craft to fight the fire.	
		Instruct the Asst. manager (Fire and Safety) to keep the fire fighting installation and fire fighting tugs in a state of readiness & activate if required.	
Dock Master	Port Control Room Coordinator	Shall monitor the communication on VHF/any other communication medium & convey and relay messages on the advice from CIC/SIC.	Duty Supervisor
		Responsible for organizing tugs for rescue.	
		Hire additional crafts as necessary.	
		Assist SIC and maintain Log of events.	
Asst. Manager (Fire & Safety)	Fire Coordinator	Shall take orders from the SIC.	Station Officer
		Lead the fire fighting team and mobilize fire tenders, men & fire-fighting equipment to the scene &	

		extend all necessary support to the master of the craft for fire fighting.	
		Inform SIC for the arrangement of any additional equipment as required.	
Dy. Manager (Safety)	Marine Pollution Control Coordinator	Shall take orders for SIC.	Safety Inspector
		Ensure safely rescue of the Master of the craft.	
		Conduct cleanup work during and after the emergency as quick as possible.	
Sr. Commandant-CISF	Security and Evacuation	Controls & directs traffic in the area.	Dy. Commandant-t CISF
		Cordon off the area.	
		Shall supervise evacuation of personnel from the scene at the time of emergency.	
Chief Manager (PPD)	Civil Coordinator	Liaise with SIC.	Manager (I, II)
Chief Manager (Mechanical & Electrical)	In-charge of Electrical Installation	Shall be responsible for Electrical supply to vital equipment and systems at the berth.	Asst. Engineer
Sr. Dy. Chief Medical Officer	Medical Coordinator	Shall be responsible to organize and keep first aid team with ambulance & necessary medicines to attend to any injured person at the site of the accident.	Alternate Officer
Chief Manager (Traffic)	Traffic Coordinator	Shall prepare vessels (in the vicinity) to vacate from berth.	Asst. Manager (Traffic)
		Shall mobilize and dispatch sufficient number of vehicles to the site of emergency.	
		Coordinates with ship owners/agents/stevedores.	
Duty Pilot	In-Charge of Pilotage	Shall be ready on site for taking the ship out of berth, if required.	Standby Pilot
		Shall be ready for providing any assistance on site.	
Manager (Marine Engg.)	ME Coordinator	Responsible for organizing tugs for combating the fire and rescue.	Sr. Manager (Marine Engg.)
		Hire additional crafts as necessary.	

S10: Scenario 10
Part A
1. Ship Grounding/Collision within JNPT port limit.

2. **Precautions:** Navigational Aid, Designated Pilots, Continuous monitoring and communication with the Port Control Centre and Pilot.

3. **Impact Zone:** Navigational Channel and Anchorage area.

4. **Resources required:** Organizational setup enumerated in Figure S10.2 and major material and equipment resources as given in **Appendix B**.

Figure S10.1: Action Flow Chart

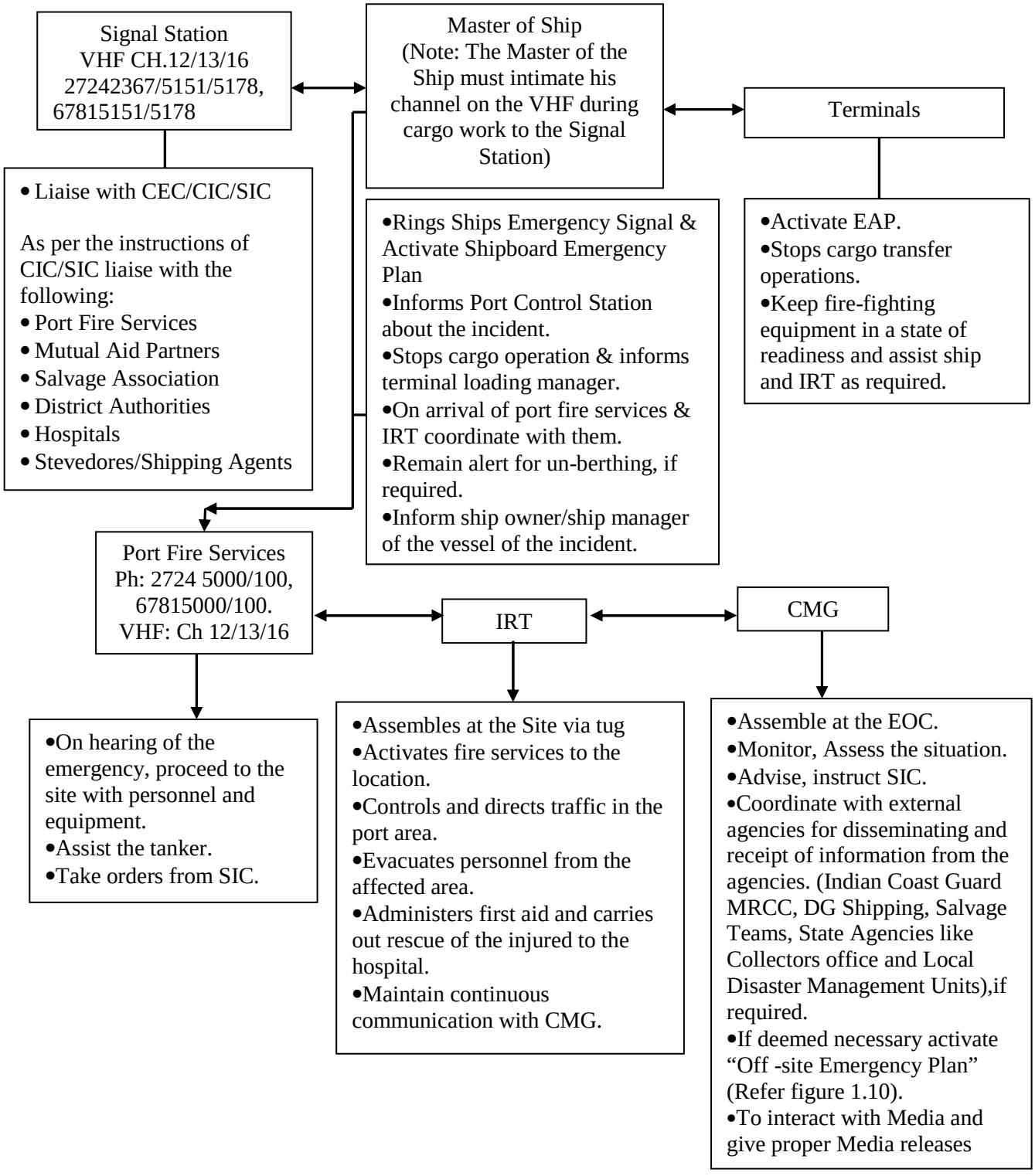
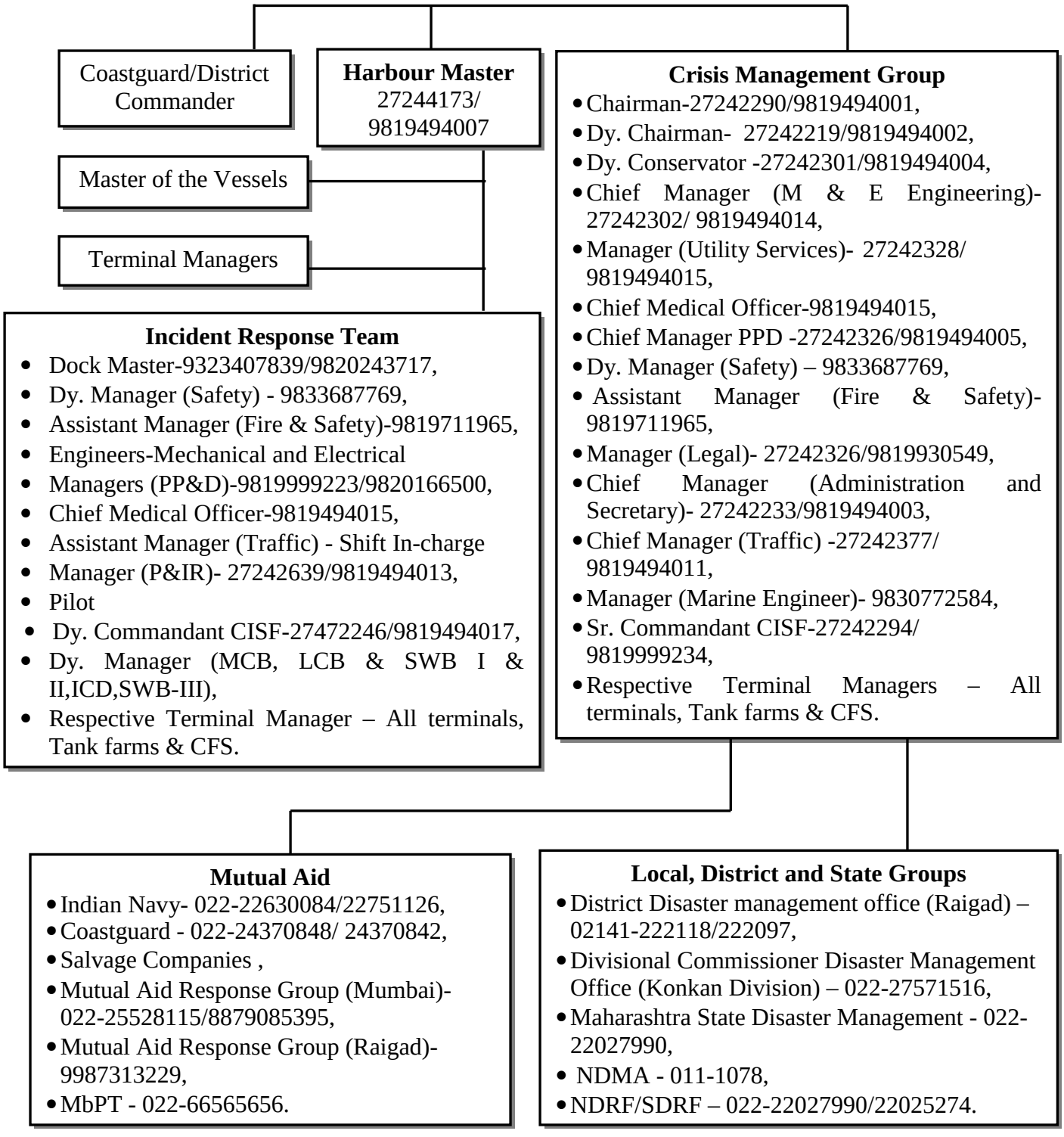


Figure S10.2: Action group



Part B: Action Plan

1. The Masters of the Vessels (Alternate: Chief Officers)

Response Action	Contact
a. Should raise ships emergency alarm and activate ship board emergency action plan including evacuation of the personnel.	
b. Vessel in the vicinity, Terminal and Port should be informed of any incident on the craft without delay.	• Terminal • Vessel in the vicinity • Port Control Station
c. Shut down transfer operation (if at berth).	
d. Take appropriate damage control measures in case of flooding including leak stoppage and pumping out, vessel list correction etc.	
e. Estimate the extent of under water damage, sounding of tanks and actions for the refloating of the vessel.	
f. Shall be responsible for fighting the fire (in case of fire) with vessels own resources as well as with the available support from IRT.	

2. The Port Control Station

Response Action	Contact
a. Liaise with Master of the Vessel/Pilot and gather the information about the type of vessels involved in the incident, cargo and location of the incident and convey the message to CIC/SIC.	• Master of the vessel • Pilot • CIC • SIC
b. Gather information related to the weather conditions. Monitor the wind directions and accordingly convey the message to CIC/SIC and F& SO.	• CIC • SIC • F&SO
c. Listening watch to be maintained on VHF channel-16 and walkie-talkie channel-12.	
d. Notify to CIC, SIC and the vessels moving into, through and inside the port. Keep CIC/SIC informed of all the messages received by telephone, VHF sets or by messenger.	• CIC • SIC
e. Notify the other Authorities and stakeholders within Port as per instructions of CIC/SIC.	• Indian Navy • Coastguard • Stakeholders
f. Notify the information to the owner of the vessel as per the instruction of CIC/SIC/ Master of the Vessel.	

3. Deputy Conservator (Alternate: Harbour Master)

Response Action	Contact
a. Assess the level of disaster and activate the DMP and OSCP.	
b. Establish EOC and be stationed to review & assess possible developments to determine the most necessary course of action.	
c. Give necessary instructions to SIC and Port Control Station & arrange for external aid as necessary.	• SIC • Port Control Station
d. Review the situation and accordingly inform to the Chairman/ Dy. Chairman.	• Chairman • Dy. Chairman
e. Decide on clearing of ships in close proximity to the incident location.	
f. Be in constant touch with District and Local Administration for rescue and relief operation.	
g. Terminate the response and debrief before allowing normal operation.	

4. Duties of IRT

Designated Officer	Role	Duties	Alternate Officer
Harbour Master	Site Incident Controller	During Emergency, he shall proceed to the affected location & communicate & collect all necessary information's from the Master of the ship.	Dock Master
		Report the situation to the CIC/CMG.	
		Activate Port DMP and OSCP.	
		In case of fire on board the vessel after collision or contact he will extend all necessary help to the Master of the ship.	
		Instruct Dock Master/ Marine Engineer(s) to keep tugs ready for fire-fighting.	
		Alert other vessels within the vicinity.	
		Ascertain oil pollution- leak source, if any.	
		Obtain information regarding stability and hull stress of the vessel.	

		If vessels have blocked or a possibility of blocking the channel, in co-ordination with the Master, the vessel shall be taken to berth / anchorage.	
		In case of grounding, make arrangements through Dock Master/ Marine Engineers/Pilots to proceed to the spot and to take soundings, plot them in a chart and to ascertain the location of grounding damage on the hull.	
		Depending on the way the vessel is grounded and the available high tide on the day, all advance preparations should be made to commence the towing operation at least two hours before the high water or as advised by CIC/SIC.	
		Inform MOEF and MPCB approved parties for safe disposal and providing reception facilities for Oil/Sludge. Also, inform Salvage association.	
Dock Master	Port Control Room Coordinator	Shall be ready for taking the instructions from CIC/SIC and evacuate/move/shift the vessel from the area.	Duty Supervisor
		If possible, accompany SIC to inspect the vessel.	
		Plot exact location of the incident.	
		Responsible for organizing tugs for rescue. Instruct Marine Engineers.	
		Hire additional crafts as necessary.	
Dy. Manager – Safety	Marine Pollution Control Coordinator	Supervise and direct personnel to follow the instructions given by SIC.	Safety Inspector
		Report to SIC and seek advice if in doubt.	
		Lead the response team and support personnel in combating the disaster by deploying booms and other equipments.	
		Coordinate with the party involved in disposal of the Oil/sludge in a	

		safe manner.	
		Liaise with the OSRO team and coordinate with the team in combating the disaster by taking necessary actions as per the OSCP.	
		Maintain records of the claims.	
Asst. Manager (Fire & Safety)	Fire Coordinator	Shall take orders from the SIC.	Station Officer
		Mobilize fire tenders, men & firefighting equipment to the scene & extend all necessary support to the master of the vessel for firefighting.	
		Coordinate with the party involved in disposal of the Oil/sludge in a safe manner.	
Sr. Dy. Chief Medical Officer	Medical Coordinator	Shall be responsible to organize and keep first-aid team with ambulance & necessary medicines to attend to any injured person.	Alternate Officer
Chief Manager (PP&D)	Civil Coordinator	Inform MPCB as per the instruction of CIC/SIC and other environmental agencies about the incident for getting necessary guidance.	Manager (I, II)
		Instruct the contractors to carry out urgent civil works as required.	
		Hire the barges for collecting the spilled oil and coordinate with the parties involved in the safe disposal of the oil/sludge.	
Chief Manager (Traffic)	Traffic Coordinator	Coordinates with ship owners/agents/stevedores.	Asst. Manager (Traffic)
		Regulate Traffic in the vicinity.	
Duty Pilot	In Charge of Pilotage	Shall monitor the communication on VHF & convey and relay messages on the advice from CIC/ SIC.	Standby Pilot
		He will maintain Log of events.	
Manager (Marine Engg.)	ME Coordinator	Responsible for organizing tugs for shifting the vessel to the anchorage area if required.	Sr. Dy. Manager (Marine Engg.)

S11: Scenario 11
Part A

1. **Blockage of Navigational Channel due to Grounding/sinking of vessel (Wreckage).**

Note: ***It is assumed in this case all actions to rescue safely the vessel in approach channel have not been successful and the vessel has touched bottom in the approach channel.***

2. **Precautions:** Navigational Aid, Designated Pilots, Continuous monitoring and communication with the Port Control Centre and Pilot.

3. **Impact Zone:** Navigational Channel.

4. **Resources required:** Organizational setup enumerated in Figure S11.2 and major material and equipment resources as given in **Appendix B**.

5. ***Note:*** *Under the Indian Ports Act, 1908, if a ship is wrecked, stranded or sunk within the port limits, the Conservator of the Ports or in the absence of such an office, the Harbour master may give notice to the owner of the vessel "to raise, remove or destroy the vessel within such period as may be specified in the notice and to furnish such adequate security to the satisfaction of the conservator to ensure that the vessel shall be raised, removed or destroyed within the said period". If the owner does not comply and act upon the notice, the conservator may raise, remove or destroy the property and claim the compensation from the owner. Mostly, the salvage activity will be done by private salvors in agreement with the Port Trust. Within the port limits, the capacity of the party to carry out salvage, the methods used to raise or remove or destroy the vessel is subjected to the expert opinion of the deputy conservator of the port. Normally, the court will not interfere with these technical decisions.*

Figure S17.1: Action Flow Chart

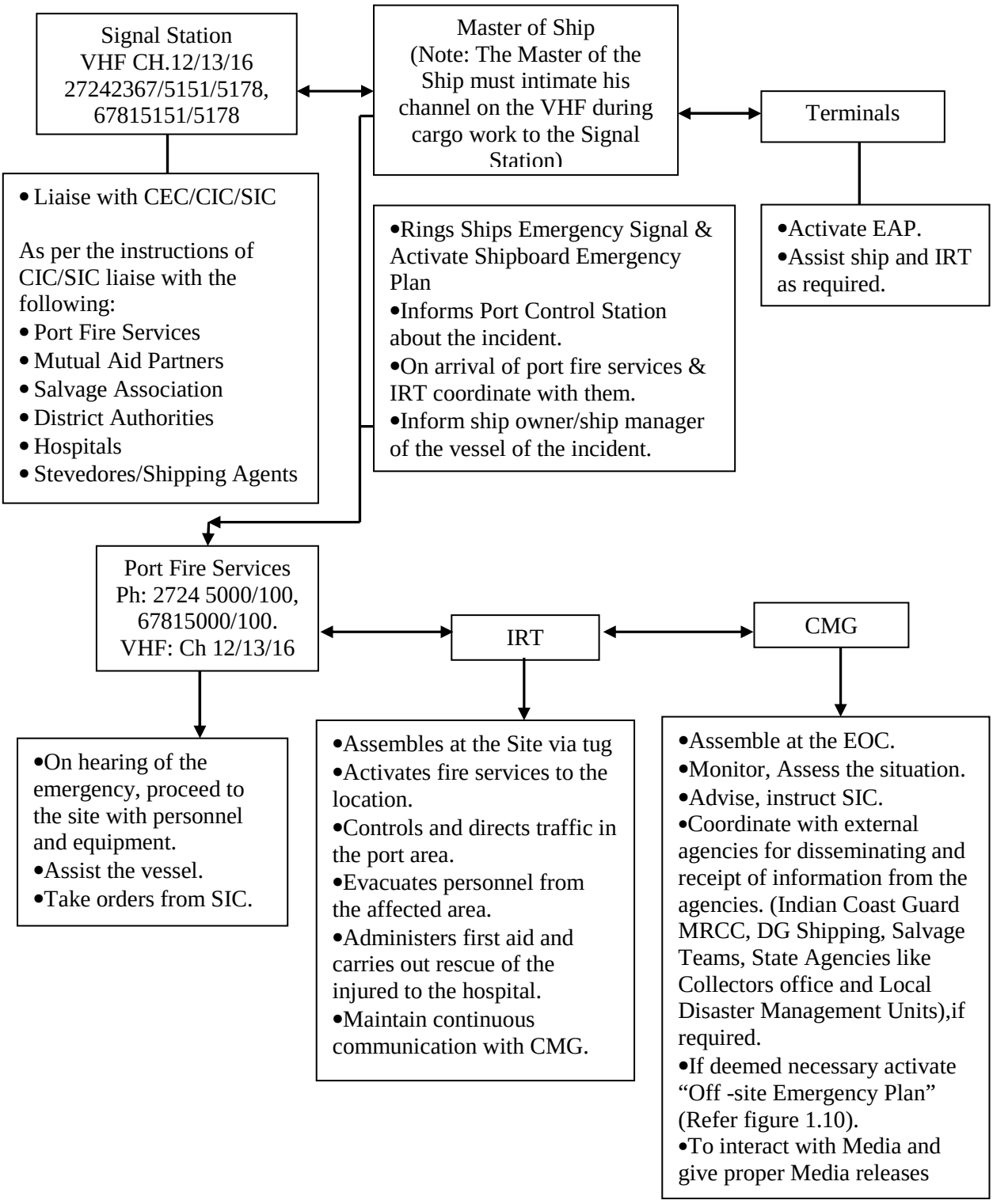
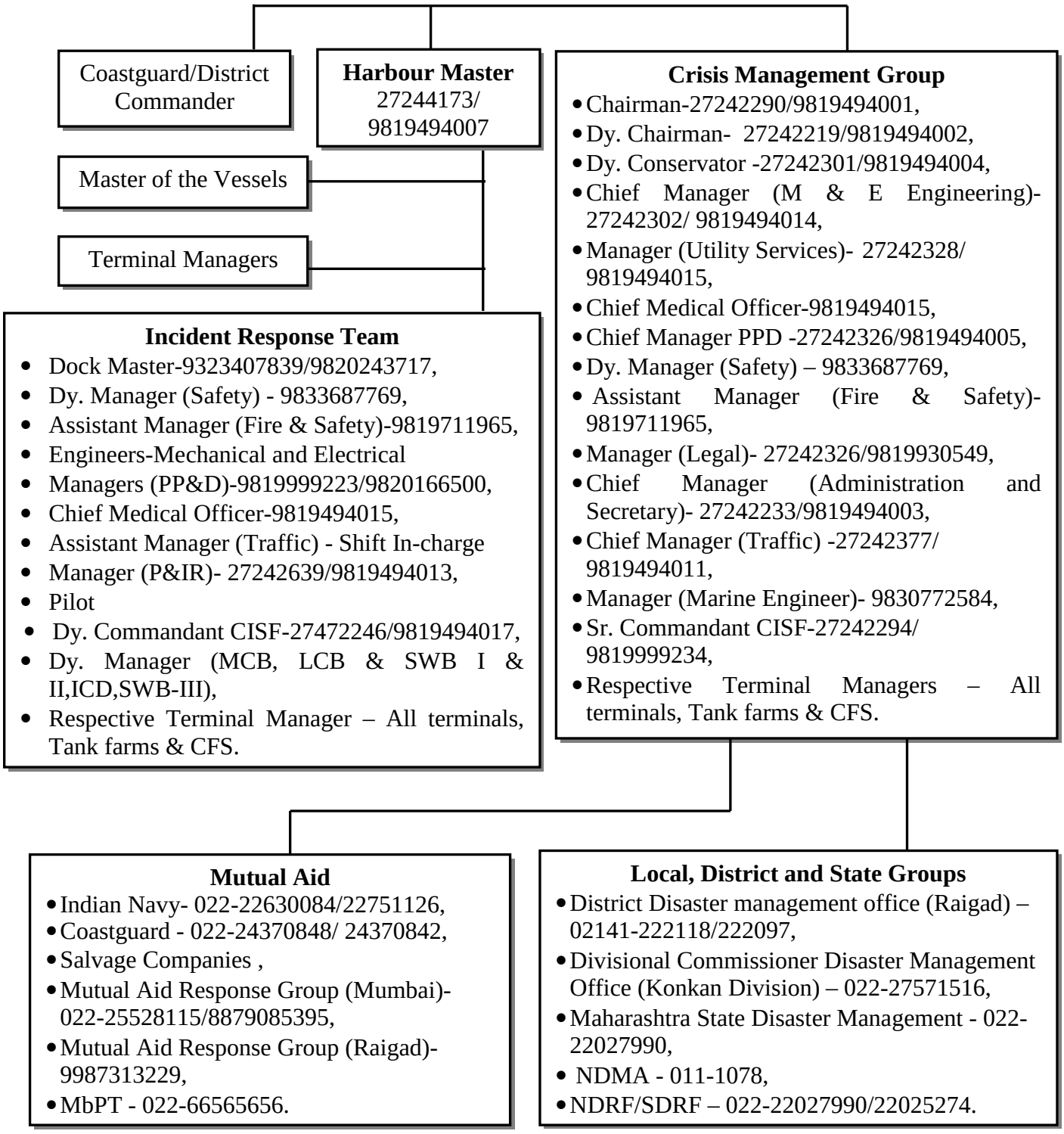


Figure S17.2: Action Group



Part B: Action Plan

1. The Master of the Vessel (Alternate: Chief Officer)

Response Action	Contact
a. Should raise ships emergency alarm and activate ship board emergency action plan.	
b. Terminal, Vessel in the vicinity and Port should be informed of any incident on the ship without delay.	• Terminal • Vessel in the vicinity • Port Control Station
c. Having raised the alarm, the Master will be responsible for taking all immediate steps to safeguard his ship. As soon as possible he is to establish the extent of grounding and damage to the vessel. He is to ascertain whether the hull has been breached and likely risk of pollution and flooding.	
d. The Master will provide the Port Authority with details of the incident as quickly as possible and will make regular and frequent reports on the progress of the incident. This is to include position of grounding, damage sustained, pollution or risk of pollution, draft of the vessel prior to grounding and soundings at grounding area, cargo on board and location, and any further information that may be at hand.	• Port Control Station

2. Port Control Station should

Response Action	Contact
a. Gather information related to the vessel type, position and time of incident.	
b. Liaise with Master of the Vessel/Pilot.	• Master of the vessel • Pilot
c. Notify to CIC, SIC and the vessels moving into, through and near the casualty and inside the port.	• CIC • SIC • Navy • Coastguard
d. Notify the information to the owner of the vessel.	

3. Deputy Conservator (Alternate: Harbour Master)

Response Action	Contact
a. Establish EOC and be stationed to review & assess possible developments to determine the most necessary course of action.	
b. Assess the level of disaster and activate the DMP.	
c. Give necessary instructions to SIC and Port Control	• SIC

Station & arrange for external aid as necessary.	• Port Control Station
d. Review the situation and accordingly inform to the Chairman/ Dy. Chairman.	• Chairman • Dy. Chairman
e. Launches and rescue craft will be sent to scene of Emergency. If required they will bring necessary personnel and equipment to site.	• Dock Master • Marine Engineers
f. **Oil Pollution:** He will be responsible to activate the Port OSCP on receipt and assessment of the information gathered. He will instruct the IRT and Master of Vessel about the precautionary measures and necessary actions to limit the extent of pollution.	• Coastguard
g. **Evacuation:** Assessment of condition of site of potential affected area and decision taken for evacuation should be taken in consultation with SIC and Master of Vessel.	
h. **Salvage and or floating of the vessel** will be controlled by either the CIC or person assigned by him. All operations will have to be sanctioned by the CIC before implementation.	• Salvage Company
i. Coordinate with external agencies/authorities.	• Indian Navy • Coastguard
j. Be in constant touch with District and Local Administration for rescue and relief operation.	
k. CIC, once the DMP is activated and underway will ensure that, at frequent intervals, issue, through Radio and via the telephone and Media, situation reports and information updates.	
l. **Press Liaison** A press office will be set up and regular briefings organized and promulgated. The DC and representatives from each emergency service will attend as circumstances permit to brief media concerns. Where necessary, the P.R. teams from Port will be alerted to ensure fullest briefings on all aspects of the emergency.	
m. Terminate the response and debrief before allowing normal operation.	

NOTES ON SALVAGE:

- *If required inform a reputable Salvage Company;*
- *Thoughts should be given to adding ballast to secure vessel in bad weather;*
- *Secure topside openings;*
- *Topside survey;*
- *Underwater survey with a diver noting all damage on plan of vessel;*

- *Information on the seabed using diver and soundings;*
- *Based on survey, draft, stability, condition of vessel openings, cargo, fuel, water etc,;*
- *Other removable weights;*
- *Refloating plan must be agreed taking into consideration, draft, stability, a clear passage off (may have to dredge a channel); safety of personnel, fire, pollution (may have to remove bunkers and cargo);*
- *Availability of tugs, bunkering vessels, divers, salvage companies;*
- *CIC in control of salvage, Salvor in command, all plans approved by CIC.*

4. Duties of IRT

Designated Officer	Role	Duties	Alternate Officer
Harbour Master	Site Incident Controller	During Emergency, proceed to the affected location & communicate & collect all necessary information's from the Master of the ship.	Dock Master
		Discuss with the Master or owner for refloating or salvaging of the vessel. Endeavour to obtain from owners/agents a General Arrangement Plan of the vessel and, if appropriate the Cargo Plan.	
		Gather information from Port Control Station regarding position and time.	
		He will report the situation to the CIC/CMG.	
		Activate Port DMP and OSCP.	
		Commence search and rescue operation immediately.	
		He will instruct Dock Master to keep tugs ready.	
		Alert other vessels within the vicinity and the movement of other vessels into, through and near the location should be stopped.	
		Assistance may be sought from other suitable and available vessels.	
		Inform Salvage association and instruct Dock Master to coordinate.	
		In the case of a capsized vessel, make arrangements to hold the	

		vessel in position if drifting would place her in grave danger and, on completion of rescue operations, secure the vessel in position or remove and secure her at some other safe location, whichever is safest and possible, until such time as salvage operations can be undertaken.	
		When clear to do so, arrange for the capsized or sunken vessel to be marked with appropriate buoy(s) and lights, to warn other vessels of her position.	
		Discuss with the Master, owner or agent plans for righting, refloating or salvaging the vessel. Action in this regard is particularly important where the vessel is obstructing fairways, channels or approaches to berths.	
		Ascertain oil pollution- leak source, if any.	
		Inform the MoEF & MPCB approved private parties for safe disposal and providing reception facilities for Oil/Sludge.	
Dock Master	Port Control Room Coordinator	Plot exact location of the incident.	Duty Supervisor
		Assist in monitoring of other vessels and communicating with the Master and restricting them to enter the emergency location.	
		Allow vessels directly involved in rescue operations within the vicinity.	
		Responsible for Organizing tugs for search and rescue.	
		Hire additional crafts as necessary.	
		Arrange for the marking arrangements with appropriate buoy(s) and lights.	
		Instruct the oil pollution response team to maintain a state of readiness and standby.	
		Assist Salvage association and SIC.	

		Liaise with the OSRO team and coordinate with the team in combating the disaster by taking necessary actions as per the OSCP.	
Pilot/ Marine Engineer	In Charge of Pilotage	Shall be ready for taking the instructions from CIC/SIC and evacuate/move/shift the vessel from the area.	Standby Pilot
		Shall monitor the communication on VHF & convey and relay messages on the advice from CIC/ SIC.	
		Responsible for organizing tugs for shifting the vessel to the anchorage area if required.	
Dy. Manager – Safety	Marine Pollution Control Coordinator	Shall take orders from the SIC.	Safety Inspector
		Extend all necessary support to the Master of the vessel for search and rescue operation.	
		Make arrangements for oil pollution combat personnel and equipment.	
		Coordinate with the party involved in disposal of the Oil/sludge in a safe manner.	
		Supervise and direct personnel to follow the instructions given by SIC.	
		Report to SIC and seek advice if in doubt.	
		Maintain records of the claims.	
Asst. Manager (Fire & Safety)	Fire Coordinator	Shall take orders from the SIC.	Station Officer
		Mobilize fire tenders, men & firefighting equipment to the scene & extend all necessary support to the master of the vessel for firefighting.	
		Coordinate with the party involved in disposal of the Oil/sludge in a safe manner.	
Sr. Dy. Chief Medical Officer	Medical Coordinator	Shall be responsible to organize and keep first-aid team ready with ambulance & necessary medicines to attend to any injured person.	Alternate Officer
Chief Manager (PP&D)	Civil Coordinator	Inform MPCB as per the instruction of CIC/SIC and other	Manager (I, II)

		environmental agencies about the incident for getting necessary guidance.	
		Instruct the contractors to carry out urgent civil works as required.	
		Hire the barges for collecting the spilled oil and coordinate with the parties involved in the safe disposal of the oil/sludge.	
Chief Manager (Traffic)	Traffic Coordinator	Coordinates with ship owners/agents/stevedores.	Asst. Manager (Traffic)
		Regulate water traffic in the vicinity.	
Sr. Commandant-CISF	Security and Evacuation	Controls & direct traffic in the area.	Dy. Commandant-CISF
		Shall cordon off the area.	
		Shall supervise evacuation of personnel from the scene at the time of emergency.	
		Allow vehicles which are directly involved in rescue operations within the vicinity of the rescue operations.	

S12: Scenario 12
Part A

1. **Emergency/Disaster within the facility (Reliance/IMC/GBL/Deepak Fertilizer/Suraj Agro/IOCL/Bharat Shell tank farms).**

2. **Precautions:** MSDS, SOP, House Keeping,

3. **Impact Zone:** Facility area and neighboring facility/facilities.

4. **Resources required:** As per facility DMP.

Part B: Action Plan

1. Activate facility EAP.
2. Alert staff within the facility as well as the neighboring facility.
3. Inform Port signal station and CIC/SIC.
4. Inform neighboring and mutually aid partners.
5. Gather as much information as possible pertaining to the nature and scope of the impending or possible emergency.
6. Assist and advice the external Emergency services as appropriate.

If there is a potential to affect other Port operators

1. Notify CIC/SIC/Signal Station as appropriate and seek help.
2. Notify neighboring facilities as appropriate and seek help.

S13: Scenario 13
Part A

1. **Fire in CFS - Warehouse.**

2. **Precautions:** Protected/covered Electrical installations, Fire fighting systems, trained personnel to combat fire, No smoking zone, House Keeping.

3. **Impact Zone:** Warehouse and immediate area.

4. **Resources required:** Organizational setup enumerated in Figure S13.2 and major material and equipment resources as given in **Appendix B**.

Figure S13.1: Action Flow Chart

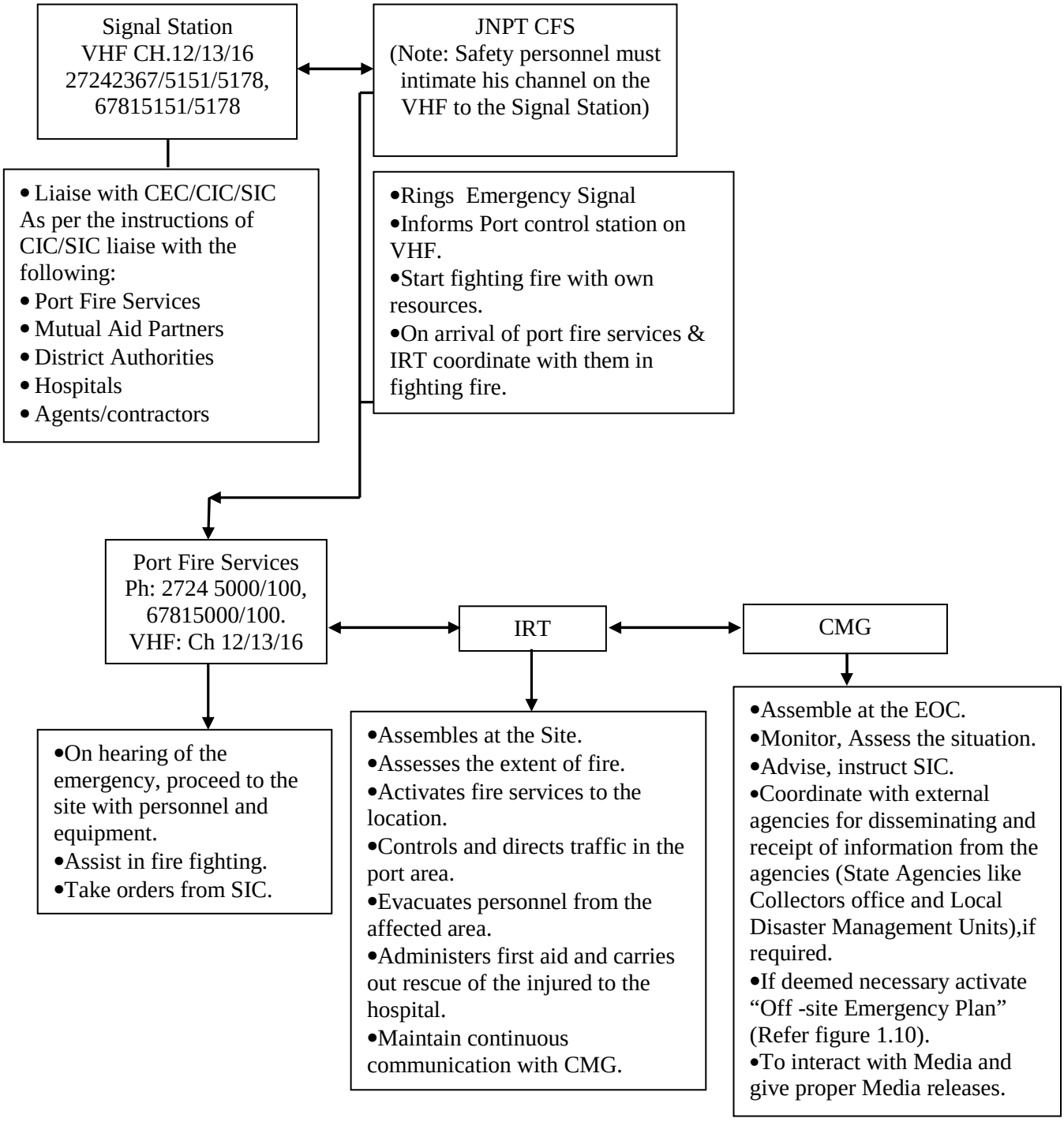
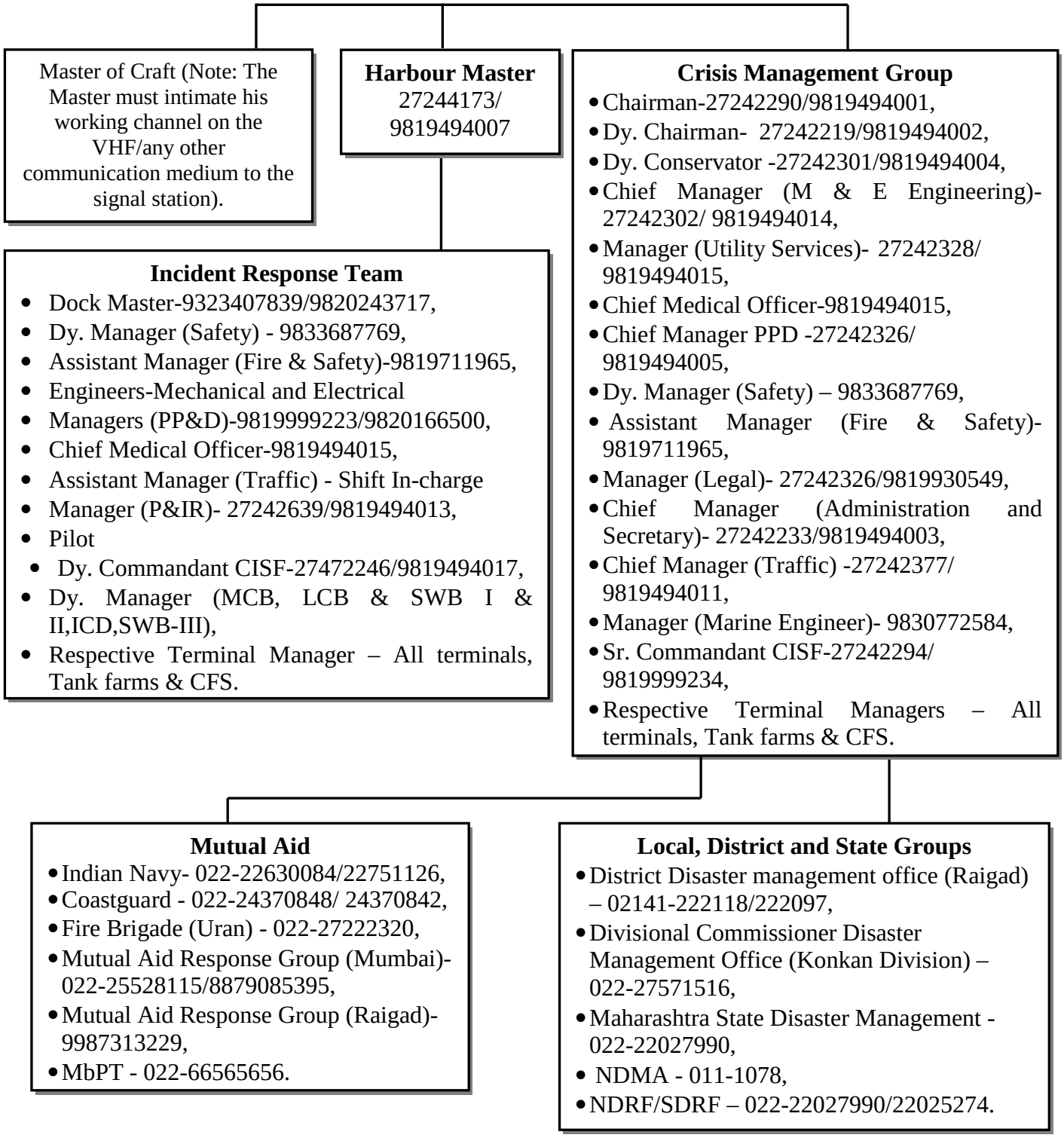


Figure S13.2: Action group



Part B: Action Plan

1. The safety personnel of CFS

Response Action	Contact
a. Should raise emergency alarm and activate emergency action plan.	
b. Vehicles in the vicinity and Port should be informed of any incident without delay.	• Vehicles in the vicinity • Port Control Station
c. Shall be responsible for fighting the fire with own resources as well as with the available support from IRT.	

2. Port Control Station should

Response Action	Contact
a. Gather information related to the fire and time of incident.	
b. Notify to CIC and SIC.	• CIC • SIC
c. Gather information about the wind direction and notify CIC/SIC.	• CIC • SIC

3. Deputy Conservator (Alternate: Harbour Master)

Response Action	Contact
a. Assess the level of disaster and activate the DMP.	
b. Establish EOC and be stationed to review & assess possible developments to determine the most necessary course of action.	
c. Give necessary instructions to SIC and Port Control Station & arrange for external aid as necessary.	• SIC • Port Control Station
d. Review the situation and accordingly inform to the Chairman/ Dy. Chairman.	• Chairman • Dy. Chairman
e. Coordinate with external agencies/authorities.	• Local Authorities
f. Be in constant touch with District and Local Administration for rescue and relief operation.	
g. Terminate the response and debrief before allowing normal operation.	

4. The Fire-fighting Personnel (F &ASO-I) should (Alternate: F &ASO-II)

Response Action	Contact
a. Collect the information from Port Control Station and SIC.	• SIC • Port Control Station

b. Assist CFS in fighting fire.	
c. He will mobilize fire fighting tenders, personnel & fire fighting equipments to the scene & extend all necessary support in case of fire, if required.	
d. Assist in evacuation of the personnel as directed by SIC.	
e. Inform SIC for arrangement of any additional equipment as required.	

5. Duties of IRT

Designated Officer	Role	Duties	Alternate Officer
Harbour Master	Site Incident Controller	During Emergency shall proceed to the scene & communicate & collect all information.	Dock Master
		Assess and report the situation to the CIC/CMG.	
		Extend all necessary support to fight the fire.	
		He will instruct the Asst. manager (Fire and Safety) to keep the fire-fighting equipment and fire fighting tenders in a state of readiness & activate if required.	
Dock Master	Port Control Room Coordinator	Shall monitor the communication on VHF/any other communication medium & convey and relay messages on the advice from CIC/SIC.	Duty Supervisor
		Assist SIC and maintain Log of events.	
Dy. Manager (Safety)	Marine Pollution Control Coordinator	Shall take orders for SIC.	Safety Inspector
		Ensure safely rescue of personnel and labors.	
		Ensure cleanup work during and after the emergency as quick as possible.	
Sr. Commandant-CISF	Security and Evacuation	Controls & directs traffic in the area.	Dy. Commandant-CISF
		Cordon off the area.	
		Shall supervise evacuation of personnel from the scene at the time of emergency.	
Chief Manager (PPD)	Civil Coordinator	Liaise with SIC.	Manager (I, II)
Chief Manager	In-charge of	Shall be responsible for Electrical	Asst. Engineer

(Mechanical & Electrical)	Electrical Installation	supply to vital equipment and systems.	
Sr. Dy. Chief Medical Officer	Medical Coordinator	Shall be responsible to organize and keep first aid team with ambulance & necessary medicines to attend to any injured person at the site of the accident.	Alternate Officer
Chief Manager (Traffic)	Traffic Coordinator	Shall mobilize and dispatch sufficient number of vehicles to the site of emergency. Coordinates with SIC/CIC.	Asst. Manager (Traffic)

S14: Scenario 14
Part A

1. **Fire in Port Administration building/PUB/Customs House/Port Operation Centre.**

2. **Precautions:** Smoke and Fire Detection system, Fire fighting system, trained personnel to combat fire, No Smoking zone, and Protected/covered Electrical installations.

3. **Impact Zone:** Administration building/PUB/Customs House/Port Operation Centre.

4. **Resources required:** Organizational setup enumerated in Figure S14.2 and major material and equipment resources as given in **Appendix B**.

Figure S14.1: Action Flow Chart

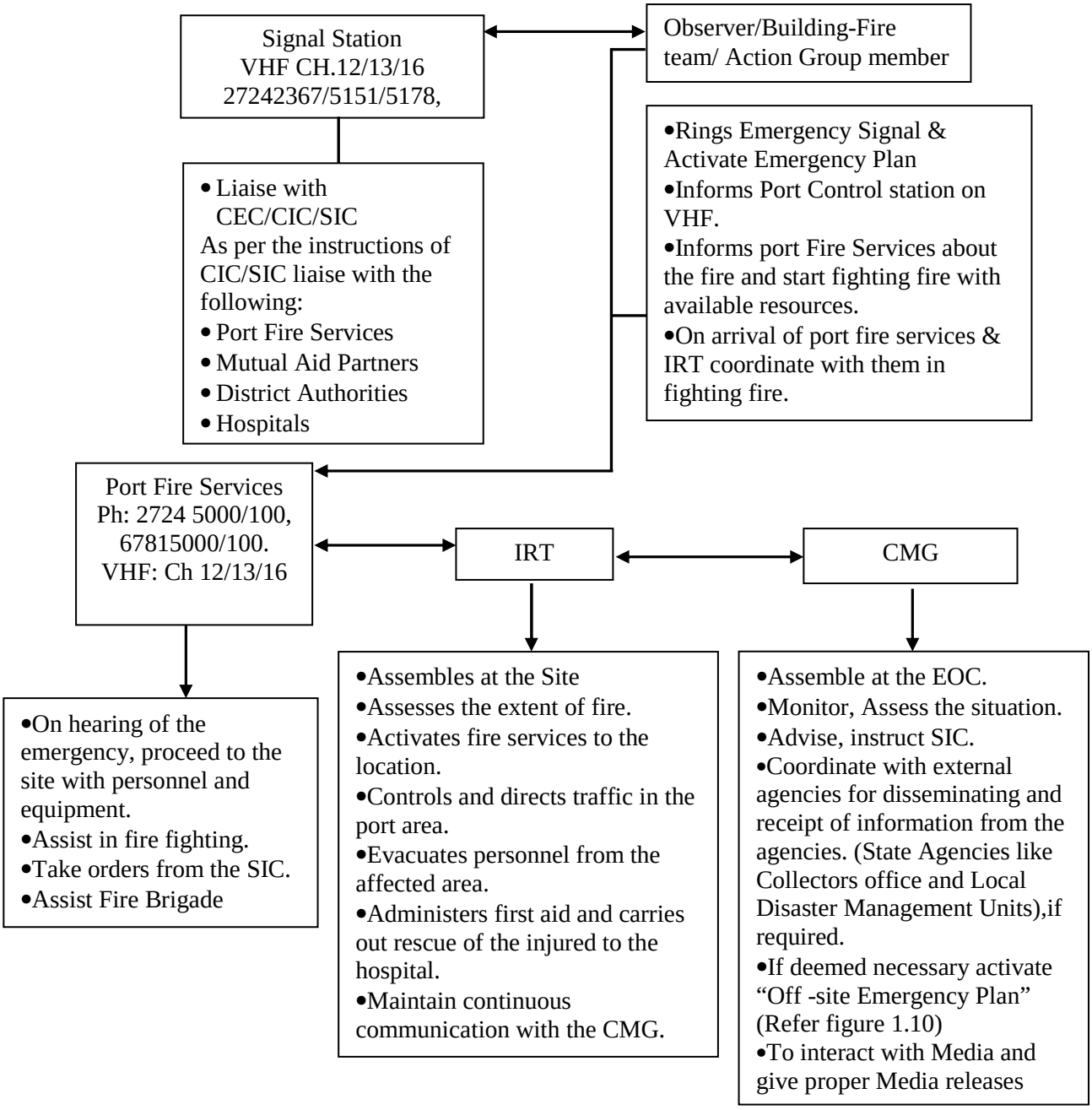
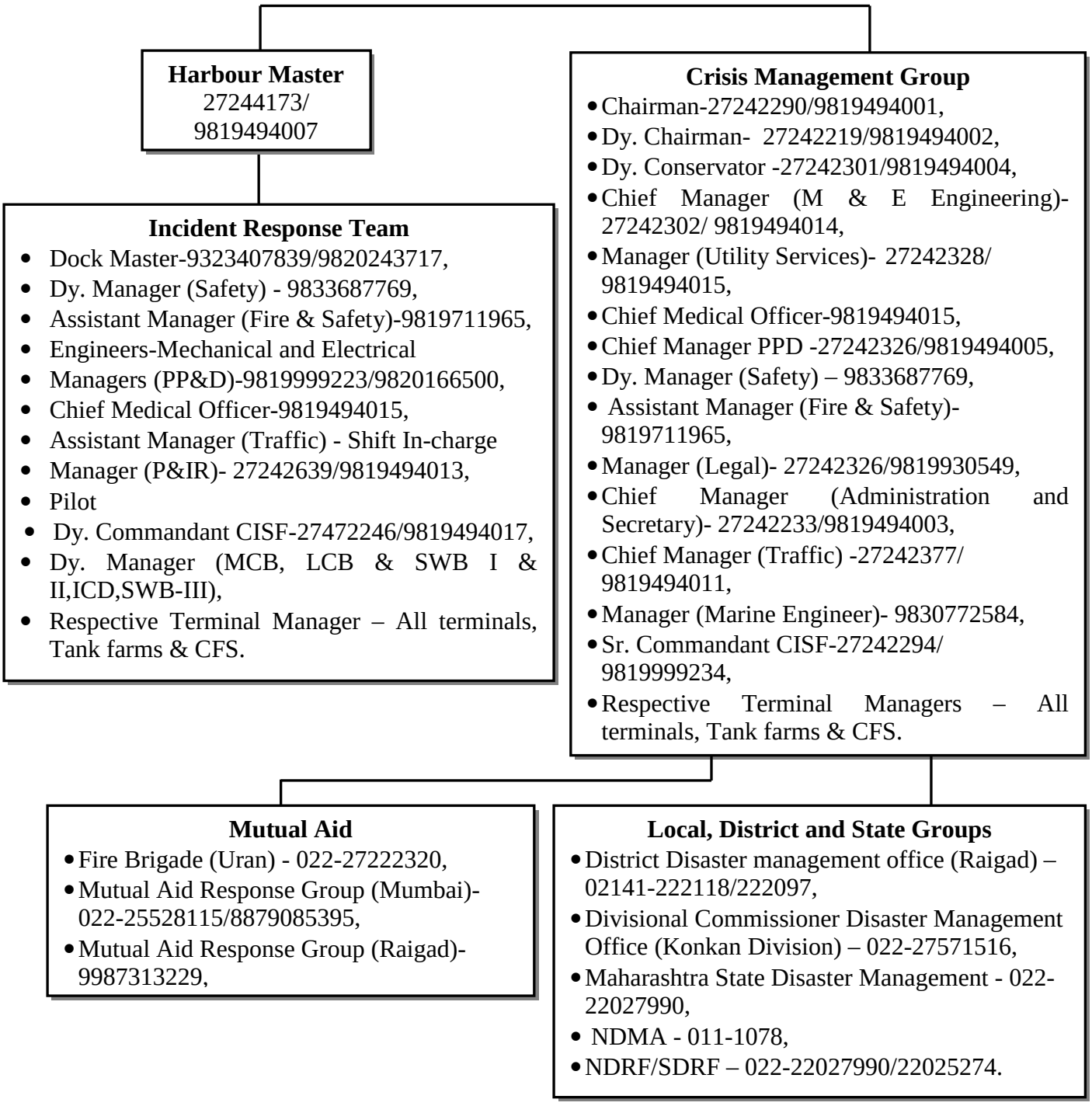


Figure S14.2: Action Group



Part B: Action Plan

1. The Observer/ Building-Fire team/ Action Group member

Response Action	Contact
a. Shout "Fire Fire Fire" and should raise alarm.	
b. Port Control Station should be informed of any incident without delay.	• Port Control Station
c. If fire is in the Port Control Station , inform F &SO and SIC	• F &SO • SIC
d. If trained, try to extinguish the fire and try to evacuate people.	

2. Deputy Conservator (Alternate: Harbour Master)

Response Action	Contact
a. Assess the level of disaster and activate the DMP.	
b. Establish EOC and be stationed to review & assess possible developments to determine the most necessary course of action.	
c. Give necessary instructions to SIC and Port Control Station & arrange for external aid as necessary.	• SIC • Port Control Station
d. Review the situation and accordingly inform to the Chairman/ Dy. Chairman.	• Chairman • Dy. Chairman
e. Assess the condition of site take decision on evacuation in consultation with SIC.	
f. Be in constant touch with District and Local Administration for rescue and relief operation.	
g. Terminate the response and debrief before allowing normal operation.	

3. The Fire-fighting Personnel (F& ASO –I) (Alternate : F& ASO –II) should

Response Action	Contact
a. Raise Alarm (siren)	
b. Collect the information about the exact location of the fire and people trapped in the building. Ensure safe evacuation of the people in the affected area to a safe location.	
c. He will lead the team and mobilize fire tenders, personnel & fire fighting equipments to the scene & extinguish the fire.	
d. If the fire is out of control, convey the message to CIC/SIC and seek assistance from Mutual aid partners or other organizations.	• CIC • SIC
e. Open the water curtain valve to protect shore installations	

from heat radiation.	
f. Control cleanup work during and after the emergency as quick as possible.	
g. If the fire is under control and extinguished, give all clear signal	

4. Duties of IRT

Designated Officer	Role	Duties	Alternate Officer
Harbour Master	Site Incident Controller	During Emergency shall proceed to the scene & communicate & collect all information.	Dock Master
		Assess and report the situation to the CIC/CMG.	
		Instruct the Asst. Manager (Fire & Safety) to keep the fire-fighting equipment in a state of readiness & activate if required.	
Dock Master	Port Control Room Coordinator	Shall monitor the communication on VHF/any other communication medium & convey and relay messages on the advice from CIC/SIC.	Duty Supervisor
		Maintain Log of events.	
Dy. Manager (Safety)	Marine Pollution Control Coordinator	Shall take orders from the SIC.	Safety Inspector
		Ensure safe evacuation of the people in the affected area to a safe location.	
		Control cleanup work during and after the emergency as quick as possible.	
Sr. Commandant-CISF	Security and Evacuation	Shall supervise evacuation of personnel from the scene at the time of emergency.	Dy. Commandant-CISF
		Cordon off the area.	
		Coordinate with Police and Fire Brigade.	
Chief Manager (PPD)	Civil Coordinator	Assist SIC.	Manager (I, II)
Chief Manager (Mechanical & Electrical)	In-charge of Electrical Installation	Shall be responsible for Electrical supply to vital equipment and systems.	Asst. Engineer
Chief Manager (Traffic)	Traffic Coordinator	Provide necessary assistance to CIC/SIC.	Asst. Manager (Traffic)

		Shall mobilize and dispatch sufficient number of vehicles to the site of emergency. Control and Directs Traffic in the affected area.	
Sr. Dy. Chief Medical Officer	Medical Coordinator	Shall be responsible to organize and keep first aid team with ambulance & necessary medicines to attend to any injured person.	Alternate Officer
Duty Pilot	In-Charge of Pilotage	Shall be ready for providing any assistance on site.	Standby Pilot

S15: Scenario 15

Part A:

1. **War and Terrorism.**

2. **Precautions:** Trained Security Personnel, CCTV and Continuous Vigilance including radioactive detectors and intelligence from designated local and national agencies.

3. **Impact Zone:** Entire port.

4. **Resources required:** Intelligence inputs from agencies and organizational setup enumerated in Figure S15.2 and major material and equipment resources as given in **Appendix B**.

Part B: Action Plan

When war like situation is developed or during the declaration of war the priority is to be given to all important/critical areas to remain vigilant to prevent sabotage, to remain ready to combat emergency and to keep normal operation going.

B.1 Prior Emergency Situation (after warnings/inputs)

- Set up Crisis management centre and manned continuously.
- CMG to declare plan/guideline to be followed which could be based on CISF Contingency Plan/Government of India/Statutory bodies/Indian Navy/Air Force/Government of Maharashtra etc. instructions.
- CMG to ensure utmost vigilance in identified area to ensure the adequate resources in terms of security personnel, experts in handling equipment, trained manpower, and flood lights, earth moving equipment, mobile cranes, and rescue crafts are available to guard all gates, roads etc. In case of any unidentified/unauthorized person is found, he must be handed over to police.
- CMG to ensure that evacuation plan is prepared and backup systems such as power generator, communication equipment, and safety systems are working. CMG should also ensure that all required manpower such as electricians/technicians/laborer is available all time.
- All terminals should be informed.
- No movement of the vessels in the port vicinity will be allowed.

B.2 During Emergency

- CMG to adopt relevant DMP to combat the emergency.
- In case of an enemy attack inform relevant authorities & internal security to defend installations till the external support arrives.
- When additional security (army/BSF) arrives, situation is to be handled jointly.
- CMG to ensure sufficient supply of food and water.
- All vessels inside the port and at the anchorage will observe blackout as per the instruction of CMG.

Figure S15.1: Action Flow Chart

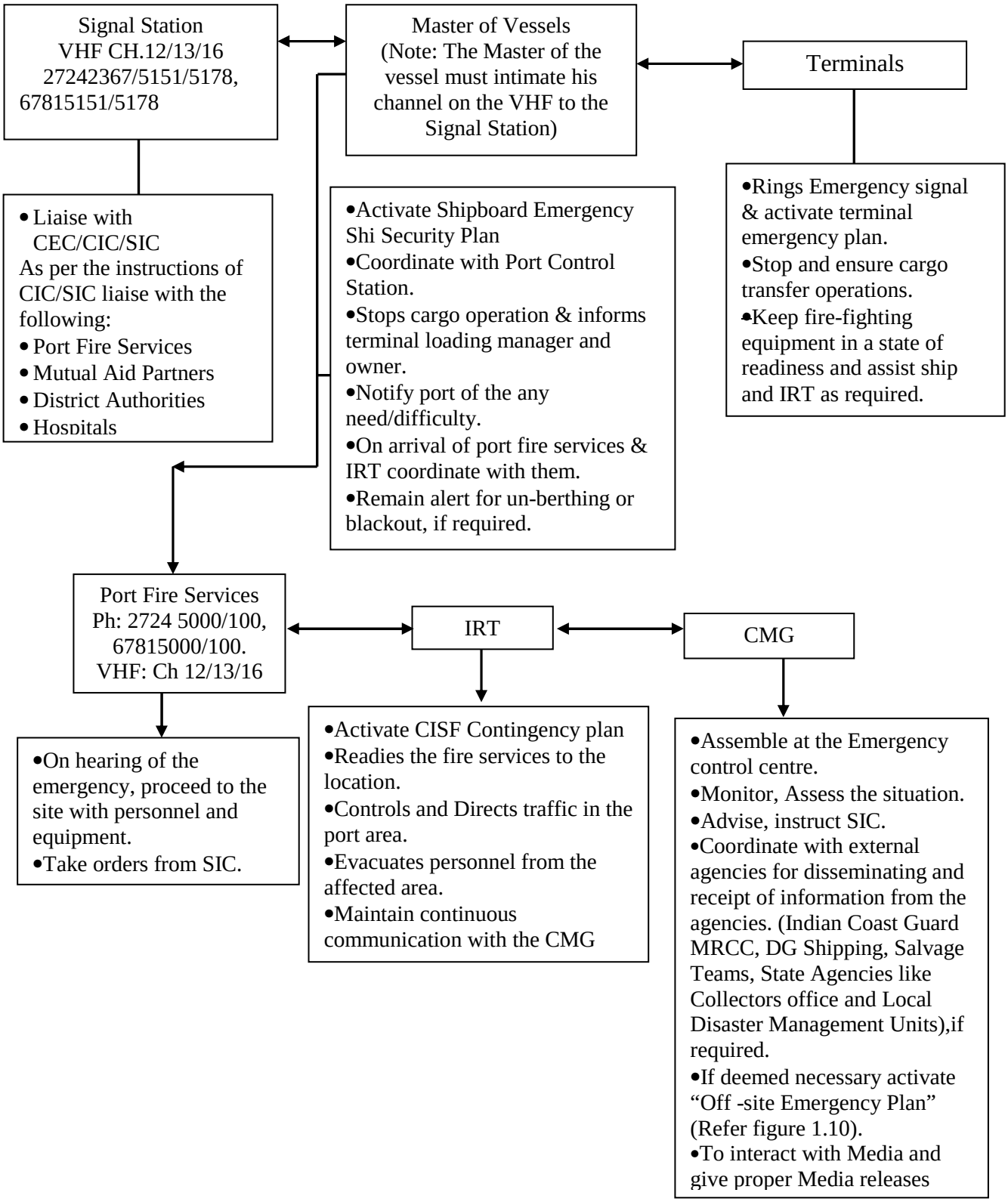
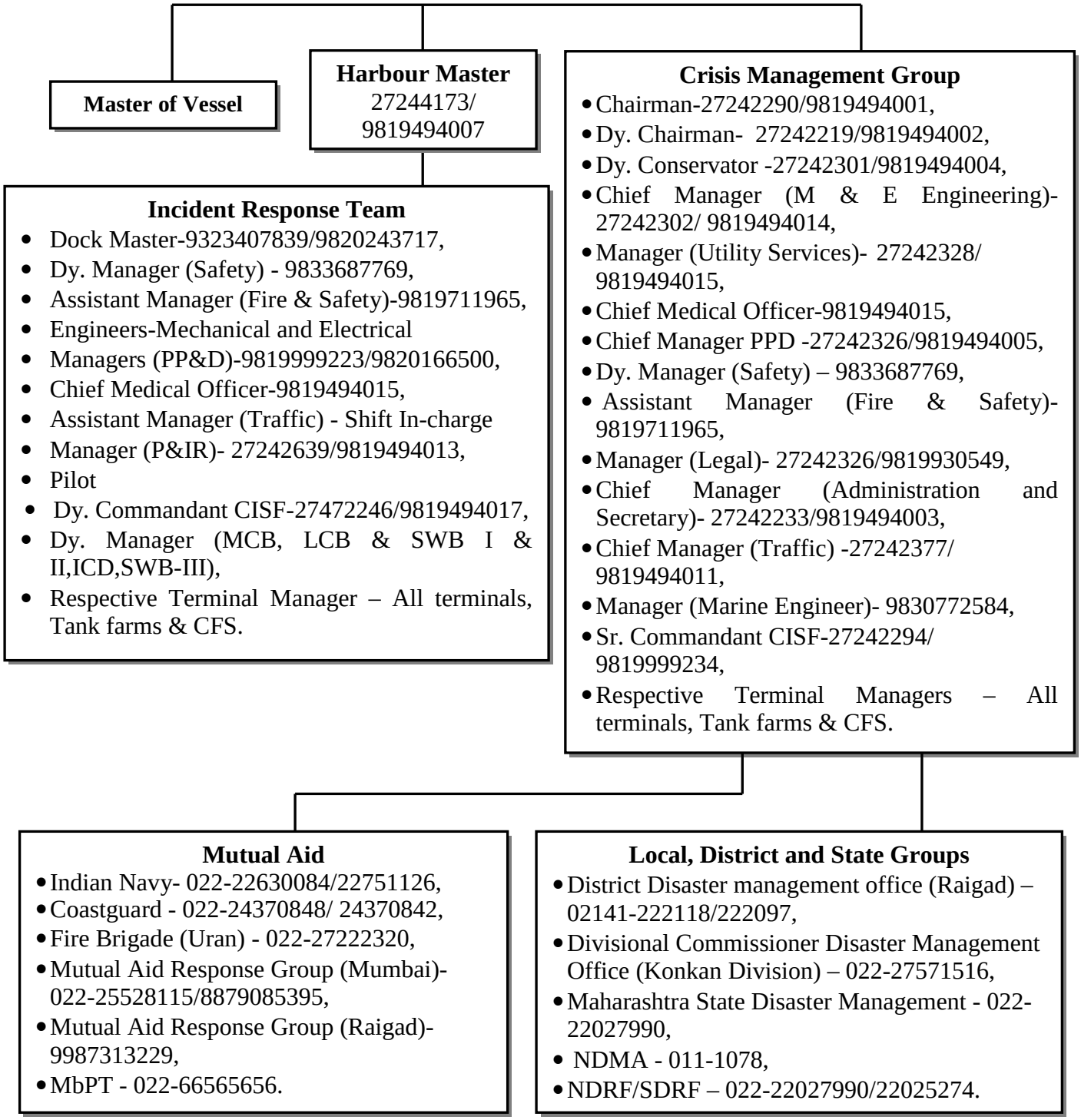


Figure S15.2: Action group



Part B: Action Plan

1. Deputy Conservator (Alternate: Harbour Master)

Response Action	Contact
a. Assess the situation and activate the DMP.	
b. Establish EOC and be stationed to review & assess possible developments to determine the most necessary course of action.	
c. Give necessary instructions to SIC and Port Control Station & arrange for external aid as necessary.	• SIC • Port Control Station
d. Review the situation and accordingly inform to the Chairman/ Dy. Chairman.	• Chairman • Dy. Chairman
e. Be in constant touch with District and Local Administration for rescue and relief operation.	
f. Terminate the response and debrief before allowing normal operation.	

2. Duties of IRT

Designated Officer	Role	Duties	Alternate Officer
Harbour Master	Site Incident Controller	During Emergency shall communicate & collect all information.	Dock Master
		Report the situation to the CIC/ CMG.	
		Extend all necessary help to CISF as and when required.	
		Ensure that there is blackout at the port and the vessels at the anchorage area as per the guidance and instruction of CMG/CIC.	
Dock Master	Port Control Room Coordinator	Shall be ready for taking the instructions from CIC/SIC and evacuate/move/shift the vessel from the area.	Duty Supervisor
Master of the vessel	In-Charge of fire fighting operation on board vessel	Be ready to take the vessel out of the port as per the instructions of CIC/SIC.	Chief Officer of vessel
		Coordinate with IRT leader and will be responsible for shutting down all cargo operation on board in coordination with terminal In-Charge.	
Terminal Managers	Cargo Work	Shall be responsible of shutting down of cargo operation &	Assistant Terminal

		coordinating with JNPT and rendering necessary assistance to the SIC by providing additional fire fighting & emergency equipment as required.	Manager
		Arrange to protect cargo in vicinity from damage.	
		Submits consolidated list of dangerous goods in port – Vessels in port.	
		Coordinates with ship in-charge/C & F agents/stevedores.	
Asst. Manager (Fire & Safety)	Fire Coordinator	Shall take orders from the SIC.	Station Officer
		Keep the fire –fighting installation in a state of readiness and be in continuous liaise with SIC/CIC.	
Dy. Manager (Safety)	Marine Pollution Control Coordinator	Ensure all employees (port and contract) within port shifted to safe locations.	Safety Inspector
Sr. Commandant-CISF	Security and Evacuation	Act as per the CISF Contingency plan.	Dy. Commandant - CISF
		Controls & Directs traffic in the area.	
		Shall supervise evacuation of personnel from the scene at the time of emergency.	
Sr. Manager (PPD)	Civil Coordinator	Assist SIC.	Manager (I, II)
Chief Manager (Mechanical & Electrical)	In-charge of Electrical Installation	Arrange for specialized equipment if required as per the instruction of the SIC.	Asst. Engineer
		Take orders from CIC/SIC with regards to power supply and shutdown.	
Sr. Dy. Chief Medical Officer	Medical Coordinator	Shall be responsible to organize and keep first aid team with ambulance & necessary medicines to attend to any injured person at the site of the accident.	Alternate Officer
Berth Managers	Traffic Coordinator	Shall prepare vessels to vacate from berth.	Dy. Manager - Berths
		Arrange to protect cargo in vicinity from damage.	

		Submits consolidated list of dangerous goods in port – Vessels in port.	
		Coordinates with ship owners/agents/stevedores.	
Chief Manager (Traffic)	Traffic Coordinator	Submits consolidated list of dangerous goods in port-tank farms in port area.	Asst. Manager (Traffic)
		Coordinates with the tank truck contractors.	
		Ensure sufficient numbers of vehicles are available.	
		Controls traffic in the JNPT area.	
Duty Pilot	In-Charge of Pilotage	Shall be ready on site for taking the ship out of berth and be ready for providing any assistance on site.	Standby Pilot
Manager (Marine Engg.)	ME Coordinator	Responsible for organizing tugs for shifting the vessel to the anchorage area.	Sr. Dy. Manager (Marine Engg.)

S16: Scenario 16
Part A

1. **Bomb Threat**

2. **Precautions:** Trained Security Personnel, CCTV and Continuous Vigilance including radioactive detectors.

3. **Impact Zone:** Entire port.

4. **Resources required:** Organizational setup enumerated in Figure S16.2 and major material and equipment resources as given in **Appendix B**.

Figure S16.1: Action Flow Chart

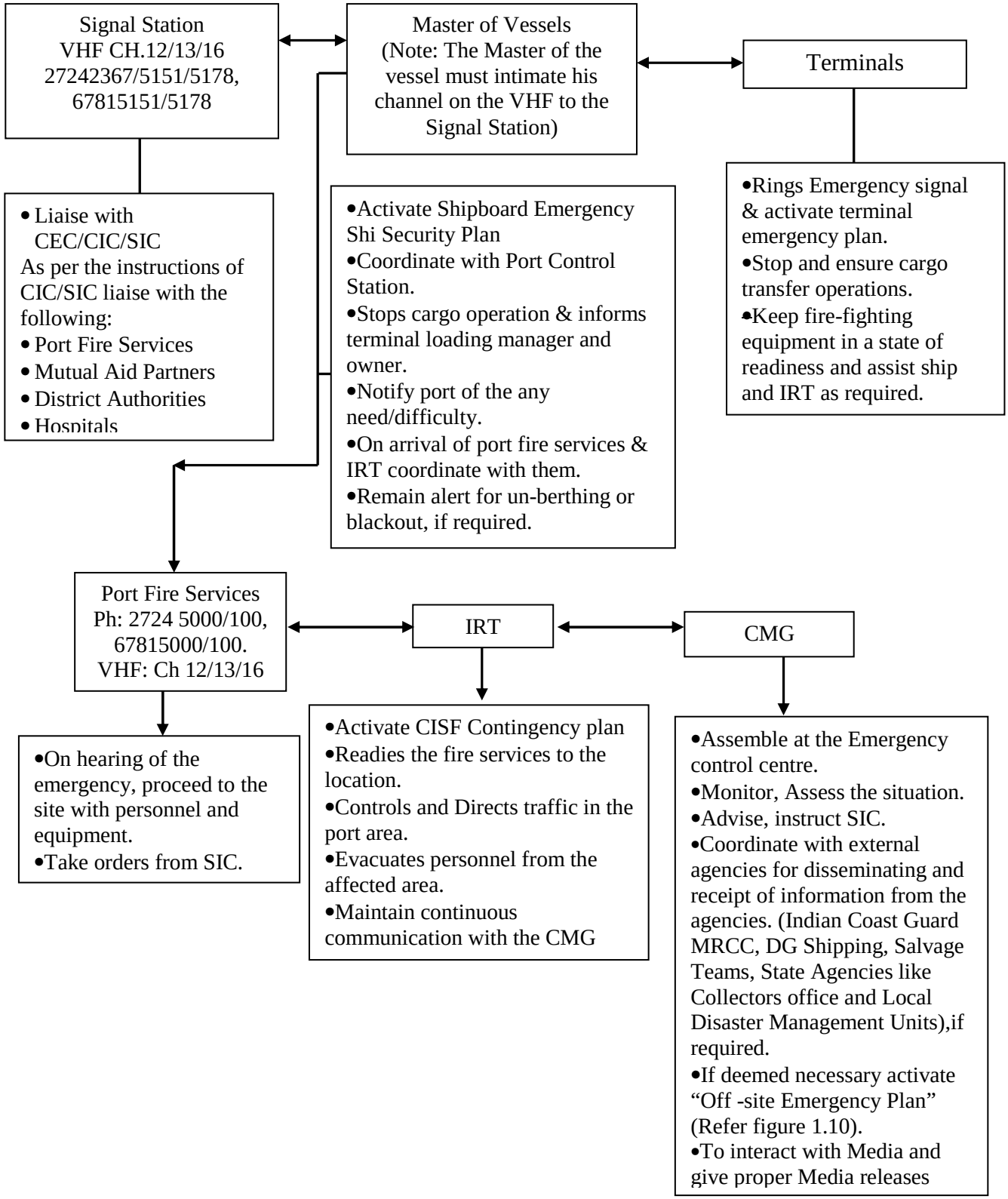
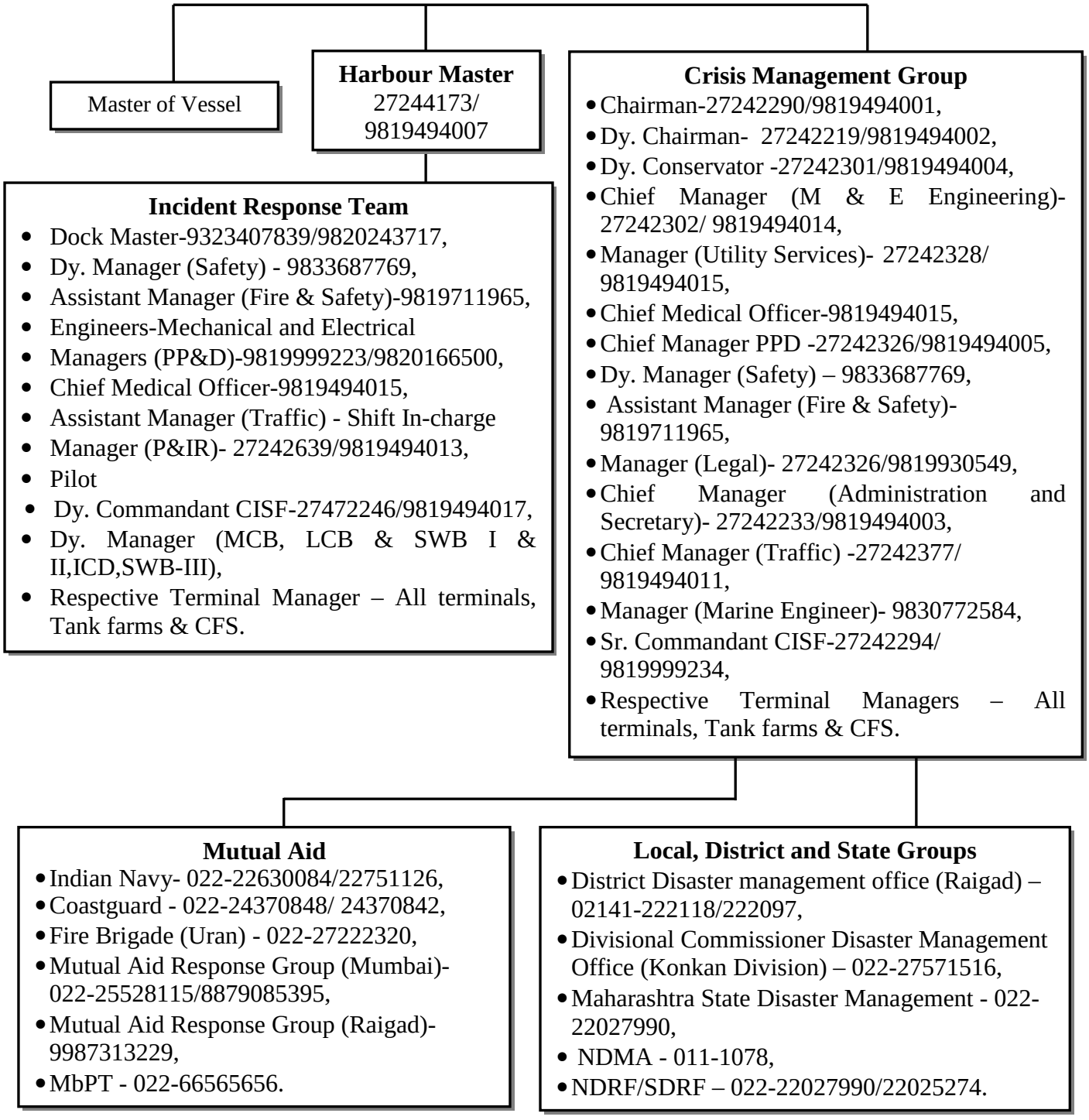


Figure S16.2: Action group



Part B: Action Plan

1. The Observer

Response Action	Contact
a. Port Control Station/CISF should be informed without delay.	• Port Control Station

2. CISF Should

Response Action	Contact
a. Gather the information as per CISF bomb threat checklist.	
b. Should Implement/activate CISF Contingency Plan and search operation as per the message received of the location.	
c. Identify the location and cordon off the area.	
d. Assist District Police and Bomb Squad as required.	
e. All terminals should be informed.	
f. Port should be shut down and people inside the port should be taken to a safe location.	

3. Deputy Conservator (Alternate: Harbour Master)

Response Action	Contact
a. Assess the situation and activate the DMP.	
b. Establish EOC and be stationed to review & assess possible developments to determine the most necessary course of action.	
c. Give necessary instructions to SIC, CISF and Port Control Station & arrange for external aid as necessary.	• SIC • CISF • Port Control Station
d. Review the situation and accordingly inform to the Chairman/ Dy. Chairman.	• Chairman • Dy. Chairman
e. Be in constant touch with District and Local Administration for rescue and relief operation.	
f. Terminate the response and debrief before allowing normal operation.	

4. Duties of IRT

Designated Officer	Role	Duties	Alternate Officer
Harbour Master	Site Incident Controller	During Emergency shall communicate & collect all information.	Dock Master
		Ensure that the identified location is cordoned off and the people are evacuated.	
		Report the situation to the CIC/ CMG.	
		Extend all necessary help to CISF as and when required.	
Dock Master	Port Control Room Coordinator	Shall be ready for taking the instructions from CIC/SIC and evacuate/move/shift the vessel from the area.	Duty Supervisor
Master of the vessel	In-Charge of fire fighting operation on board vessel	Be ready to take the vessel out of the port as per the instructions of CIC/SIC.	Chief Officer of vessel
		Coordinate with IRT leader and will be responsible for shutting down all cargo operation on board in coordination with terminal In-Charge.	
Terminal Managers	Cargo Work	Shall be responsible of shutting down of cargo operation & coordinating with JNPT and rendering necessary assistance to the SIC by providing additional fire fighting & emergency equipment as required.	Assistant Terminal Manager
		Arrange to protect cargo in vicinity from damage.	
		Submits consolidated list of dangerous goods in port – Vessels in port.	
		Coordinates with ship in-charge/C & F agents/stevedores.	
Asst. Manager (Fire & Safety)	Fire Coordinator	Shall take orders from the SIC.	Station Officer
		Keep the fire –fighting installation in a state of readiness and be in continuous liaise with SIC/CIC.	
Dy. Manager (Safety)	Marine Pollution	Ensure all employees (port and contract) within port shifted to safe	Safety Inspector

	Control Coordinator	locations.	
Sr. Commandant-CISF	Security and Evacuation	Act as per the CISF Contingency plan. Controls & Directs traffic in the area. Shall supervise evacuation of personnel from the scene at the time of emergency.	Dy. Commandant - CISF
Sr. Manager (PPD)	Civil Coordinator	Assist SIC.	Manager (I, II)
Chief Manager (Mechanical & Electrical)	In-charge of Electrical Installation	Arrange for specialized equipment if required as per the instruction of the SIC. Take orders from CIC/SIC with regards to power supply and shutdown.	Asst. Engineer
Sr. Dy. Chief Medical Officer	Medical Coordinator	Shall be responsible to organize and keep first aid team with ambulance & necessary medicines to attend to any injured person at the site of the accident.	Alternate Officer
Berth Managers	Traffic Coordinator	Shall prepare vessels to vacate from berth. Arrange to protect cargo in vicinity from damage. Submits consolidated list of dangerous goods in port – Vessels in port. Coordinates with ship owners/agents/stevedores.	Dy. Manager - Berths
Chief Manager (Traffic)	Traffic Coordinator	Submits consolidated list of dangerous goods in port-tank farms in port area. Coordinates with the tank truck contractors. Ensure sufficient number of vehicles is available. Controls traffic in the JNPT area.	Asst. Manager (Traffic)
Duty Pilot	In-Charge of Pilotage	Shall be ready on site for taking the ship out of berth and be ready for providing any assistance on site.	Standby Pilot

Manager (Marine Engg.)	ME Coordinator	Responsible for organizing tugs for shifting the vessel to the anchorage area.	Sr. Dy. Manager (Marine Engg.)

S17: Scenario 17
Part A:

1. **Natural Disaster (Cyclone, Earthquake, Flood, Tsunami)**

2. **Precautions:** Continuous weather monitoring, Early warning system.

3. **Impact Zone:** Entire port**.**

4. **Resources required:** Refer Figure S17.2 and **Appendix B**.

Figure S17.1: Action Flow Chart

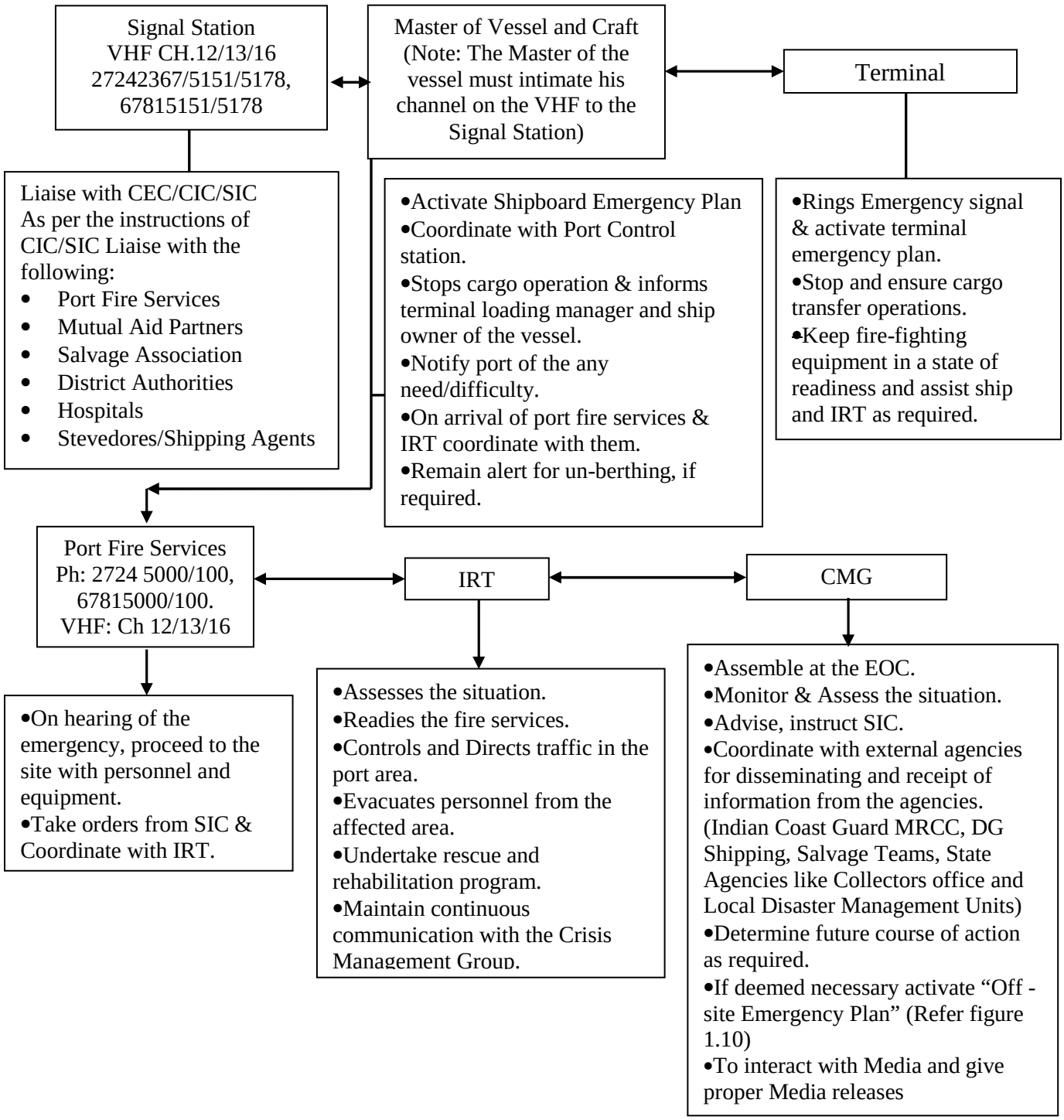
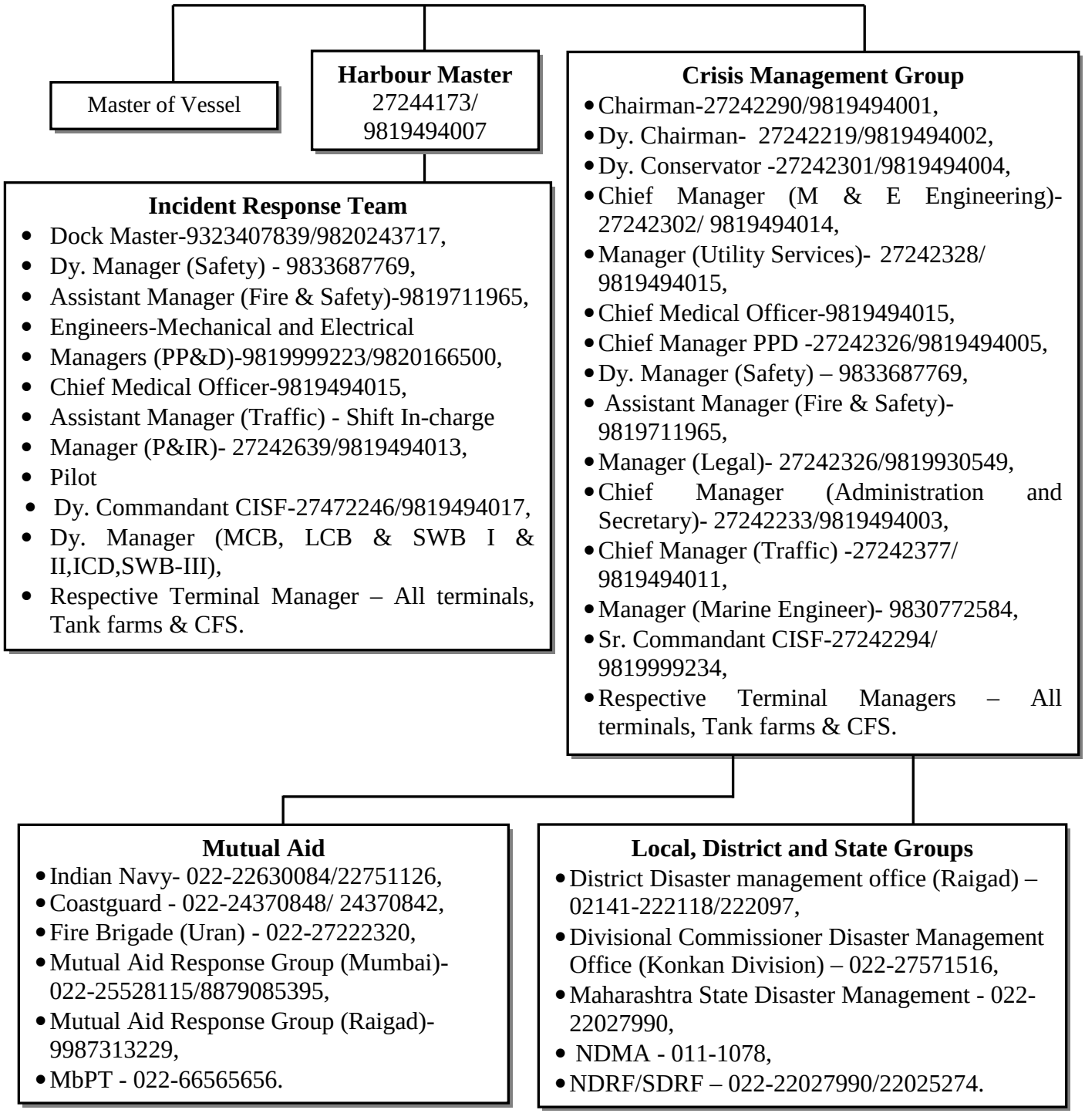


Figure S17.2: Action group



Part B: Action Plan

1. The Port Control Station

Response Action	Contact
a. Gather information related to the vessel type and position in the port limit.	
b. Gather information related to the weather conditions by liaising with competent agencies for issuing warnings as mentioned in section 9.2.3 and other media. Monitor the weather map either through Internet or Television and record approximate position of the weather and information about its movement as given in the news.	
c. Liaise with Master of the Vessel/Pilot.	
d. Ensure that both IT and Civil telephones, one VHF and one walkie-talkie all are operational in the Port control centre. Listening watch to be maintained on VHF channel-16 and walkie-talkie channel-12.	
e. Notify to CIC, SIC and the vessels moving into, through and inside the port. Keep CIC/SIC informed of all the messages received by telephone, VHF sets or by messenger.	• CIC • SIC
f. Notify the other Authorities and stakeholders within Port as per instructions of CIC/SIC.	• Navy • Coastguard • Stakeholders
g. Notify the information to the owner of the vessel as per the instruction of CIC/SIC/ Master of the Vessel. Pass the information to various Port departments and other Port related organizations through telephones and VHF.	• Terminal Operators
h. Inform the Dock Master/Marine Engineer of any buoys or crafts or any Port installation is seen adrift.	• Dock Master • Marine Engineer
i. Hoist signals or raise alarms, as per the warnings received by the competent agencies for issuing warnings. (for warning signals refer section 9.2.3)	
j. On behalf of Chairman / Dy. Chairman, the control centre should liaise with Revenue/Police/Health. Administration/Municipal Corporation for additional assistance.	

2. The Master of the Vessel (Alternate : Chief Officer)

Response Action	Contact
a. Should raise ships emergency alarm and activate ship board emergency action plan.	
b. Having raised the alarm, the Master will be responsible for taking all immediate steps to safeguard his ship.	
c. The Master will provide the Port Authority with details of	• Port Control

the vessel.	Station
d. Should follow the instruction of the CIC/SIC and be in continuous liaise with the CIC/SIC/Port control station.	• CIC • SIC • Port Control Station
e. Should be in a state of readiness to take the vessel out of the port.	

3. The terminal personnel should

Response Action	Contact
a. Activate EAP (prepared by the terminal) and inform JNPT.	• Port Control Station
b. Shall be responsible of shutting down of cargo operation (as per Terminal SOP) & coordinate with JNPT and Master of the Vessel and rendering necessary assistance to the SIC and vessel by providing emergency equipment as required.	
c. Submit consolidated list of dangerous goods in port – Vessels in port. Make arrangements to protect cargo.	
d. Assist IRT and provide all necessary equipment.	• SIC
e. He will direct operation staff. Coordinate with the ship in-charge/C&F agents/stevedores.	

4. Deputy Conservator

Response Action	Contact
a. Activate the DMP.	
b. Establish EOC and be stationed to review & assess possible developments to determine the most necessary course of action.	
c. Give necessary instructions to SIC and Port Control Station & arrange for external aid as necessary.	• SIC • Port Control Station
d. Review the situation and accordingly inform to the Chairman/ Dy. Chairman.	• Chairman • Dy. Chairman
e. Consult with Chairman / Dy. Chairman and decide on clearing of ships as soon as the cyclone is confirmed to pass in close proximity to the Port.	
f. Plan movements of vessels such that the vessels are cleared in shortest possible time.	
g. Coordinate with external agencies/authorities such as Indian Navy and Coastguard.	• Indian Navy • Coastguard
h. Be in constant touch with District and Local Administration for rescue and relief operation.	

i. Terminate the response and debrief before allowing normal operation.	

5. Duties of IRT

Designated Officer	Role	Duties	Alternate Officer
Harbour Master	Site Incident Controller	During Emergency shall proceed to the scene & communicate & collect all information.	Dock Master
		Take over the charge of control centre and ensure the action plan is promulgated as per the instructions of CIC.	
		Inform and ask Masters to keep their ships ready to proceed to the sea at short notice as per the instruction of CIC.	
		Ensure port control, hoists appropriate storm signal as per the situation.	
		Report the situation to the CIC & the CMG.	
		Keep rescue team ready with rubber boats, Life jackets etc.	
		Inform ships alongside berths to double up their moorings and provide shore gang assistance.	
		Ensure that the hazardous cargoes are shifted out of the port or secured/stored in a safe manner.	
		Ensure that the operations are brought back to normal after the termination of the emergency procedure.	
Dock Master	Port Control Room Coordinator	Shall monitor the communication on VHF/any other communication medium & convey and relay messages on the advice from CIC/SIC.	Duty Supervisor
		Instruct Marine engineers to secure tugs and workboats.	
		He will maintain LOG of events.	
Asst. Manager (Fire & Safety)	Fire Coordinator	Shall take orders from the SIC.	Station Officer
		Keep fire tenders and fire-fighting equipment in a state of readiness.	

		Ensure the Fire tugs is properly manned and secured with double ropes and engines running in idling condition.	
		Responsible for mobilizing fire tenders, men & fire fighting equipments to the scene & extend all necessary support.	
		Ensure hazardous cargo out are kept at a sheltered or safe location.	
		The port Fire & Safety Officer will make announcement in the township and the adjoining habitats area indicating the precautionary measures to be taken.	
		Liaise with State Fire brigade for any assistance.	
Dy. Manager (Safety)	Marine Pollution Control Coordinator	Ensure workers within perimeter of safety dangerous / chemical tank farms shifted to safer perimeters.	Safety Inspector
		All other workers to move out of port area.	
Sr. Commandant-CISF	Security and Evacuation	Controls & Directs traffic in the area.	Dy. Commandant-CISF
		Shall supervise evacuation of personnel from the scene at the time of emergency.	
		Ensure that all barges / small vessels are directed to go to the sheltered area.	
		The fishing trawlers and fishing crafts to be sent to safer place.	
		Till normality is restored, arrangement will be made for thorough checks on all out-going vehicles to guard against pilferage.	
		Round the clock patrolling duty shall be introduced along the electric lines to guard against the removal of copper wires which are likely to be grounded during cyclone.	

		A special task force to be set up by the CISF for the rescue operation.	
Chief Manager (Traffic)	Traffic Coordinator	Submits consolidated list of dangerous goods in port-tank farms in port area. Coordinators with the tank truck contractors. Ensure availability of vehicles and mobilize and dispatch sufficient number of vehicles to the site during emergency. Controls traffic in the JNPT area.	Asst. Manager (Traffic)
Chief Manager (PPD)	Civil Coordinator	All types of cranes, forklifts, heavy earth moving equipment to be secured in a safe manner. Keep enough number of cement bags ready as per SIC instructions. Diesel engines for raw water and clean water, all pump house equipment and all generator sets meant for water supply shall be tried out and kept ready. As soon as the contingency plan is made operational all the water tanks should be filled up and standby arrangement for supply of water to be made.	Manager (I, II)
Chief Manager (Mechanical & Electrical)	In-charge of Electrical Installation	Shall be responsible for Electrical supply to vital equipment and systems at the berth. All Sub Stations, Power Control rooms will be manned round the clock.	Asst. Engineer
Sr. Dy. Chief Medical Officer	Medical Coordinator	Shall be responsible to organize and keep first aid team with ambulance & necessary medicines to attend to any injured person.	Alternate Officer
Duty Pilot	In-Charge of Pilotage	Shall be ready on site for taking the ship out of berth or will not bring the ship to berth as per the instruction given by CIC/SIC.	Standby Pilot

		Inform the Masters of all vessels at the berths to double the moorings and to keep engine ready to proceed out to sea if situation warrants.	
		Decision regarding moving ships to the anchorage will be taken depending on the strength of the wind likely to be encountered and number of vessels in the Port.	
		Maintain a close liaison and co-ordination with the Operations In-charge.	
		Take all necessary steps for the safety of the Port crafts.	
		Ensure all other crafts are placed at safe place and properly secured excepting one pilot launch and one stand by launch used for inspection and emergency duties.	
		Ensure all barges will be secured at safe place along with emergency squad will make frequent round (minimum two hourly) to check the safety of Port Crafts.	
		Fender and extra lengths of ropes/wires will be kept ready so as to attend to any craft whose moorings may part.	
		Inform the signal station immediately in the event any craft is seen adrift or any other Port installation is seen in danger. Arrange an Emergency Maintenance team.	
Manager (Marine Engg.)	ME Coordinator	Responsible for organizing tugs for combating the fire and rescue.	Sr. Dy. Manager (Marine Engg.)
		Hire additional craft as necessary.	
Floating Craft		Masters will shift their respective crafts at suitable places as directed by the Harbour Master and will secure them suitably with additional moorings.	

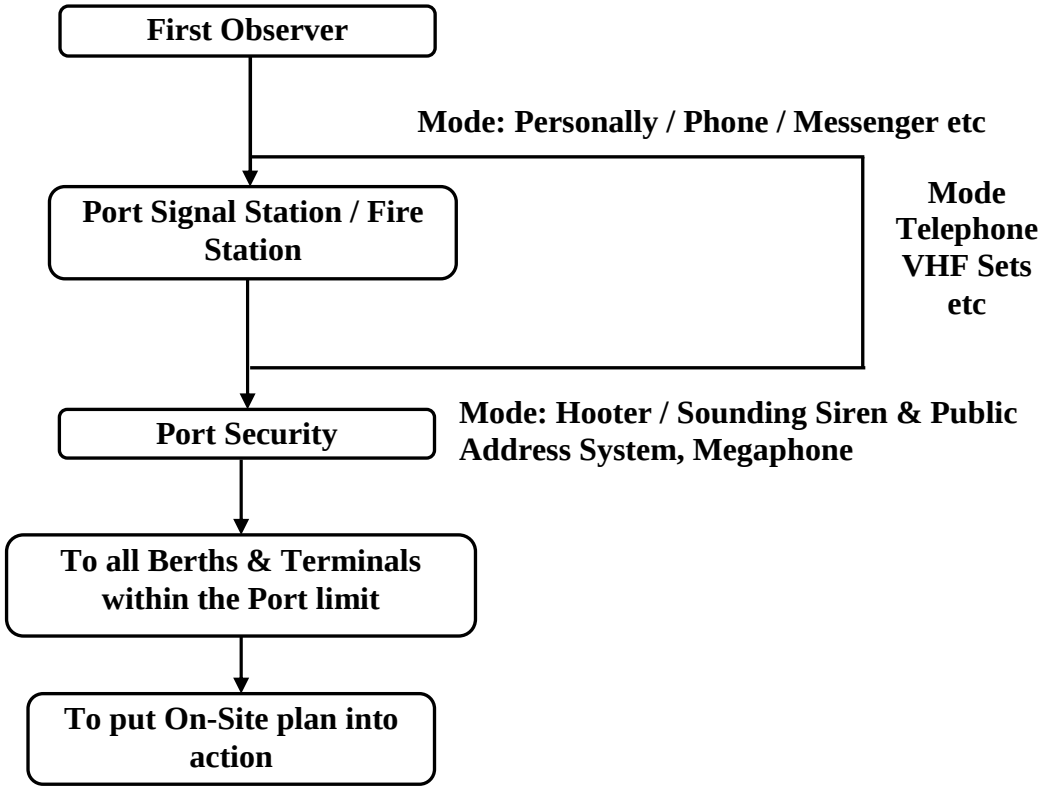
		Masters of respective crafts will be responsible for proper securing and safety.	
		Masters will keep the engines of their crafts ready to proceed at short notice as per the instructions of the Operation In-charge.	
		Extra fenders will be kept ready on board the Tug for use as required.	
		Engine room entrance doors, sky lights etc. of all the floating crafts to be kept shut.	
		The Floating Crafts shall be in constant touch with Signal Station.	
Workshops		Workshop should be manned continuously and should be ready with all the necessary equipment to attend during emergency.	
Material Management		During cyclonic season sufficient stock of stores like AC sheets, J.Hooks, screw hinges, gunny bags, tarpaulins, ropes and wires for Port Crafts, diesel oil, kerosene oil, hurricane lantern, kerosene lamps, torch lights with batteries and bulbs, electrical items etc. is kept.	
		All the materials which are likely to get damaged in rain are covered with tarpaulin.	
		Store Supdt. and store keeper along with other staff required to issue materials.	
Data Entry and Storage Cell		Start downloading isobaric internet pictures and reports 6 hourly after Signal No.1 and 3 hourly after signal 3.	
		Give copy to CIC and SIC and they in turn will apprise the Deputy Chairman and Chairman.	

9.4 ACTIVATION OF RESPONSE PLAN

9.4.1 Prevention/Protection action implementation plan

Following is the typical Prevention/Protection action plan.

Figure 9.1: Action Implementation Plan



The person who observes the emergency first is called as the First Observer. The First Observer, noticing an unusual occurrence like a fire /gas release /collapse of structure etc., should immediately notify the Signal Room with available means of communication and also contact the concerned Officer of the area in person.

He would:

1. Raise alarm

2. Call fire station and pass on following information:

   - Introduce himself
   - State briefly the type of emergency
   - Give the location of the incident.

3. Proceed to a safe place. However, he would return to the location of the incident and place himself in a safe area cross-wind to the wind direction and standby to give assistance if he is part of the action group.

After receiving information from the First Observer, the Signal Station would notify all the key personnel of the Port and also direct the security personnel to activate

Siren and will subsequently announce on the available means of Public Address System (say fire jeep which is fitted with PA system) as follows:

- Location of the emergency.
- Type of the emergency.
- Severity of emergency.

After hearing siren or the public announcement, all concerned personnel (identified in the plan) would move to their respective positions and will begin actions as documented in the plan.

SITE CONTROL PROCEDURE			
Site Control should be established for every site where access is to be controlled. This includes the EOC, sites of shoreline cleanup, waste storage, response vessel mooring areas or any site containing hazards or hazardous materials			
Task	**Action**		**Status**
1	Identify perimeter of the "Hot" (secure or prohibited) zone. This may be:		
	i	Oiled shoreline. (Note: This zone should contain all hazards and sensitive areas where access should be restricted).	
	ii	Response vessels.	
	iii	Area around the incident.	
	iv	EOC	
2	Identify the "Hot" zone perimeter by sign-posting or establishing a cordon.		
3	Identify the "Warm" (exclusion, controlled or support) zone. (Note: This is a non-contaminated/ non-hazardous zone). For e.g.:		
	i	Area behind beach including all areas used for support (shelter, canteen, car park).	
	ii	Jetty.	
	iii	Any water area established to exclude non-response vessels.	
4	Identify the "Warm" zone perimeter by sign-posting or establishing a cordon.		
5	Establish any required "Hot" zone perimeter facilities. For example (i) and (ii) this may include:		
	i	Decontamination facility.	
	ii	Temporary waste storage.	
6	Establish "Warm" zone perimeter facilities. Generally this is site security.		
7	Establish support facilities within Warm zone as required		

Note 1 Entry to a Hot Zone should be restricted to:

- Personnel involved in the on-site work.
- Personnel equipped with appropriate protective gear.
- Personnel who have undergone correct training and induction.

Note 2 The Warm Zone surrounds the Hot Zone and is the zone and is generally:

- The area from which personnel and equipment are deployed.
- The perimeter where site control is exercised i.e. the entry points to the Hot Zone.
- Restricted to those people who operate in the Hot Zone and those who support them.

Note 3 The Cold Zone is all public or otherwise unrestricted areas, i.e. those areas outside of the controlled site.

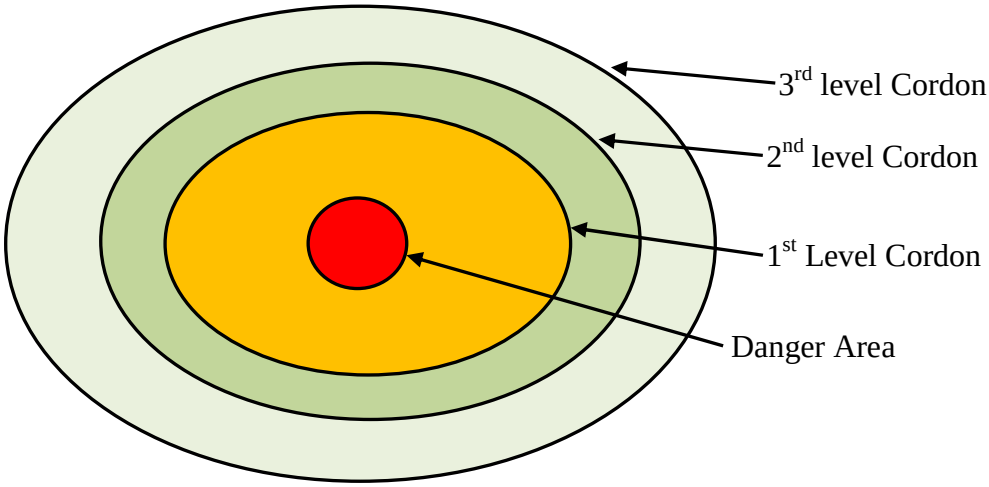
PLANNING MEETING SCHEDULE & PREPARATION OF THE INCIDENT ACTION PLAN (IAP)					
Phase/ Task			**Action**	**Responsibility**	**Check**
Meeting	1		Briefing on situation.	CIC or others as nominated.	
		a	Current situation		
		a	i Incident location		
		a	ii Resources mobilized		
		b	Predicted situation:		
		b	i Trajectory/Dispersion		
		b	ii Resources at potential risk		
	2		State Aim of Response.		
	3		Develop and rank response objectives based on protection priorities.	CIC	
	4		Develop Strategies and Tactics.	CIC and all Coordinators	
	5		Identify necessity for obtaining any permit (e.g. dispersant use).	CIC	
	6		Prepare Draft Incident Action Plan.	CIC	
	7		Determine need and location of Advanced Operations Centres or Staging Areas.	CIC and all Coordinators	
	8		Approve and Document IAP.	CIC	

Process to be repeated throughout the response as scenario, objectives, strategies or tactics change.

9.4.2 Mechanism for access control and isolation of the Danger area

1. All gates and landing jetties should be guarded,
2. Unauthorized person should not be allowed to the restricted area,
3. Authorized person will be entering the zone with all the necessary PPEs,
4. The area should be cordoned off during operation,
5. Proper signage board and warning should be displayed at the place of the operation,
6. Fire fighting facilities and other required resources should be available till the 4operation is terminated,
7. The restricted areas should be under surveillance at all times.

Figure 9.2: Isolation of Danger Area



- Danger/Hazardous area
- 1st Level Cordon off
- 2nd Level Cordon off
  - Site Control point
  - Ambulance
  - Casualty Clearing point
- 3rd Level Cordon off
  - Traffic Control

Note: Positions will depend on the wind directions

9.4.3 Evacuation

1. On blast of Disaster warning siren, the workers will assemble at the respective assembly points to be transported to the refugee centers.

2. The assembly point earmarked at JNPT are as follows

Table 9.3: Assembly Points

Sr. No	Assembly Points
1.	CT Shift in-charge office
2.	In front of POC building
3.	POC Canteen building
4.	In front of Administration building
5.	Shallow Water Berth No.1
6.	TT Maintenance Section
7.	Office of Dy. Manager (LCB & SWB I & II)
8.	ICD Building
9.	E-7 Substation
Sr. No	**BPCL Jetty - Assembly Points**
1.	Jetty Control Room/Pump House building
2.	Near Liquid Cargo Jetty Entry Gate
3.	At the South west corner of Loading Berth

Sr. No	**APM Terminal – Assembly Points**
1.	Front House of GTI House
2.	Behind Eng. Workshop
3.	Central gate Complex
4.	Rail Head – ICD
5.	Wharf (Near Central Orange House)
6.	Yard 1U near South bridge starting
7.	ODC gate
8.	TDC
9.	Marshalling Yard
Sr. No	**DP World Terminal – Assembly Points**
1.	Wharf office (NSICT wharf office and NSIGT wharf office)
2.	Old Canteen
3.	E6 substation
4.	Operations center
5.	ICD Office
6.	Gate complex
Sr. No	**BMC Terminal – Assembly Points**
1.	Wharf office
2.	Workshop
3.	Admin Building
4.	Gate Complex
5.	Rail Goomti (near sub station1)
6.	Rail Office

3. The vehicle-carrying victim should be given the first priority in traffic movement.

4. While assessing the evacuation route, constant communication link should be maintained with the EoC as well as with the individual assembly point station from where the evacuation is to be undertaken.

5. As far as possible people should be advised not to use their vehicles since any breakdown of the same on the evacuation route would act as an obstacle to the vehicles being used for evacuation.

9.4.3.1 Evacuation Routes

In case of a general emergency one of the first duties of the CIC is to alert outside authorities and advice them about the actions that should be taken to protect the

public, if any. The most significant risk affecting the local population is that of a toxic materials release.
The evacuation route could be by two ways

a. Land
b. Sea

9.4.4 Temporary Shelters

In the event of an impending disaster the affected population would have to be transported to intermediate temporary shelter. The temporary shelters identified for Port are schools and colleges located at Port Area and City.

9.4.4.1 Gathering & Rehabilitation centers

Table 9.4: Gathering and Rehabilitation centers

Centres	Location
Multipurpose Hall	JNPT Township
JNPT Hospital	
St. Mary's JNP School	
JNP Vidyalaya	
Officers and Staff club	

Administration department shall ensure adequate quantity of water supply at all the temporary evacuation centres.
CMO shall ensure that necessary medicine and medical assistance at the temporary evacuation centres is available.
Administration department shall take care of the requirement for food for the evacuees in the temporary evacuation centres. For supply of food packets, etc., they shall immediately contact the agencies (**Appendix C**) of the area.
As a part of emergency relief Port Trust to consider 500 gm of rice per day per adult and 250 gm of rice per day per child. Relief of this scale should be catered to by consent of collector for a period of 3 days whereas a relief of 7 days could be obtained with the approval of Relief commissioner.
Extension of relief beyond 15 days could be sought from the State Government or Central Government.
Apart from the above, if required, he may contact the hotels (**Appendix C**) for supply of food packets.

9.4.5 Transportation

9.4.5.1 Vehicle Pool

As soon as this Emergency Action comes into force, the vehicle pool is formed. The pool shall be controlled by Administration Department. Refer **Appendix B** for list of vehicles.
Apart from the Port vehicles, The Engineers shall hire vehicles with spark arrestors from other available sources for emergency work. Refer **Appendix B** for list of private vehicles.
Engineers should ensure the availability of the drivers and vehicles and report compliance to the Deputy Chairman/Dy. Conservator. All vehicles whether it is of

Port Trust or hired should be parked in the location as designated by Deputy Conservator from where it can be taken readily for immediate use.

9.4.5.2 Contact with Railways & State Road Transport Corporation

SIC should ensure for the smooth movement of workers/employees for which he may get in touch with the concerned officers and apprise them about the situation so that the movement of staff is not suffered.

9.4.6 Generator Sets

Wherever generator sets are required, CM (M&EE) officers shall be contacted, who shall immediately hire/procure or provide from whatever sources.

9.4.7 Decontamination

Additional issues in relation to decontamination of the public may arise at some hazardous materials incidents. Decontamination in this context refers to a range of procedures employed to remove hazardous materials from people and equipment. It includes terms such as:

- Clinical decontamination, meaning medical treatment by health professionals of patients affected by or contaminated with hazardous materials;
- Emergency decontamination, when time does not allow for the deployment of specialist resources and it is judged imperative that decontamination of people is carried out as soon as possible;
- Personnel decontamination meaning the decontamination of uninjured exposed persons;
- Mass decontamination is the procedure deployed where significant numbers of persons are deemed to require decontamination, beyond the normal decontamination capacity; and
- Equipment decontamination is the procedure used to clean the specialist equipment/protective suits which personnel use in dealing with hazardous material incidents.

The need for decontamination of individuals will be established by the On-Site Coordinator, in association with the other Controllers of Operations. The Medical Service Executive has responsibility for providing clinical decontamination and medical treatment to casualties affected by hazardous materials. The fire services have responsibility for providing other forms of physical decontamination of persons at the site. The Medical Service Executive will be responsible for decontamination where required to protect health service facilities, such as hospitals, from secondary contamination. Where emergency decontamination of the public is required, the fire service may use its fire-fighter decontamination facilities, or improvised equipment may be used prior to the arrival of dedicated equipment. Where persons have to undergo this practice it should be carried out under the guidance of medical personnel. It should be noted that emergency contamination carries risks for vulnerable groups, such as the elderly and the injured.

9.4.8 Medical Facilities

Depending on the nature of the emergency, it may be necessary to alert medical facilities within and outside the port.

Medical facilities likely to be used will need to be informed

- The nature and location of the emergency,

- The likelihood or number of casualties,
- Whether medical staff are required at the location of the emergency,
- Actual details of the casualties, including the names, as soon as these are known.

9.4.8.1 First Aid Centers

First Aid treatments provided at the port and the Port ambulance placed at every First Aid centers and hired vehicles, can be used for taking the person to the medical centre. Refer **Appendix B**.

9.4.9 SEARCH AND RESCUE MECHANISM

Search and Rescue mechanism shall start as soon as the public warning signal has been issued and should be carried out as per the instructions of CIC/SIC.

9.4.10 Resource Management

Resources available with the port should be used effectively during the emergencies. The equipment should always be maintained, inspected and tested periodically. Resources available with the JNPT for the preparedness program can be found in **Appendix B.**

9.5 LOGISTICS/SERVICE DELIVERY MECHANISM

The required/necessary equipment and assistance during various types of emergency can be requested from the Local Industry crisis groups, district crisis group MoU signed with Oil Industries and Tank farms association operating in port. Additional resources available for disaster relief with the various departments in the Raigarh District can be found from IDRN (Refer **Appendix B**)

10. RECOVERY AND RECONSTRUCTION

10.1 RESPONSIBILITY FOR TERMINATING THE RESPONSE

The decision to terminate a response is taken by the CIC in consultation with the JNPT Chairman or CMG.

10.2 CONDITIONS FOR TERMINATION

10.2.1 Marine Response Operations should be terminated when:

- Oil has been recovered to the extent practicable; or
- The surface oil slick has broken up; or
- The oil slick has gone out to sea and is beyond the range of response options, and is unlikely to return; or
- Oil has impacted shorelines and is no longer on the water.

In the last case marine response resources must remain on standby and equipment maintained at the ready until shoreline response operations have been completed.

10.2.2 Shoreline Response Operations should be terminated when:

- All accessible shorelines are clean to the extent practicable.
- Cleanup is having no further net beneficial effect or having a deleterious effect on the shoreline or associated plants or animals.

Shoreline cleanup operations may be terminated only upon the instruction of the **MPCB/Coastguard.**

10.2.3 Land Spill Response Operations should be terminated when:

- Chemical has been recovered to the extent possible,
- Area has been declared “Risk or Hazardous” free.
- Source of leakage is stopped and the condition of the area is safe for operation.

Land spill cleanup operations may be terminated only upon the instruction of the **MPCB and PNGRB.**

10.2.4 Fire Extinguishing operation should be terminated when:

- Fire has been completely extinguished,
- Area has been declared as “Risk or Hazardous or Smoke’ free area.

10.2.5 Response action can also be terminated as per the Warning signals given by the agencies (Refer 9.2.3).

10.3 STAND-DOWN PROCEDURES

10.3.1 Return of Equipment

Upon completion of the response, the SIC (or delegate) will:

- Arrange recovery of all equipment, and unused materials.
- Ensure that all equipment is cleaned.
- Ensure that all equipment is returned to the owner.

10.3.2 Debrief

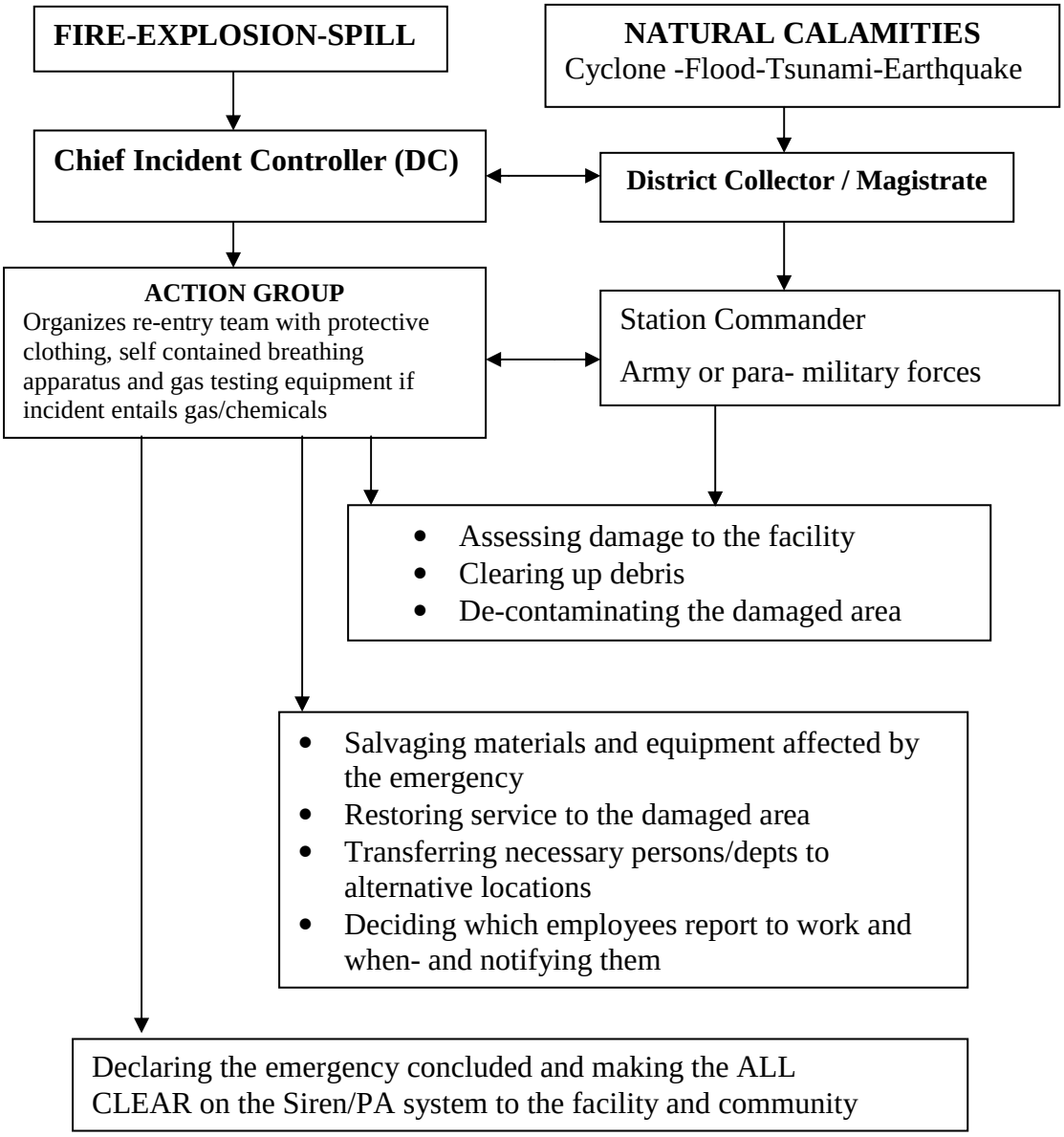
The SIC may hold a post-spill debriefing. Debriefing should address:

- Spill causes (if known) and future prevention methods.
- Speed of response activation.
- Effectiveness or suitability of strategies, tactics and equipment.
- Health and Safety issues (if any).
- Any other issues required to be communicated.
- Damage in terms of life, injury and loss of property should be assessed.

10.3.3 Incident Report

The Chairman JNPT and relevant authority may request the preparation of an Incident Report. This should follow the debrief outline or other format as specified.

Figure 10.1: DE-ACTIVATION OF THE PLAN-RECOVERY-RESTORATION



Note: *-For natural calamities etc at the District level-the District collector or District magistrate will make the necessary initiative through the paramilitary group. The*

Port Chairman or CIC may also request para military personnel to assist when the accidents have originated at the port premises.

Specific procedures for recovering from an emergency and re-entering the facility can hardly be provided, since they will have to be determined on a case by case basis, depending on the type of accident and the severity of the damage suffered. However, provision would be made for the following:

1. Inspecting the damaged area
2. Declaring the emergency concluded and making the "all clear" known to the facility employees and the community
3. Deciding which employees would report to work and notifying them
4. Beginning an investigation into the causes of the emergency
5. Assessing the damage to the facility
6. Transferring necessary operations to alternative locations
7. Decontaminating the damaged area
8. Restoring services to the damaged area
9. Clearing up the debris
10. Salvaging material and equipment affected by the emergency
11. Restoring the parts of the facility affected by the emergency
12. Determining responsibilities and instituting possible insurance and damage claims.

10.3.4 Cost recovery

1. All records of costs must be collated for submission to the relevant insurer.
2. For expenses incurred assisting third parties, costs should be kept and submitted to relevant authority.

10.4 DAMAGE, LOSS AND NEED ASSESSMENT

10.4.1 Initial Damage Assessments

Following any major disaster, rapid assessment of damage is important for restoring the facilities, resuming Port operations and cost recovery. In certain cases e.g. terrorism and security related, thorough site or damage assessment is not possible immediately after an event. Access to, and assessment of Port facilities and its contents may be delayed for a period of time. The delays may be due to possible loss of structural integrity, necessary forensic investigation, or the existence or potential existence of toxic or hazardous materials.

Immediately following a disaster and as soon as it is safe to do so, the CISF or other designated team shall conduct a preliminary damage and environmental assessment by conducting a drive-through of all Port facilities. Damage will be noted in enough detail to allow it to be communicated to assess whether conditions are such that the Damage Assessment Team can be allowed entry and to prioritize recall of Key Personnel and begin developing action plans for recovery.

10.4.2 Secondary Damage Assessments/Temporary Repairs

Once the affected site is approved for entry, a Damage Assessment Team assembled by the Engineering Department will conduct a more thorough assessment of damage to facilities and utilities. This assessment will focus on those assets needed to facilitate a rapid recovery such as electric power, communications and transportation. The assessment should also identify any potential environmental issues that require

immediate attention. Damage should be noted in enough detail to allow it to be communicated to begin developing action plans for recovery. At this time the actions will be initiated for recall of personnel and authorizing the purchase of materials and services needed to begin making repairs to critical systems or addressing environmental hazards. Local utility companies need to be contacted at this time for anticipated schedules for restoration of critical utility services.

10.4.3 Assessment of Damage to Navigational Channel

The assessment of damage to the Navigation Channel is under the jurisdiction of the Indian Navy and Hydrographic department of Survey of India. Assessment of damage to the berthing area portion of the channel is under the jurisdiction of the terminal owner/operator. Assessment of damage to Aids to Navigation is under the jurisdiction of the Port. The Harbormaster or other designated personnel will provide status report the condition of the channel to the Deputy Conservator.

10.4.4 Potential loss estimates analyzed include

- Physical damage to residential and commercial buildings, schools, critical facilities, and infrastructure.
- Economic loss, business interruptions, repair and reconstruction costs.
- Social impacts, including estimates of shelter requirements, displaced households, and population exposed to scenario floods, earthquakes and cyclone Short Term Reconstruction.
- The decision to rehabilitate or abandon port structures depends on the extent of damage, importance of the structure, and limits on its use. Aspects of an inspection may include:
- An underwater inspection by divers to check for possible demolition damage or deterioration of footings.
- An inspection of the piling at low water from a boat to check for decay, borer attack, or other damage. The stringers and deck are examined from below to determine the need for repair.
- Breakwaters, jetties, or seawalls are inspected for damage. If breached, such structures are repaired to avoid scour and further damage.
- Assessment of facilities by civil engineers and surveyors to ensure compliance with local building and architectural codes and to ensure that damaged or repaired buildings are safe for occupancy.

In the event of a terrorist act at the port, reconstruction planning should also take into account the interests of security representative, and the need to collect evidence.

10.5 REPAIR/RESTORATION PHASE

The repair and restoration phase of recovery must be a coordinated effort between all departments. Collectively, decisions will have to be made regarding the priority and order of repairs considering:

- Health and safety issues;
- Available cash flows;
- Spending authority;
- Bidding requirements;
- Contractor availability;

- Customer requirements;
- Lease/contract requirements; and
- Insurance claim management.

10.6 RECOVERY PLANNING

10.6.1 Short-term recovery planning

Short-term recovery planning runs parallel to short term response, and begins during and immediately after an incident

10.6.2 Medium-term recovery planning

In the medium-term recovery planning, port will engage in contracting and setting up for largescale reconstruction and reconstitution operations. This may include financial planning, contracting, and the formation of joint venture agreements to assist in long-term business continuity.

Initial reconstruction of damaged or destroyed facilities begins, as structural and civil engineers rehabilitate existing port structures. They use appropriate methods of lightering and port construction to handle cargo.

The reconstruction activities which may require an Environmental Impact Assessment are as follows:

a. Debris Removal
b. Emergency Protective Measures
c. Repair to Pre-Disaster Condition
d. Modification, Expansion, and Mitigation Projects
e. New Construction and Ground Disturbance

Sr. no. (d) Above has been included so as to undertake proactive mitigation steps as part of **"Build-Back-Better"** of the Sendai Framework.

10.6.3 Long-term recovery planning

In the event that a part of the entirety of a port becomes unusable or requires rebuilding, the long-term reconstruction considerations will be taken by MoS GoI taking into account the financial planning and resources that may be involved in the process. This may include budgetary support.

10.7 RE-OPENING OF BERTHS TO VESSELS

After the channel to the Port has been re-opened and the Port infrastructure is found to be in sound condition, the Port will be in a position to begin accepting request for berthing. This will require coordination between the Port, ship pilots, customers, tenants and private terminals.
Areas of consideration for prioritizing the calling vessels include:

- Available depth in the channel/draft of vessel;
- Condition of facilities to receive the vessel;
- Availability of labor to offload/load cargo;
- Is vessel carrying a critical feedstock for area manufacturing?
- Is vessel carrying commodities that can be used in recovery?

10.8 RAIL-WAGON DELIVERIES

After the Port has found the terminal rail infrastructure in sound condition, the Port will be in a position to begin accepting rail car deliveries. This will again require coordination between the Port, rail authority, customers, tenants and private terminals.

11. BUDGETARY PROVISIONS

11.1 JNPT FINANCIAL ARRANGEMENT IN CASE OF DISASTER

11.1.1 Insurance of Port Assets

In view of incidents like Earthquake, Tsunami, Cyclones, etc. and also directives received from Ministry as well as report of the Committee constituted by IPA, the Port finalized the comprehensive Port Package Policy w.e.f. March, 2006 after valuation of certain Port's Assets by an Independent Valuer. The comprehensive Port package policy comprises Insurance cover for the following properties:

1. Building, Shed and other structure inside port
2. Roads, Culverts, Bridges & Fencing walls in the port area/vicinity
3. VTMS, Navigational aids & Fire fighting aids
4. Berths, Docks & Jetties
5. Port Equipment & Plant & Machineries
6. Oil Pipeline
7. Electrical Installations
8. IT Infrastructure

The Comprehensive Port Package Policy number is 12030022180900000002 (The New Indian Insurance Co. ltd.) with validity from 01.07.2018 to 30.06.2019.

The above policy also covers terrorism (Endt. No 12030022180983000001)

12. PLAN MANAGEMENT

12.1 DEVELOPMENT, APPROVAL, IMPLEMENTATION, REVIEW AND REVISION

- This plan is developed in accordance with the template issued by MoS GoI and guidelines of NDMP (2019) and structured to suit the port organization. The implementation will be undertaken by the office of the Deputy Conservator in association with various stakeholders. It is understood that lessons learned from previous near disaster/disaster situations have been studied and cognizance of the aftereffect of these disasters noted. Understanding of risk and preventive measures has thus been analyzed and mitigation plan prepared. Prioritization of risks has been done in the HRVCA section.
- Plan would be circulated to all stakeholders.
- Regular Drills/exercises would be conducted to test the efficacy of the plan and check the level of preparedness.
- NDRF, SDRF, BARC (for nuclear and radiological emergencies only) and other agencies e.g. civil defense, local govt. departments would be integrated into the plan.
- Review and updating of the plan would be carried out annually as per Disaster Management Act, 2005 Section 37.
- Consequent to any change/modification, the Dy. Conservator/Harbour master is responsible for reviewing, updating and maintaining the DMP.

REFERENCES

1. Data and documents provided by JNPT and various terminals within JNPT.

2. 'National Disaster Management Guidelines' issued by National Disaster Management Authority (NDMA), Govt. of India.

3. Disaster Management Act, 2005.

4. National Disaster Management Plan, 2019.

5. Post 2015- Global Framework.

6. PM of India outline- Point agenda for Disaster Risk Reduction.

7. IMO publication 'Manual on Oil Spill Risk Evaluation and Assessment of Response Preparedness' 2010 edition, London, UK.

8. IMO publication 'Manual on oil pollution – Section IV – Combating oil spills', 2nd edition, 2005, London, UK.

9. IMO, Evaluation of accidental oil spills from bunker tanks submitted by INTERTANKO, Sub-committee on ship design and equipment, 46th session, 5 December 2002.

10. ITOPF (1985) 'Effects of marine oil spills', Technical information paper No. 10, London, UK.

11. ITOPF (1986) 'Fate of marine oil spills', Technical information paper No. 11, London, UK.

12. International Safety Guide for Oil Tankers and Terminals (ISGOTT), 5th Edition, London, UK.

13. IMO publication 'Manual on oil pollution – Section V – Administrative aspects of oil pollution response', 2nd edition, 2009, London, UK.

14. Port and Harbour Risk Assessment and Safety Management System in New Zealand prepared for Maritime Safety Authority of New Zealand, 2004.

15. Internet sites of CG (www.indiancoastguard.nic.in), IMO (www.imo.org), ITOPF (www.itopf.com)

16. IMO publication 'Revised Recommendations on the Safe Transport of Dangerous Cargoes and related activities in Port Areas', ISBN: 9789280114720, 2007.

17. Bureau of Indian Standards (BIS) 'Hazard identification and risk analysis – Code of practice, IS 15656:2006'.

18. Port of Geelong Emergency Management Plan, 2012.

19. Operational Risk Assessment of Port of London May 2001 by Port of London Authority.

20. National Oil Spill Disaster Contingency Plan, Presentation by Mr. Hebbar Director (Environment), Coast Guard Headquarters.

APPENDIX A
RESPONSE SUPPORT DIRECTORY

Aircraft: Surveillance	Will be deployed by the resource agencies if required.
Dispersant: H&S	Refer Material Safety data Sheets (MSDS) for the available dispersants.
Environmental Information	Local Forest & Environment dept. may provide reliable and useful information.
Equipment:	MOU should be made with operators of the Port estate.
Equipment: State	The equipment available in Maharashtra (Raigarh) is listed in IDRN (www.ndmindia.nic.in) database.
Equipment: Fire fighting	**Appendix B** lists the fire fighting response equipment held with JNPT and the stakeholders within port.
Equipment: Oil Port	**Appendix B** lists the pollution response equipments held with JNPT and the stakeholders within port.
International Assistance	International Assistance can be obtained through OSRL & EARL.
Oil Spill Weathering Modeling	JNPT has to utilize available INCOIS facility.
Oil Spill Trajectory Modeling (OSTM)	JNPT has to utilize available INCOIS facility.
Personal: Local	Refer to Directory in **Appendix C** for JNPT personnel.
Personal: State	Support service personnel from state may be obtained through the CMG Coordinator. Contact details are given in **Appendix C**.
Personal: National	Support service from National Response Team (NRT) may be requested through Ministry of Home Affairs (see **Appendix C**).

APPENDIX B
RESOURCES

B.1 JNPT Fire fighting details:

Sea water Fire Fighting facility (installed at Container berth, Container yards, shallow water berth and utility area)		
Main Pump	01 nos.	Electrical Motor Driven Main Pump VERTICAL TURBINE type (Saline Water) Compatible and capable to deliver 4550 lpm (273 m^3/hr) at 145 psi head. The pump is coupled to TEFC motor of suitable HP with speed of 1450 rpm
Diesel Engine Pump	01 nos.	Diesel Engine Driven Pump set VERTICAL TURBINE type (Saline Water) Compatible and capable to deliver 4550 lpm (273 m^3/hr)at 145 psi
Jockey Pump	01 nos.	Electrical Motor Driven Jockey Pump VERTICAL TURBINE type (Saline Water) Compatible and capable to deliver 250 lpm (40 m^3/hr) at 145 psi head. The pump is coupled to TEFC motor of suitable HP with speed of 2900 rpm
Fire Hydrant points	92 nos.	Single Headed Hydrant Valve (Above Ground) as per IS 5290
Fire Monitors	04 no.	Water Monitor made out of seamless steel tubes, hot dip galvanized, 63mm flanged inlet 32 mm nozzle bore, gunmetal ball bearing, swivel joint with locking arrangement permitting 360 Deg. horizontal, 80 - 145 Deg. vertical transverse, confirming to IS:8442

HAZBUND area		
Fire Pump	01 nos.	
Fire Hydrant points	02 nos.	Double Headed Hydrant Valve (Above Ground) as per IS 5290
Fire plastic water tank	04 nos.	Capacity 10,000 ltr

Administration building		
Main Pump	01 nos.	Electrical Motor Driven , 2250 lpm at 70m head conforming to IS 1520
Diesel Engine pump	01 nos.	Diesel Engine Driven Pump set of 2250 lpm at 70m Head conforming to IS 1520
Jockey pump	01 nos.	Electrical Motor Driven Jockey Pump 180 lpm at 70 m. head conforming to IS: 1520
Fire Hydrant points	27 nos.	Headed Hydrant Valve (Above Ground) as per IS 5290
Fire Hose reel	17 nos.	30 m. long 20 mm (nominal internal) dia. water hose Thermoplastic (Textile reinforced) Type - 2 as per IS :

		12585
4 way fire brigade connection	02 nos.	for 150 mm dia. MS pipe connection, conforming to IS 904
79^0C sprinklers	50 nos.	installed at car parking area only
Fresh water tank	04 nos.	25000 ltr each
Submersible pump	01 nos.	5 hp , for priming the tank with required pipeline

Total Gas flooding system (FS125) UL approved at CTCC located at POC building and P.M.C located at administration building		
CTC located at POC building		
Cylinder with discharge valve 120 ltr (centralized)	04 nos.	Room vide and ceiling vide
Cylinder with discharge valve 65 ltr	01 no	Modular – floor vide
Discharge nozzles	25 nos.	
Multi criteria detectors	25 nos.	
Optical detectors	25 nos.	
Hooters	12 nos.	
Manual abort & release set	04 nos.	
Response Indicator	30 nos.	

PMC located at Administration building		
Cylinder with discharge valve 100 ltr (centralized)	04 nos.	Room vide and ceiling vide
Cylinder with discharge valve 42 ltr	01 nos.	Modular – floor vide
Discharge nozzles	21 nos.	
Multi criteria detectors	20 nos.	
Optical detectors	20 nos.	
Hooters	08 nos.	
Manual abort & release set	04 nos.	
Response Indicator	20 nos.	

Guest House no. 2		
Main Pump	01 nos.	Electrical Motor Driven , 1600 lpm at 70m head conforming to IS 1520
Jockey pump	01 nos.	Electrical Motor Driven Jockey Pump 180 lpm at 70 m. head conforming to IS: 1520

Fire Hydrant points	14 nos.	Single Headed Hydrant Valve (Above Ground) as per IS 5290
2 way fire brigade connection	02 nos.	150 mm dia. MS pipe connection, conforming to IS 904 with NRV, for external hydrant system
2 way fire brigade connection	01 nos.	with NRV , direct to Fire Water Tank
Addressable Photoelectric Smoke Detectors	92 nos.	
Addressable Heat Detectors	08 nos.	
Addressable Manual Call point	16 nos.	
Addressable Hooters	16 nos.	
Response Indicator	47 nos.	
Fresh water tank	04 nos.	Capacity 25000 ltr each

Port User building		
Main Pump	01 nos.	Electrical Motor Driven , 1800 lpm at 70m head ,synchronous speed 1500 RPM, conforming to IS 1520
Diesel Engine Pump	01 no	Diesel Engine Driven Pump set of 1800 lpm at 70m head ,synchronous speed 1500 RPM, conforming to IS 1520
Jockey pump	01 nos.	Electrical Motor Driven Jockey Pump 180 lpm at 70 m. head conforming to IS: 1520
Fire Hose reel	08 nos.	30 m. long 20 mm (nominal internal) dia. water hose Thermoplastic (Textile reinforced) Type - 2 as per IS : 12585
4 way fire brigade connection	02 nos.	for 150 mm dia. MS pipe connection, conforming to IS 904
Addressable Photoelectric Smoke Detectors	320 nos.	Wireless
Addressable Heat Detectors	30 nos.	Wireless
Addressable Manual Call point	20 nos.	Wireless
Addressable Address speaker	06 nos.	Wireless with LCD
Fibre Plastic water tank	02 nos.	Capacity 50000 ltr each
Clean gas agent (NAF	250 nos.	

P IV) fire extinguisher. (2 kg.)		
CO_2 4.5 kg. Fire extinguishers	60 nos.	
68^0 c side wall sprinklers	600 nos.	
68^0 c pendant type sprinklers	500 nos.	

High Velocity Water Spray System (HVWSS) for 4 MVA Transformer located at Electric sub-station – E – 6A		
Main Pump	01 no	$97m^3$/hr capacity 70 MWC head 1500 rpm electric motor driven
Jockey Pump	01 no	capacity 10.8 m^3/hr at 70 MWC head 2900 rpm
Automatic deluge valve	01 no	with Water motor gang, Basic trim and Electrical trims etc.
Spray Nozzle brass	35 nos.	
Q.B. Detector 79^0C	28 nos.	
Water Storage Tanks	05 nos.	Capacity 10000 ltr

High Velocity Water Spray System (HVWSS) for 02 Nos. 5 MVA Transformer located at Electric sub-station – E -6A		
Main Pump	01 no	$171m^3$/hr capacity 70 MWC head electric motor driven
Jockey Pump	01 no	10.8 m^3/hr at 88 MWC head, electric motor driven
Automatic deluge valve	02 nos.	with Water motor gang, Basic trim and Electrical trims etc
Spray Nozzle brass	85 nos.	
Q.B. Detector 79^0C	65 nos.	
Water Storage Tanks	04 nos.	Capacity 25000 ltr

High Velocity Water Spray System (HVWSS) for one no. 10 MVA and 02 Nos. 5 MVA Transformers located at Electric sub-station – E – 7 using existing Sea water fire pumps and fire hydrant line		
Automatic deluge valve	02 nos.	with Water motor gong, basic trim and electrical trims etc.
Spray Nozzle brass	126 nos.	
Q.B. Detector 79^0C	96 nos.	

Hospital Building		
Main Pump	01 no	Electrical Motor Driven , 2850 lpm at 70m head conforming to IS 1520

Diesel Engine Pump	01 no	Diesel Engine Driven Pump set of 2850 lpm at 70m Head conforming to IS 1520
Jockey pump	01 no	Electrical Motor Driven Jockey Pump 180 lpm at 70 m. head conforming to IS: 1520
Fire hydrant points	27 nos.	Single Headed Hydrant Valve (Above Ground) as per IS 5290
Fire Hose reel	09 nos.	30 m. long 20 mm (nominal internal) dia. water hose Thermoplastic (Textile reinforced) Type - 2 as per IS : 12585
4 way fire brigade connection	01 no	for 150 mm dia. MS pipe connection, conforming to IS 904
79^0C Sprinklers	950 nos.	
Addressable Photoelectric Smoke Detectors	540 nos.	wireless
Addressable Heat Detectors	32 nos.	wireless
Addressable Manual Call point	32 nos.	wireless
Strobe Cum Speaker	40 nos.	
Fresh water tank	04 nos.	Capacity 25000 ltr each
Submersible pump	01 no	5 hp , for priming the tank with required pipeline

JNPT Fire service Organization chart (existing strength)	
Asst. Manager (Fire & Safety)	01
Station Officer	01
Sub Officers	07
Sr. Driver Cum Pump Operators	02
Driver cum Pump Operators	04
Firemen	36

Portable fire extinguisher installed at different location of JNPT area and JNPT township

Location	Clean agent	Water (Stored pressure) 9 ltr.	CO_2 2 kg	CO_2 3 kg	CO_2 4.5 kg	CO_2 6.8 kg	ABC 2 kg	ABC 5 kg	DCP 5 kg	DCP 10 kg	DCP 22.5 kg	FOAM	TOTAL
Workshop				3	3	1			3	2			12
Auto Garage				5					3			1 (45 ltr)	9
Main Store					4				7	2			13
Bulk Area				29	1	1			2		3		36
Sub-Station (PORT)				12	7	8			2				29
POC Area		1		9	14	3		1					28

Cont. Terminal C/T Gate			1		1				2	2			06
ICD, RMGC **		1		1	7				2	1			12
C/T.(RTGC) **			3	20	1	-	-	-		-	-	-	24
QC (C/T) **			11	20	05	05	-	-	15	5	-	-	61
Administration Building		33		24	2	2	1		01	02			65
Guest House **	30	12			3				1	2			48
Training centre **	25												25
Hospital		23		15	7		1		2	02			50
IES School (Primary)		10				2	4		3				19
IES School (Secondary)		9	2	3	1	2	8		3				28
St. Mary's School		6		3	1	2	8		3				23
E/Sub-station (Township)					1	11			6	1			19
MP Hall , CLUB Township		4	10						2				16
Training Hostel (Township)					2	1			1	2			6
CISF Barrack		2		3		3				2		2 (9 ltr)	12
PUB Building **	250			1	43								294
Total Ext. on site	305	101	27	148	103	41	22	1	58	23	3	3	835
Fire station Full exting. **	09	19	8	7	23	26	4	6	7	12	6		127
Fire station. Empty exting. **		02											02
Extinguisher gone for Refilling	09	12	10	11	16	14		14	27	13			126
Total extinguishers	323	134	45	166	142	81	26	21	92	48	9	3	1090

Mobile fire fighting system

Sr. No.	Equipment/System	Quantity
1.	Fire Water Tenders :– MH-43-U-572, MH-43-U-573 Water tank capacity: 6000 ltr **Pump discharge capacity** – 2000 lpm The pump is centrifugal type, multi pressure having output capacity of 2000 LPM at 7 Kg/cm2 (normal pressure) and 300 LPM at 35 kg/cm^2 (high pressure) at 3 meters suction lift at NTP conditions. **PRIMER: Automatic** reciprocating piston primer capable of lifting water from 7 meters depth at a rate of 30cm/sec at NTP.	02 nos.
2.	Fire Foam Tender :- MH-43-U-571 Water tank capacity: 3000 ltr	01no.

	Foam Tank Capacity: 800 ltr DCP Fire Extinguishers (70 kg) :02 nos. CO_2 Fire Extinguishers (22.5 kg) :04 nos. Pump discharge capacity – 2000 LPM	
3.	Multipurpose Fire Tender- MH-43-P-0040 Water tank capacity: 3000 ltr Foam Tank Capacity: 800 ltr DCP Vessel : 500 kg CO_2 Fire Extinguishers (22.5 kg) : 04 nos. Pump discharge capacity – 2000 LPM	01no.
4.	Hazmat Cum Emergency Rescue Tender :- MH-43-G-0101 With several type of life saving equipments, cutting, spreading, lifting tools and water mist system to combat small fires, Light Mast with Generator facility.	01no.
5.	Self-Contained Breathing Apparatus Sets :- (Open circuit type with positive pressure) Air cylinder Capacity – 1800 ltr Working Duration – 45 min. Spare cylinders - 11nos.	22 Sets
6.	Fire proximity suits	06 nos.
7.	Total portable Fire Extinguishers (different type and capacity to tackle all types of fires during incipient stage.	**1239** nos.

JN Port – Self Contained Breathing Apparatus Sets		
Apparatus	**Capacity &/ Specifications**	**Quantity**
Air Cylinder Spare cylinders	1800 ltr Working duration – 45 min	22 11
Fire Proximity suits	--	04
Fire Entry Suits	--	02
Chemical handling PVC suits	--	10

B.2 Tank Terminal Fire fighting details

B.2.1 Suraj Agro Tank terminal

Sr. No.	**Equipment/System**	**Quantity**
1.	Water storage capacity	500 KL
2.	Fire pump	2 nos. (1 electrical driven, 1 diesel driven)
3.	Jockey pump	1 no.
4.	No. of Single Hydrant Points	14 nos.
5.	No. of Double Hydrant Points	04 nos.
6.	Monitors	06 nos.

7.	No. of Fire Hose Boxes	16 nos.
8.	Fire Hoses RRL type with Male/Female couplings	18 nos. (15m)
9.	Foam pourer system is provided to all tanks	(Presently non-functional)

B.3 Shell India Tank terminal

Sr. No.	Equipment/System	Quantity
1.	Water storage capacity	
2.	Fire pump	1 no. (diesel driven)
3.	Jockey pump	1 no.
4.	Sprinkler system in tank loading bay	
5.	Portable extinguishers	
6.	Water Monitors	

B.4 Reliance Tank terminal

B.4.1 Fire Water Pumps and Pump House

Pump Detail	Flow Rate	Quantity	Pressure
Main Pumps	273 m^3/ hr	2 nos.	10.5 kg/cm^2
Jockey Pump	20 m^3/ hr	1 no.	10.5 kg/cm^2

B.4.2 Fire Water Ring Main

Existing fire hydrant system comprises of double outlet hydrants and water monitors at different locations along the periphery of the dyke-walls and single outlet hydrants on the upper floor of sub-station and Administration Building.

B.4.3 Water Monitors and Foam MOVs

Sr. No.	Monitor No.	Location	Sr. No.	Foam MOVs
1	WM1	Bet.T102/T109	1	T 101
2	WM2	Bet.T101/T102	2	T 102
3	WM3	Bet.T101/T106	3	T 106
4	WM4	Bet.T106/T116	4	T 107
5	WM5	Near BPH	5	T 108
6	WM6	Near TLPH	6	T 109
7	WM7	Near T110	7	T 110

B.4.4 Automatic Fire Detection System

Terminal has automatic fire detection system installed at various locations.
The system comprises of the following elements

1. Heat sensing cable,
2. Thermal detectors,
3. Heat Detectors/Smoke Detectors,

4. Manual Call Points,
5. Fire Alarm Panel (Security Gate),
6. Fire Alarm Hooter,
7. F&G detection system,
8. Manual Electronic Siren.

B.5 IMC Tank terminal

Sr. No.	Equipment/System	Quantity
1.	Jockey Pump	02
2.	Fire Engine	04
3.	Sprinkler system	Provided to all tanks
4.	Sprinkler system	TLFS-I & TLFS-II
5.	Foam Pourer	Provided to all tanks
6.	Water tanks	03
7.	Foam tanks	03
8.	Double hydrant	25
9.	Water cum foam monitor	21
10.	Fire Extinguisher	189
11.	Small fire hose boxes	14
12.	Eye wash shower	04
13.	Foam trolley	03
14.	Mobile water cum foam monitor	02
15.	Hydro carbon detectors	04
16.	Gas meter	02
17.	Fire bucket stands	05
18.	SCBA sets	02 nos. (01 spare cylinder)
19.	Public Address system	02
20.	First Aid box	03
21.	UHF sets for communication	13
22.	Total fire water tanks	03
23.	Total fire water tank capacity	7600 KL
24.	Total foam tanks	03
25.	Total foam available in tanks	6255 ltr
26.	Total foam suction solution available in terminal including tank	8000 ltr

B.6 IOCL Tank terminal

B.6.1 Fire fighting facilities

Water Tank				
Tank No.	**Diameter (m)**	**Height (m)**	**Capacity (KL)**	**Total Water Storage KL**
18	16	15	2854	**11300**
19	16	15	2854	
20	24	15	5600	

No of F/E	**Pump**		**Engine**	
	KL/hr	**Head**	**HP**	**RPM**
1	616	105	355	2100
2	616	105	355	2100
3	616	105	355	2100
4	616	105	355	2100
5	616	105	355	2100
6	616	105	355	2100

No of Jockey Pump	**Pump**		**Motor**	
	KL/hr	**Head(M)**	**KW**	**RPM**
1	171	125	90	2900
2	171	125	90	2975

B.6.2 Fixed fire-fighting equipment covering all activities /operating areas

Sr. No.	**Equipment/System**	**Quantity**
1.	Water Monitor	17 nos.
2.	Water cum Foam Monitors	8 nos.
3.	Double head hydrants	39 nos.
4.	HVLR	2 nos.
5.	Portable HVLR	3 nos.
6.	MEFG	3 nos.

B.7 GBL Tank terminal

B.7.1 Fire Fighting Facility

Terminal fire fighting system comprises of fixed and portable fire fighting equipments as following:

a) Fire Hydrant Network – All around the terminal boundary and hazardous operating area consisting of fire hydrant valves & monitors, Medium Velocity Water Sprinkler System are available.
b) Diesel Generators: presently a hired Diesel generator set is available.

Sr. No.	Equipment/System	Quantity
1.	Water storage capacity	2000 KL
2.	Fire fighting pump	2 nos. (1 electrical driven, 1 diesel driven), 410 m^3/hr
3.	Jockey pump	1 no., 25 m^3/hr
4.	No. of Double Hydrant Points	35 nos.
5.	Water cum foam Monitor	1 no.
6.	No. of Fire Hose Boxes	35 nos.

B.8 DFPCL Tank terminal

B.8.1 Details of Fire Fighting

1. Fire Fighting systems installed	a. Fire hydrant system b. Manual open water sprinkler system for ➢ Ammonia loading bay – Old ➢ Ammonia tank top portion c. Manual water curtain system for ➢ Ammonia loading bay – New ➢ Ammonia transfer pump ➢ Ammonia compressor room ➢ Ammonia receiver d. Automatic smoke detection and alarm system at Terminal control room
2. Details of Fire pumps a. Electrical driven Fire main pump b. Diesel engine driven stand-by pump c. Electrical driven Jockey pump	 Q=171 m^3/hr, H=70m As above Q=11 m^3/hr, H=70m
3. Water Storage Capacities a. Fire water tanks-2Nos. b. Type	 Capacity: 300 m^3 each. Above ground mild steel storage tanks.
4. Hydrant Accessories a. Single Hydrant b. Double Hydrant Points c. Water Monitors d. Hose boxes containing hoses and	 9 nos. 33 nos. 3 nos. 9 nos.

nozzle	
5. Other Details	
a. Fire Jeep	1 no.
b. Manual call points (MCP)	15 nos.
c. Smoke detectors	12 nos.
d. Heat detectors	5 nos.
e. Ammonia detectors	8 nos.
f. DCP Fire Extinguishers	27 nos..
g. Foam type Fire Extinguishers capacity 9 L.	1 no.
h. CO_2 type Fire Extinguishers	16 nos.
i. Fire Brigade inlet	1 no.
j. Fire Bucket	17 nos.
k. SCBA	05 nos.

B.8.2 Location of Ammonia Detectors

Sr. No.	Location of Detector	No. of Detector
1.	Near Marine unloading arm at Jetty	02
2.	Near Ammonia transfer Pump area	01
3.	In ammonia compressor house	01
4.	At ammonia unloading bay 1 to 4	01
5.	At ammonia unloading bay 5 to 7	01
6.	Near ammonia tank outlet nozzles area	01
7.	At ammonia tank top	01

B.9 Fire fighting facility of Liquid Cargo Berth (BPCL)

The fire fighting facility of the BPCL liquid cargo jetty has been provided in line with OISD 156.

Sr. No.	Fire fighting details	
1.	Fire water pumps	3 nos. main + 2 nos. as standby (880 m^3/hr each)
2.	Jockey pump	1 no. main + 1 no. as standby (72 m^3/hr each)
3.	Tower Monitors	06 nos. (2×12 m : 3000 LPM, 2×20 m : 6000 LPM and 2×20 m : 7570 LPM)
4.	Water curtain nozzles	10 nos. (2 nos. 6000 LPM each, 8 nos. 4000 LPM each)
5.	No. of Double Hydrant Points	19 nos.
6.	Foam tank (SS)	3 nos. (15 m^3 each)
7.	Foam pumps	4 nos. (15 m^3/hr each)
8.	Oil Combat System:	Slop tank: 1 no. (11 KL) Oil dispersant spray units: 2 nos. Oil sorbents: pillows (50 nos.) Oil containment boom: 240 meters
9.	Manual Call Points (MCP)	18 nos.

10.	Gas detectors	07 nos.
11.	Fire extinguishers DCP/CO_2	34 nos.
12.	Hose boxes	18 nos.

B.10 Container Terminal Fire fighting details

B.10.1BMCT Terminal

Description	Wharf Pump House	Admin Pump House
Jockey Pump capacity	180 lpm at head of 180 m	180 lpm at head of 200 m
Main pump capacity	4560 lpm at head of 180 m	2850 lpm at head of 200 m
Diesel pump	4560 lpm at head of 180 m	2850 lpm at head of 200 m

B.10.1.1Fire fighting system in terminal and infra building

Sr. No.	Equipment/system
1.	Fire hydrant system in container yard and infra building
2.	Fire hose reel drum in each floor in the infra building and yard
3.	4-way fire brigade inlet
4.	Sprinkler system
5.	Smoke detector
6.	Heat detector and Multi sensor detector
7.	Fire alarm control panel
8.	Manual call point
9.	Fire hydrant pump
10.	Fire sprinkler pump
11.	Fire jockey pump
12.	Fire diesel pump and panel
13.	Fire booster pump
14.	Pressure release valve
15.	PA system
16.	Hooter
17.	Central battery system panel
18.	Annunciation panel
19.	Sand buckets

B.10.1.2 Fire extinguishers installed on equipment and utilities

Sr. No.	Type	Equipment	Quantity
1.	CO_2	QC	11
2.	CO_2	RTGC	4
3.	CO_2	RMGC	10
4.	CO_2	Empty container handler	1
5.	CO_2	Reach stacker	1

6.	NOVEC 1203 fire suppression system	IT server room	2
7.	Nitrogen injection fire protection system	Substation 1, transformers	3
8.	DCP	Placed as required	--
9.	Trolley mounted foam fire extinguisher	Hazardous Bund	1

B.11APM Terminal

Sr. No.	Description	Quantity
Fire Hydrant system		
1.	Hydrant valve external wharf area	31
2.	Hydrant valve external yard area	65
3.	Hose reel drum	10
4.	Hose boxes with RRL hose	40
Fire pump system- wharf area		
1.	Main pump hydrant	1
2.	DG pump set	1
3.	Jockey pump set	1
Fire alarm system		
1.	Fire alarm panel	1
2.	Smoke detector	197
3.	Manual call point	8
4.	Hooter	10
GTI Pump house		
1.	Main pump hydrant	1
2.	DG pump set	1
3.	Jockey pump set	1
4.	Hydrant valve internal	2
5.	First aid hose reel drum	2
6.	Hose boxes with canvas hose	2

B.12Resources for combating Oil spill

B.12.1 JNPT

Sr. No	Items	Quantity	Weight/Dimensions
1.	Oil Spill dispersant kept on board tugs and in stock	5300 ltr	2800 ltr on board tugs 2500 ltr in stock
2.	Oil absorbent pads	30 no. 100 no.	40 * 50 cm each 15” * 19” each
3.	Oil absorbent pillows	05 no. 100 no.	30 * 50 cm each 18” * 18” each

4.	Oil absorbent socks	15 no. 105 no.	08 * 120 cm each 3” * 8” each
5.	Saw dust	2500 kg	50 bags of 50 kg each

B.12.2 Bharat Petroleum Corporation ltd. (Operator of Liquid Cargo handling berths)

Sr. No	Items	Quantity
1.	Oil boom	240 m
2.	Oil dispersant spray system	02 nos.
3.	Oil absorbent pillows	200 nos.
4.	Oil spill dispersant	1800 ltr

B.12.3 Nhava Sheva International Container Terminal (DP World)

Sr. No	Items	Quantity	Weight/ Dimensions
1.	Oil boom	12 pieces	3” diameter * 8 feet
2.	Oil absorbent pads	20 packets * 10 each	50cm * 50cm
3.	Long handle deck brushes, heavy duty	4 pieces	40 cm brush length
4.	Long handle cane booms, suitable for liquid	4 pieces	
5.	Saw dust	200 kg	20 bags of 10 kg each
6.	Hand booms suitable for liquids	2 pieces	
7.	Long handle shovel (Non spark)	4 pieces	
8.	Hand held plastic scoops	4 pieces	
9.	Plastic bags (Heavy duty)	250 nos.	
10.	Empty oil drums with lids	4 no.	200 ltr
11.	Oil Spill chemical dispersant	5 drums	20 ltr
12.	Oil resistant gloves	4 pairs	
13.	Fire extinguishers foam type	2 nos.	9 ltr each
14.	Plastic buckets	4 nos.	10 ltr each
15.	Plastic funnels	4 nos.	
16.	Rags, general use	20 kg	
17.	Sawdust bags	60 bags	
18.	Sand bags	60 bags	
19.	Scoop	12 pieces	
20.	Eye Protective Goggles	10 pieces	
21.	Rubber Hand Gloves	12 pieces	
22.	Oil Spill Containment Boom	12 pieces	

23.	Long handle coir broom	12 pieces	
24.	Absorbent pads	100 pieces	
25.	Dust Mask	50 pieces	
26.	Shovel	10 pieces	
27.	Cotton Bags		

B.12.4 APM Terminal

Sr. no	Description	Quantity	Weight/ Dimensions
1.	Oil Absorbent Socks	6 boxes (6 pieces per box)	7.6 cm * 244 cm
2.	Oil Absorbent pillow	2 boxes (16 pieces per box)	18” * 18”
3.	Oil Absorbent pads	2 boxes (32 pieces per box)	9” * 9”
4.	Booms	9 bales (4 per bale)	8” * 10”
5.	Perforated rolls	6 bales (1 per bale)	46cm * 38cm
6.	Sheets	2 bales (100 Sheets per bale)	38cm * 48cm
7.	Sweep – sorbent roll, bonded to a P.P Rope	2 bales (1 per bale)	30.5 m * 48 cm

B.13 JN Port - Response Craft

Response crafts	Craft Name/From	Description	Response capability
Speed Boat (Owned)	JNPT	1 no.	Pilot Launch
		2 nos.	VIP launches
Speed Boat (Hired)		4 nos.	Pilots launches
		2 nos.	Patrolling
Speed boat	Catamaran -NSICT III	01 no.	With LSA and Fire fighting appliances
Speed boat	Catamaran- NSICT IV	01 no.	
Hired Tugs (8 nos.)	M/S Tag Offshore ltd.	2 no. -50 tonnes Bollard Pull	All tugs have fire fighting equipments and are equipped to deploy booms for spraying oil spill dispersants
	M/S Ocean Sparkle ltd.	1 no. – 60 tonnes Bollard Pull	
		2 nos. tonnes Bollard Pull	
		3 no. tonnes Bollard Pull	

B.14 JN Port - IMO OPRC level trained Responders

Name	Designation	Contact no	IMO OPRC level ½
Mr. J.P Raval	Dy. Manager (Safety)	9833687769	IMO OPRC Level1
Mr. S.G. Saxena	Asst. Manager (Fire & Safety)	9819711965	IMO OPRC Level1
Mr. Manish Shukla	Asst. Manager (Proc)	9920036602	IMO OPRC Level1 &2
Mr. D.G Dhande	Safety Inspector	9076405137	IMO OPRC Level1

In addition to above all, Fire & Safety and MCPC Staff is trained in IMO OPRC level 1.

B.15 First Aid Post

Post Number	Location
First Aid Post No.1 - With ambulance service	Fire station
First Aid Post No.2 - With ambulance service	Ambulance Room near CT Shift office
First Aid Post No.3	BT Office
First Aid Post No.4	CT Sub Store
First Aid Post No.5	Auto Garage
First Aid Post No.6	Main Stores
First Aid Post No.7	Workshop
First Aid Post No.8	Port Control Room
Private Terminals	
GTI –APM	GTI House - Paramedic centre and Ambulance
NSICT - DP World	Paramedic Centre

B.16 Port Vehicle and Hired Vehicle

Vehicle	Quantity
Port Vehicle	
Car	5
Jeep	1
Hired	
Bus	28
Car & Jeep	16 &5
Car & Jeep	16 &6
Car & Jeep	14 &4
Cars 7 Jeep	15 &4
Mini Lorry	

B.17 EMERGENCY CONTROL ROOM EQUIPMENT

Sr. No	Equipment	Quantity
1.	Emergency Lights and torches	6
2.	Radio	1
3.	Computer	1
4.	Printer	1
5.	Telephone-one for in; other for outgoing calls	2
6.	White board and colored marker pens	1
7.	Flip charts	1
8.	Portable PA sets	2
9.	Walkie Talkies	6
10.	Binoculars	1
11.	Copy of EAP	2
12.	Table –seating	1
13.	Tables for equipment	4
14.	Chairs	10

B.18 Required resources for the identified Emergencies

The following table shows the risks identified in this plan and the key resources that may be required during emergencies arising from each risk.

Identified Risk	First Aid/ Medical equip-ment	Lifting equipment/ Fork lift	Cranes	High angle rescue equipment	Boats/ Vessels	Fire Fighting equip-ment	Communica tions	Oil Containment/ cleanup equipment	Others
Marine casualty (Collision/Grounding)	√				√		√		PPE, Ambulance
Fire or Explosion on a vessel at berth	√	√	√		√	√	√		Ambulance, vehicles, PPE, Equipment for cordoning, torch light
Fire or Explosion on a vessel on the water	√				√	√	√		Ambulance, vehicles, PPE, Equipment for cordoning, torch light
Oil Spill					√		√	√	PPE
Utility Failure							√		PPE, Generator, Lightings, torch light
Dangerous Goods spill (other than oil)	√				√	√	√	√	PPE, Dangerous good container/cleanup equipment, Equipment for cordoning, torch light
Gas dispersion	√					√	√		PPE, Equipment for cordoning, torch light
Crane Collapse/Container fall	√	√	√	√	√		√		PPE, Equipment for cordoning, torch light
Terrorist incident	√	√	√	√	√	√	√		Ambulance ,vehicles, Equipment for cordoning, torch light
Bomb Threat	√					√	√		
Cyclone /Severe Storm/Tsunami	√	√	√	√	√	√	√		
Flooding	√	√			√		√		
Earthquake	√	√				√	√	√	PPE, torch light, ambulance, vehicles

B.19 Mutual Aid Agreement

All Port operators/agencies/institutions, where possible, will supply resources to support emergency response operations when requested by CEC/CIC/SIC or whole of Port Emergency Operation Centre as per the Mutual Aid Agreement.

B.20 Resource Inventory (IDRN)

India Disaster Resource Network is an online inventory designed as a decision making tool for the Government administration and crisis managers to coordinate effective emergency response operations in the shortest possible time.

The Ministry of Home Affairs, Government of India has developed a web-based database of resource named India Disaster Resource Network (IDRN). This database contains information about equipment (such as boats, bulldozers, etc), manpower (divers, swimmers, etc) and critical supplies (oxygen cylinder, fire fighting foams, etc) required during the response.

Resources which are available with the various departments in the Raigarh District are uploaded in IDRN.

idrn.gov.in
India Disaster Resource Network

COUNTRY WIDE DISASTER MANAGEMENT RESOURCE INVENTORY - QUERY RESULT

(DISTRICT WISE INVENTORY)

Sl.No	DEPARTMENT/AGENCY DETAILS	DESCRIPTION OF RESOURCE	QUANTITY

..RAIGARH DISTRICT of MAHARASHTRA STATE

.Resource Name - First aid kits

1	**DEPT NAME:**Tahasil Office, Tala **DEPT ADDR:**Tahasil Office, Tala , Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. D B Sawant **CONTACT NO.:**02140-269317, 02140-269324, 02140-202090, 9422379528 **EMAIL ID:**tahasiltala@gmail.com	**RESOURCE DESC:**First aid kits **LOCATION:**Tahasil Office Tala PHC **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**1-Box**
		Total no. of First aid kits available	1-Box

.Resource Name - Vaccines

1	**DEPT NAME:**Tahasil Office, Tala **DEPT ADDR:**Tahasil Office, Tala , Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. D B Sawant **CONTACT NO.:**02140-269317, 02140-269324, 02140-202090, 9422379528 **EMAIL ID:**tahasiltala@gmail.com	**RESOURCE DESC:**Vaccines **LOCATION:**Tahasil Office Tala PHC **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**10-Box**
		Total no. of Vaccines available	10-Box

.Resource Name - Set of rope tackle (3 sheave - 2 sheave)

1	**DEPT NAME:**Roha Muncipal Council **DEPT ADDR:**Roha, Tal. Roha Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Balasaheb Chavan **CONTACT NO.:**02194-235520, 02194-234078, 02194-234607, 9921512632 **EMAIL ID:**	**RESOURCE DESC:**Set of rope tackle (3 sheave - 2 sheave **LOCATION:**Treatment Plant **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**50-Meter**
2	**DEPT NAME:**Roha Muncipal Council **DEPT ADDR:**Roha, Tal. Roha Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. Balasaheb Chavan **CONTACT NO.:**02194-235520, 02194-234078, 02194-234607, 9921512632 **EMAIL ID:**	**RESOURCE DESC:**Set of rope tackle (3 sheave - 2 sheave **LOCATION:**Treatment Plant **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**50-Meter**
		Total no. of Set of rope tackle (3 sheave - 2 sheave) available	100-Meter

.Resource Name - Gas Cutters

1	**DEPT NAME:** Private **DEPT ADDR:**Private,,**Pin Code:** **CONTACT PERSON:** , NOT Availble **CONTACT NO.:**NOT Availble, -, -, **EMAIL ID:**	**RESOURCE DESC:**Not Availble **LOCATION:**Panvel Taluka **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**31-Nos**
2	**DEPT NAME:**Tahasil Office, Mahad **DEPT ADDR:**Tahasil Office, Mahad, Tal. Mahad Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr.Sandip Kadam **CONTACT NO.:**02145-222142, 02145-222689, , 9561120083 **EMAIL ID:**tahsilmahad@gmail.com	**RESOURCE DESC:**two **LOCATION:**Mahad **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**2-Nos**
3	**DEPT NAME:**Tahasil Office, Pen **DEPT ADDR:**Tahasil Office, Pen Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mrs. Sukeshini Pagare	**RESOURCE DESC:**Gas Cutters **LOCATION:**Ispat Industries, Ltd **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**3-Nos**

	CONTACT NO.:02143-252036, , , 9867112317 **EMAIL ID:**		
		Total no. of Gas Cutters available	36-Nos

.Resource Name - Bolt cutters (Shears)

1	**DEPT NAME:**Police **DEPT ADDR:**Murud police station,,**Pin Code:** **CONTACT PERSON:** , P.I. Murad **CONTACT NO.**:02144-284033, 02144-274106, , **EMAIL ID:**	**RESOURCE DESC:**Bolt cutters (Shears) **LOCATION:**Work shop **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**2-Nos**
2	**DEPT NAME:**Police **DEPT ADDR:**Murud police station,,**Pin Code:** **CONTACT PERSON:** , P.I. Murad **CONTACT NO.**:02144-284033, 02144-274106, , **EMAIL ID:**	**RESOURCE DESC:**Bolt cutters(Shears) **LOCATION:**work shop **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**2-Nos**
		Total no. of Bolt cutters (Shears) available	4-Nos

.Resource Name - Electric Drill

1	**DEPT NAME:**Revenue department /tahsil office roha **DEPT ADDR:**tahasil office roha,,**Pin Code:** **CONTACT PERSON:** , Shri. Gopinath R. Thombre **CONTACT NO.**:02140-243928, 02141-242202, , 9422381296 **EMAIL ID:**	**RESOURCE DESC:**Electric Drill **LOCATION:**M.I.D.C. Dhatav **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**1-Nos**
2	**DEPT NAME:**Tahasil Office, Pen **DEPT ADDR:**Tahasil Office, Pen Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mrs. Sukeshini Pagare **CONTACT NO.**:02143-252036, , , 9867112317 **EMAIL ID:**	**RESOURCE DESC:**Electric Drill **LOCATION:**Ispat Industries, Ltd **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**3-Nos**
3	**DEPT NAME:**Tahsil Khalapur **DEPT ADDR:**Tahasil Office, Khalapur, Tal. Mahad Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. Ramnath Karhad **CONTACT NO.**:02192-275048, 02192-275008, , 9960660088 **EMAIL ID:**	**RESOURCE DESC:**Electric Drill **LOCATION:**Uttam Steel Co. **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**5-Nos**
		Total no. of Electric Drill available	9-Nos

.Resource Name - Chipping Hammer

1	**DEPT NAME:**Roha Muncipal Council **DEPT ADDR:**Roha, Tal. Roha Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Balasaheb Chavan **CONTACT NO.**:02194-235520, 02194-234078, 02194-234607, 9921512632 **EMAIL ID:**	**RESOURCE DESC:**Chipping Hammer **LOCATION:**Town hall **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**2-Nos**
2	**DEPT NAME:**Tahasil Office, Pen **DEPT ADDR:**Tahasil Office, Pen Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mrs. Sukeshini Pagare **CONTACT NO.**:02143-252036, , , 9867112317 **EMAIL ID:**	**RESOURCE DESC:**Chipping Hammer **LOCATION:**Ispat Industries, Ltd **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**2-Nos**
		Total no. of Chipping Hammer available	4-Nos

.Resource Name - Cutters-Battery

1	**DEPT NAME:**Tahasil Office, Murud **DEPT ADDR:**Tahasil Office, Murud, Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. Panmand **CONTACT NO.**:02144-274026, 02144-274084, , 7744815403 **EMAIL ID:**murudtah@yahoo.com	**RESOURCE DESC:**Cutters-Battery **LOCATION:**Salav **AVAILABLE TIME:**February to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**1-Nos**
		Total no. of Cutters-Battery available	1-Nos

.Resource Name - Jack with 5 ton lift

1	**DEPT NAME:**Murud Janjira, Municipal council **DEPT ADDR:**Murud, Dis- Raigad,,**Pin Code:** **CONTACT PERSON:** , chief officer **CONTACT NO.**:02144-274022, 02144-274769, , **EMAIL ID:**	**RESOURCE DESC:**Jack with 5 ton lift **LOCATION:**present at departent **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**1-Nos**
2	**DEPT NAME:**Police	**RESOURCE DESC:**Jack with 5 ton lift	

	DEPT ADDR: Murud police station,,**Pin Code:** **CONTACT PERSON:** , P.I. Murad **CONTACT NO.:**02144-284033, 02144-274106, , **EMAIL ID:**	**LOCATION:**present **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**1-Nos**
3	**DEPT NAME:**Tahasil Office, Pen **DEPT ADDR:**Tahasil Office, Pen Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mrs. Sukeshini Pagare **CONTACT NO.:**02143-252036, , , 9867112317 **EMAIL ID:**	**RESOURCE DESC:**Jack with 5 ton lift **LOCATION:**Ispat Industries, Ltd **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**2-Nos**
4	**DEPT NAME:**Tahsil Khalapur **DEPT ADDR:**Tahasil Office, Khalapur, Tal. Mahad Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. Uttam Kumbhar **CONTACT NO.:**02192-275048, 02192-275008, , 9975655375 **EMAIL ID:**	**RESOURCE DESC:**Jack with 5 ton lift **LOCATION:**Uttam Steel Co. **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**6-Nos**
		Total no. of Jack with 5 ton lift available	10-Nos

.Resource Name - Sledge hammer

1	**DEPT NAME:**Police **DEPT ADDR:**Murud police station,,**Pin Code:** **CONTACT PERSON:** , P.I. Murad **CONTACT NO.:**02144-284033, 02144-274106, , **EMAIL ID:**	**RESOURCE DESC:**Sledge hammer **LOCATION:**present **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**1-Nos**
2	**DEPT NAME:**Tahasil Office, Pen **DEPT ADDR:**Tahasil Office, Pen Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Tahasildar **CONTACT NO.:**02143-252036, , , **EMAIL ID:**	**RESOURCE DESC:**Sledge hammer **LOCATION:**Ispat Industries, Ltd **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**3-Nos**
		Total no. of Sledge hammer available	4-Nos

.Resource Name - Heavy Axe

1	**DEPT NAME:**Police **DEPT ADDR:**Murud police station,,**Pin Code:** **CONTACT PERSON:** , P.I. Murad **CONTACT NO.:**02144-284033, 02144-274106, , **EMAIL ID:**	**RESOURCE DESC:**Heavy Axe **LOCATION:**present **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**1-Nos**
2	**DEPT NAME:**Revenue department /tahsil office roha **DEPT ADDR:**tahasil office roha,,**Pin Code:** **CONTACT PERSON:** , Shri. Gopinath R. Thombre **CONTACT NO.:**02140-243928, 02141-242202, , 9422381296 **EMAIL ID:**	**RESOURCE DESC:**Heavy axe **LOCATION:**M.I.D.C. Dhatav **AVAILABLE TIME:**February to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**3-Nos**
		Total no. of Heavy Axe available	4-Nos

.Resource Name - Single sheave snatch block

1	**DEPT NAME:**Home guars **DEPT ADDR:**zilla homeguard mukhyalay, raigad alibag,,**Pin Code:** **CONTACT PERSON:** , Mr. Rajabhau Pawar **CONTACT NO.:**02141-222014, 02141-222012, 02141-222015, 9821343933 **EMAIL ID:**	**RESOURCE DESC:**Single sheave snatch block **LOCATION:**present at department **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**1-Nos**
		Total no. of Single sheave snatch block available	1-Nos

.Resource Name - Set of rope tackle (3 sheave - 2 sheave)

1	**DEPT NAME:**Home guars **DEPT ADDR:**zilla homeguard mukhyalay, raigad alibag,,**Pin Code:** **CONTACT PERSON:** , K D Patil **CONTACT NO.:**02141-222014, 02141-222012, 02141-222015, **EMAIL ID:**	**RESOURCE DESC:**Set of rope **LOCATION:**present at department **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**3-Nos**
2	**DEPT NAME:**Home guars **DEPT ADDR:**zilla homeguard mukhyalay, raigad alibag,,**Pin Code:** **CONTACT PERSON:** , Mr. Rajabhau Pawar **CONTACT NO.:**02141-222014, 02141-222012, 02141-222015, 9821343933 **EMAIL ID:**	**RESOURCE DESC:**set of rope **LOCATION:**present at department **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**3-Nos**
3	**DEPT NAME:**M.S.E.B.Mahad	**RESOURCE DESC:**set of rope tackle	**2-Nos**

	DEPT ADDR:M.S.E.B.Mahad,,**Pin Code:** **CONTACT PERSON:** , Sub Divisional Engineer **CONTACT NO.:**NOT Availble, , , **EMAIL ID:**	**LOCATION:**M.S.E.B.Mahad **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	
	Total no. of Set of rope tackle (3 sheave - 2 sheave) available		8-Nos

.Resource Name - Gloves-Rubber, Tested up to 25, 000 volt

1	**DEPT NAME:**M.S.E.D.C.L. Alibag **DEPT ADDR:**Alibag, Dr.Pant Nagar, Alibag,,**Pin Code:** **CONTACT PERSON:** , Executive Engineer **CONTACT NO.:**02141-225822, 02141-226322, , **EMAIL ID:**eealibag@gmail.com	**RESOURCE DESC:**Gloves-Rubber, Tested up to 25, 000 volt--Hand Gloves **LOCATION:**With Field Staff **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	109-Nos
2	**DEPT NAME:**Revenue department /tahsil office roha **DEPT ADDR:**tahasil office roha,,**Pin Code:** **CONTACT PERSON:** , Mrs. Urmila Patil **CONTACT NO.:**02140-243928, 02141-242202, , 9130799939 **EMAIL ID:**	**RESOURCE DESC:**Gloves-Rubber up to 25, 000 volt **LOCATION:**M.I.D.C. Dhatav **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	2-Nos
	Total no. of Gloves-Rubber, Tested up to 25, 000 volt available		111-Nos

.Resource Name - Stretcher harness (set)

1	**DEPT NAME:**M.S.E.B.Mahad **DEPT ADDR:**M.S.E.B.Mahad,,**Pin Code:** **CONTACT PERSON:** , Sub Divisional Engineer **CONTACT NO.:**NOT Availble, , , **EMAIL ID:**	**RESOURCE DESC:**Not Availble **LOCATION:**M.S.E.B.Mahad **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	1-Nos
2	**DEPT NAME:**Revenue department /tahsil office roha **DEPT ADDR:**tahasil office roha,,**Pin Code:** **CONTACT PERSON:** , Mrs. Urmila Patil **CONTACT NO.:**02140-243928, 02141-242202, , 9130799939 **EMAIL ID:**	**RESOURCE DESC:**Strecher harness (set) **LOCATION:**M.I.D.C. Dhatav **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	2-Nos
	Total no. of Stretcher harness (set) available		3-Nos

.Resource Name - Inflatable Light Tower

1	**DEPT NAME:**Collector Office Raigad Alibag **DEPT ADDR:**Revenue,Alibag,**Pin Code:**402201 **CONTACT PERSON:**Mr.Sagar Pathak , Dist Disaster Management Officer **CONTACT NO.:**02141227449, 02141222097, , 9763646326 **EMAIL ID:**sagarpathak99@gmail.com	**RESOURCE DESC:**Inflatable Light Tower **LOCATION:**Collector Office **AVAILABLE TIME:**January to December **SOURCE:**Govt **ENTERED ON: 5/31/2018(MM/DD/YY)**	2-Nos
2	**DEPT NAME:**Tahasildar Alibag **DEPT ADDR:**Tahasil Office Alibag, Near District Court, Alibag District Raigad,Alibag,**Pin Code:**402201 **CONTACT PERSON:**Tahasildar , Tahasildar **CONTACT NO.:**02141222054, , , 9260320820 **EMAIL ID:**	**RESOURCE DESC:**Inflatable Light Tower **LOCATION:**Tahasil Office **AVAILABLE TIME:**January to December **SOURCE:**Govt **ENTERED ON: 6/1/2018(MM/DD/YY)**	1-Nos
3	**DEPT NAME:**Tahasildar Murud **DEPT ADDR:**Tahasil Office Murud,Murud,**Pin Code:** **CONTACT PERSON:**Tahasildar , Tahasildar **CONTACT NO.:**02144274026, , , 9527557687 **EMAIL ID:**	**RESOURCE DESC:**Inflatable Light Tower **LOCATION:**Tahasil Office **AVAILABLE TIME:**January to December **SOURCE:**Govt **ENTERED ON: 6/1/2018(MM/DD/YY)**	1-Nos
4	**DEPT NAME:**Tahasildar Pen **DEPT ADDR:**Tahasil Office Pen,Pen,**Pin Code:** **CONTACT PERSON:**Tahasildar , Tahasildar **CONTACT NO.:**02143252036, , , 9527557687 **EMAIL ID:**	**RESOURCE DESC:**Inflatable Light Tower **LOCATION:**Tahasil Office **AVAILABLE TIME:**January to December **SOURCE:**Govt **ENTERED ON: 6/1/2018(MM/DD/YY)**	1-Nos
	Total no. of Inflatable Light Tower available		5-Nos

.Resource Name - Electric Generator (10 kv)

1	**DEPT NAME:**Tahasil Office, Karjat **DEPT ADDR:**Tahasil Office, Karjat,,**Pin Code:** **CONTACT PERSON:** , Mr. G.R. Girase **CONTACT NO.:**02148-222037, 02148-222174, , 9322152781 **EMAIL ID:**	**RESOURCE DESC:**Electric Generator (10 kv) **LOCATION:**Dahiwali **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	1-Nos
2	**DEPT NAME:**Tahasil Office, Mhasala **DEPT ADDR:**Tahasil Office, Mhasala, Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. Virendr Visave **CONTACT NO.:**02149-232224, 02149222436, ,	**RESOURCE DESC:**Electric Generator (10 kv) **LOCATION:**Dahivali, Mudre Khurd, Kadav **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	3-Nos

	8888992211 **EMAIL ID:**		
		Total no. of Electric Generator (10 kv) available	4-Nos

.Resource Name - Trucks - Aerial Lift

1	**DEPT NAME:**Tahasil Office, Managaon **DEPT ADDR:**Tahasil Office, Managaon Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. Mahesh Sagar **CONTACT NO.:**02140-262632, , , 9767944999 **EMAIL ID:**	**RESOURCE DESC:**Trucks - Aerial Lift **LOCATION:**Tahasil Office, Managaon **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**27-Nos**
		Total no. of Trucks - Aerial Lift available	27-Nos

.Resource Name - Dumper

1	**DEPT NAME:**Tahasil Office, Karjat **DEPT ADDR:**Tahasil Office, Karjat,,**Pin Code:** **CONTACT PERSON:** , Mr. Ravi Baviskar **CONTACT NO.:**02148-222037, 02148-222174, , 9892871493 **EMAIL ID:**	**RESOURCE DESC:**Dumper **LOCATION:**In Karjat Block **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**57-Nos**
2	**DEPT NAME:**Tahasil Office, Managaon **DEPT ADDR:**Tahasil Office, Managaon Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. Mahesh Sagar **CONTACT NO.:**02140-262632, , , 9767944999 **EMAIL ID:**	**RESOURCE DESC:**Dumper **LOCATION:**Managaon **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**3-Nos**
3	**DEPT NAME:**Tahasil Office, Mhasala **DEPT ADDR:**Tahasil Office, Mhasala, Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. Virendr Visave **CONTACT NO.:**02149-232224, 02149222436, , 8888992211 **EMAIL ID:**	**RESOURCE DESC:**Dumper-Private **LOCATION:**In Karjat Block **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**57-Nos**
		Total no. of Dumper available	117-Nos

.Resource Name - Earth movers

1	**DEPT NAME:**Tahasil Office, Managaon **DEPT ADDR:**Tahasil Office, Managaon Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. Mahesh Sagar **CONTACT NO.:**02140-262632, , , 9767944999 **EMAIL ID:**	**RESOURCE DESC:**Earth movers **LOCATION:**Managaon **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**5-Nos**
		Total no. of Earth movers available	5-Nos

.Resource Name - Lifebuoy

1	**DEPT NAME:**Tahasil Office, Managaon **DEPT ADDR:**Tahasil Office, Managaon Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. Mahesh Sagar **CONTACT NO.:**02140-262632, , , 9767944999 **EMAIL ID:**	**RESOURCE DESC:**Lifebuoy **LOCATION:**Managaon **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**1-Nos**
2	**DEPT NAME:**Tahasil Office, Mhasala **DEPT ADDR:**Tahasil Office, Mhasala, Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. Virendr Visave **CONTACT NO.:**02149-232224, 02149-232316, , 8888992211 **EMAIL ID:**	**RESOURCE DESC:**Lifebuoy **LOCATION:**Mhasala **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**1-Nos**
		Total no. of Lifebuoy available	2-Nos

.Resource Name - Life Jackets

1	**DEPT NAME:**Tahasil Office, Mhasala **DEPT ADDR:**Tahasil Office, Mhasala, Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. Virendr Visave **CONTACT NO.:**02149-232224, 02149-232316, , 8888992211 **EMAIL ID:**	**RESOURCE DESC:**life jackts **LOCATION:**Mhasala **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**2-Nos**
2	**DEPT NAME:**Tahasil Office, Tala **DEPT ADDR:**Tahasil Office, Tala , Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. D B Sawant	**RESOURCE DESC:**Life Jackets **LOCATION:**Tahasil Office Tala **AVAILABLE TIME:**January to December	**1-Nos**

	CONTACT NO.:02140-269317, 02140-269324, 02140-202090, 9422379528 **EMAIL ID:**tahasiltala@gmail.com	**SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	
		Total no. of Life Jackets available	3-Nos

.Resource Name - High Rise Buildings - fire fighting team

1	**DEPT NAME:**Tahasil Office Khalapur **DEPT ADDR:**Tahasil Office Khalapur,,**Pin Code:** **CONTACT PERSON:** , Tahasildar **CONTACT NO.**:02192-275048, -, -, **EMAIL ID:**	**RESOURCE DESC:**Not Availble **LOCATION:**NA **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**8-Nos**
		Total no. of High Rise Buildings - fire fighting team available	8-Nos

.Resource Name - Stretcher normal

1	**DEPT NAME:**Tahasil Office, Mhasala **DEPT ADDR:**Tahasil Office, Mhasala, Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. Virendr Visave **CONTACT NO.**:02149-232224, 02149-232316, , 8888992211 **EMAIL ID:**	**RESOURCE DESC:**Stretcher normal **LOCATION:**Mhasala & Khamgaon **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**2-Nos**
		Total no. of Stretcher normal available	2-Nos

.Resource Name - Portable oxygen cylinders

1	**DEPT NAME:**Tahasil Office, Mhasala **DEPT ADDR:**Tahasil Office, Mhasala, Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. Virendr Visave **CONTACT NO.**:02149-232224, 02149-232316, , 8888992211 **EMAIL ID:**	**RESOURCE DESC:**Portable oxygen cylinders **LOCATION:**Mhasala **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**3-Nos**
		Total no. of Portable oxygen cylinders available	3-Nos

.Resource Name - Water filter

1	**DEPT NAME:**Tahasil Office, Mhasala **DEPT ADDR:**Tahasil Office, Mhasala, Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. Virendr Visave **CONTACT NO.**:02149-232224, 02149-232316, , 8888992211 **EMAIL ID:**	**RESOURCE DESC:**Water filter Hygine **LOCATION:**mhasala, khamgaon, mendadi **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**3-Nos**
		Total no. of Water filter available	3-Nos

.Resource Name - 4 wheel drive vehicle

1	**DEPT NAME:**Tahasil Office Khalapur **DEPT ADDR:**Tahasil Office Khalapur,,**Pin Code:** **CONTACT PERSON:** , Tahasildar **CONTACT NO.**:02192-275048, , , **EMAIL ID:**	**RESOURCE DESC:**Not Availble **LOCATION:**Tahasil Office Khalapur **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**1-Nos**
2	**DEPT NAME:**Tahasil Office, Alibag **DEPT ADDR:**Tahasil Office, Alibag Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mrs. Sharada Powar **CONTACT NO.**:02141-222054, 02141-222554, , 9270014945 **EMAIL ID:**	**RESOURCE DESC:**4 wheel drive vehicle- Sumo **LOCATION:**Tahasil Office, Alibag **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**1-Nos**
3	**DEPT NAME:**Tahasil Office, Managaon **DEPT ADDR:**Tahasil Office, Managaon Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. Mahesh Sagar **CONTACT NO.**:02140-262632, , , 9767944999 **EMAIL ID:**	**RESOURCE DESC:**4 wheel drive vehicle **LOCATION:**Managaon **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**1-Nos**
4	**DEPT NAME:**Tahasil Office, Tala **DEPT ADDR:**Tahasil Office, Tala , Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. D B Sawant **CONTACT NO.**:02140-269317, 02140-269324, 02140-202090, 9422379528 **EMAIL ID:**tahasiltala@gmail.com	**RESOURCE DESC:**jeep **LOCATION:**Tahasil Office Tala **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**2-Nos**
		Total no. of 4 wheel drive vehicle available	5-Nos

.Resource Name - Truck

1	**DEPT NAME:**Tahasil Office, Karjat **DEPT ADDR:**Tahasil Office, Karjat,,**Pin Code:** **CONTACT PERSON:** , Mr. Ravi Baviskar **CONTACT NO.:**02148-222037, 02148-222174, , 9892871493 **EMAIL ID:**	**RESOURCE DESC:**Truck **LOCATION:**In Karjat Block **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**65-Nos**
2	**DEPT NAME:**Tahasil Office, Tala **DEPT ADDR:**Tahasil Office, Tala , Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. D B Sawant **CONTACT NO.:**02140-269317, 02140-269324, 02140-202090, 9422379528 **EMAIL ID:**tahasitala@gmail.com	**RESOURCE DESC:**Truck **LOCATION:**Tahasil Office Tala **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**10-Nos**
		Total no. of Truck available	75-Nos

.Resource Name - Mini Bus

1	**DEPT NAME:**Tahasil Office, Karjat **DEPT ADDR:**Tahasil Office, Karjat,,**Pin Code:** **CONTACT PERSON:** , Mr. Ravi Baviskar **CONTACT NO.:**02148-222037, 02148-222174, , 9892871493 **EMAIL ID:**	**RESOURCE DESC:**- Mini Bus **LOCATION:**Humgaon **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**1-Nos**
		Total no. of Mini Bus available	1-Nos

.Resource Name - Tractor

1	**DEPT NAME:**Tahasil Office, Karjat **DEPT ADDR:**Tahasil Office, Karjat,,**Pin Code:** **CONTACT PERSON:** , Mr. Ravi Baviskar **CONTACT NO.:**02148-222037, 02148-222174, , 9892871493 **EMAIL ID:**	**RESOURCE DESC:**Tractor **LOCATION:**In Karjat Block **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**102-Nos**
2	**DEPT NAME:**Tahasil Office, Managaon **DEPT ADDR:**Tahasil Office, Managaon Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. Mahesh Sagar **CONTACT NO.:**02140-262632, , , 9767944999 **EMAIL ID:**	**RESOURCE DESC:**Tractor **LOCATION:**Managaon **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**11-Nos**
		Total no. of Tractor available	113-Nos

.Resource Name - V-SAT

1	**DEPT NAME:**Tahasil Office, Tala **DEPT ADDR:**Tahasil Office, Tala , Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. D B Sawant **CONTACT NO.:**02140-269317, 02140-269324, 02140-202090, 9422379528 **EMAIL ID:**tahasitala@gmail.com	**RESOURCE DESC:**V-SAT **LOCATION:**Tahasil Office Tala **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**1-Nos**
		Total no. of V-SAT available	1-Nos

.Resource Name - Mobile Phone CDMA

1	**DEPT NAME:**Tahasil Office, Mhasala **DEPT ADDR:**Tahasil Office, Mhasala, Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. Virendr Visave **CONTACT NO.:**02149-232224, 02149222436, , 8888992211 **EMAIL ID:**	**RESOURCE DESC:**Mobile Phone CDMA **LOCATION:**Mhasala **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**1-Nos**
		Total no. of Mobile Phone CDMA available	1-Nos

.Resource Name - Plastic drums

1	**DEPT NAME:**Tahasil Office Khalapur **DEPT ADDR:**Tahasil Office Khalapur,,**Pin Code:** **CONTACT PERSON:** , Tahasildar **CONTACT NO.:**02192-275048, -, -, **EMAIL ID:**	**RESOURCE DESC:**Not Availble **LOCATION:**Tahasil office Khalapur **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**1-Nos**
		Total no. of Plastic drums available	1-Nos

.Resource Name - Office building

1	**DEPT NAME:**Collector Office Raigad Alibag **DEPT ADDR:**Revenue,Alibag,**Pin Code:**402201 **CONTACT PERSON:**Mr.Sagar Pathak , Dist Disaster Management Officer **CONTACT NO.:**02141227449, 02141222097, , 9763646326 **EMAIL ID:**sagarpathak99@gmail.com	**RESOURCE DESC:**Office Building **LOCATION:**Collector Office **AVAILABLE TIME:**January to December **SOURCE:**Govt **ENTERED ON: 5/31/2018(MM/DD/YY)**	**1-Nos**
		Total no. of Office building available	1-Nos

.Resource Name - Search and Rescue Teams for Collapsed Structures

1	**DEPT NAME:**Tahasil Office, Tala **DEPT ADDR:**Tahasil Office, Tala , Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. D B Sawant **CONTACT NO.:**02140-269317, 02140-269324, 02140-202090, 9422379528 **EMAIL ID:**tahasiltala@gmail.com	**RESOURCE DESC:**Search and Rescue Teams for Collapsed Structures **LOCATION:**NA **AVAILABLE TIME:**July to September **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**20-Persons**
		Total no. of Search and Rescue Teams for Collapsed Structures available	20-Persons

.Resource Name - General physician

1	**DEPT NAME:**Tahasil Office, Tala **DEPT ADDR:**Tahasil Office, Tala , Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. D B Sawant **CONTACT NO.:**02140-269317, 02140-269324, 02140-202090, 9422379528 **EMAIL ID:**tahasiltala@gmail.com	**RESOURCE DESC:**General physician **LOCATION:**NA **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**1-Persons**
		Total no. of General physician available	1-Persons

.Resource Name - Vaccines

1	**DEPT NAME:**Tahasil Office, Mhasala **DEPT ADDR:**Tahasil Office, Mhasala, Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. Virendr Visave **CONTACT NO.:**02149-232224, 02149222436, , 8888992211 **EMAIL ID:**	**RESOURCE DESC:**Vaccines **LOCATION:**mhasala, khamgaon, mendadi **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**100-Sets**
		Total no. of Vaccines available	100-Sets

.Resource Name - Chlorine tablets

1	**DEPT NAME:**Tahasil Office, Tala **DEPT ADDR:**Tahasil Office, Tala , Dist. Raigad,,**Pin Code:** **CONTACT PERSON:** , Mr. D B Sawant **CONTACT NO.:**02140-269317, 02140-269324, 02140-202090, 9422379528 **EMAIL ID:**tahasiltala@gmail.com	**RESOURCE DESC:**Chlorine tablets **LOCATION:**Tahasil Office Tala PHC **AVAILABLE TIME:**January to December **SOURCE:**Govt **LAST UPDATED ON: 7/29/2015(MM/DD/YY)**	**1000-Tablets**
		Total no. of Chlorine tablets available	1000-Tablets

APPENDIX C
EMERGENCY CONTACT NUMBERS

Emergency Control Centre (Port Control room or Chamber of Chief Manager – Admin block & Secy. or as directed by the Chairman)

27245151/67815151/27245178/67815178/27242367 or VHF Channel – 13

➢ **IMPORTANT PHONE NUMBERS**

1. FIRE: 2724 5000, 27245100, 67815000, 67815100
2. MEDICAL: 27473565, 27473538, 27473568, 67813568, 24743560, 67813560
3. AMBULANCE ROOM: 27245200, 67815200
4. SECURITY - CISF CONTROL ROOM: 27244545, 67814545, 27242354 (Direct)
5. OFFICE LIQUID CARGO BERTH: 27245075
6. SHIFT INCHARGE (CONTAINER TERMINAL): 27245013, 27245037, 67815013, 67815037
7. POC CONTROL ROOM: 2724 2367, 27245178, 27245151, 67815178, 67815151
8. MASTER UNIT SUB STATION (MUSS); 27244691, 67814691, 27869496

Designation	EPABX	Direct		RC Office, Mumbai
	Office	Office	Mobile	
Chairman	27244001/ 6784001	27242290	9819494001	22832458
Deputy Chairman	27244011/ 67814011	27242219	9819494002	22045372
Deputy Conservator	27244171/ 67814171	27242301	9819494004	---
Harbour Master	24274173/ 67814173	27242334	27710513/ 9819494007	---
Dock Master – I	27245175/ 67815175	---	9323407839	---
Dock Master - II	27245175/ 67815175	---	9820243717	---
Chief Manager (Finance)	27244081/ 67814081	27242241	9769769100	---
Chief Manager (M&E Engineering)	27244181/ 67814181	27242302	27564505/ 9819494014	---
Chief Manager (Traffic)	27244191/ 67814191	27242377	27472661/ 9819494011	---
Chief Manager (Administration) & Secretary	27244021/ 67814021	27242233	9819494003	---
Sr. Dy. Chief Medical Officer	27473565/27243552	---	27472980/ 9819494015	---
Chief Manager (Port Planning & Development)	27244156/ 67814156	27242326	9819494005	---

Manager (P & IR)	27244023	27242639	27472314/ 9819494013	---
Manager (Finance) – I	27244087	---	25205241/ 9867385341	---
Manager (Main Container Berth)	27245003/ 67815003	---	9819999226	---
Manager (Liquid Cargo Berths & Shallow water berths I & II)	27244191/ 67814191	27242377	27719349/ 9819494010	---
Manager (Utility services)	27244196/ 67814196	27242328	27743137/ 9819494015	---
Manager (ICD & SWB III)	27245005/ 67815005	---	9820160457	---
Manager (Port equipment maintenance) – I	27245001/ 67815001	---	9819494918	---
Manager (Materials)	27244198/ 67814198	---	9819999227	---
Manager (C&C) & MR	27244699/ 67814699	---	9819999227	---
Manager (Marine Engineer)	27245166/ 67815166	---	9830772584	---
Manager (Legal)	27244068/ 67814068	27242326	9819930549	---
Manager (Admin.)	27244025/ 67814025	---	9820618326	---
Manager (Estate)	27244066/ 67814066	---	9819999231	---
Manager (PPD) –I	27244160/ 67814160	---	9819999223	---
Manager (PPD) –II	27244158/ 67814158	---	9820166500	---
Manager (MS)	27244038/ 67814068	27242317	9833673162	---
Dy. Manager (MS)	27244038/ 67814038	---	9820864080	---
Dy. Manager (Safety)	27245205/ 67815205	---	9833687769	---
Asst. Manager (Fire & Safety)	27245173/ 67815173	---	9819711965	---
Master unit sub-station (MUSS), JNPT	27244691/ 67814697	27869496	---	---
Shift In-Charge (CT)	27245013/ 67815013	---	---	---
JNPT Hospital	27473568/67813568/	---	---	---

	24743560/67813560			
Ambulance Room – Shift Office	27245200/ 67815200	---	---	---
Fire Station	27245000/67815000/ 272451000/67815100	---	---	---
Port Control Station	27245151/67815151/ 27245178/67815178	27242367	Marine VHF Channel No. 13	---
JNPT township main gate	27243570/ 67813570	---	---	---
JNPT Pump house	27245179/ 67815179	---	---	---

CISF Unit			
	EPABX	**Direct**	**Contact**
CISF Control station	27244545/ 67814545	27242354	---
Sr. Commandant (CISF)	27244216/ 67814216	27242294	9819999234
Dy. Commandant (CISF)	27244222/ 67814222	---	27472246/ 9819494017
Asst. Commandant (CISF)	27244222/ 67814222	---	27472323
Asst. Commandant (CISF)	27244682/ 67814682	---	9757090291
Central gate Complex -CISF	27244682/ 67814682	27242354	---
North Gate Complex – CISF	27245195/ 67815195	24272362	---
South gate Complex – CISF (ODC gate)	27274681/ 67814681	---	---
Admn. Building Reception – CISF	27244218/ 67814218	---	---
CISF line township	27472275/ 27472356	---	---

NDRF – 5th Battalion					
Name & Designation	**Address**	**Contact**	**Fax no.**	**Mobile**	**Unit control room no**
Sh. Anupam-Commandant	5th Battalion NDRF, Sudumbare Taluka,Dist –	02114-247010	02114-24700 8	0942231562 8	02114-247000

	Maval, Pune Maharashtra - 412109				

Port users handling Dangerous Cargo	Contact	Fax
JNPCT		022 27244020
NSICT & NSIGT – DP World	5590 1234	5590 2415
GTI-APM	6681 1000	6681 1110
BMCT		
BPCL office	9049271609/ 27240835/ 27872011	
BPCL jetty (Lilli Marine)	9987072586/ 27240366/ 27242490	
IOCL	65162131/32	
IOTL	65162135/1992	
IMC	9004879994/ 27240875 9004897868/ 27240864	
GBL	9552546101 27241460/ 27242136/39	
RIL	67277200/ 27242001/ 27242091	
Suraj Agro ltd.	27241869/ 27240409	
Bharat Shell	9833366183 27241461	
Deepak Fertilizer ltd.	9892814356 27242097/ 27242117	
CFS		

Hospitals	
Name	**Contact**
JNPT – Hospital	27473568/538/67813568
L.T.M.G. Hospital, Sion, Mumbai	24076381 / 24063000/24092020
J.J. Hospital, Byculla, Mumbai	02071173180/433
KEM Hospital, Parel, Mumbai	+91-22-24107000
G.T. Hospital, Mumbai	22621465
Civil Hospital, Thane	022- 25472582

Palvi Hospital, Uran	27222561
MGM Hospital, CBD, Belapur, Navi Mumbai	022-27576703/27581060/61/62
Lifeline , Panvel	61567000/7003
Civil Hospital , Alibag, Dist – Raigad	02141-222667
NMMC, Vashi	27899901/9906
MGM, Vashi	61526666/66464748

Specialist Teams	**Contact Number**
Commander Coast Guard, ICG Western Region –Mumbai	022-24370848/ 24370842 Fax: 022-24333727/ 24322534/24301455
Disaster Management Unit (Mumbai)	9923693163/9167533885/ 9552229069/9404739083
NDMA – Raigad	02141-222118/227449/ 222079/9763646326

Salvage Company	**Contact Number**
M/s. Sealord Diving & Salvage Pvt. Ltd.	+91-22-27682825/ 9833413650/9967336422
i-Marine Infratech (India) Pvt. Ltd.	+91-22-40561222

Experts	
Name of Body	**Telephone No / Fax No**
Nautical Advisor cum addl. DG (Nautical)	022-25752009 jayakumar-dgs@nic.in
DG Shipping, Mumbai	022-25752005 022-25752010 / 25752011 amitabh.kumar63@nic.in
Indian Register of Shipping, Mumbai	022-30519400 / 25703611 ho@irclass.org
IIT – Mumbai	022-2572 2545 / 2572 3480
Cyclone Detection Radar, IMD Mumbai	022-22150517/ 22174707 patoddgm_rmcmumbai@yahoo.co.in
Area Cyclone Warning Centre (ACWC) – Colaba, Mumbai	022-22150431 / 22160824 acwc.mumbai@gmail.com
Ministry of Environment & Forest (MoEF), Admin, New Delhi	011-24695370 vlvarma.edu@nic.in
The National Environmental Engineering & Research Institute (NEERI), Nagpur	0712-2249999 / 660 / 2244900
Directorate of Maharashtra Fire Services, Mumbai	022-26677555 / 26677666 info@mahafireservice.gov.in
Ministry of Petroleum & Natural Gas	011-23382426 / 23383100
Port Health Officer (PHO), JNPT user building, Sheva, JNPT	022-27242592 / 022-27241373 phonhevasheva@gmail.com

National Institute of Ocean Technology (NIOT), Chennai	044-66783300 / 22460275 / 22460645
National Ship Design and Research Centre, Visakhapatnam	0891-2578360 / 2577754 nsdrc@itpvis.ap.nic.in
Chief Controller of Explosives, Nagpur Joint Chief Controller of Explosives, CBD Belapur, Navi Mumbai	0712-2510248 022-27575946 / 27575946 / 27564941 explosives@explosives.gov.in jtccemumbai@explosives.gov.in
Inspectorate Dock Safety, Navi Mumbai,	022-24060510 / 22623391 idsjnpt@gmail.com idsjnpt@dgfasli.nic.in bsc@dgfasli.nic.in
Inspectorate Dock Safety, Mumbai	022-22692180 / 56565511 / 56565558 022-22613391 idsmumbaigov@gmail.com idsmumbai@dgfasli.nic.in vjg@dgfasli.nic.in
MPCB - Mumbai	022-24020781 / 24014701 022-24023516
MPCB - Navi Mumbai (SRO Taloja)	022-27572740 / 27571586 srotaloja@mpcb.gov.in
MPCB - Navi Mumbai (RO Raigad)	022-27572739 / 27571586 ronavimumbai@mpcb.gov.in mpcbnavimumbai@mpcb.goc.in

Government Services	
Name of the Authority & Address	**Telephone number**
Asst. Director (Safety), Inspectorate Dock Safety, MbPT OSC building, 3rd floor, Opp. GPO, P.D. Mello Road, Mumbai – 400 038.	022-2269 2180/66565511/58/ 09892098006 Fax No. – 02-2261 3391 idsmumbaigov@gmail.com idsmumbai@dgfasli.nic.in vjg@dgfasli.nic.in
Asst. Director (Safety), Inspectorate Dock Safety, POC Canteen Building, Ground floor JNPT, Navi Mumbai - 400707	022-24060510 / 07387146786 idsjnpt@gmail.com idsjnpt@dgfasli.nic.in bsc@dgfasli.nic.in
Director General, Factory Advice Service & Labour Institute, Central Labour Institute, N.S. Mankikar Marg, Sion, Mumbai – 400022.	022-24060502 Fax: 407 1986 fasli@dgfasli.nic.in
Maharashtra Pollution Control Board, Mumbai	022-24020781/782/783 ms@mpcb.gov.in
Regional Officer, MPCB, CBD, Navi Mumbai.	roraigad@mpcb.gov.in mpcbraigad@mpcb.gov.in
Chief Controller of Explosives A Block CGO Complex Fifth floor,	(0712)2510248 explosives@explosives.gov.in

Seminary Hills Nagpur – 440006	
Joint Chief Controller of Explosives A-1 and A-2 Wing, 5th Floor, C.G.O. Complex, CBD Belapur, Navi Mumbai – 400614	022-27575946, 27575946,27564941 jtccemumbai@explosives.gov.in
Directorate of Industrial Safety and Health	+91-22-26572504 dirdish.mum-mh@gov.in
District Collector, Raigad, Alibag	+91-2141-222001/222118 collector.raigad@maharashtra.gov.in
Home Guard, Raigad, Alibag	2141 – 222012 rai.hg-mh@nic.in
Municipal Commissioner, Navi Mumbai CBD, Belapur, Navi Mumbai	+91-22-27567070
Municipal Commissioner, Thane	+91-22-25336523/29 mc@thanecity.gov.in
MSEB, Uran	022-27222388
District Collector, Thane	+91-22-25347444 collector.thane@maharashtra.gov.in
Tahsildar, Uran, Raigad	022 27222352
Relief Commissioner of Maharashtra	022-22025274/9920044125 Fax: 22026712 acs.r@rmaharashtra.gov.in
Director (DM), SDMA	022-22026868/712/8007902145 Fax: 22020454 dir.dm@maharashtra.gov.in

Transport	
Divisional Controller, Raigarh	02143-252289
Divisional Controller, Thane	022-25331132

Civil Defense	
Commandant General Home Guards & Director Civil Defence	022-22842423/22022246 dghg.2014@gmail.com
Director & Fire Adviser	022-26677555/26670438/439 directormfs@mahafireservice.gov.in
Dy. Controller of Civil Defence, Uran	022- 27221355/27222343
Air Force Station (SHEVA)	27241370/71/72

Fire Services	
Fire Stations	**Office number**
Port Fire Station	9879711965/ 2227245173/ 2725000/ 27245100
Uran Nagar Corporation	27222320
ONGC fire station	27212237

Fire Station – Belapur	9967023096/ 27572111
Fire Station – New Panvel	9892492241/ 27452337
Fire Station – Old Panvel	9341158443/ 27461500
Fire Station – Vashi	27660101
Fire Station – Mumbai	23076111/23086181
Fire Station – Taloja MIDC	8108077791/ 27401055
Fire Station – Kalamboli	9867725004/ 27420138
Mumbai Port Trust	022 66565656

Police	
Superintendent of Police, Raigad, Alibag	02141 – 222093
Police Commissioner, Thane	022-25344499/ 9773199678
Commissioner of Police, Navi Mumbai, CBD, Belapur, Navi Mumbai	022-27561099/ 8474820686/8424820665
Traffic Police, Navi Mumbai CBD, Belapur, Navi Mumbai	7738393839/ 8424820665 / 8424820686
Police Control Room, Mumbai	22620111/ 22621855/22621983/ 22625020/22641449/100
Police Control Room, Raigad	02141 – 222100
Police Station, Sheva, Uran (Port Division)	022-27220642/ 27222366/ 9870117903
Nhava Sheva – Jaskhar	27472264/27471012

Water Supply	
Water Supply Station, JNPT	27242243
Maharashtra Jeevan Pradhikaran	+91-22-22026249/ 22835247/22025354
Supdt. Engineer, MWSSB, Thane	25427855
Executive Engineer, MWSSB, Panvel	27453632

First Aid Post		
Post Number	**Location**	**Contact**
First Aid Post No.1 With ambulance service	Fire station	27245000 / 27245100 67815000 / 67815100
First Aid Post No.2 With ambulance service	Ambulance Room near CT Shift office	27245200 / 67815200
First Aid Post No.3	BT Office	27244687 / 27244689 67814687 / 67814689
First Aid Post No.4	CT Sub Store	27245032 / 67815032
First Aid Post No.5	Auto Garage	27245159 / 67815159
First Aid Post No.6	Main Stores	27245136 / 67815136

First Aid Post No.7	Workshop	27245146 / 67815146
First Aid Post No.8	Port Control Room	27245151 / 27245178 67815151 / 67815178
Private Terminals		
GTI –APM	GTI House - Paramedic centre and Ambulance	9821669309
NSICT – DP World	Paramedic Centre	8879419343

Raigad District Help line numbers	
Services	**Helpline numbers**
Coastal Security	1093 (helpline number)
Fire Service	101
Police	100
Ambulance	102
Medical Advice Service, Govt. of Maharashtra	104
Emergency and Disaster Management	108/1077
Maritime SAR Emergency services to Indian Coast Guards	1554

OSRO Particulars (Outsourced)	
Operators Name	Sadhav Shipping Limited
Address	521, Loha Bhavan, P. D'Mello Road, Masjid (East), Mumbai – 400 009.
Phone No	2348 25 24
Fax	2348 25 26
Email	shipping@sadhav.com

School		
Name Of School	**Tel No**	**Address**
IES JNP Vidyalaya	022-27472646/ 27472647/ 27472645	Sheva, Navi Mumbai -400707
St. Mary's JNP School	022-27470555	Sector 2,JNPT Township, Sheva, Navi Mumbai 400707

Food Supply Agency		
Sr. No	**Name of the Food Supply Agency**	**Contact**
1.	Janardhan Shetty	8879658834

Hotel		
Sr. No	**Name of the Hotel**	**Tel No.**
1.	Raj Vikas Residency	9867763004

PORT VEHICLES			
Vehicle	**Qty**	**Details**	**Contact No & Email**
Car	5	Vehicles under Control of Administration Department	--
Jeep	1	--	--
HIRED VEHICLES			
Bus	28	M/s. Vikas Travels, R-502,MIDC,TTC Area, Rabale, Navi Mumbai-400701	022-27692910/ 9322296750 kbjoshi@vikastravels.co.in
Car & Jeep	16 &5	M/s. Abhijeet travels, Office No.5,Coorporate park, At: Sonari, Post-JNPT township,Uran, Navi Mumbai -400707	022-27247000/2847/ 9820675807
Car & Jeep	16 &6	M/s. Tannu transport & Travels, 410 , Matru Chayya, Tal:Uran, Dist:Raigad,Navi Mumbai -400702	022-27231506/ 9870089169
Car & Jeep	14 &4	M/s. Asha Trasport, At: Jaskhar, Post- JNPT Township, Uran, Navi Mumbai-400707	9833583583
Cars 7 Jeep	15 &4	M/s. Dessam Travel Corporation,375/11,Ram Nivas Bldg., Gr. Floor, Agripada, Mumbai -400011	022-27472030/ 23012975/ 9594829262
Mini Lorry		M/s. Tannu Transport & Travels,410,Matru Chayya,Tal:Uran,Dist:Raigad, Navi Mumbai -400702	022-27231506/ 9870089169

AMBULANCES		
Sr. no	**Name of the Institution**	**Contact**
1.	Ganesh Mohite (Private)	9322891871,9323002896
2.	Life Line Hospital, Panvel	27458171
3.	Shekapaksha Karyalay, Panvel	27453701
4.	Uran Municipal Corporation	27222320/27220460

APPENDIX D
ANTIDOTES AND FIRST AID TREATMENT

D.1 USE OF ANTIDOTES FOR SELECTED POISONING

POISON	ANTIDOTE	MECHANISM	ADULT DOSE	PEDIATRIC DOSE	CAUTIONS
Methanol, Ethylene glycol	Ethyl alcohol 5% solution (Abbott)	Inhibit Metabolism to toxic products	Loading dose (LD) 0.6mg/kg maintenance dose (MD) 109 mg/kg/hr. For oral or masogastric administration use 5% ethanol	Same as adult	Adjust achieve ethanol blood level of 100-200 mg% (22-24 mm ol/L)
Cyanide	Cyanide Antidote kit (Lilly) Any 1 nitrite pearls	Converts Felt in Haemoglobin to Felt so CN can attach to methoemoglobin and freely to chrame oxidose.	Break pearls, one at a time and hold them under the patients nose for 15-30 see each minute until sodium nitrate ready, then stop.	Same as adult	Observe for hypotension. Avoid m H bg of over 30%.
	Sodium nitrate 3% in 10 ml ampoules.	As for amyl nitrate	10 ml of 3% souln (300mg) 1.v slowlyover 3-5 mts.	6-8 ml/m2 (or 0.3 ml/kg) over 3-5 mts; do not exceed 10 ml.	As per Amylnitride. Excessove amounts may result in fatal methofatal methomoglobin mia.
	Sodium thiosulphate	Provides excess sulphur to accelerate	50 ml. Of a 25% solutions give over a 10mt period.	30-40 ml/m2 (or 1.65 ml/kg)	

	25% in 50 ml ampoules.	metaglobism of CN to thiocyanate, a non toxic product.			
Metals Arsenic, lead, Mercury	Dimercaprol (BAL) 100 mg/ml in 3 ml ampoules.	Chelates metal to firm inte	35 mg/kg deep 1.M. every 4 hrs for 2 days; then every 4 – 12 hrs for upto 7 days	500 mg/m2 (or 24 mg/kg) 24 hrs. undivided doses every 4 hrs. for 5 days.	Observe for hypert-ens tachycardia headache and nausea
	Dimercaprol (BAL) 100 mg/ml in 3 ml ampoules	Chelates metal to firm inte	50-75 mg/kg/4 hrs deep 1.M. in 2 divided doses or by slow 1.v infusion (total dose over 12.24 hrs) for upto 5 days. No more than 500 mg/kg/course	1000 mg/m2 (or 50 mg/kg) 24 hrs deep 1.M undivided doses every 8-12 hrs for 3-5 days to max. of 2 gms.	Proteinuric, hematura, hyper calcemi fever, lacimation and myalgias may occur.
	Paneicillamin e (cuprimine)	-do-	250 mg/given orally 4 times daily for 5-10 days	600 mg/M2 (0.30/ kg/24 hrs. orally in 2 equally divided doses to max. of 1 gm.	Leokopenia, thrombosis topenia and raphroti like syndrome may develop.
POISON	**ANTIDOTE**	**MECHANISM**	**ADULT DOSE**	**PEDIATRIC DOSE**	**CAUTIONS**
Narcotics	Naloxone	Competitive	0.4-2 mg 1.V Push: repeat as	0.01 mg/kg 1.V	Administration

	(Narcan)	antagonism for re-ceptor sites	needed to 10 mg.	push: repeat as needed	to an addict may cause a withdrawal syndrome.
Nitrate	Methylele Blue (1% soln.)	Reduces methomoglo-bin to haemoglobin	1.2 mg/kg 1.v 1% soln. Over 5-1	Same as adult	Treatment is not necessary unless methemoglobin is 730 soln. And other fluids may turn blue avoid extravasations.
Hydrogen Fluoride	Antidote	2 to 5 CC – 10% solution of Calcium gluconate beneath affected part			--
Chlorine	Antidote	Administer oxygen Tablets (1) VOX (2) DIOVOL (3) AMINOFFILLIN INJECTION (1) Decadron (2) Benasol (3) Deriffillin (4) Siquil			
Organo Phosphorous Compounds PARA. ETHION-ENDO-	Antidote MALATHIO N, PHURATE, SULPHON ETC.	Administer Atropin PAM Injection	Sulphate		
AMMONIA	Antidote	ADMINISTER OXYGEN, GIVE WARMMILL, THOROUGHLY WASH THE			

	First Aid	AFFECTED PART APPLY 0.9 TO 1% ALUM WATER OR 5% SOLN. OF ACETIC, CITRIC, TARTARIC & SULPHONIC ACID. TAKE THE VICTIM TO FRESH AIR IF OXYGEN NOT AVAILABLE.	

D.2 SOME COMMON INDUSTRIAL EXPOSURES AND THEIR FIRST AID TREATMENT

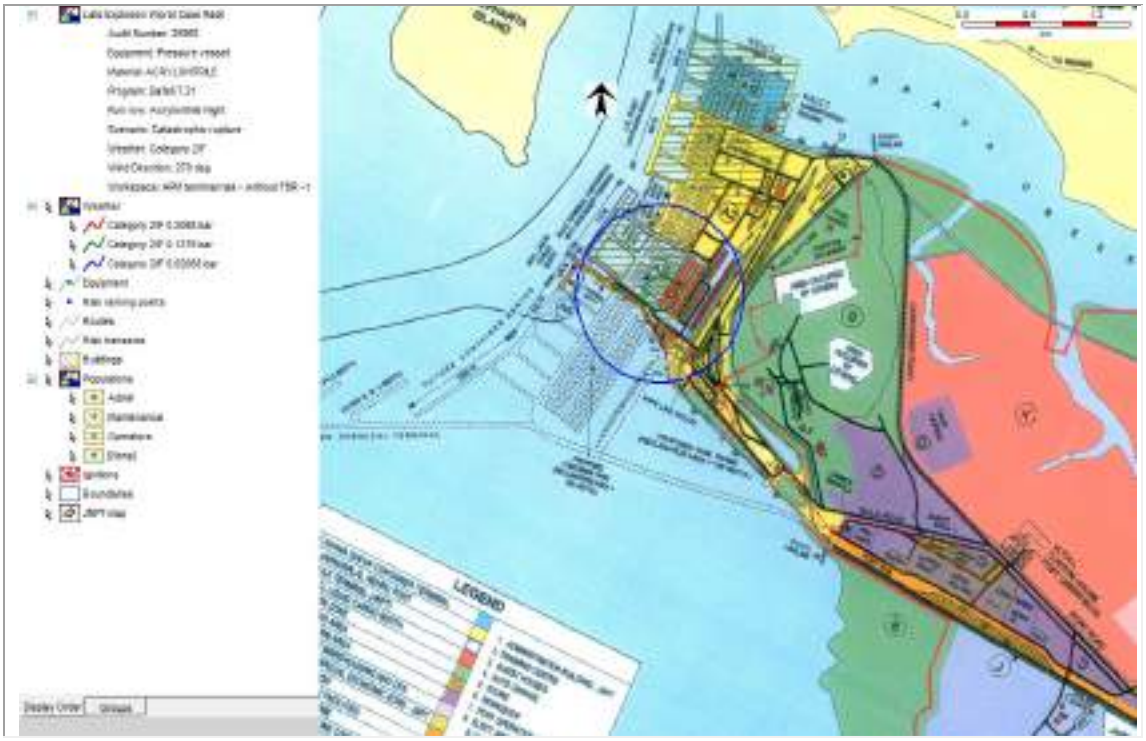
Sr. no	EXPOSURE	EXAMPLE	TYPE OF INJURY	FIRST AID ACTIONS
1.	IRRITANT CASES	Acid/Alkali Vapours, Ammonia, Chlorine, Dimethyl Sulphate, Flourine, Hydrogen Chloride, Hydrogen Sulphide, Isocyanates, Methyl Bromide, Oxides of Nitrogen (No2) Ozone, Phosgene, Phosphine, Phosphorous Oxychloride, Phtalic Anhydride, Silane, Sulphur dioxide, sulphuric acid, C.S. Acid oleum.	Throat, Nose, Eye and Lung Inflammation with possible fluid collection in lung following large exposures.	1. Removal from exposure 2. Maintain airway 3. Oxygen 6 L/min. 4. Physician Referral 5. Beware of possible 12-24 hr delayed onset of lung symptoms.
II.	ACID/ ALKALI SKIN OR EYE CONTACT	Hydrochloric Acid, Hydrofluoric Nitric, Sulphuric, Acetic, Phosphoric, Aqua-Regia (HCL+ HNO3) Oxalic Acid, C.S. Acid, Ammonia, Sodium Hydroxide, Potassium Hydroxide, Calcium Chloride, Sodium Sulphide, Calcium Sulphate.	Skin or Eye Corrosion Destruction.	1. Immediate wash with copious water or buffered salt solution irrigation of contact area for no less than 15 minutes usually longer. 2. Remove contaminated clothing. 3. Physician referral if symptoms persist, large painful area of burn, or evidence of eye-injury (pain, Persistent redness vision loss). 4. Usually specific neutralizing chemicals are unnecessary if water irrigation is prompt and copious. An

				exception is Hydrofluoric acid in which calcium gluconate gel or injections are effective.
III	HYDRO-CARBON SOLVENTS	Aliphatics-Hexane, Aromatics-Toluene, Xylene, Ketones NEK Esters-N-Butyl-Acetate, Ethers-Dioxide, Chlorinated-Trichloro-ethane, Perchloroethylene, chlorobenzenes, Preons.	Temporary depression in Brain function (like "high% of drunkenness)	1 Removal from Exposure 2 Decontamination (remove contaminated clothing and wash any contaminated parts if body) 3 Observation until patient regains normal function. 4 Physician referral if condition worsens, vital signs (Pulse, respiratory rate blood pressure) are unstable patient losses consciousness of large exposure.

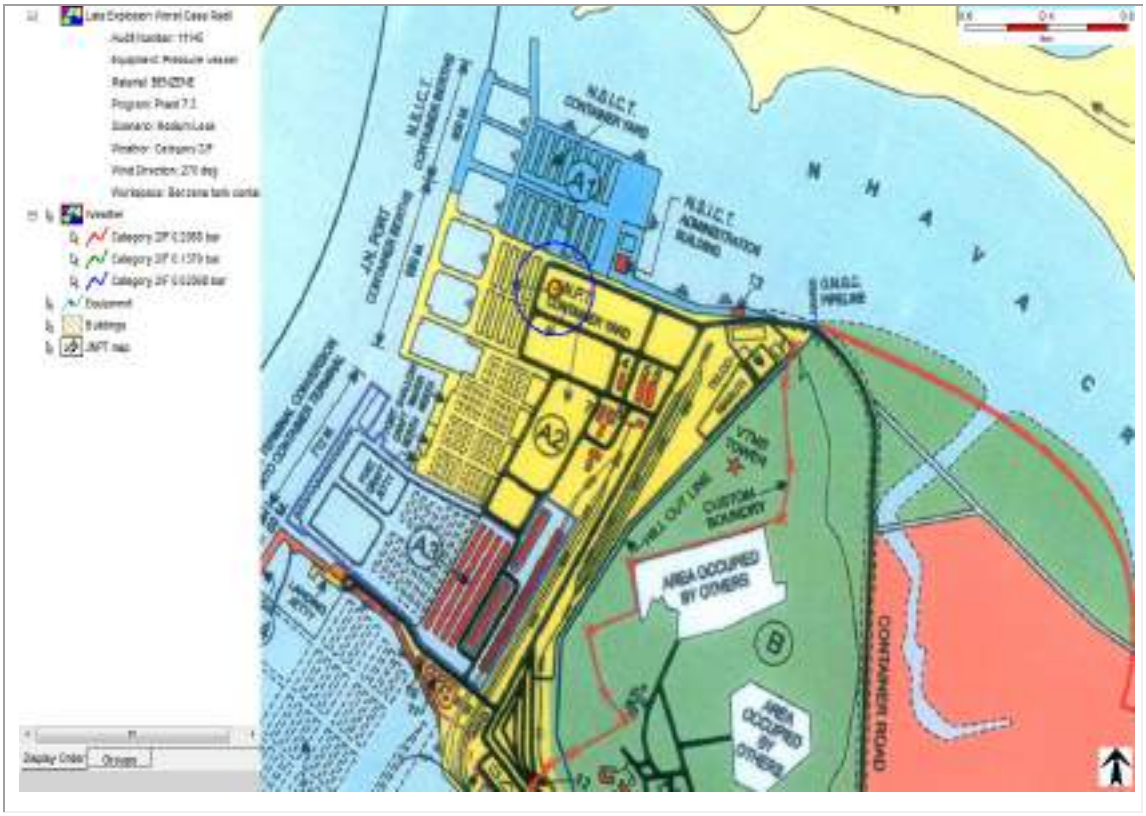
APPENDIX E
CONSEQUENCE ANALYSIS RESULTS

1. Toxic dispersion from Leakage of Acrylonitrile tank container at APM terminal with wind speed **2 m/s, F** stability class and **5 m/s**, **D** stability class.

2. Vapor cloud explosion from Rupture of Acrylonitrile tank container at APM terminal with wind speed **2 m/s** and **F** stability class.

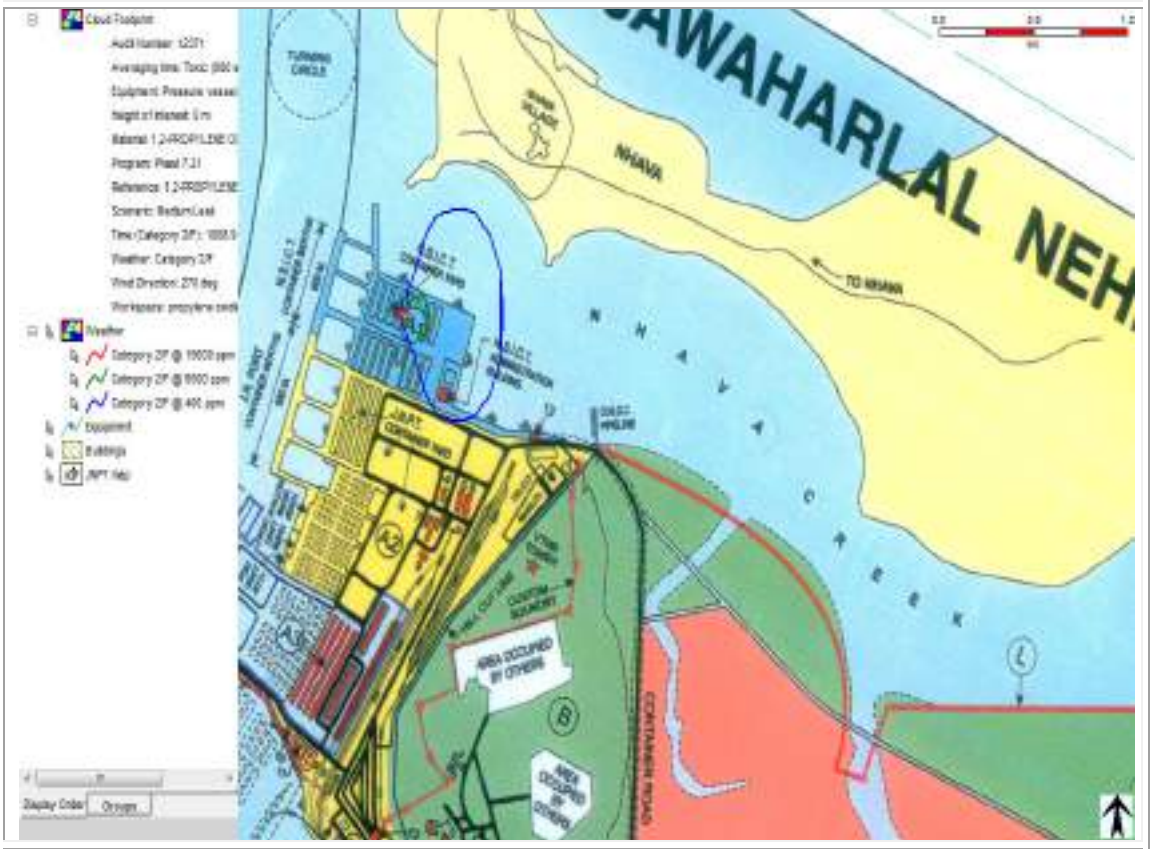


3. Vapor cloud explosion from leakage of Benzene tank container at JNPCT with wind speed **2 m/s** and **F** stability class.

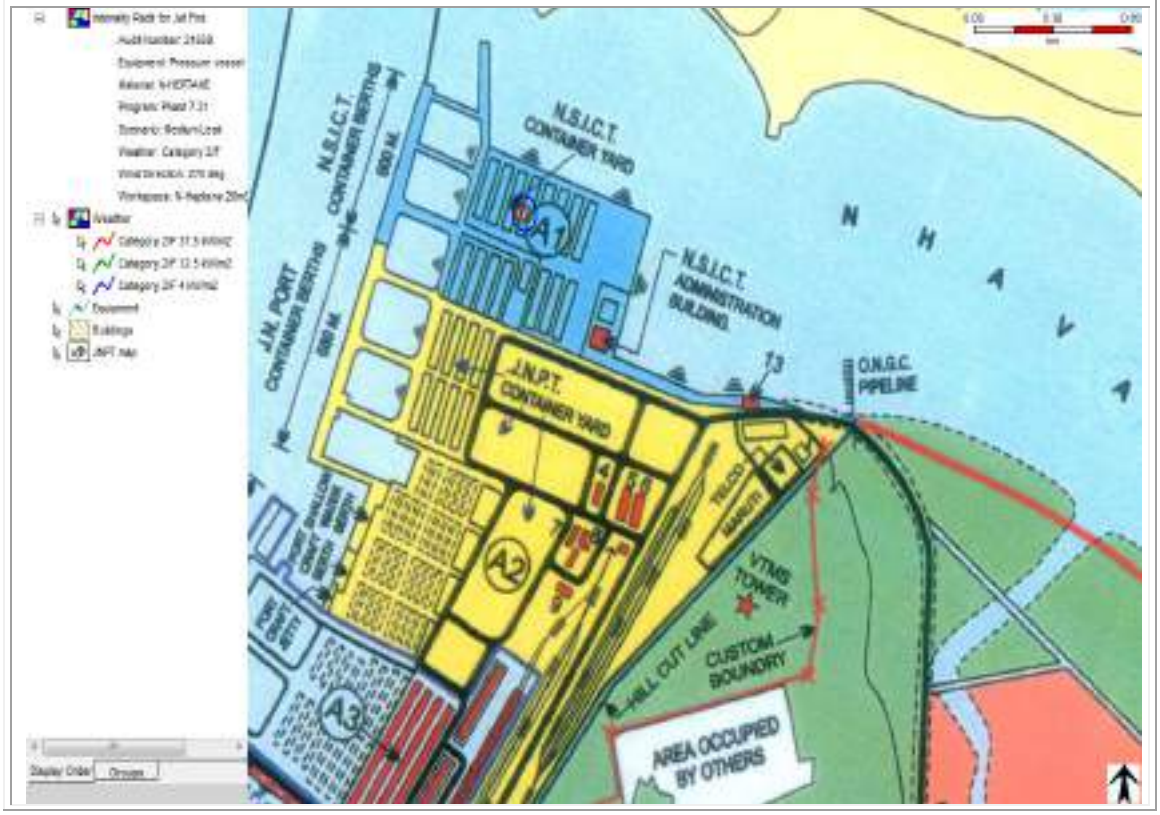


4. Toxic dispersion from leakage of Carbon disulphide tank container at JNPCT with wind speed **2 m/s** and **F** stability class.

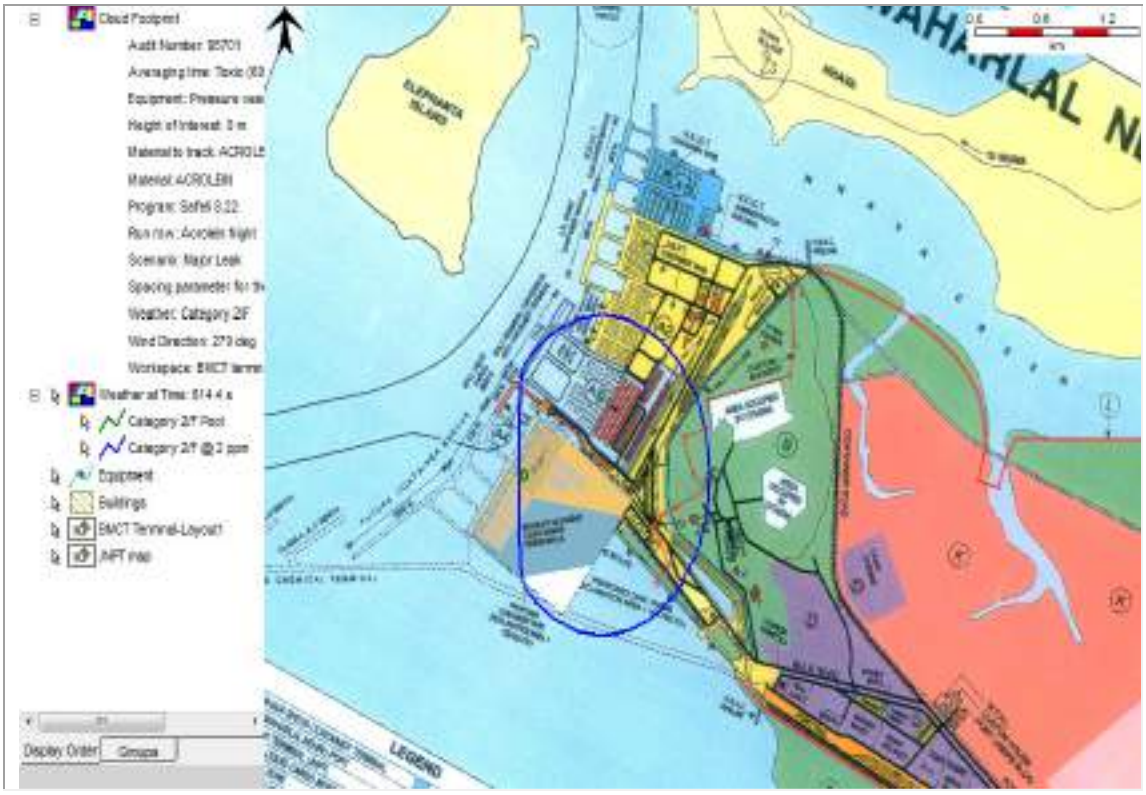
5. Toxic dispersion from leakage of Propylene oxide tank container at DP world terminal with wind speed **2 m/s** and **F** stability class.



6. Jet fire from leakage of N-Heptane tank container at DP world terminal with wind speed **2 m/s** and **F** stability class.

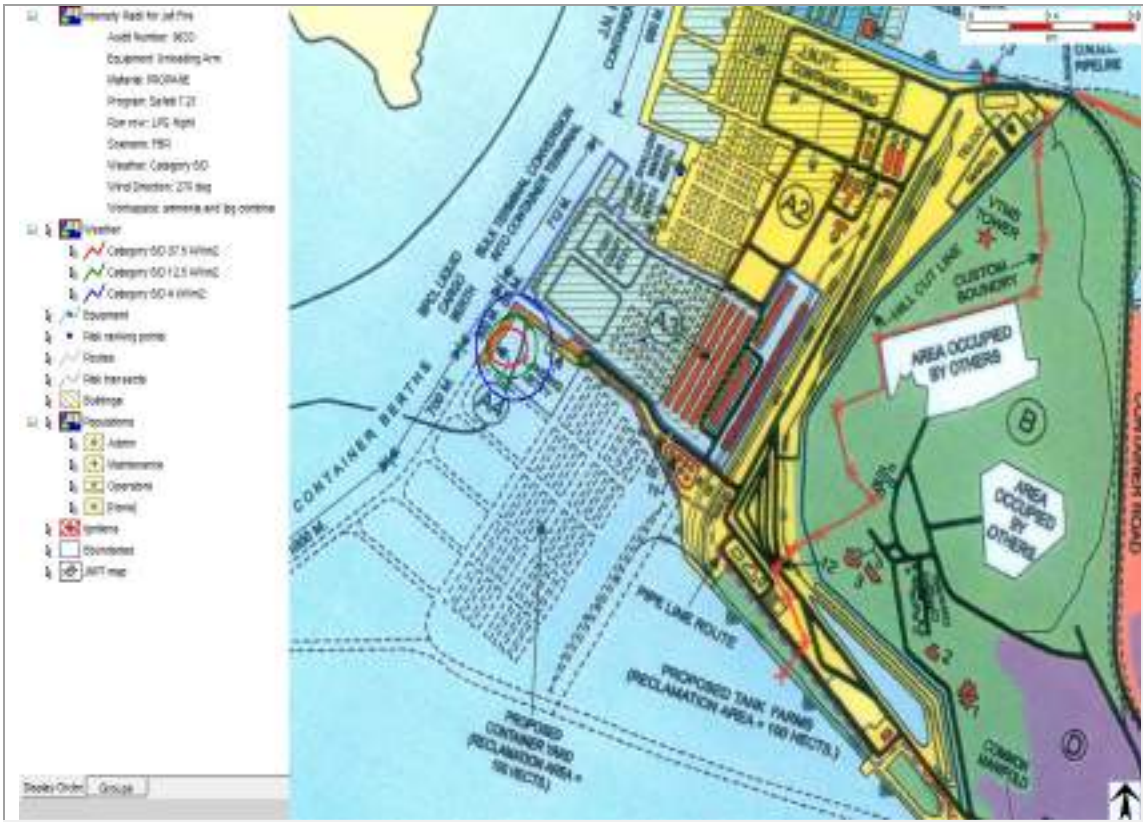


7. Toxic dispersion from leakage of Acrolein tank container at BMCT terminal with wind speed **2 m/s** and **F** stability class.

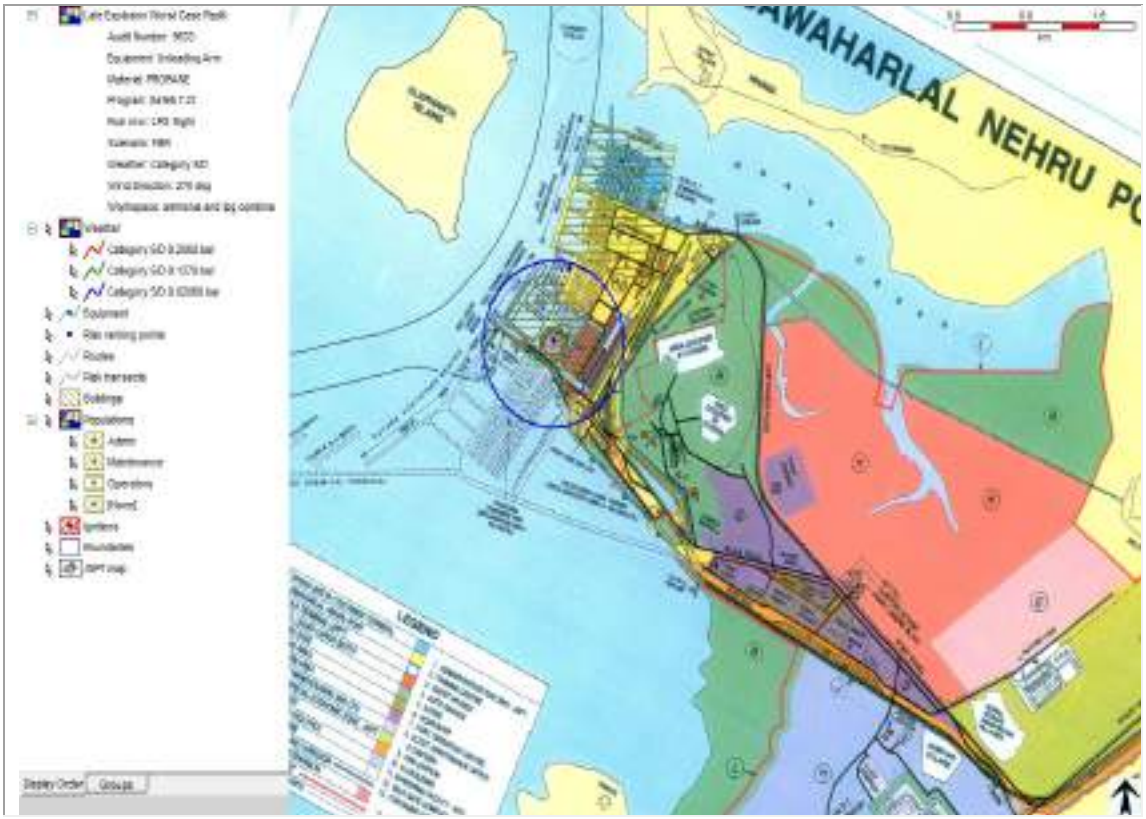


8. Toxic dispersion from leakage of Acrylonitrile tank container at BMCT terminal with wind speed **2 m/s** and **F** stability class.

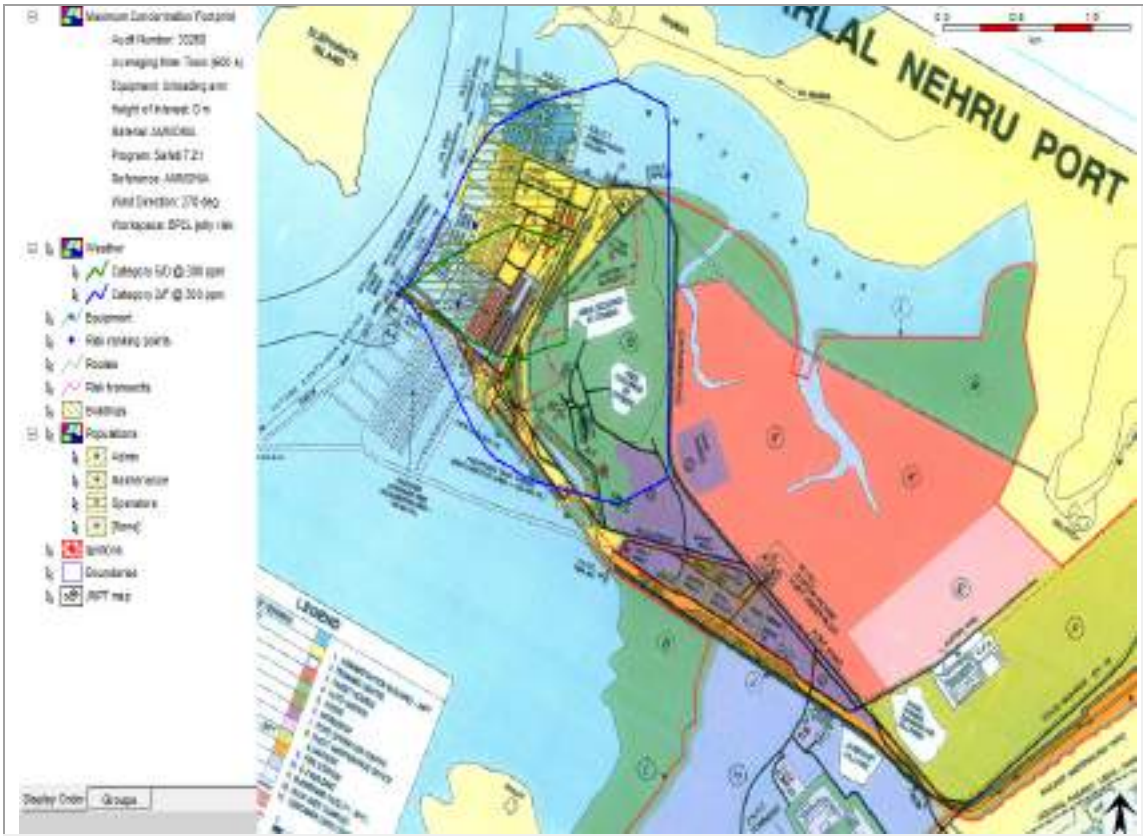
9. Jet fire from Full Bore Rupture of LPG unloading arm with wind speed **5 m/s** and **D** stability class at BPCL LCB.



10. Late Vapor Cloud Explosion from Full Bore Rupture of LPG unloading arm with wind speed **5 m/s** and **D** stability class at BPCL LCB.

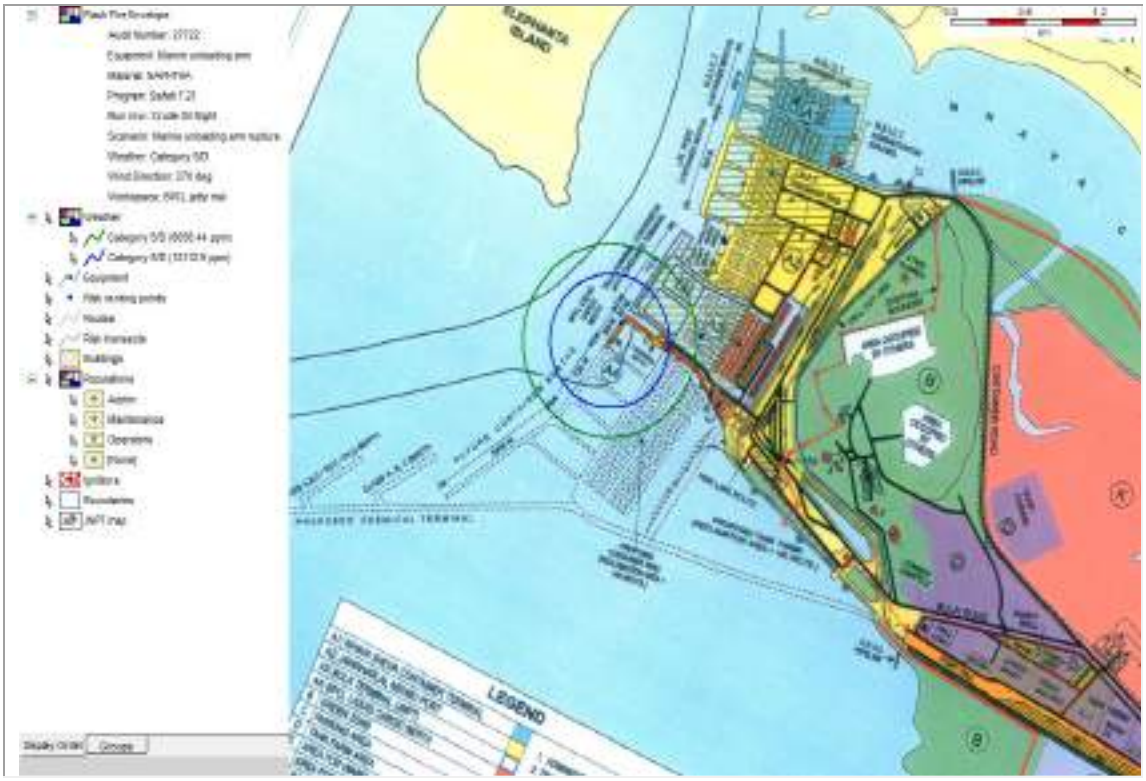


11. Toxic Dispersion from Small leak of Ammonia unloading arm with wind speed 2 **m/s** and **F** stability class at BPCL LCB.



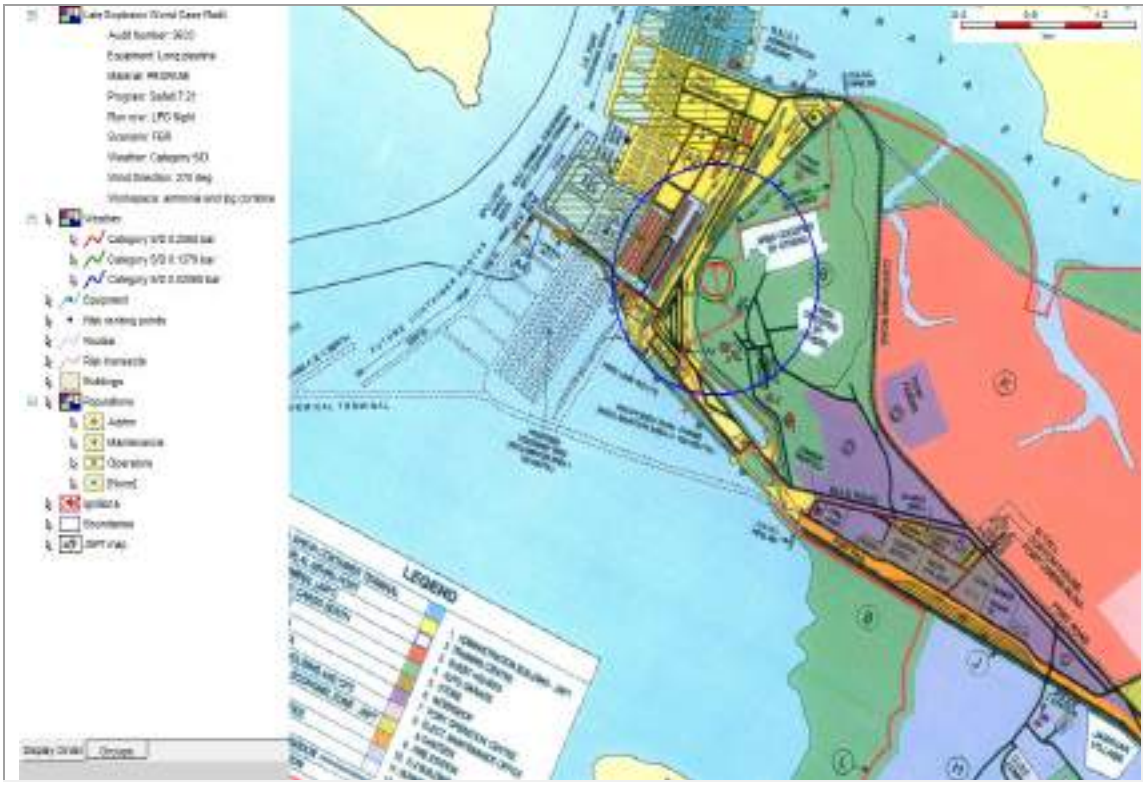
12. Jet fire from Full bore rupture of MS unloading arm with wind speed **5 m/s** and **D** stability class at BPCL LCB.

13. Flash fire from Full bore rupture of Naphtha unloading arm with wind speed **5 m/s** and **D** stability class at BPCL LCB.



14. Pool fire from Full Bore Rupture of 12"LPG pipeline from jetty to storage terminal with wind speed **5 m/s** and **D** stability class at pipeline corridor (1000 m from BPCL LCB).

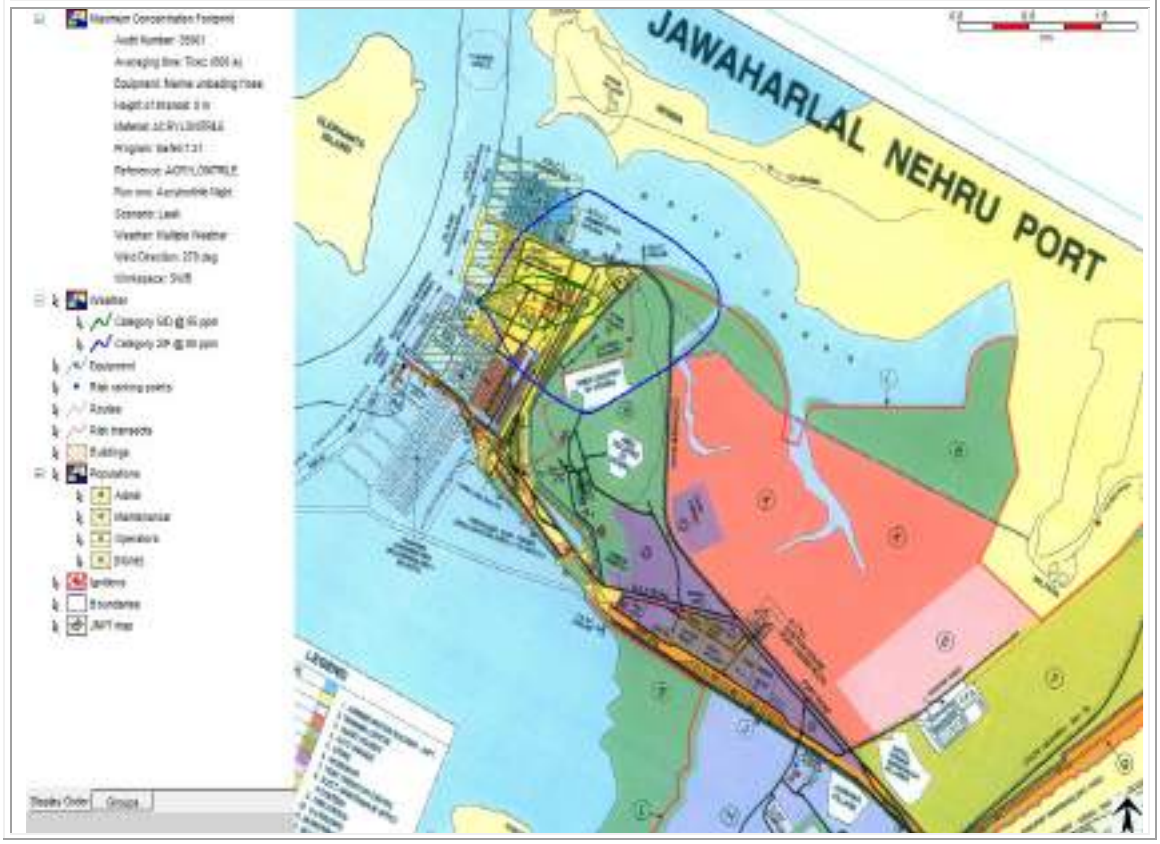
15. Vapor Cloud Explosion from Full Bore Rupture of 12”LPG pipeline from jetty to storage terminal with wind speed **5 m/s** and **D** stability class at pipeline corridor (1000 m from BPCL LCB).



16. Jet fire from Full bore rupture of Crude oil unloading arm with wind speed **5 m/s** and **D** stability class at BPCL LCB.

17. Jet fire from Full bore rupture of Acetone flexible hose at SWB with wind speed **2 m/s** and **F** stability class.

18. Toxic dispersion from Leakage of Acrylonitrile flexible hose at SWB with wind speed **2 m/s** and **F** stability class.



19. Toxic dispersion from Full bore rupture of Benzene flexible hose at SWB with wind speed **2 m/s** and **F** stability class.

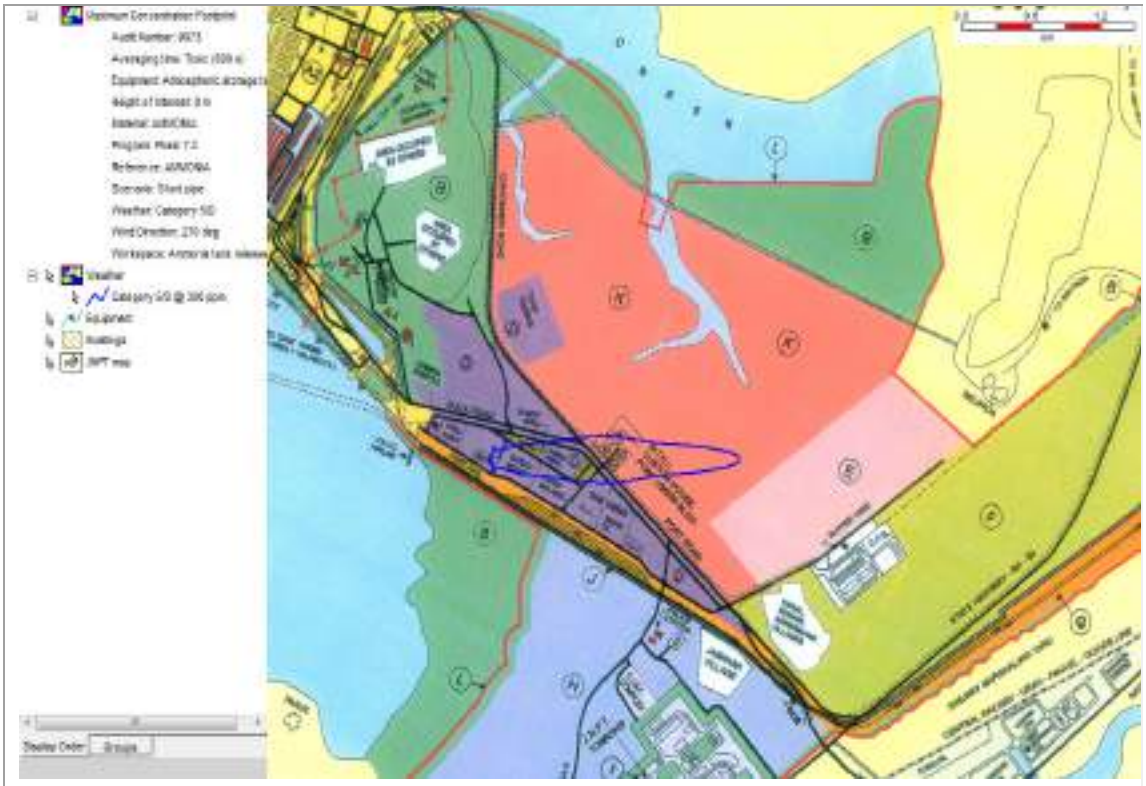
20. Flash fire from Full bore rupture of Cyclohexane flexible hose at SWB with wind speed **5 m/s** and **D** stability class.

21. Flash fire from Full bore rupture of Propylene flexible hose at SWB with wind speed **5 m/s** and **D** stability class.

22. Jet fire from Full bore rupture of Toluene flexible hose at SWB with wind speed **2 m/s** and **F** stability class.

23. Pool fire from Leakage of Ammonia tank at Dipak fertilizer terminal with wind speed **2 m/s** and **F** stability class.

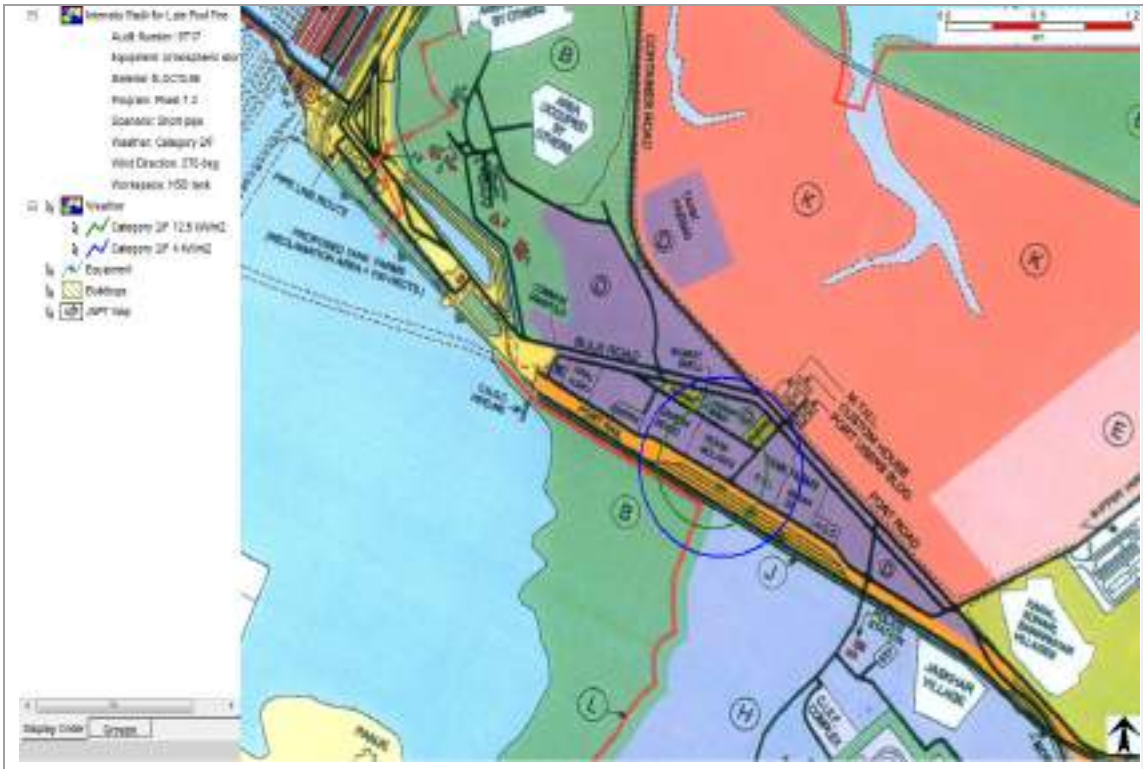
24. Toxic dispersion from Leakage of Ammonia tank at Dipak fertilizer terminal with wind speed **5 m/s** and **D** stability class.



25. Jet fire Leakage of Butyl acrylate tank at IMC terminal with wind speed **2 m/s** and **F** stability class.

26. Pool fire Leakage of Ethanol tank at IMC terminal with wind speed **2 m/s** and **F** stability class.

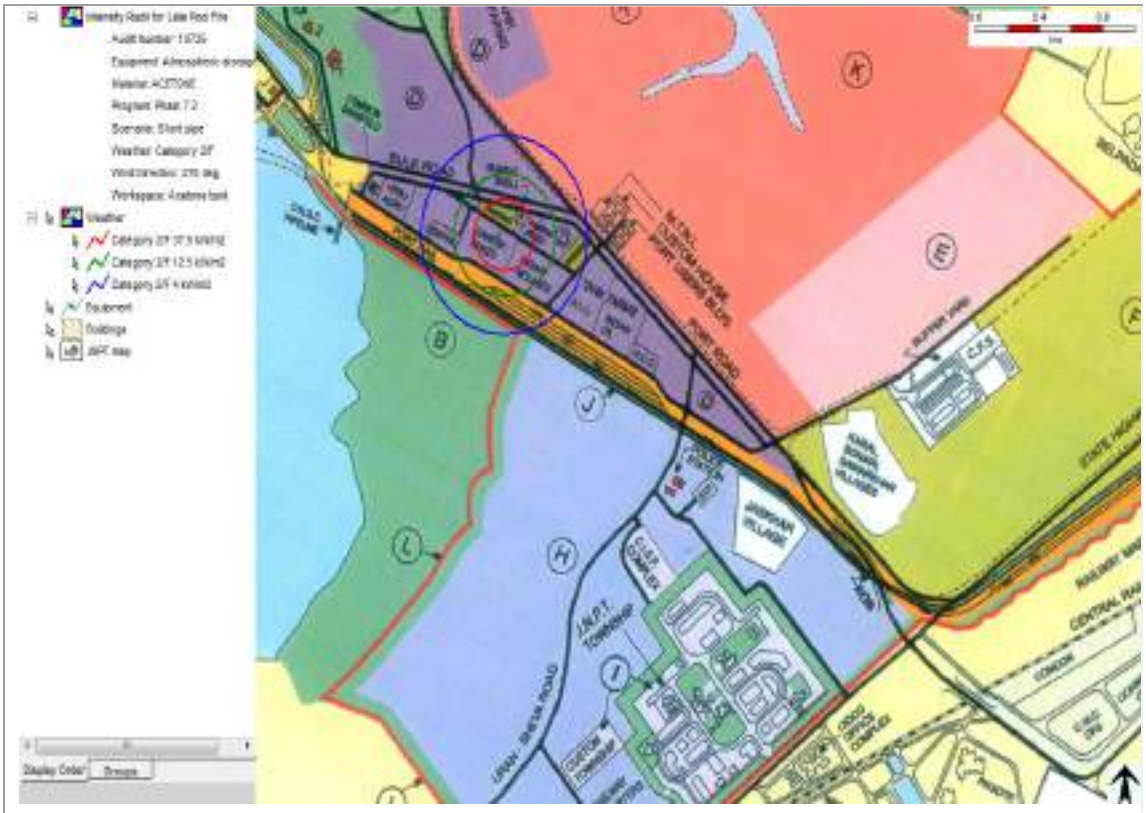
27. Pool fire Leakage of HSD tank at IMC terminal with wind speed **2 m/s** and **F** stability class.



28. Pool fire Leakage of Styrene monomer tank at IMC terminal with wind speed **2 m/s** and **F** stability class.

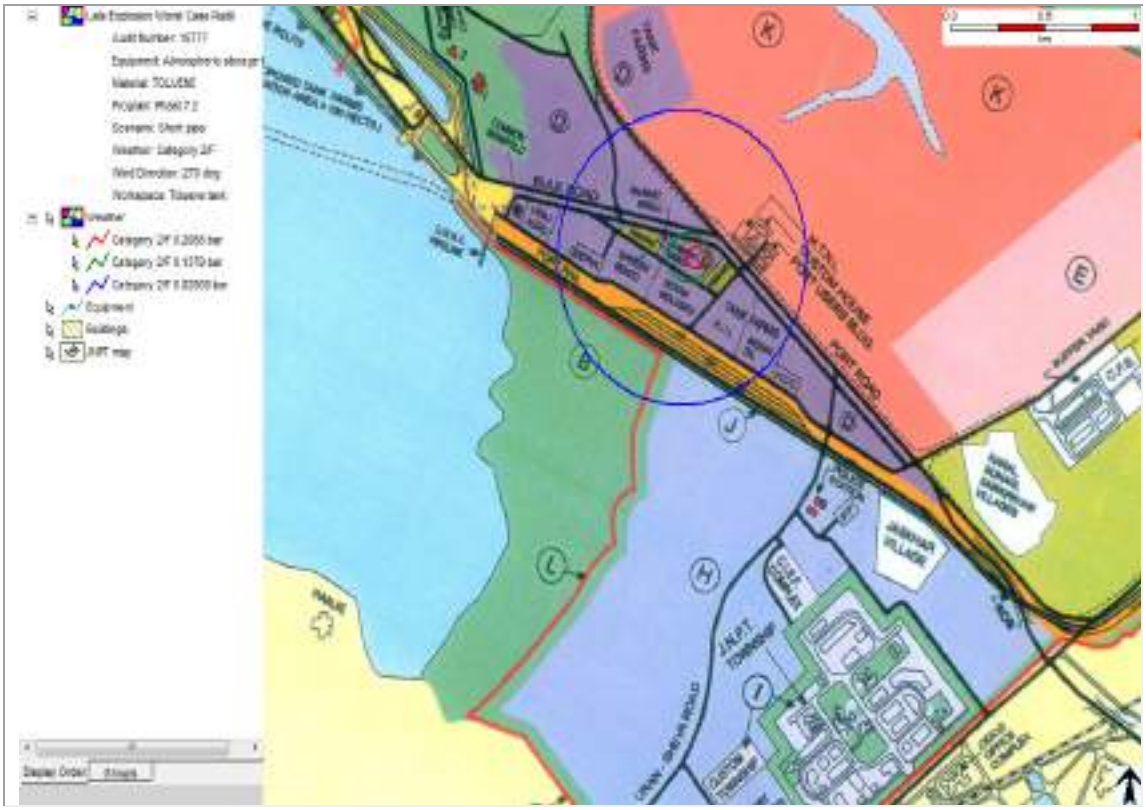
29. Toxic dispersion from Leakage of Acetic acid tank at GBL terminal with wind speed **5 m/s** and **D** stability class.

30. Pool fire from Leakage of Acetone tank at GBL terminal with wind speed **2 m/s** and **F** stability class.

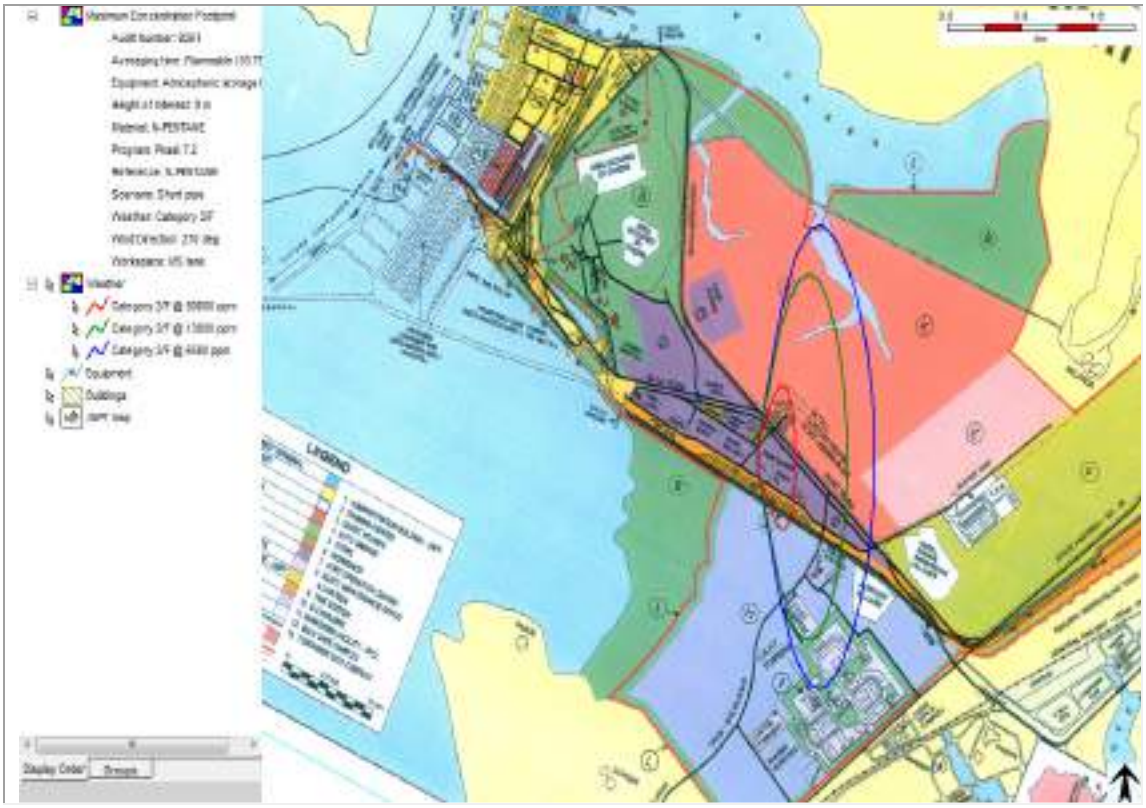


31. Pool fire from Leakage of Aniline tank at GBL terminal with wind speed **2 m/s** and **F** stability class.

32. Vapor cloud explosion from Leakage of Toluene tank at GBL terminal with wind speed **2 m/s** and **F** stability class.



33. Flash fire from Leakage of MS tank at RIL terminal with wind speed **2 m/s** and **F** stability class.



34. Vapor cloud explosion from Leakage of Naphtha tank at RIL terminal with wind speed **2 m/s** and **F** stability class.

35. Flash fire from Leakage of ATF tank at IOCL terminal with wind speed **2 m/s** and **F** stability class.

36. Vapor cloud explosion from Leakage of MS tank at IOCL terminal with wind speed **2 m/s** and **F** stability class.

Part II

ENSURING BUSINESS CONTINUITY OF JNPT

In the case of Level 2 and Level 3 disasters where serious disruptions in port business is possible due to collapse and damage to infrastructure and services in addition to human casualties, the process of recovery is conducted by undertaking a business impact analysis (BIA).

The Port EOC will provide the initial response to a major disaster and stakeholders will have unique function that requires individual recovery and restoration efforts. Each stakeholder is expected to maintain their respective business recovery plan for use and activation.

1. OBJECTIVES AND PLANNING CONSIDERATIONS FOR BUSINESS CONTINUITY OF THE PORT

1.1 Objectives

- Preserving the lives and safety of human capital.
- Returning ports to business operations as quickly and efficiently as possible.
- Preservation of cargo flows and of maritime supply chains.
- Developing partnerships between the public and private sector to improve the resiliency.
- Assessing and determining resources available to mitigate economic impacts of an incident on the port and its businesses.
- Determining how to create redundant and resilient power, water, sanitation, and data storage systems.
  - To provide a framework to include operations and logistics of the port recovery efforts.
  - To identify the areas that need to be addressed and that should be considered within the existent processes in place.

1.2 Planning considerations

- JNPT will consider short-, medium-, and long-term priorities to better organize and improve recovery. In case of major incident or following a natural disaster resulting in stoppage of port operations, a BIA will be undertaken. Priority areas will be identified for short term recovery amounting to approx. 30 % capacity of cargo handling, medium term recovery amounting to approx. 70 % capacity of cargo handling and long-term recovery for 100 % capacity cargo handling. These figures will be based on BIA.
- Local priorities would be taken into account when determining where to focus recovery efforts.
- Potential priority areas include
  - Oil Terminal
  - Break bulk cargo loading/unloading areas, and
  - Container loading/unloading areas.
- Assess the port functions, both internally and externally, to determine which staff, materials, procedures and equipment are absolutely necessary to keep the port operating.

- Review or create business process flow charts.
- Identify operations critical to survival and recovery.
- Include emergency payroll, expedited financial decision-making and accounting systems to track and document costs in the event of a disaster.
- Establish procedures for succession of management. Include at least one stand by person

- Create a contact list for existing critical business contractors and others that the port can use in an emergency.

2. SHORT-TERM RECOVERY PLANNING

Short-term recovery planning runs parallel to short term response, and begins during and immediately after an incident.

2.1 Damage Assessment and Prioritization of Restoration Work

Tasks during initial damage assessment will include the following.

- Assessment of Engineering Assets
- Assessment of Current Condition of Facilities
- Assessment of Utility Infrastructure

2.2 Mitigation efforts that assist in damage assessment might include the following.

- Conducting Vulnerability Analysis
- Documentation of Replacement Costs
- As-Built Building Plans, Specifications and Other Facility Records
- Determining, positioning, and planning for assistance to obtain Critical Recovery Resources

Note: In relation to Oil Spill following an incident the OSCP will be brought into effect and immediate containment and recovery of oil will be undertaken.

Immediately following an incident, port will undertake assessment along with construction specialists, civil and structural engineers to assess the infrastructure. This inspection will determine a partial/complete loss of an asset.

2.3 Aspects of an inspection may include the following:

- An underwater inspection by divers to check for possible demolition damage or deterioration of footings.
- An inspection of the piling at low water from a boat to check for damage. The stringers and deck are examined from below to determine the need for repair.
- Breakwaters, jetties, or seawalls are inspected for damage.
- Assessment of facilities by civil engineers to ensure compliance with local building and architectural codes and to ensure that damaged or repaired buildings are safe for occupancy.

3. MEDIUM-TERM RECOVERY PLANNING

In medium-term recovery planning, the port will engage in contracting and setting up for reconstruction and resumption of operations at an affected site. This may include financial planning, contracting and the formation of mutual aid agreements to assist in business continuity.

3.1 Mutual Assistance

The port may include the recovery operations plans, provisions for the pooling of recovery and business resources (heavy lift equipment, for example), and pre-positioning where needed. Additionally, port may consider creating mutual assistance plans and documents specifying actions that will be undertaken. Thus, creating a mechanism for redeployment of inter-terminal infrastructure that may be already available.

Port may require to develop an alternate operational logistics support plan for cargo diversion that addresses diversion of cargo in an incident at the port. It may also explore the agreements with Railways/CONCOR regarding goods movement in the event of an incident.

In case of damage to road infrastructure, port may also consider examining alternative transportation routes to and from the port and also within the port itself.

Additionally, given the intermodal nature of goods movement and transit from the port to consumers, it may consider examining intermodal transportation hubs at the port premises and at any inland port. Consulting and engaging trucking companies and freelance truckers will also be undertaken when formulating recovery plans.

3.2 Medium-term reconstruction projects include:

- Expedient repair of existing structures.
- Repair of unloading facilities e.g. quay cranes, loading arms
- Continuing work on highways, railways and storage facilities outside the wharf area.

3.3 Marketing and Communications

Post-incident, port may consider publishing press releases and advertisements to demonstrate to the public that the port is open for business and still functional.

4. LONG-TERM RECOVERY PLANNING

The lessons learned from earthquake damage to Kandla Port during Bhuj earthquake 2001 reveals damage to jetties, piles and RCC structures such as warehouse, the signal control tower and office building. Similarly, Paradip Port on the eastern coast suffered prolonged shut down and damage to roads, uprooting of trees and damage to civil infrastructures. In such an eventuality occurring at JNPT steps to restore the functioning of the affected cargo berths and control stations will need extensive repair and rehabilitation measures. This may include assessment and short- and medium-term measures as discussed earlier to provide temporary relief and alternate sites for cargo handling and VTMS. For full recovery certain steps as listed below will be required.

- Determining the financial impact of the emergency on the port and the budget needed for recovery, including insurance reimbursement and non-reimbursement issues, and central govt. assistance;
- Building relationships with emergency management and first responders based on unmet coordination needs;
- Initiating public relations activities to rebuild confidence in the transit operation on the part of customer and the community as a whole.
- Administering a comprehensive cargo movement recovery policy.
- Provide support for Construction & Maintenance, repair, alteration and reconstruction of port facilities and infrastructure.

- Laying out of plans and specifications and other contract documents necessary for the construction of new facilities and for any modifications to existing port facilities by engineering dept.
- Maintenance and repair of extensive damage to port buildings and properties.
- Assessment of environmental impacts of reconstruction projects and determining mitigation measures as appropriate by Environment dept.